

**BEFORE THE
MARYLAND PUBLIC SERVICE COMMISSION**

BALTIMORE GAS AND ELECTRIC
COMPANY'S APPLICATION FOR
ADJUSTMENTS TO ITS ELECTRIC
BASE RATE

CASE NO. 9888

DIRECT TESTIMONY AND EXHIBITS

OF JOHN HOWAT

ON BEHALF OF

THE MARYLAND OFFICE OF PEOPLE'S COUNSEL

SEPTEMBER 22, 2026

TABLE OF CONTENTS

INTRODUCTION	1
BACKGROUND	4
I. PREPAID SERVICE BACKGROUND	4
II. BGE’s prepaid service proposal	11
ANALYSIS OF BGE’S PREPAID SERVICE PROPOSAL	17
I. FlexPay proposal will increase utility terminations.	18
II. BGE’s FlexPay proposal will raise the costs of acquiring essential services when vulnerable customer are already struggling to pay bills	22
III. FlexPay will not help customers afford their bills.	29
IV. BGE’s FlexPay proposal would not be an equitable or effective energy efficiency program.....	38
V. The informational benefits of the FlexPay program do not justify forgoing important consumer protections	39
SUMMARY AND CONCLUSIONS	45

Appendix A – Qualifications of John Howat

Exhibit JGH-1 - Referenced Responses to Data Requests

Exhibit JGH-2 – Referenced Publications

Exhibits JGH-3 and JGH-4 – Supporting Workpapers

INTRODUCTION

Q. Please state your name, job title and employer.

A. My name is John Howat. I am a Senior Policy Analyst at the National Consumer Law Center ("NCLC"). NCLC is a non-profit law and policy advocacy organization using expertise in consumer law and energy policy to advance consumer justice, racial justice, and economic security for low-income families and individuals in the United States.

Q. Please state your business address for the record.

A. My business address is 7 Winthrop Square, Boston, Massachusetts 02110.

Q. Please describe your professional background and experience.

A. Over the past 27 years at NCLC, I have managed a range of regulatory, legislative, and advocacy projects across the country in support of low-income consumers' access to utility and energy-related services. I have been involved with the design and implementation of energy affordability and efficiency programs, regulatory consumer protections, transportation and building electrification, rate design, home energy improvement financing, issues related to metering and billing, credit scoring and reporting, and energy burden and demographic analysis. In addition, I have presented at national conferences, including for the National Community Action Partnership, National Community Action Foundation, National Association of Regulatory Utility Commissions, and National Association of State Utility Consumer Advocates, National Energy Assistance Directors Association, National

1 Energy and Utility Affordability Coalition, and the National Governors
2 Association.

3 I am the co-author of Access to Utility Service, a law and policy manual
4 published by NCLC, and the Lawrence Berkeley National Laboratory reports,
5 "Advancing Equity in Utility Regulation," "The Future of Transportation
6 Electrification: Utility, Industry and Consumer Perspectives, and "Recovery of
7 Utility Fixed Costs: Utility, Consumer, Environmental and Economist
8 Perspectives." I am the primary author of "Home Energy Costs: The New Threat
9 to Independent Living for the Nation's Low-Income Elderly," "Tracking the
10 Home Energy Needs of Low-Income Households through Trend Data on
11 Arrearages and Disconnections," "Rethinking Prepaid Utility Service: Customers
12 at Risk," and "Public Service Commission Consumer Protection Rules and
13 Regulations: A Resource Guide." I have been professionally involved with energy
14 program and policy issues since 1981.

15 Prior to joining the Advocacy Staff at National Consumer Law Center, I
16 consulted with a broad range of public and private entities on issues related to
17 utility industry restructuring. Previously, I worked as Research Director of the
18 Massachusetts Joint Legislative Committee on Energy, Economist with the
19 Electric Power Division of the Massachusetts Department of Public Utilities, and
20 Director of the Association of Massachusetts Local Energy Officials. I have a
21 Master's Degree from Tufts University's Graduate Department of Urban and

1 Environmental Policy and a Bachelor of Arts Degree from The Evergreen State
2 College.

3 **Q. Have you testified previously before state public utilities commissions?**

4 A. Yes. I have presented testimony before utility regulatory commissions in Alabama,
5 Arizona, California, Idaho, Illinois, Indiana, Louisiana, Maryland, Massachusetts,
6 Missouri, New Mexico, Nevada, North Carolina, Pennsylvania, Rhode Island,
7 South Carolina, Texas, Vermont, Virginia, Washington State, and Wisconsin. A
8 list of my Testimony and Comments filed before utility regulatory commissions
9 over the past 27 years is attached as Appendix A to this testimony.

10 **Q. On whose behalf are you testifying in this proceeding?**

11 A. I am testifying on behalf of the Office of People's Counsel ("OPC").

12 **Q. What are the purposes of your testimony?**

13 A. My testimony responds to Baltimore Gas and Electric Company's ("BGE" or "the
14 Company") application and testimony regarding its prepaid service proposal,
15 which it calls "FlexPay." I will summarize and critique the proposal as laid out in
16 the Prepared Direct Testimony, exhibits and discovery responses of BGE
17 witnesses John C. Frain and Jennifer A. Karas; provide general and historical
18 background of prepaid utility service experience in the U.S. and abroad; and
19 discuss the risks associated with prepaid service as it is typically implemented and
20 as proposed in this rate case by BGE. I will provide recommendations regarding
21 alternative approaches to providing residential utility customers with tools to

1 monitor usage, expenditures and establish credit balances. I will recommend that
2 the Commission reject BGE's proposal to implement a prepaid service program.

3 **Q. Please summarize your findings, conclusions, and recommendations.**

4
5 A. I find that BGE's FlexPay prepaid service proposal is not an affordability
6 program, that prepaid service increases rates of terminations and threatens health
7 and safety, and it does not justify waiver of important consumer protections. I note
8 that other, similar proposals have been rejected because of the consumer
9 protection waivers that have been requested.

10 Based on the forgoing, I respectfully recommend that the Maryland
11 Commission reject the current BGE FlexPay proposal.

12 **BACKGROUND**

13 **I. PREPAID SERVICE BACKGROUND**

14 **Q. How does prepaid service differ from traditional post-paid service?**

15 A. Immediate or rapid disconnection of service is the central feature that
16 differentiates prepaid service from conventional post-paid service. Typically, in
17 the United States, electric and natural gas service has been billed on a post-paid
18 basis where a utility company tracks a customer's usage during the previous
19 monthly or quarterly period and then mails or electronically transmits a bill to the
20 customer based on that usage and terms of an approved tariff. The customer is
21 then required to make payment within a predetermined period, usually set forth in
22 statute or regulation, or face collection and disconnection procedures. In most

1 jurisdictions, a utility must provide notification of an impending disconnection by
2 mail or through direct contact, and offer a customer facing disconnection a
3 payment plan to pay down an arrearage over a period of months while retaining
4 access to service.¹

5 Prepaid service requires customers to establish an account credit balance and pay
6 in advance for their service, with prepaid account balances decreasing as service is
7 delivered. Under the prevailing prepaid model, service is automatically shut off—
8 usually within a period of 3 or 4 days—when the account balance is depleted.

9 Rather than providing retrospective billing and disconnection notification by mail
10 or through direct contact, utilities offering prepaid service typically contract with a
11 software vendor to provide electronic communication of disconnection,
12 consumption, expenditure, and account balance information to customers through
13 mobile broadband devices. When a prepaid account balance is depleted, there is no
14 obligation on the part of the utility to deliver shutoff notification through the mail,
15 or to continue providing service for same period of time afforded post-paying
16 customers with an arrearage balance. For this reason, prepaid service usually
17 requires waiver from rules requiring utilities to work with payment-challenged
18 customers by offering reasonable payment plans or other means of retaining
19 access to basic utility service.

¹ BGEThe requirements applicable to BGE are listed in John Frain's Exhibit JCF-2A.

1 While prepaid service in the U.S. does provide participating customers with more
2 real-time usage and expenditure information than that provided to post-paying
3 customers, immediate or rapid disconnection is the central feature of prepay.

4 **Q. Please describe the technology associated with prepaid electric service.**

5 A. Prepaid service in the United States is typically delivered through advanced,
6 digital metering infrastructure with remote disconnection and reconnection
7 capabilities, advanced communication features, and capability to measure and
8 record usage in short time increments. However, it is not a modern concept. In the
9 nineteenth century, certain customers were required to prepay for utility service
10 and engaged the meter by feeding coins or tokens. This system was more prevalent
11 in Great Britain, where prepaid utility service is still common compared to the
12 United States and still is largely used in servicing lower-income customers.

13 The modern re-emergence of prepaid utility service began during the late
14 Apartheid era when South Africa's utility (Eskom) developed new technologies
15 for it.² The intermediate technology first developed there involved customers
16 going to a public kiosk to insert cash and transfer deposit information to a smart
17 card. The customer then returned home with the card and fed it into an in-home
18 device linked to the meter. The meter then operated until preloaded credits were
19 depleted. The in-home device, in addition to accepting credits from the smart card,

² Eskom Prepayment History, Eskom, <https://www.eskom.co.za/prepayment/prepayment-history/> (last visited Sept. 21, 2026), included in Exhibit JGH-2.

1 served the purpose of sounding an audible alarm as prepaid credits were running
2 low.

3 Current technology is more complex. The customer prepays the utility,
4 usually through an electronic transfer. The utility credits the customer's account
5 and provides service until prepaid credits (and any grace period) are expired.
6 Service is delivered through a smart meter with 2-way communication capacities.
7 When credits are depleted, the remote disconnection feature of the meter is
8 engaged and service is disconnected. If and when the customer makes additional
9 payment, the utility re-credits the account and service is remotely restored.
10 Utilities typically contract with a third-party software vendor who relays billing
11 and expenditure to the customer via broadband service – usually through text or
12 email messages. Clearly, the advent of advanced metering infrastructure
13 technology has prompted an increasing number of utility companies to consider
14 implementation of prepaid service.

15 **Q. Have other utilities in the United States implemented prepaid service**
16 **programs?**

17 A. Yes. Existing prepaid programs in the United States tend to be concentrated in
18 service territories served by municipally- or cooperatively-owned utility systems
19 in southeastern states that are not subject to the full regulatory jurisdiction of state
20 utility commissions. In Texas, prepaid service is offered by over 20 of the lightly-
21 regulated retail electric providers, but not by Texas's public utilities. Increasingly,
22 investor owned utilities have pursued these programs.

1 **Q. Have any states rejected prepaid programs?**

2 A. Yes, notably California. San Diego Gas & Electric (“SDG&E”) proposed a
3 prepaid service that was rejected by the California Public Utilities Commission
4 (“CPUC”). In rejecting the proposed program, the California Public Utilities
5 Commission stated

6 We also take note of Consumer Groups’ logical
7 inference that, depending on the communications
8 means chosen (e.g., text message, automated phone
9 message, or e-mail), customers on the proposed Prepay
10 Program might receive no advance notice of
11 termination at all since customers who are behind on
12 their electric bills may also be behind on their internet or
13 phone bills. We find that such an outcome is
14 unacceptable.³

15 Further, the California Public Utilities Commission found SDG&E’s argument
16 that a customer may “voluntarily forego statutory prior notice requirements in
17 order to obtain the benefits of the proposed Prepay program relies on inappropriate
18 precedent and is unconvincing.”⁴

19 **Q. Are there any examples of prepaid service in the United States that are**
20 **particularly informative?**

21 A. Yes, prepaid service has been offered by Salt River Project (“SRP”) and the
22 Arizona Public Service Company also implemented a prepaid service program
23 with significantly more enrollment than BGE’s pilot.

³ Cal. Pub. Util. Comm’n, Decision 14-01-002, at 54, 2014 Cal. PUC LEXIS 37, *79-80, *San Diego Gas & Elec. Co.* (Jan. 16, 2014)

⁴ *Id.*

1 **Q. Please discuss the experience with prepaid metering by Arizona's Salt River**
2 **Project and Arizona Public Service Company?**

3 A. One of the longest running prepaid meter programs in the United States is
4 operated by Salt River Project ("SRP"), Arizona's second largest electric utility
5 and the third largest municipally-owned utility in the United States. The SRP M-
6 Power prepayment meter program is the largest prepayment program in the United
7 States. The M-Power program features an in-home user display terminal that
8 provides customers with real-time consumption, expenditure, and account balance
9 information. This device emits visual and audible alerts as a credit balance is
10 running low. Unlike BGE's proposal, M-Power customers are not required to
11 retain access to costly internet or cell phone service in order to receive notification
12 of impending electric service disconnection

13 SRP revealed a troubling aspect of full-scale prepaid meter programs. The
14 vast majority of SRP prepayment program participants were low-income
15 households, and the median income of M-Power customers declined considerably
16 over a 4-year period. In 2007, the median participant income was \$27,500. Within
17 a year, it dropped to \$19,500. In 2010, the median income fell below the poverty
18 level for a family of three or more to \$17,900. In 2010, 82 percent of program
19 participants had household incomes of less than \$30,000.

20 Additionally, a study of customers in the M-Power program showed that an
21 increasing proportion of racial and ethnic minorities enrolled in prepayment
22 service. Surveys prior to 2010 showed that Hispanics comprised 22 to 23 percent

1 of SRP's prepaid service customers in 2006, and Hispanic participation increased
2 to 48 percent by 2008.⁵ In Phoenix, the largest city served by the Salt River
3 Project, Hispanics accounted for 40.8 percent of the population, and were thus
4 disproportionately represented in the prepaid service program.⁶

5 A 2009 analysis showed that M-Power customers were "more likely to be
6 relatively young, have families, have relatively low-income, be low-use electricity
7 consumers, live in apartments, have been SRP customers for less than five years,
8 and have unsatisfactory or 'new credit ratings' compared to other residential
9 customers."⁷ On average, the head of a household with a prepaid meter was 36
10 years old, made an average annual income of \$24,400, and was Hispanic.⁸

11 **Q. Please describe the APS prepaid pilot.**

12 A. In March of 2012, Arizona Public Service Company ("APS") launched a prepaid
13 service pilot program, ultimately enrolling approximately 2,000 of its residential
14 customers. Similar to BGE's proposed plan, the APS pilot entailed customers
15 prepaying for electricity rather than receiving a monthly bill after usage of
16 electricity.⁹ Analysis based on the entire pilot program participant pool reflected a

⁵ Bruce Neenan, *Paying Upfront: A Review of Salt River Project's M-Power Prepaid Program*, Electric Power Research Institute, at 4-6, tbl.4-3 (2010) (hereinafter, "EPRI Report"), <https://www.energy.gov/oe/articles/arra-sgig-salt-river-project-agricultural-improvement-and-power-district>, included in Exhibit JGH-2.

⁶ *Id.* at 4-6.

⁷ *Id.* at 4-6, tbl.4-3.

⁸ *Id.*

⁹ Ariz. Pub. Serv. Co., *Demand Side Management Residential Home Energy Information Pilot Program End of Pilot Report*, Docket No. E-01345A-10-0075 (Ariz. Corp. Comm'n Feb. 13, 2015), included in Exhibit JGH-2 hereto.

1 very high rate of disconnections throughout the implementation period. In the APS
2 prepaid service pilot there was an average of 0.8 disconnections per customer per
3 month.¹⁰ This result is similar to the reported SRP disconnection rate of one
4 disconnection per customer per month.

5 **II. BGE's prepaid service proposal**

6 **Q. Please describe the company's proposed "FlexPay" proposal.**

7 A. The current BGE prepaid service proposal is typical of other proposed or
8 operational prepaid service programs in the United States.

9 BGE introduces its current prepaid service proposal (branded "BGE
10 FlexPay") in the Prepared Direct Testimony of John C. Frain.¹¹ Mr. Frain states
11 that the proposal is intended to "provide customers with tools that allow them
12 greater control over the affordability of their energy bills..."¹² He further
13 characterizes FlexPay as an "affordability" program, similar to efforts such as the
14 Limited Income Mechanism (described more fully below).¹³ However, he later
15 responded to a discovery request that FlexPay is not a cost-saving program for
16 customers, as they would pay the same ("traditional") rates and charges applicable
17 to similarly-situated post-pay customers.¹⁴ Mr. Frain proposes that the program

¹⁰ *Id.* at 21.

¹¹ Direct Testimony of John C. Frain at 20:5-11 ("Frain Direct").

¹² *Id.* at 26:4-8.

¹³ *Id.* at 2:13-17.

¹⁴ Exhibit JGH-1 (BGE responses to StaffDR14-10 and StaffDR14-04).

1 should not be offered as a pilot, but rather as an ongoing, permanent service
2 offering.¹⁵

3 Similar to prepaid service programs implemented in the U.S., FlexPay
4 would require participants to pay for service in advance rather than after a monthly
5 bill is rendered. Participants would be allowed to make frequent, incremental
6 payments and would be sent electronic notifications regarding usage and account
7 balance.¹⁶

8 As a participating customer uses electricity, the prepaid account balance
9 would be reduced according to terms of the prevailing tariff. The electric service
10 rate paid by prepay customers would be no less than that paid by similarly-situated
11 post-paying customers.¹⁷ If the customer's account balance reaches zero, that
12 customer would not be automatically reverted to post-paid service subject to
13 applicable consumer protections and credit/collections rules. Nor would that
14 customer be offered a "reasonable" payment agreement based on the customer's
15 actual income and expense circumstances.¹⁸ Rather, that customer's service
16 would be shut off involuntarily on the following business day.¹⁹ Relative to the
17 bill payment, termination notification, and service termination timeframes

¹⁵ Frain Direct at 35:5-13.

¹⁶ *Id.* at 35:14-39:12.

¹⁷ Exhibit JGH-1 (BGE responses to StaffDR14-10 and StaffDR14-04).

¹⁸ I discuss payment agreement terms based on a "reasonableness" standard below.

¹⁹ Frain Direct at 39:6-7.

1 specified in subtitle 31 of the Commission's regulations, FlexPay participants with
2 a zero balance would lose access to service in a drastically abbreviated period.

3 Because the FlexPay program is premised on BGE being able to quickly
4 and automatically shut off a customer's service, to function as proposed, BGE
5 must obtain waivers of key consumer protection regulations, including those
6 related to termination notices, and termination conditions, limitations and
7 prohibitions.²⁰

8 Mr. Frain stated that the Company intends to conduct outreach to promote
9 enrollment in the program, including through engagement "with community
10 stakeholders to communicate with their constituents and promote this service."²¹
11 He does not state whether the Company in a non-pilot environment would employ
12 a risk-ranking program or algorithm to inform outreach efforts geared toward
13 recruiting those customers deemed most likely to miss post-paid payments due to
14 lack of income or other circumstances.²² Program applicants would be required to
15 complete an eligibility questionnaire, identify a preferred communication channel,
16 provide household income information, and make a \$40 payment to enroll.²³ Mr.

²⁰ Exhibit JCF-2A.

²¹ Frain Direct at 38:2-4.

²² Mr. Frain specified on page 29, line 20 to page 30, line 1 of his Direct Testimony that the evaluator of the BGE's prepaid service pilot program utilized "credit risk" data in its analysis. The testimony does not specify the source or nature of this data.

²³ *Id.* at 38:8-10.

1 Frain added that customers with a household member with a serious illness or
2 needing life-sustaining medical equipment would not be eligible to apply.²⁴

3 Twenty-five percent of payments from customers participating in FlexPay
4 entering the program with an arrearage balance would be allocated toward payoff
5 of that balance, and 75% would be allocated to the prepaid account balance. Mr.
6 Frain refers to this payment allocation requirement as an “arrearage management
7 component.”²⁵

8 Most BGE residential customers would be eligible to participate in the
9 proposed prepaid service program. However, those who report a serious medical
10 condition or use of a medical device would be ineligible. Further, customers with
11 an arrearage balance of \$1,000 or more, and those purchasing electricity from a
12 retail supplier would not be eligible.²⁶

13 **Q. Please describe the history of BGE’s prepaid service pilot program.**

14 A. In addition to outlining the parameters of the BGE FlexPay proposal, Mr. Frain
15 provided testimony regarding a similarly designed prepaid service pilot program
16 that began enrolling customers in August 2019 with the target enrollment goal of
17 at least 1,000 customers.²⁷ However, the Commission directed BGE to cease
18 enrolling new participants at the end of November 2019 with colder winter months

²⁴ *Id.* at 36:7-9.

²⁵ *Id.* at ii, 38:11-15.

²⁶ *Id.* at 36:11-37:3.

²⁷ *Id.* at 26:17-20.

1 approaching.²⁸ At that time only 527 customers had enrolled in the pilot program,
2 after which there was an attrition rate of 8 percent for the first few months, when
3 BGE was permitted to disconnect customers.²⁹ After the March, 2020 BGE was
4 subject to a COVID moratorium but even without the threat of power shutoffs,
5 disenrollment continued until the program concluded on November 30 2020 with
6 313 customers remaining.³⁰

7 In its order approving the pilot, the Commission acknowledged the
8 increased risk of disconnection associated with prepaid service, noting BGE
9 “proposes a new – and more rapid – termination process than Maryland utility
10 customers are accustomed to” and that the Commission “want[ed] to be certain
11 that customers are afforded every opportunity to avoid utility service
12 termination.”³¹

13 **Q. Please describe the evaluation of BGE’s prepaid service pilot program.**

14 A. BGE Commissioned APPRISE Incorporated (“APPRISE”) to evaluate its prepaid
15 pilot.³² That evaluation identified moderate electricity usage reduction among
16 participants, ranging from 1.6 percent for heating and 2.4 percent for non-heating

²⁸ *Id.* at 28:1-2.

²⁹ *Id.* at 28:6-11

³⁰ *Id.*

³¹ Order No. 88438, *Request of Balt. Gas & Elec. Co. for Approval of a Prepaid Pilot Program & Request for Waivers of COMAR & Comm’n Orders* (Case No. 9453, Oct. 25, 2017), at 15.

³² Frain Direct at 27:2-3. The APPRISE evaluation was filed on June 1, 2021, in Case No. 9453. The evaluation has not, however, been filed into the record in this proceeding. Baltimore Gas and Electric Company, Report on Evaluation of Prepaid Pilot, ML# 235543 (Case No. 9453, June 1, 2021), Attachment 1, APPRISE, Incorporated, BGE Prepaid Pilot Evaluation Final Report (May 2021) (“APPRISE Report”), updated by errata ML# 235859 (June 23, 2021).

1 participants.³³ Evaluation also found that the participant termination rate was 10
2 times higher than the non-participant rate, although the average duration of the
3 terminations was lower among prepaying customers.³⁴ Analysis of survey
4 responses identified positive reported participant satisfaction, particularly over
5 program features providing better control over energy expenses. Some
6 participants also reported satisfaction with arrearage the pay down aspect, though
7 the Company noted that its traditional deferred payment agreement structure and
8 protocols result in a failure rate of nearly 90 percent.

9 **Q. Has Exelon sought to implement prepaid service in other jurisdictions?**

10 A. Yes, Exelon-owned utilities have sought permission to begin comparable services
11 in Illinois,³⁵ Pennsylvania,³⁶ and Delaware.³⁷ However, other than BGE's pilot
12 program, no program has moved forward.

³³ APPRISE Report at 69.

³⁴ Frain Direct at 31:3-12 & Fig. 2.

³⁵ Ill. Comm. Comm'n Docket No. 17-0837.

³⁶ Pa. Pub. Util. Comm'n Docket No. P-2016-2573023

³⁷ Del. Pub. Serv. Comm'n, Docket No. 18-0953

ANALYSIS OF BGE'S PREPAID SERVICE PROPOSAL

I. BGE's characterization of FlexPay as completely voluntary is incomplete and misleading

Q. BGE has proposed to offer the FlexPay program to prospective participants on a completely voluntary basis, is that true?

A. Not entirely. BGE claims the program is "the program is completely voluntary,"³⁸ but this ignores the fact that BGE proposed to offer powerful, unrelated incentives that will make it difficult for certain vulnerable customers not to enroll or to leave once enrolled.

As noted above, the study of the Salt River Project M-Power program demonstrated that program participation was concentrated among low-income households. In fact, over a 4-year study horizon, the median household income of participants declined, with the program signing up increasing numbers of low-income customers. It should also be noted that participating customers, on average, made purchases of electricity about 7 times monthly during the peak summer season, suggesting a participant base operating on a very tight cash flow.³⁹

Utility customers in such a financial position may feel compelled to accept participation in a prepaid service program – even while understanding the risk of sudden or frequent loss of service in the future – in order to avoid an immediately

³⁸ Frain Direct at 40:3.

³⁹ EPRI Report at 4.6-4.7.

1 impending service loss under post-paid credit and collections protocols. Cash-
2 strapped new customers may similarly accept future prepaid service termination
3 risk to avoid payment of an unaffordable security deposit required to establish
4 service. Thus, while participation in prepaid service programs such as the
5 proposed Flexpay is, technically speaking, completely voluntary, for some the
6 decision to participate may have been a “Hobson’s choice.”

7 **I. FlexPay proposal will increase utility terminations.**

8 **Q. Does prepaid service result in higher rates of termination than post-paid**
9 **service?**

10 A. Yes. There is little doubt or debate over the fact that prepaid utility service, as it is
11 currently constructed and delivered in the U.S. and abroad, results in highly
12 elevated rates of termination. In fact, in his discussion of the BGE pilot program
13 Mr. Frain noted that the highly elevated rate of terminations observed among pilot
14 participants—relative both to non-participants and the rate experienced by
15 participants prior to enrollment in the program—was “as expected.”⁴⁰

16 **Q. Please discuss the potential ramifications of loss of access to electric service.**

17 A. As demonstrated by available data, prepaid utility service in the U.S is typified by
18 very high rates of disconnection. The Company, by offering no assurance of long-
19 term commitment to a non-disconnection model, has offered no evidence
20 suggesting that disconnection rates would be lower than those experienced in

⁴⁰ Frain Direct at 30:22.

1 programs operating in Arizona, in the BGE pilot, and elsewhere. Electricity
2 service is widely considered to be a necessity of life and essential to public health
3 and safety. In addition to providing everyday functions, secure, reliable electricity
4 service is critical in avoiding health and safety risks by providing safe lighting,
5 cooling during high temperatures, power for medical devices and refrigeration of
6 food and medications, fuel for electric cooking appliances and electrically-heated
7 hot water, and, increasingly home heating during cold seasons.⁴¹

8 When candles are used for light in the absence of electricity, there is
9 additional risk of fatal fire according to the National Fire Protection Association
10 (“NFPA”). In a report entitled “Home Candle Fires,” reported that from 2014 to
11 2018 candle fires cause an average of 81 civilian fire deaths a year.⁴² Candles were
12 used for light following a utility shutoff in 68 percent of the fires resulting in 62
13 percent of the deaths.⁴³ An example of 10 fatalities caused by a candle fire after a
14 utility shut-off was the case of Tashika Turner, who lost three of her young
15 children in a candle fire in New York in October, 2013, one day after her electric
16 utility disconnected service for non-payment.⁴⁴ And in 1994 nine people in West

⁴¹ Electricity is not only required to power heat pumps and electric resistance space heating but is also required to operate a boiler or furnace fueled by natural gas or heating oil.

⁴² *Candle Fires*, Nat’l Fire Prot. Ass’n, <https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/candle-fires> (last visited Sept. 21, 2026), at 2, included in Exhibit JGH-2.

⁴³ *Id.* at 3.

⁴⁴ *Official: 3 Children Die in Bronx Fire After Candle Lit*, CNN (Oct. 26, 2013), <http://www.cnn.com/2013/10/26/us/bronx-deadly-fire/>.

1 Baltimore, including seven children, were killed when a rowhouse fire began with
2 a candle used for lighting after electricity was shut off for nonpayment.⁴⁵

3 In addition to safe lighting, electric service is required to operate most
4 indoor cooling equipment. Loss of such equipment can have fatal consequences.
5 Extreme heat leads to deaths and illnesses that are preventable when people are
6 able to stay cool indoors. This problem is only becoming more urgent. This year
7 was Maryland's deadliest summer on record for heat-related deaths with 60
8 victims since May so far and more than more than fifteen thousand emergency
9 room visits and EMS calls.⁴⁶ Department of Health and Human Services, Centers
10 for Disease Control and Prevention, recommends air condition to prevent heat
11 related illness, noting that fans are ineffective above 90 degrees Fahrenheit.⁴⁷

12 In a 2007 report entitled "Unhealthy Consequences: Energy Costs and
13 Child Health: A Child Health Impact Assessment of Energy Costs and the Low
14 Income Home Energy Assistance Program," researchers identified effects of high
15 energy bills and utility disconnections on health and safety. A key finding of the
16 report is that "[i]n addition to imposing general hardship, disconnected utilities
17 make it difficult to manage chronic conditions such as asthma or diabetes, which

⁴⁵ *Nine Die in House Fire Sparked by Candles*, Victoria Advoc. (Victoria, Tex.), Feb. 28, 1994, at 8A, <https://news.google.com/newspapers?nid=861&dat=19940227&id=AzhOAAAAIBAJ&sjid=6UoDAAAIBAJ&pg=7195,6125903&hl=en> (last visited Sept. 21, 2026), included in Exhibit JGH-2.

⁴⁶ Adam Willis, *With 59 lost to heat, 2026 was Maryland's deadliest summer on record*, Balt. Banner, <https://www.thebanner.com/community/climate-environment/maryland-summer-heat-deaths-IMQ73V5UBNCH3OKUN4KQHWEBBU/> (last visited Sept. 21, 2026), included in Exhibit JGH-2.

⁴⁷ *About Heat and Your Health*, Ctr. for Disease Control & Prevention, <https://www.cdc.gov/heat-health/about/index.html> (last visited Sept. 21, 2026).

1 require electricity to operate medical equipment or to refrigerate medications, such
2 as insulin.”⁴⁸

3 **Q. Are you concerned about BGE’s FlexPay proposal as it relates to customers**
4 **with a serious illness or who use a critical medical device?**

5 A. Yes. Mr. Frain stated that that customers with a serious illness or who need life-
6 sustaining equipment would not be eligible to participate in the FlexPay
7 program.⁴⁹ I’m very concerned that with a quick shutoff program like FlexPay
8 some customers may fall through the cracks, lose service, and suffer serious
9 consequences, including death. Sadly, there is history of such occurrences, such
10 as the death of Linda Daniels in New Jersey in 2018.⁵⁰

11 In addition do some FlexPay applicants falling through the crack at the time
12 of enrollment, I am especially concerned about those who develop an illness or
13 become dependent upon a medical device after they have enrolled and gone
14 through an initial screening process. In short, any program that is centered on
15 rapid, remote termination poses a very serious threat to health and safety. The
16 FlexPay proposal should be therefore be rejected.

⁴⁸ Lauren A. Smith et al., *Unhealthy Consequences: Energy Costs and Child Health: A Child Health Impact Assessment of Energy Costs and the Low Income Home Energy Assistance Program*, Child Health Impact Working Grp. 7 (Apr. 2007), <https://www.pew.org/-/media/assets/2018/07/childhiaofenergycostsandchildhealth.pdf>, included in Exhibit JGH-2.

⁴⁹ Frain Direct at 36:7-9.

⁵⁰ Rick Rojas, ‘Totally Preventable’: How a Sick Woman Lost Electricity, and Her Life, N.Y. Times (July 13, 2018), <https://www.nytimes.com/2018/07/13/nyregion/woman-dies-oxygen-machine-electricity-linda-daniels.html>.

II. BGE's FlexPay proposal will raise the costs of acquiring essential services when vulnerable customer are already struggling to pay bills

Q. Please comment on the likelihood of prospective FlexPay participants incurring transaction fees.

A. I am very concerned that in a non-pilot environment, BGE prepaid service customers will incur substantial transaction fees. We have seen that prepaid service participants in SRP M-Power program made an average of about 7 payment per month during peak summer months.⁵¹ Prepaid service customers tend to have low incomes and often face cash flow challenges. Small, frequent payments and associated transaction fees would add to the cost of retaining access to service, further undermining the characterization of FlexPay as an affordability program.

Q. How will FlexPay affect energy insecurity in the BGE service territory?

A. Indicators of energy insecurity include foregoing necessities to pay for home energy, maintaining unhealthy indoor temperatures, receipt of disconnection notices, and inability to use heating or cooling equipment because of utility service disconnection, inability to afford bulk fuel delivery, or broken equipment. As the attached report demonstrates, energy insecurity is on the rise across the country.⁵² Prepaid service, with its rapid termination feature will put added pressure on some participating customers to forgo non-energy necessities like food and medicine,

⁵¹ EPRI Report at 4-8, included in Exhibit JGH-2.

⁵² Nat'l Consumer L. Ctr., *Energy Insecurity on the Rise: Preliminary Findings from the 2024 Residential Energy Consumption Survey* (Mar. 2026), <https://www.nclc.org/resources/energy-insecurity-on-the-rise-preliminary-findings-from-the-2024-residential-energy-consumption-survey/>, included in Exhibit JGH-2.

while increasing the likelihood those participants will maintain unhealthy indoor temperatures.

Income above 200% federal Poverty Guideline * Any Home Energy Insecurity Crosstabulation					
			Any Home Energy Insecurity		Total
			No	Yes	
Income above 200% federal Poverty Guideline	No	Count	239400	241899	481299
		% within Income above 200% federal Poverty Guideline	49.7%	50.3%	100.0%
	Yes	Count	1528472	271565	1800037
		% within Income above 200% federal Poverty Guideline	84.9%	15.1%	100.0%
Total		Count	1767872	513464	2281336
		% within Income above 200% federal Poverty Guideline	77.5%	22.5%	100.0%
2020 EIA RECS					

In 2020, over one half of Maryland households with income at or below 200% of poverty reported experiencing at least one form of energy insecurity. If FlexPay is approved, we can only expect that number to go higher.

Attached is an article chronicling one person's experience with prepaid service and the stress that the ever-present threat of shutoff brought.⁵³

Q. Why are some BGE customers sometimes late in paying their electricity service bills?

A. This answer is simple: utility customers are late paying their bills because they do not have the money available to spend on utility bills at that time. For many customers with past due accounts, there is simply insufficient income to pay for basic necessities such as rent, food, clothing, childcare, and health care. Understanding low-income household utility arrearages, and designing programs and credit and collection protocols that effectively reduce past due accounts, requires examination of income and expense realities faced by households lacking sufficient income to make ends meet. The "Self-Sufficiency Standard" provides an analytical framework for conducting such an examination.

Q. What is the Self-Sufficiency Standard?

A. Over the past 25 years, a number of alternatives to the traditional poverty measurements have been developed by analysts interested in overcoming shortcomings of the traditional, federal poverty measurement. These shortcomings include inability to account for locational price differences, family or household composition, and the true cost of a "basket of goods" of basic

⁵³ Kerry Hudson, *The Monster in My Home Was a Meter, and It Decided Whether I Ate and Slept*, N.Y. Times (Dec. 30, 2022), <https://www.nytimes.com/2022/12/30/opinion/prepayment-meters-uk.html>, included in Exhibit JGH-2.

1 necessities. One particular useful such measure is the “Self-sufficiency Standard,”
2 developed primarily by Diana Pearce of the University of Washington.

3 The Self-sufficiency Standard entails a calculation of the amount of income
4 required to meet basic needs. Self-sufficiency budgets are calculated for a range of
5 family compositions, from one adult with no children, to one adult with one infant,
6 one adult with one preschooler, up to two or more adult families with up to six
7 children.

8 The self-sufficiency budget includes the cost of only the most basic
9 necessities, including food, housing (including home energy service), health care,
10 childcare, transportation, and clothing. There is nothing for entertainment,
11 vacations, or other “non-essential” items. The Standard is calculated by city/town
12 using publicly-available data sources, including HUD Fair Market Rents, USDA
13 Low Cost Food Plan, the National Household Travel Survey and other sources.⁵⁴

14 In 2023, staff at the University of Washington’s Center for Women’s
15 Welfare calculated the Self-sufficiency Standard for Maryland counties.⁵⁵
16 Calculations of the Standard incorporate geographic variations in costs and cost
17 variation by family composition.

18 I computed the household size and self-sufficiency ration of income to
19 poverty variables reflected in the tables below using Self-Sufficiency Standard

⁵⁴ *Methodology*, Ctr. for Women’s Welfare, <https://selfsufficiencystandard.org/the-standard/methodology/> (last visited Sept. 21, 2026).

⁵⁵ *Maryland*, Ctr. for Women's Welfare, <https://selfsufficiencystandard.org/maryland/> (last visited Sept. 21, 2026).

1 microdata and the 2023 poverty guidelines from the U.S. Department of Health
2 and Human Services. (The data and formulas used will be provided electronically
3 as Attachments JGH-3 and JGH-4 hereto.)

**Baltimore City 2023 Self-Sufficiency Wage and Corresponding Ratio
of Self-Sufficiency Wage to Poverty Level by Selected Household
Composition**

<i>Family Composition</i>	<i>Baltimore city Self-Sufficiency Wage - 2023</i>	<i>Ratio of 2023 Self-Sufficiency Wage to Poverty</i>
1 Adult	\$33,199	228%
1 Adult, 1 Preschooler	\$64,841	329%
1 Adult, 1 Teenager	\$48,978	248%
2 Adults, 1 Infant, 1 Preschooler	\$95,095	317%
2 Adults, 2 Schoolagers	\$80,540	268%

Sources: 2023 Maryland Self-Sufficiency Standard Microdata, 2023 HHS Poverty Guidelines, NCLC computations.

4
5 The table above shows that for a broad range of Baltimore City households
6 and family compositions, income well above 200% of the federal poverty level is
7 required to make ends meet. For example, a Baltimore City household consisting
8 of one adult and one preschooler needed income of nearly \$65,000 in 2023 to pay
9 for basic goods and services. That income level equated to 329% of the federal
10 poverty level. Similarly, the table below reflects by household size the median

2023 annual self-sufficiency income and corresponding income to poverty ratio needed to get by. The table shows that, irrespective of household size, income below 200% of the poverty guidelines is simply insufficient to pay for even the most basic necessities. For example, the median self-sufficiency wage for a 3-person household was over \$72,000, or nearly three times the federal poverty level.

**Baltimore city 2023 Self-Sufficiency Wage and
Corresponding Ratio of Self-Sufficiency Wage to Poverty
Level by Household Size**

<i>Household Size</i>	<i>Baltimore city Median Self- Sufficiency Wage - 2023</i>	<i>Ratio of 2023 Self- Sufficiency Wage to Poverty</i>
1	33,199	228%
2	58,385	296%
3	72,265	291%
4	92,731	309%
5	110,071	313%
6	133,361	331%
7	152,987	337%
8	165,875	328%

*Sources: 2023 Maryland Self-Sufficiency Standard Microdata,
2023 HHS Poverty Guidelines, NCLC computations.*

Q. How many people in Baltimore city lived below 200% of the federal poverty level in 2023?

A. Based on the Census Bureau data highlighted in the table below, well over 210,000 people, or about 38% of the Baltimore city population lived below 200% of the federal poverty level in 2023. Thus, for many families living in the BGE service territory, particularly those with young children, basic economic survival presents a great challenge.

**Ratio of Income in 2023 to Poverty:
Baltimore city**

	Population	Cumulative Population	%	Cumulative %
Total:	557,089			
Under .50	59,272	59,272	11%	11%
.50 to .99	52,605	111,877	9%	20%
1.00 to 1.24	29,804	141,681	5%	25%
1.25 to 1.49	22,562	164,243	4%	29%
1.50 to 1.84	31,565	195,808	6%	35%
1.85 to 1.99	14,677	210,485	3%	38%
2.00 and over	346,604	557,089	62%	100%

*Source: American Community Survey, C17002, 2023 5-yr.
estimates.*

Q. How do your findings from the Self-Sufficiency Standard bear on the BGE FlexPay proposal?

A. As described above, prepaid service has been shown to result in drastically higher rates of termination. For the thousands of households in BGE's service territory

1 that already lack sufficient income to pay for necessities, the heightened and
2 perpetual threat of prepaid service would result in increased energy insecurity and
3 all of its attendant consequences. The informational benefits outlined in the BGE
4 FlexPay proposal may be welcomed by these customers. But the forfeiture of
5 essential consumer protections and frequent shutoffs should not be approved.

6 **III. FlexPay will not help customers afford their bills.**

7 **Q. What benefits does BGE claim will be associated with FlexPay?**

8 A. In addition to the inducement described above, BGE claims that FlexPay will
9 provide (1) more control for customers in the form of allowing piecemeal
10 payments and information on usage (2) encourage energy conservation by making
11 energy usage more visible and (3) leading to shorter disconnection periods.⁵⁶

12 **Q. Does FlexPay provide more control?**

13 A. No. BGE confirmed in discovery that its customer can already “make payments at
14 any time before a bill is due through BGE’s available payment channels.”⁵⁷
15 Therefore, customers already have the ability to “control” their billing by paying
16 ahead. Therefore, it is absurd for BGE to claim that FlexPay would offer “greater
17 control over their energy expenses by permitting advance payment for their energy
18 use”⁵⁸ since customers are already “permitted” to do that under conventional
19 billing with consumer protections.

⁵⁶ Frain Direct at 26:1-39:18.

⁵⁷ Exhibit JGH-1 (BGE response to OPCDR09-04).

⁵⁸ Frain Direct at 26:6-8.

1 **Q. Does FlexPay provide more visibility into energy usage?**

2 A. Perhaps trivially. BGE confirmed in discovery that it “BGE currently provides
3 customers with access to energy usage and account information through My
4 Account on BGE.com and the BGE mobile application” and that “[m]any of the
5 informational and payment capabilities referenced in Direct Testimony of
6 Company Witness Frain are already available to residential customers today.”⁵⁹
7 It’s conceivable that a new application would make consumption more visible.
8 However, BGE does admits that this BGE would not provide new monitoring
9 capabilities but rather “combine those capabilities” in a system that requires
10 prepayment.⁶⁰

11 **Q. Will FlexPay lead to shorter disconnections?**

12 A. Perhaps. However, as described, even a short disconnection is highly disruptive
13 and can lead to disastrous results. Moreover, if a disconnection would not have
14 otherwise occurred under conventional billing, the fact that it is relatively shorter
15 does not make that disconnection a benefit.

16 **Q. Do you consider the proposed FlexPay program to be an affordability**
17 **program?**

18 A. No. An effective affordability program lowers participants’ home energy burdens
19 in a way that *enhances* access to vital utility service. In most cases utility payment
20 difficulties stem from affordability problems—not informational barriers. While
21 BGE may allow some customers to avoid certain deposit charges and late payment

⁵⁹ Exhibit JGH-1 (BGE response to OPCDR09-04).

⁶⁰ *Id.*

1 fees in the short term if they enroll in prepaid service, prepayment does not
2 enhance the long-term affordability of service. Indeed, customers would pay more
3 per unit of energy as described above. The informational components of prepaid
4 service, providing participants with feedback about usage and expenditures, may
5 help some customers monitor and control payments in ways that contribute to
6 usage reductions that do not involve deprivation. However, the elevated prepay
7 termination rates obviously run counter to the principle of enhanced access to
8 service.

9 **Q. What about the arrearage element and elimination of certain fees, wouldn't**
10 **these make energy more affordable?**

11 A. These short-term benefits might seem attractive to a customer in a desperate
12 situation. But they do not actually lower the bill the customer will pay. Indeed,
13 enrolling in FlexPay, the customer will ultimately pay more in fees and time value
14 of money in addition to facing the psychological burden of the potential for
15 automatic power shutoffs. In addition, these inducements are not actually integral
16 to prepayment format, and are simply an incentive that will drive BGE's most
17 marginalized customers to it.

18 **Q. Please identify the programs and rates that reduce BGE residential customer**
19 **payments.**

20 A. BGE's low-income residential customers can apply to several programs that can
21 provide bill assistance that are administered by the Maryland Department of
22 Human Services, Office of Home Energy Programs ("OHEP"). These include the
23 Maryland Energy Assistance Program ("MEAP," which includes regular energy

1 assistance grants and crisis grants), the Electric Universal Service Program
2 (“EUSP”), the EUSP Arrearage Retirement Assistance program (“EARA”) and the
3 Gas Arrearage Retirement Assistance program (“GARA”). OHEP coordinates
4 with the Maryland’s Department of Housing and Community Development
5 (“DHCD”) which administers the EmPOWER low-income efficiency programs.
6 The EmPOWER measures work to reduce usage, thus lowering bills. Starting in
7 January 2027, low-income BGE customers who receive OHEP energy assistance
8 will receive lower bills that are designed to achieve a 6% energy burden for gas
9 and electric customers or all electric customers. Low-income BGE customers that
10 are only on gas service will see a bill aimed at a 3% energy burden. This new
11 program is called the Residential Customer Assistance Program (“R-CAP”).

12 **Q. Please Describe the Maryland Energy Assistance Program (“MEAP”).**

13 A. The Maryland Department of Human Services, Office of Home Energy Programs
14 (“OHEP”) administers MEAP. MEAP is a federally funded energy assistance
15 program that helps low-income households pay for home energy service (heating
16 and/or cooling). The federal program is called the Low-Income Home Energy
17 Assistance Program (“LIHEAP”).⁶¹ The US Department of Health and Human
18 Services (“HHS”), Administration for Children and Families administers the
19 LIHEAP program. Each year LIHEAP receives an annual appropriation from
20 Congress, and thus the amount of funding for LIHEAP that a state receives can

⁶¹ 42 U.S.C. §§ 8621-8629 (Lexis through Pub. L. 119-102).

1 vary. LIHEAP is a block grant to the states and each year the states must submit
2 an annual plan to HHS regarding the design of their program (e.g., eligibility
3 criteria, benefit amounts, heating and/or cooling, crisis program, etc.).⁶² The block
4 grant nature of the federal funds provides Maryland with the flexibility to tailor
5 MEAP to meet the needs of Maryland residents (for example to direct funds
6 primarily towards heating assistance).⁶³ Currently, the MEAP program provides a
7 regular energy assistance grant (a one-time credit) to BGE on behalf of the BGE
8 low-income customer. There is also a MEAP winter Crisis grant that is in addition
9 to the regular grant to address heat-related emergencies during November 1
10 through March 31.⁶⁴

11 **Q. Please describe the electric universal service program (“EUSP”).**

12 A. The Commission has oversight responsibility for the EUSP⁶⁵ and OHEP
13 administers the EUSP programs which includes bill payment assistance and an
14 arrearage retirement component (described below).⁶⁶ Low-income BGE customers
15 enrolled in EUSP receive a monthly credit their electric bill or they can receive

⁶² See Maryland’s FY2026 Model Plan for MEAP (*Detailed Model Plan (LIHEAP) Grantee Name: Maryland Department of Human Services, U.S. Dep’t of Health & Hum. Servs., Admin. for Children & Families*, https://liheapch.acf.gov/docs/2026/state-plans/MD_Plan_2026.pdf (last visited Sept. 21, 2026)) and Maryland’s FY2027 Model Plan for MEAP (*Detailed Model Plan (LIHEAP) Grantee Name: Maryland Department of Human Services, Md. Dep’t of Hum. Servs.*, [https://dhs.maryland.gov/documents/OHEP/DETAILED%20MODEL%20PLAN%20\(LIHEAP\)%20FF27.pdf](https://dhs.maryland.gov/documents/OHEP/DETAILED%20MODEL%20PLAN%20(LIHEAP)%20FF27.pdf) (last visited Sept. 21, 2026))

⁶³ See Maryland’s FY2026 Model Plan for MEAP and Maryland’s FY2027 Model Plan for MEAP.

⁶⁴ See Maryland’s FY2026 Model Plan for MEAP and Maryland’s FY2027 Model Plan for MEAP.

⁶⁵ Md. Code Ann., Hum. Servs. § 5-5A-08(a)(2) (the components of EUSP include bill assistance, low-income weatherization and arrearage retirement).

⁶⁶ Md. Code Ann., Hum. Servs. § 5-5A-08(a)(6).

1 their assistance as a lump sum credit on the electric bill. The Commission provides
2 an annual EUSP report to the General Assembly.⁶⁷

3 **Q. Please describe the EUSP Arrearage Retirement Assistance Program**
4 **("EARA").**

5
6 A. The EUSP Arrearage Retirement Assistance program ("EARA") is available once
7 every 5 years⁶⁸ to low-income BGE customers who are eligible for MEAP or
8 EUSP and have a past-due balance of at least \$300. The EARA goes towards the
9 retirement of the participant's arrearage and is applied as a one-time credit on the
10 BGE electric account.

11 **Q. Please Describe the Gas Arrearage Retirement Assistance Program**
12 **("GARA").**

13 A. The GARA is a gas arrearage retirement program. It's funding is from the federal
14 LIHEAP funds as EUSP only covers low-income assistance on electric bills. It is
15 available once every 5 years to low-income BGE customers who participate in
16 MEAP and have a past-due balance of at least \$300. The GARA goes towards the
17 retirement of the participant's arrearage and is applied as a one-time credit on the
18 BGE gas account.

⁶⁷ Md. Code Ann., Hum. Servs. § 5-5A-08(c); *see also Report on the Electric Universal Service Program*, Md. Pub. Serv. Comm'n (Aug. 2026), <https://psc.maryland.gov/wp-content/uploads/2026/08/2025-EUSP-Annual-Report.pdf>.

⁶⁸ Md. Code Ann., Hum. Servs. § 5-5A-08(a)(2)(iii) (availability of arrearage retirement limited to once in five years).

1 **Q. Please describe the DHCD EmPOWER programs.**

2 A. DHCD administers the EmPOWER Limited-Income Programs which provides
3 energy savings to single family low-income owners (Whole Home Efficiency) as
4 well as low-income tenants in multifamily dwellings (Multifamily Energy
5 Efficiency and Housing Affordability (“MEEHA”)).⁶⁹ DHCD also administers
6 low-income weatherization measures funded by MEAP and the federally funded
7 low-income Weatherization Assistance Program (“WAP”).⁷⁰ Measures covered by
8 these funds include free furnace repair or replacement, insulation.

9 **Q. Please describe the Residential Customer Assistance Program (“R-CAP”).**

10 A. In November 2023, the Commission initiated Public Conference 59 (PC 59)
11 seeking comments on programs addressing low-income energy bill affordability
12 per a 2021 law⁷¹ requiring utility companies to “adopt a limited-income
13 mechanism to benefit an eligible limited-income customer.”⁷²

14 The Commission directed a Work Group to propose a model Limited
15 Income Mechanism (LIM) for the Commission to consider. The Commission
16 accepted the Work Group’s recommendations and directed the Work Group to
17

⁶⁹ See e.g., Md. Dep’t of Hous. & Cmty. Dev., *EmPOWER Maryland Limited Income Programs Semi-Annual Report Q1Q2 2026*, ML# 333358 (Case No. 9705, Aug. 18, 2026).

⁷⁰ *Energy Grants and Loans for Residents*, Md. Dep’t of Hous. & Cmty. Dev., <https://dhcd.maryland.gov/energy-home-repair/energy-grants-and-loans-residents> (last visited Sept. 21, 2026).

⁷¹ Md. Code Ann., Pub. Util. Art. (“PUA”) § 4-309; 2021 Md. Laws, Chs. 638, 639; 2026 Md. Laws, Ch. 353, § 4

⁷² PUA § 4-309(c)(1).

1 continue making progress to achieve a January 2027 implementation date for the
2 program.⁷³

3 The Work Group proposed, for the general LIM design, to establish a tiered
4 discount that uses OHEPS benefit matrix tiers to define the poverty level range for
5 each tier. The LIM will be a percent of rate discount (except for SMECO, who is
6 approved to have a flat bill discount and Columbia and UGI were permitted to
7 submit proposals for alternative programs). The LIM is designed to achieve a
8 target 6% energy burden for customers on gas and electric service or customers on
9 all electric service. The target energy burden is 3% for electric customers using a
10 deliverable fuel for heat. The calculation of the LIM assistance will be based on
11 the average customer bills, OHEP benefits and household income for customers in
12 each of the tiers. The result is that the lower the income tier, the greater the LIM
13 support amount.

14 To streamline administration, this phase of the LIM will leverage the OHEP
15 MEAP benefit determinations. The way to receive LIM will be to first apply to
16 OHEP for energy assistance. OHEP will be performing the eligibility
17 determinations and sending the utilities a data feed that builds on the information
18 provided with MEAP benefits (e.g., benefit tier) and add other information (e.g.,
19 heating source is electric or other/deliverable fuel).⁷⁴

⁷³ Order No. 92190, *Limited Income Mechanisms for Utility Customers* (Case No. PC 59, Feb. 12, 2026),

⁷⁴ *Id.*

1 The Work Group agreed on naming the LIM program the Residential
2 Customer Assistance Program (“R-CAP”) as more consumer-friendly and more
3 readily understood as an assistance program.

4 **Q. How are these programs relevant to BGE FlexPay proposal?**

5 A. In two ways. First, as a comparison of an effective affordability program and
6 second because FlexPay should not compete with these valuable programs as a
7 perceived means for customers to handle difficult bills. These programs all work
8 to address the root cause of energy insecurity by lowering the cost of power
9 through additional funds or more efficient consumption without the loss of quality
10 of service. FlexPay would not lower the cost of power and would decrease energy
11 consumption by forbearance not efficiency. In that way, these programs illustrate
12 the drawbacks of FlexPay and show that there are superior options for BGE’s
13 customers facing difficulty paying their bills.

14 The second concern is that these programs provide valuable benefits but
15 many eligible participants do not take advantage of them. A report Commissioned
16 by APPRISE, Inc. noted that because “participation rates are not predominately a
17 result of program-eligibility issues and need” the state should focus on
18 “improv[ing] outreach and increase awareness of the program in areas.”⁷⁵ BGE

⁷⁵ APPRISE, *Maryland Low-Income Market Characterization Report*, Md. Office of People's Counsel (Sept. 2018), at 27

<https://opc.maryland.gov/Portals/0/Files/Publications/Reports/APPRISE%20Maryland%20Low-Income%20Market%20Characterization%20Report%20-%20September%202018.pdf?ver=ScReQ-dA9Sk4xlj1V6bp1w%3d%3d>

1 indicated it intends to use “a multi-channel recruitment strategy that may include
2 email, postcards, website banners, and other outreach methods” to market
3 FlexPay.⁷⁶ This marketing could distract from the existing programs that provide
4 real customer assistance and prevent or delay eligible participants from enrolling
5 in those programs. This is especially concerning because BGE presents the
6 program as a way to manage arrearages and the incentive described above are
7 most valuable to those already struggling to afford their bills.⁷⁷

8 **IV. BGE’s FlexPay proposal would not be an equitable or effective energy**
9 **efficiency program**

10 **Q. Please discuss the usage reduction dynamic associated with prepaid service.**

11 A. Prepaid service proponents and researchers often point to participant usage
12 reduction as an advantage of the service. In fact, credible research on this topic
13 confirms that prepaying customers do reduce usage, particularly when the program
14 design includes disconnection of service upon depletion of the credit balance.⁷⁸
15 However, evaluators state that more research is required to draw firm conclusions
16 regarding the causes of this usage reduction. One analysis concludes that prepaid
17 service customers in Minnesota could reduce electricity usage by 8.5% if the
18 program includes disconnection or 2% if the program design entails reverting

⁷⁶Exhibit JGH-1 (BGE Response to StaffDR02-10).

⁷⁷ See, e.g., Frain Direct at 36:12-15 (“In this new BGE FlexPay program, 13 BGE is requesting the Commission permit pre-program arrearage balances up to \$1,000. This request is to provide customers with higher arrearages another tool to help them manage their energy bill.”).

⁷⁸ See Sussman, R., *et al.*, *Examining Potential for Prepay as an Energy Efficiency Program in Minnesota*, Minn. Dep’t of Com. (Dec. 2018), <https://mn.gov/commerce-stat/pdfs/card-examining-potential-for-prepay.pdf>, included in Exhibit JGH-2.

1 participants to postpaid service if the credit balance is depleted. The primary
2 factors that researchers find contributing to usage reduction under prepaid service
3 are the threat of fast shutoff and the delivery of feedback regarding usage and
4 expenditures with the shutoff threat being the predominant factor.⁷⁹

5 Usage and corresponding expenditure reductions are clearly laudable goals
6 as long as they do not result in deprivation or threaten health and safety. Any
7 prepaid service proposal that brings these risks should not be approved.

8 **V. The informational benefits of the FlexPay program do not justify forgoing**
9 **important consumer protections**

10 **Q. Please discuss BGE's request for waivers of consumer protections,**
11 **Commission Orders, and tariff provisions.**

12 A. As discussed above, BGE must obtain waiver of key Maryland regulations,
13 Commission Orders and tariff provisions to implement the FlexPay program as
14 proposed. These provisions are related to, among other things, termination
15 limitations, restrictions, and requirements. Basic energy and utility service is a life
16 necessity. Yet, the circumstances of lower income households often make that
17 service unaffordable. Maryland regulators and other policymakers, as well as those
18 in other states have long recognized this principle explicitly in their utility laws. In
19 most cases utility payment difficulties stem from affordability problems. While
20 BGE may allow some customers to avoid certain deposit charges and late payment

⁷⁹ *Id.* at 1, 25.

1 fees in the short term if they enroll in prepaid service, prepayment does not
2 enhance the long-term affordability of service.

3 Maryland has adopted critical utility regulatory consumer protections
4 through regulations and Commission Orders that are intended to shield vulnerable
5 utility customers from loss of essential service. In Maryland, COMAR provisions
6 require regulated monopoly utility companies to allow 20 days after a bill is
7 rendered before it becomes due, to notify consumers by mail of impending service
8 termination, and to allow a minimum of 14 days after notification before
9 termination may occur. Utilities are required offer customers facing termination an
10 alternative payment plan as an alternative to termination. Importantly, utilities are
11 required to suspend termination for a period of 55 days for customers who have
12 applied for energy assistance.

13 However, consumers who enroll in prepaid electric or natural gas service
14 must forfeit these basic consumer protections. When prepaid billing credits are
15 exhausted, service is terminated disconnected remotely, automatically, and swiftly
16 without the benefit of the mailed notifications or the offer of a deferred payment
17 agreement that apply to traditional, credit-based customers. Low-income
18 customers awaiting administrative processing of bill assistance forfeit the 55-day
19 grace period.

1 This consumer protection framework in Maryland has evolved over
2 decades and is intended to prevent terminating vital home energy service,
3 particularly where there is financial hardship and where loss of service poses a
4 threat to human health and safety. Prepaid utility service is designed to allow
5 utility companies to sidestep this critical life- saving customer protection
6 blueprint. The reason that prepaid service is concentrated in the United States
7 among cooperatively- and municipally-owned utilities is that in most states these
8 entities' rates and credit/collection protocols are not subject to the jurisdictional
9 authority of state regulatory entities.

10 **Q. Is there anything preventing BGE from offering the potential informational**
11 **benefits of FlexPay without asking customers to forego essential consumer**
12 **protections?**

13 A. Other than cost of development and implementation, which apparently are not
14 trivial,⁸⁰ I see no reason that BGE could not provide all customers with the tools to
15 monitor usage and expenditures in near-real-time and make multiple payments
16 during a billing period. These informational and payment attributes are the
17 aspects of prepaid service that participants seem to respond most positively to.
18 But if they are to be offered, it should not be contingent upon customers forfeiting
19 those protections that are intended to help customers, particularly those most
20 vulnerable to the ill-effects of shutoffs, stay connected to the system.

⁸⁰ See Operating Income Adjustment 32E.

1 **Q. What other long-term changes and reforms—absent punitive prepaid**
2 **service—are required to help customers manage arrearages?**

3 A. As noted above, the 75 percent current charges and 25 percent past due balance
4 payment allocation proposed by BGE is referred to by the Company as “arrearage
5 management.” At best, when coupled with the constant threat of shutoff, this is
6 utility arrearage management, not customer arrearage management. Allocating 25
7 percent of payments to past due balances detracts from affordability of current
8 usage and fails to relieve financial pressure on households already struggling to
9 make ends meet.

10 **Q. What is a better approach to arrearage management for low-income**
11 **customers?**

12 A. For income-eligible customers, a good example is Exelon Pepco's Arrearage
13 Management Plan in DC. Pepco's Arrearage Management Plan (“AMP”)
14 Program is a program to help low-income customers with large arrears reduce or
15 eliminate their debt through regular payments of current bills. At the start of the
16 AMP, the customer's arrearage amount is fixed and set aside. During participation
17 in the AMP, the customer is not disconnected due to this arrearage. Customers are
18 enrolled on a budget billing plan and each full payment of a current bill results in
19 1/12 of arrearage being forgiven. AMP customers may cure up to 2 consecutive
20 missed payments by making a full payment in the 3rd month. Disconnected
21 customers can participate in AMP by paying the lesser of \$500 or 25 percent of
22 the arrearage. The reconnection fee is waived. Eligible customers in the first year

1 of AMP are customers with a minimum arrearage of \$300 that is at least 60 days
2 past due.⁸¹ This approach, coupled with the new tiered discounts, will give low-
3 income customers a fighting chance to make affordable payments on current bills
4 while paying down arrears -- without the continual threat of termination.

5 **Q. What about past residential customers with past due balances who are not**
6 **income-eligible for energy assistance?**

7 A. BGE's deferred payment agreements failure rate is 90%, so something clearly
8 must change. Iowa has adopted an approach that is centered on establishing
9 payment agreement terms that account for a household's actual income and
10 expense circumstances. The state requires electric and gas utilities to offer
11 residential customers who have received a disconnection notice an initial payment
12 agreement of at least 12 months in duration.⁸² In setting the terms of the initial
13 payment agreement, the utility is required to employ a "reasonableness" standard,
14 taking into account the customer's income and expense circumstances that have
15 bearing on ability to pay.⁸³ In the event a customer makes a good faith effort – as
16 exhibited by making at least two consecutive timely payments under the initial
17 agreement – but then is late or misses a payment, the utility is required to offer a
18 subsequent agreement of a term at least as long as that of the initial agreement.⁸⁴

⁸¹ *Energy Assistance*, We Power DC, <https://www.wepowerdc.org/energy-assistance> (last visited Sept. 22, 2026).

⁸² Iowa Admin Code r. 199-19.4(11)(c)(1)(1) (Lexis through Sept. 22, 2026).

⁸³ Iowa Admin Code r. 199-19.4(11)(b).

⁸⁴ Iowa Admin. Code r. 199-19.4(11)(c)(11)(2)(1)..

1

2 Clearly, there is no silver bullet to solving customer arrearage challenges. As
3 illustrated in Self-Sufficiency Standard discussion above, some households simply lack
4 the income required to pay for basic necessities and will sometimes be late in paying a
5 utility bill. But we also know that punitive approaches, particularly those centered
6 around termination or imposition of unaffordable payment plans, do not keep customers
7 connected to utility service and generate outcomes that are not in the public interest.

8 **Q. How did California regulators respond to a similar request to waive**
9 **consumer protections from terminations?**

10 **A.** In Application 11-10-002, San Diego Gas and Electric Company filed a prepaid
11 service proposal that was similar in many respects to the BGE FlexPay proposal.
12 In Decision 14-01-002 the California Public Utilities Commission (“CA PUC”)
13 responded as follows:

14 SDG&E’s reliance upon D.06-10-051 for its legal argument
15 that the Commission should allow a “fully informed”
16 customer to voluntarily forego statutory prior notice
17 requirements in order to obtain the benefits of the proposed
18 Prepay program relies on inappropriate precedent and is
19 unconvincing. That decision concerned a voluntary tariff that
20 retained customer protections against unanticipated rate
21 increases for the first year, not an experimental payment
22 program that could induce customers to forego fundamental
23 protections regarding their BSF. We also take note of
24 Consumer Groups’ logical inference that, depending on the
25 communications means chosen (e.g., text message, automated
26 phone message, or e-mail), customers on the proposed Prepay
27 Program might receive no advance notice of termination at all
28 since customers who are behind on their electric bills may

also behind on their internet or phone bills. We find that such an outcome is unacceptable.⁸⁵

This CA PUC Decision was issued over 12 years ago, but is still relevant today.

As described above, BGE's FlexPay program does not provide anywhere near the benefits to enrollees to justify giving up the protections BGE's asks in exchange.

I respectfully urge that the Maryland Commission to similarly reject the current BGE prepaid service proposal.

SUMMARY AND CONCLUSIONS

Q. Please summarize your conclusions.

A. I have found that BGE's FlexPay prepaid service proposal is not an affordability program, that prepaid service increases rates of terminations and threatens health and safety. I have further found that other, similar proposals have been rejected because of the consumer protection waivers that have been requested.

Based on the forgoing, I respectfully recommend that the Maryland Commission reject the current BGE FlexPay proposal.

Q. Does this conclude your testimony?

A. Yes, it does.

⁸⁵ Cal. Pub. Util. Comm’n, Decision 14-01-002, at 54, 2014 Cal. PUC LEXIS 37, *79-80, *San Diego Gas & Elec. Co.* (Jan. 16, 2014) (citing D.06-10-051, at 3-4, *Pac. Gas & Elec. Co.* (Oct. 19, 2006)).

JOHN G. HOWAT

PROFESSIONAL EXPERIENCE

Senior Energy Policy Analyst: National Consumer Law Center. 1999 - Present Boston, MA

- Advocate for enhanced low-income home energy security with particular focus on energy and utility economics, technologies and regulation
- Manage broad range of state and national low-income energy advocacy projects
- Provide expert testimony on low-income energy and utility issues before state regulatory agencies
- Support the enhancement of advocacy capacity of a national network of low-income program delivery and policy organizations through targeted advice and assistance, trainings, and maintenance of communications networks
- Track technology, economic, programmatic, regulatory and policy developments pertaining to low-income access to energy and utility service
- Provide state and federal legislative services on behalf of low-income advocates and clients
- Develop reports and publications; coordinate and present low-income energy advocacy perspectives at national energy conferences

Sole Proprietor: John Howat Associates. 1995 - 1999 Boston, MA

- Conducted market and economic analysis, analysis of customer energy consumption and load profiles, development of power supply requests for proposals, and analysis of utility rates, assets and power purchase contracts.
- Provided Legislative and Regulatory representation
- Provided communications planning and program implementation
- Registered Massachusetts Energy Broker

Resource Planning Economist: Massachusetts Department of Public Utilities. 1991 - 1995 Boston, MA

- Participated in adjudication and settlement proceedings pertaining to electric utility resource planning.
- Conducted technical analysis in conjunction with development of regulatory review policies.
- Prepared and conducted discovery and cross examinations of witnesses.
- Drafted Orders, Decisions, and internal communications.
- Acted as liaison to various public and private sector organizations.

Massachusetts State Legislature. 1985 - 1991 Boston, MA

Research Director: Joint Committee on Energy. 1991

- Directed all committee legislative activities.
- Hired, trained and supervised research and support staffs.
- Conducted legal research and quantitative analysis leading to development of new legislation.
- Worked with Committee Chairmen, rank and file legislators, lobbyists, members of the public and the press.

Legislative Director: State Senator Sal Albano. 1988 - 1990

- Coordinated all legislative and budgetary activities for Senate Chairman of the Joint Committees on Education and Public Safety, including drafting of legislation, amendments and budgetary proposals, and supervision of legislative aides and interns.
- Advised the Senator on policies and programs related to education, health care, human services, housing, the environment, public safety, and taxation.
- Coordinated public relations, including drafting of press releases and answering press inquiries.
- Developed a legislative tracking system.
- Wrote briefing materials for debates and public presentations.

Senior Legislative Research Analyst: Joint Committee on Energy. 1985 - 1988

- Conducted research and analysis of legislation before the committee.
- Drafted new legislation relative to energy efficiency programs and policies, non-utility generation, low-income energy programs, utility rates, municipal utilities, and the "Bottle Law."

Executive Director: Association of Massachusetts Local Energy Officials. 1982 - 1985 Boston, MA

- Promoted, monitored and evaluated four statewide institutional energy conservation programs as a consultant to the Mass. Municipal Assn. and the Mass. Executive Office of Energy Resources.
- Wrote and negotiated grant proposals.
- Conducted member recruitment, fund raising and financial management.
- Produced, edited and contributed to quarterly newsletters distributed statewide.
- Organized workshops and conferences for public sector energy managers.

Teaching Assistant: Tufts University Graduate Department of Urban and Environmental Policy.
1983 - 1984 Medford, MA

- Conducted graduate workshops in financial analysis and management of local governments and non-profit organizations.
- Subject matter included cash flow, net present value, internal rate of return, business planning and benefit/cost analyses with emphasis on externalities and non-quantitative values.

Legislative Aide: Washington State Senator King Lysen. 1981 - 1982 Olympia, WA

- Conducted inquiry into energy consumption, rate structures and taxation of Direct Service Industrial customers of energy suppliers and brokers in the Pacific Northwest.
- Coordinated media relations and production of constituent newsletters.

County Coordinator/Research Analyst: "Don't Bankrupt Washington" Campaign. 1981 Olympia, WA

- Conducted analysis of economic impacts to electric utility ratepayers caused by cost overruns on five Washington Public Power Supply System nuclear power plants.
- Served as Thurston County Coordinator of the organization that sponsored Initiative Measure No. 394, requiring voter approval for bonding of public energy facilities.
- Conducted fund raising activities, coordinated the efforts of 30 volunteers, and waged an effective voter turnout campaign.

EDUCATION

Master of Urban and Environmental Policy. Tufts University. Graduate Department of Urban and Environmental Policy. Medford, Massachusetts. January, 1984.

Areas of Study: Community Energy Planning, Energy Economics, Housing Policy, Community Economic Development, Communications Methods, Financial Analysis and Management, Research Methods, Statistical Analysis, and various computer applications.

Bachelor of Arts. The Evergreen State College. Olympia, Washington. June, 1981.

Areas of Study: Economics, Political Science, American and European History.

John Howat Regulatory Commission Testimony and Comments

Case Name/Docket	Client	Topic	Jurisdiction	Date
Docket No. 25-0514	Docket No. 25-0574	Performance-based ratemaking, Affordability Metric	Illinois	25-Jul
Docket No. 25-0574	Community Organizing and Family Issues	Performance-based ratemaking, Affordability Metric	Illinois	25-Jul
D.P.U. 24-15	National Consumer Law Center on Behalf of its Low-Income Clients	Tiered Discount Rates	Massachusetts	25-Jul
D.P.U. 23-150	Massachusetts Energy Directors Association	General Rate Case – Tiered Discount Rates	Massachusetts	24-Mar
Docket No. E-2. Sub 1300	Southern Environmental Law Center, North Carolina Justice Center, North Carolina Housing Coalition, Southern Alliance for Clean Energy	Adjustment of Rates and Charges Applicable to Electric Utility Service in North Carolina	North Carolina	Mar-23
Docket No. E-01933A-22-0107	Arizona Wildfire	Surrebuttal Testimony - Establishment of a tiered discount and arrearage management program	Arizona	Mar-23
Docket No. E-01933A-22-0107	Arizona Wildfire	Direct Testimony - Establishment of a tiered discount and arrearage management program	Arizona	Jan-23
Docket No. 22-0067	Community Organizing and Family Issues	Establishment of an affordability performance metric	Illinois	Apr-22
Docket No. 22-0063	Community Organizing and Family Issues	Establishment of an affordability performance metric	Illinois	Mar-22
Cause No. 45576	Citizens Action Coalition	Direct Testimony - Low-Income program design and consumer protections	Indiana	Oct-21
Docket 17-1203RE11	CT Office of Education, Outreach, and Enforcement	Direct Testimony - Analysis of Service disconnections by zip code and establishment of a tiered discount and arrearage management program	Connecticut	Apr-21
Rulemaking 18-07-005	NCLC's low-income clients	Establishment of a Percentage of Income Payment Plan	California	Feb-21
Docket No. E-01345A-19-0236	Arizona Wildfire - AZ Community Action Association	Surrebuttal Testimony - Establishment of a tiered discount and arrearage management program	Arizona	Jan-21

Docket No. E-01345A-19-0236	Arizona Wildfire - AZ Community Action Association	Direct Testimony - Establishment of a tiered discount and arrearage management program	Arizona	Oct-20
Case No. PUR-2020-00117	Southern Environmental Law Center and Appalachian Voices	Establishment of a PIPP rate - Appalician Power Company	Virginia	Sep-20
Case No. PUR-2020-00109	Southern Environmental Law Center and Appalachian Voices	Establishment of a PIPP rate - Dominion Energy	Virginia	Sep-20
Docket No. E-7, Sub 1214 - Duke Energy Carolinas	North Carolina Justice Center, North Carolina Housing Coalition, Natural Resources Defense Council, Southern Alliance for Clean Energy, Southern Environmental Law Center	Affordability of electric utility service	North Carolina	Feb-20
Docket No. 32953 - Alabama Power Company	Energy Alabama and Gasp	Direct Testimony - Affordability of residential electricity service	Alabama	Dec-19
Cause No. 45253 - Duke Energy Indiana	Indiana Citizens Action Coalition, Indiana Community Action Association, Environmental Working Group	Direct Testimony - Low-income affordability program, credit and collections data reporting	Indiana	Oct-19
D.P.U. 18-150 - National Grid	Massachusetts Energy Directors Association	Direct Testimony - Transportation Electrification, Rate Design	Massachusetts	Mar-19
Docket No. 2018-318-E - Duke Energy Progress	Southern Environmental Law Center, NAACP, South Carolina Coastal Conservation League	Direct Testimony - Rate design, low-income energy efficiency and affordability programs	South Carolina	Mar-19
Cause No. 45159 - Northern Indiana Public Service Company	Citizens Action Coalition of Indiana	Direct Testimony - Rate design, low-income affordability program, credit and collections data reporting	Indiana	Feb-19
Docket No. 2018-319-E - Duke Energy Carolinas	Southern Environmental Law Center, NAACP, South Carolina Coastal Conservation League	Direct Testimony - Rate design, low-income energy efficiency and affordability programs	South Carolina	Feb-19
Docket No. 18-1008/1009 - Ameren Illinois Company	Illinois Attorney General's Office	Rebuttal Testimony - Prepaid utility service	Illinois	Nov-18
Docket No. 18-1008/1009 - Ameren Illinois Company	Illinois Attorney General's Office	Direct Testimony - Prepaid utility service	Illinois	Sep-18
D.P.U. 18-40 - The Berkshire Gas Company	Massachusetts Low-Income Weatherization and Fuel Assistance	Direct Testimony - General rate case, low-income discount rate	Massachusetts	Sep-18

	Program Network and the Massachusetts Energy Directors Association			
D.P.U. 18-45 - Bay State Gas Company d/b/a Columbia Gas of Massachusetts	Massachusetts Low-Income Weatherization and Fuel Assistance Program Network and the Massachusetts Energy Directors Association	Direct Testimony - General rate case, low-income discount rate	Massachusetts	Aug-18
Case No. 18-00043-UT - Public Service Company of New Mexico	New Mexico Coalition for Clean Affordable Energy	Direct Testimony - Rate design	New Mexico	Aug-18
Cause No. 45029 - Indianapolis Power & Light Company	Citizens Action Coalition of Indiana, Indiana Coalition for Human Services, Indiana Community Action Association, Sierra Club	Direct Testimony - Rate design	Indiana	May-18
Docket No. 17-0837 - Commonwealth Edison Company	Illinois Attorney General's Office	Direct Testimony - Prepaid utility service	Illinois	Mar-18
D.P.U. 17-170 - Boston Gas Company, Colonial Gas Company, each d/b/a National Grid	Massachusetts Low-Income Weatherization and Fuel Assistance Program Network and the Massachusetts Energy Directors Association	Direct Testimony - General rate case, low-income discount rate	Massachusetts	Mar-18
Docket No. E-7, Sub 1146 - Duke Energy Carolinas	Southern Environmental Law Center, North Carolina Justice Center, North Carolina Housing Coalition, Natural Resources Defense Council, and Southern Alliance for Clean Energy	Direct Testimony - General rate case, rate design, affordable payment program	North Carolina	Jan-18
Cause No. 44967 - Indiana Michigan Power Company	Citizens Action Coalition of Indiana, Indiana Coalition for Human Services, Indiana Community Action Association, Sierra Club	Direct Testimony - Rate design, affordable payment program	Indiana	Nov-17
Docket No. E-2, Sub 1142 - Duke Energy Progress	Southern Environmental Law Center, North Carolina Justice Center, North Carolina Housing Coalition, Natural Resources Defense Council, and Southern Alliance for Clean Energy	Direct Testimony - General rate case, rate design, affordable payment program	North Carolina	Oct-17

Docket No. P-2016-2572033 - RECO Energy Company's plan for an advanced payments program and petition for waiver of a portion of the Commission's regulations	Pennsylvania Office of Consumer Advocate	Surrebuttal Testimony - Prepaid utility service	Pennsylvania	Aug-17
Docket No. P-2016-2572033 - RECO Energy Company's plan for an advanced payments program and petition for waiver of a portion of the Commission's regulations	Pennsylvania Office of Consumer Advocate	Rebuttal Testimony - Prepaid utility service	Pennsylvania	Jul-17
Docket No. P-2016-2572033 - RECO Energy Company's plan for an advanced payments program and petition for waiver of a portion of the Commission's regulations	Pennsylvania Office of Consumer Advocate	Direct Testimony - Prepaid utility service	Pennsylvania	Jun-17
D.P.U 15-155 - Massachusetts Electric Company, Nantucket Electric Company, each d/b/a National Grid	Massachusetts Low-Income Weatherization and Fuel Assistance Program Network	Direct Testimony - low-income discount rate, rate design, net energy metering and solar renewable energy credits	Massachusetts	Mar-16
Cause No. 44688 - Northern Indiana Public Service Company	Citizens Actions Coalition of Indiana and the Environmental Law & Policy Center	Direct Testimony - General rate case - rate design, affordability program, credit and collections data reporting	Indiana	Jan-16
Case No. 15-00261-UT - Public Service Company of New Mexico	New Mexico Coalition for Clean Affordable Energy	Direct Testimony - Rate design, affordable payment program, credit and collections data collection and reporting	New Mexico	Jan-16
6690-UR-124 - Wisconsin Public Service Corporation	Wisconsin Community Action Program Association	Comment - Rate design	Wisconsin	Oct-15

Cause No. 44576 - Indianapolis Power and Light Company	Citizens Actions Coalition of Indiana, Indiana Association for Community and Economic Development, Indiana Coalition of Human Services, Indiana Community Action Association, Indiana NAACP, and National Association of Social Workers Indiana Chapter	Direct Testimony - energy affordability program, rate design	Indiana	Jul-15
05-UR-107 - Wisconsin Electric Power Company and Wisconsin Gas Company	Wisconsin Community Action Program Association	Comment - Rate design	Wisconsin	Oct-14
3270-UR-120 - Madison Gas and Electric Company	Wisconsin Community Action Program Association	Comment - Rate design	Wisconsin	Oct-14
6690-UR-123 - Wisconsin Public Service Corporation	Wisconsin Community Action Program Association	Comment - Rate design	Wisconsin	Sep-14
Docket 14-05004 - Nevada Energy Company	Nevada Bureau of Consumer Protection	Direct Testimony - Prepaid utility service	Nevada	Aug-14
D.P.U. 14-04 - Investigation into time-varying rates	NCLC's low-income clients	Comment - Rate design, regulatory consumer protections	Massachusetts	Mar-14
Docket No. 4450 - Rules and regulations governing the termination of residential electric and natural gas service	George Wiley Center	Comment - Regulatory consumer protections	Rhode Island	Dec-13
Application 11-10-002 - San Diego Gas and Electric Company For Authority To Update Marginal Costs, Cost Allocation, And Electric Rate Design	National Consumer Law Center's low-income clients, The Utility Reform Network, Center for Accessible Technology, Greenlining Institute	Direct Testimony - Prepaid utility service	California	Jun-12

Rulemaking 09-11-014 - Rulemaking to Examine the Commission's Post-2008 Energy Efficiency Policies, Programs, Evaluation, Measurement, and Verification, and Related Issues	NCLC's low-income clients	Comment - Energy efficiency financing	California	Feb-12
Rulemaking 09-11-014 - Rulemaking to Examine the Commission's Post-2008 Energy Efficiency Policies, Programs, Evaluation, Measurement, and Verification, and Related Issues	NCLC's low-income clients	Reply Comment - Energy efficiency financing	California	Feb-12
Docket Nos. UE-111048 and UG-111049 - Puget Sound Energy	The Opportunity Council	Direct Testimony - Bill payment assistance, home energy affordability	Washington	Dec-11
R-10-02-005 - Rulemaking to address the issue of customers' electric and natural gas service disconnection	NCLC's low-income clients	Comments - Regulatory consumer protections	California	Sep-10
Docket No. 7535 - Petition of AARP for the establishment of reduced rates for low-income consumers of Green Mountain Power Corporation and Central Vermont Public Service Corporation; and as expanded to possibly	AARP Vermont	Rebuttal Testimony - Bill payment assistance	Vermont	Jun-10

include general applicability to all Vermont retail electric utilities				
Docket 10-02009 - Nevada Energy	Washoe County Senior Law Project	Direct Testimony - Advanced meter consumer protections	Nevada	Apr-10
R-10-02-005 - Rulemaking to address the issue of customers' electric and natural gas service disconnection	NCLC's low-income clients	Opening Comment - Regulatory consumer protections	California	Mar-10
Docket No. 06-0703 - Rulemaking IL Admin. Code - Part 280	South Austin Community Council and Community Action for Fair Utility Practice	Direct Testimony - Regulatory consumer protections	Illinois	Jan-10
Project No. 35533	NCLC's low-income clients	Comment - Prepaid utility service	Texas	Jan-10
Cause No. 43669 - Citizens Gas, Northern Indiana Public Service Company, and Vectren Energy Delivery	AARP and Citizens Action Coalition	Direct Testimony - Bill payment assistance, home energy affordability	Indiana	Sep-09
Docket No. 7535 - Petition of AARP for the establishment of reduced rates for low-income consumers of Green Mountain Power Corporation and Central Vermont Public Service Corporation; and as expanded to possibly include general applicability to all	AARP Vermont	Direct Testimony - Bill payment assistance	Vermont	Sep-09

Vermont retail electric utilities				
D.P.U. 09-34 - Western Massachusetts Electric Company	Low Income Weatherization and Fuel Assistance Network	Comment - Prepaid utility service	Massachusetts	Jun-09
Case No. ER-2008-0318 - Ameren UE	AARP	Surrebuttal Testimony - Hot weather safety program	Missouri	Nov-08
Case No. ER-2008-0318 - Ameren UE	AARP	Direct Testimony - Hot weather safety program	Missouri	Aug-08
D.T.E./D.P.U. 07-30 - Petition of the Attorney General for an Oversight Investigation of the Proposed Merger of National Grid and Keyspan	Low-Income Weatherization and Fuel Assistance Program Network and Massachusetts Energy Directors Association	Supplemental Direct Testimony - Customer service and regulatory consumer protections	Massachusetts	Nov-07
D.T.E./D.P.U. 07-30 - Petition of the Attorney General for an Oversight Investigation of the Proposed Merger of National Grid and Keyspan	Low-Income Weatherization and Fuel Assistance Program Network and Massachusetts Energy Directors Association	Direct Testimony - Customer service and regulatory consumer protections	Massachusetts	Nov-07
CASE NO. PAC- 07-5 - Rocky Mountain Power	Community Action Partnership of Idaho	Direct Testimony - Collection agency costs, credit and collection rules	Idaho	Sep-07

Docket No. P- 00062240 - Equitable Gas company for Approval to Increase the Level of Funding for its Customer Assistance Program and to Implement an Adjustable Rate Mechanism to Recover Associated Expenses Concerning Universal Service and Energy Conservation Plan Costs	Pennsylvania Utility Law Project	Surrebuttal Testimony - Low Income affordability programs	Pennsylvania	May-07
Docket No. P- 00062240 - Equitable Gas company for Approval to Increase the Level of Funding for its Customer Assistance Program and to Implement an Adjustable Rate Mechanism to Recover Associated Expenses Concerning Universal Service and Energy Conservation Plan Costs	Pennsylvania Utility Law Project	Rebuttal Testimony - Low Income affordability programs	Pennsylvania	May-07
Docket No. P- 00062240 - Equitable Gas company for Approval to Increase the Level of Funding for its Customer Assistance Program and to Implement an Adjustable Rate Mechanism to Recover Associated Expenses Concerning Universal Service and Energy Conservation Plan Costs	Pennsylvania Utility Law Project	Direct Testimony - Low Income affordability programs	Pennsylvania	Apr-07

Project No. 33814 - Rulemaking concerning prepaid retail electric service	AARP	Reply Comment - Prepaid electric service	Texas	Mar-07
Docket No. D-06-13 - Petition of Narragansett Electric Company and Southern Union Gas Company for Purchase and Sale of Assets	George Wiley Center	Direct Testimony - Merger impact mitigation	Rhode Island	Jun-06
Docket No. 06-0202 - Petition to Initiate Rulemaking with Notice and Comment for Approval of Certain Amendments to Illinois Administrative Code Part 280	South Austin Community Council and Community Action for Fair Utility Practice	Direct Testimony - Regulatory consumer protections	Illinois	Apr-06
Docket No. 3696 - New England Gas Company	George Wiley Center	Direct Testimony - General rate case - mitigation of low-income rate and bill impacts	Rhode Island	Oct-05
Docket 05-0237 - Petition to Initiate Rulemaking with Notice and Comment for Approval of Certain Amendments to Illinois Administrative Code Part 280	South Austin Community Council and Community Action for Fair Utility Practice	Direct Testimony - Regulatory consumer protections	Illinois	Jun-05
Docket No. 04-5003 - Nevada Power Company	Nevada Bureau of Consumer Protection	Direct Testimony - Prepaid utility service	Nevada	Jun-04
Docket No. R-00049255 - PPL Universal Service Programs	Commission on Economic Opportunity	Direct Testimony - Universal service programs	Pennsylvania	Jun-04
Docket No. UD-97-5 - Entergy New Orleans' and Entergy Louisiana's Electric and Natural Gas	Alliance for Affordable Energy, Louisiana Environmental Action Network, League of Women Voters of	Direct Testimony - Regulatory consumer protections	New Orleans City Council	Jul-00

Service Regulations, Policies and Standards	New Orleans, Pax Christi, and Bread for the World			
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**Baltimore Gas and Electric Company's Application for Adjustments
to Its Electric Base Rate**

Case No. 9888

Data Responses Cited in the Direct Testimony of John G. Howat

BGE response to OPCDR09-04

BGE Response to StaffDR02-10

BGE responses to StaffDR14-04

BGE responses to StaffDR14-10

Case No. 9888
Baltimore Gas and Electric Co.
Response to OPC Data Request 9
Request Received: August 25, 2026
Response Date: September 09, 2026
Sponsor(s): John C. Frain

Item No.: OPCDR09-04

Please describe the extent to which BGE has considered providing the informational and prepayment tools as described by Mr. Frain -- absent the threat of rapid disconnection and the need for customers to forfeit the critical consumer protections outlined in JCF 2-A -- to all residential customers with an advanced electric meter? If the Company has considered such an option, please describe why BGE rejected it in favor of the current prepaid service proposal.

RESPONSE:

BGE currently provides customers with access to energy usage and account information through My Account on BGE.com and the BGE mobile application. Customers may also make payments at any time before a bill is due through BGE's available payment channels.

BGE has not considered offering the proposed FlexPay program as a stand-alone set of informational and prepayment tools separate from a prepaid service offering. Many of the informational and payment capabilities referenced in Direct Testimony of Company Witness Frain are already available to residential customers today. The proposed BGE FlexPay program combines those capabilities with a prepaid service structure that allows participating customers to monitor account balances, manage energy expenses, make payments on a schedule that meets their needs, and avoid the accumulation of new arrearages.

Company Exhibit JCF-2A identifies the billing, tariff, and regulatory provisions for which BGE is requesting waivers to implement the proposed prepaid service program and describes the corresponding customer protections that would apply under BGE FlexPay.

Case No. 9888
Baltimore Gas and Electric Co.
Response to Staff Data Request 2
Request Received: July 15, 2026
Response Date: July 29, 2026
Sponsor(s): John C. Frain

Item No.: StaffDR02-10

In its request to continue the Prepaid pilot in ML 235543 BGE proposed to discontinue email recruitment. Please explain why BGE is proposing to use email recruitment for FlexPay (p. 38 Frain Direct).

RESPONSE:

While the Company previously proposed discontinuing email-only recruitment, it did not propose eliminating email as a recruitment channel. During the Prepaid Pilot, customers who received an email invitation were required to take additional steps to complete enrollment, which may have contributed to lower participation through that channel. BGE FlexPay will continue to use email as part of a broader, multi-channel recruitment strategy but not as the sole method of customer outreach. BGE FlexPay would leverage a more streamlined enrollment experience designed to reduce customer effort and improve participation rates. In addition, lessons learned from the Prepaid Pilot demonstrated that enrollment increased significantly after postcards and website outreach were introduced, supporting the use of a multi-channel recruitment strategy that may include email, postcards, website banners, and other outreach methods rather than relying solely on email communications.

Case No. 9888
Baltimore Gas and Electric Co.
Response to Staff Data Request 14
Request Received: July 27, 2026
Response Date: August 10, 2026
Sponsor(s): John C. Frain

Item No.: StaffDR14-04

Please explain in detail how the FlexPay monthly customer true-up will function, with examples in Excel, with all formulae and links intact.

- a. If this differs by scenario, please explain for each scenario.
- b. Please explain any differences from the Prepaid pilot.
- c. Please explain in layman's terms why a true-up is necessary.

RESPONSE:

Under the proposed BGE FlexPay program, customers will prepay for service through a prepaid account that is reduced as energy is consumed. Throughout the billing cycle, daily charges will be calculated and applied to the customer's prepaid account based on daily usage and applicable historical program rates and charges. At the end of each billing cycle, BGE will perform a monthly true-up to reconcile the cumulative daily charges applied during the billing period with the customer's actual charges calculated through the standard billing process. Actual charges will reflect all applicable BGE charges, including supply charges, delivery service charges, surcharges, taxes, and other applicable charges.

The true-up, discussed in detail below, ensures that customers ultimately pay the correct amount for utility service. Throughout the month, BGE FlexPay uses daily calculations to estimate and deduct charges from a customer's prepaid balance. While those daily calculations are designed to closely reflect actual costs, some charges are only finalized when the monthly bill is produced. As a result, the daily deductions may be slightly higher or lower than the customer's actual monthly charges.

If the actual monthly charges are less than the total daily charges already deducted from the customer's prepaid account, the difference will be treated as a credit and applied immediately to the customer's prepaid account. If the actual monthly charges exceed the total daily charges already deducted, the difference will be treated as a debit. Debits above a specified threshold will be spread over the subsequent billing cycle to reduce the impact of a single large adjustment. The applicable threshold will be finalized as part of the program design and implementation process.

The true-up process will be the same for all BGE FlexPay participants. The outcome of the true-up depends on whether the reconciliation results in a credit, a small debit, or a larger debit. This approach is subject to final program design and implementation decisions.

The proposed BGE FlexPay true-up methodology is expected to be the same as the methodology used during the Prepaid Pilot. As mentioned on page 36 of the Direct Testimony of Company

Witness Frain, one notable difference is that the proposed BGE FlexPay program is limited to customers receiving BGE Standard Offer Service ("SOS"), whereas the Prepaid Pilot was designed to accommodate both SOS customers and retail choice customers. Because BGE FlexPay will be limited to SOS customers, the true-up process will not need to account for retail supplier commodity charges, supplier billing arrangements, supplier rate changes, or other retail choice-related billing considerations. The proposed BGE FlexPay true-up will therefore be based solely on charges applicable to SOS customers.

BGE does not currently have an Excel example for this request. The detailed calculation methodology and associated business rules remain subject to final program design.

Case No. 9888
Baltimore Gas and Electric Co.
Response to Staff Data Request 14
Request Received: July 27, 2026
Response Date: August 10, 2026
Sponsor(s): John C. Frain

Item No.: StaffDR14-10

Please provide a cost benefit analysis to BGE of offering FlexPay. In other words anticipated savings to BGE from reduced collections, lower cash working capital, versus the cost of offering FlexPay.

- a. Please provide all applicable worksheets in Excel, with all formulae and links intact.
- b. If this varies by enrollment, please provide for multiple enrollment scenarios BGE believes to be realistic.

RESPONSE:

BGE has not conducted a formal cost-benefit analysis for BGE FlexPay. As noted in response to StaffDR02-18, BGE does not anticipate direct operational cost savings resulting from the implementation of BGE FlexPay. Rather, the program is expected to provide potential customer and financial benefits through improved arrearage management and payment outcomes, including reductions in collection-related activities, write-offs, and bad debt expense. Additionally, BGE FlexPay is not intended as a cost-savings program for customers. Instead, it is designed to provide customers with an additional tool to manage rising energy costs, track energy usage and costs more closely, and help avoid the accumulation of growing arrearages.

StaffDR14-10 Attachment 1 reflects the estimated avoided costs associated with improved arrearage management and compares those avoided costs to the estimated implementation and ongoing program costs. The attachment is intended to illustrate the potential financial impacts of the program under the assumptions identified therein and should not be construed as a formal cost-benefit study.

**Baltimore Gas and Electric Company's Application for Adjustments
to Its Electric Base Rate**

Case No. 9888

Reports Cited in the Direct Testimony of John G. Howat

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Prepayment History

Prior to 1988 Eskom supplied electricity mainly to large customers like mines and municipalities. Although Eskom was at that stage already one of the largest electricity generators in the world, they only had about 120 000 customers and all of them were on billed accounts. In 1988 Eskom developed the "Electricity for All" concept intended to supply electricity directly to the large masses of domestic customers that did not have access to electricity at that stage. Some of the problems to overcome included the following:

- Many customers had to be supported by the smallest number of Eskom personnel. The system therefore had to operate with a low level of management and maintenance. The standard billed system simply required too much day-to-day management to process accounts and to maintain connections and disconnections.
- Many of the areas where potential customers reside, had almost no infrastructure. There were no fixed addresses for customers, they did not have permanent jobs or bank accounts and there are no postal services in those areas. All these are requirements for a billed system to operate effectively.
- Many customers are illiterate and do not understand (or have the budget) to pay for fixed charges or bills that arrive only after the electricity has been consumed.

To address these and other problems, Eskom started the development of the basic prepayment system that is currently still in use. This system consisted of:

- Prepayments meters (also called Electricity Dispensers or EDs)
- Vending Machines where the customer can purchase electricity credit (known as Credit Dispensing Units or CDUs)
- Data Concentrators that managed the CDUs and collected the transaction data from the CDUs. (Also called System Master Stations or SMSs).

The first enquiry for electricity dispensers was issued in 1989. This enquiry was based on a very short specification produced by Eskom and every effort was made to keep the price of the electricity dispensers as low as possible. Contracts were issued to two manufacturers based on this specification for an original quantity of 10 000 meters.

The specification document was upgraded to become the more comprehensive NRS009 parts 1, 2 and 3 documents during 1990. Contracts were established with the existing two manufacturers and later increased to include a third, for meters based on the NRS009 specification. The project was also renamed to the “Eskom Electrification Project” at this time and the quantity increased to approximately 10 000 per manufacturer in 1991.

The South African Bureau of Standards produced the first national prepayment meter specification, **SABS** specification in 1990 with input from the NRS009 specification and it soon replaced the old NRS specification completely. The total contract was steadily increased to a total of 200 000 meters for 1993 and 300 000 per year from 1994 until the year 2000.

During 1993 Eskom also identified the need to standardise the vending systems to be able to sell electricity from one system to meters from various manufacturers. Eskom embarked on a program to standardise the EDs and the vending process and issued an enquiry for a vending system based on a draft specification and for EDs to accompany it. Soon thereafter development was started in conjunction with Conlog to design and build the new Common Vending System (CVS).

To enable the new vending system to transfer credit to all types of meters it was also necessary to develop a standard transfer medium and protocol to the meters. This was also part of the project and thus the “Standard Transfer Specification” **STS** was born. This Common Vending System and the STS meters form the basis of the prepayment system as it exists today in Eskom.

The specifications have been further improved over the years and are today adopted as the standard by electricity utilities in South Africa. South Africa is now seen as a world leader in prepayment technology and many other countries have adopted our standards as well.

The SANS1524 specification from the SABS was used as a major source during the development of the international **IEC** specification for payment meters. Further more, the STS

standard has since been adopted by the IEC as well, and the STS Association is currently working on the development of STS2

To **Prepayment Operation**

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Paying Upfront: A Review of Salt River Project's M- Power Prepaid Program

1020260

Paying Upfront: A Review of Salt River Project's M-Power Prepaid Program

1020260

Technical Update, October 2010

EPRI Project Manager

B. Neenan

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ABSTRACT

Arizona's Salt River Project (SRP) has operated M-Power, the largest electricity prepayment program in the United States, since 1993. The customer population has grown to about 100,000 (approximately 12% of all residences served by SRP), and it has expanded from the initial target population—consumers with arrears facing service terminations and low-income customers—to include consumers with different expectations from M-Power service. The in-home portion of the SRP prepay configuration consists of a user display terminal (UDT) that communicates with the customer's meter. The purchasing component of the M-Power program is the self-service kiosk, known as a PayCenter, accessed via a Smart Card, which is also the conduit through which electricity consumption information is transferred back to SRP.

The constant aspects of the M-Power experience have been a high level of customer satisfaction and an overall conservation effect reported by SRP of approximately 12%. SRP attributes the conservation effect to a variety of factors, noting that M-Power requires consumers to pay attention to when and how they use electricity, allowing them to make immediate adjustments in usage to lower their bills.

This report provides an overview of how the M-Power program works along with an examination of the technology, systems, and costs associated with the program. The overview is followed by an analysis of customer perceptions of the program as well as a discussion of the program's potential conservation effect. The report concludes with a discussion of impact studies needed to answer several outstanding research questions, including the effect of various types of payment options on conservation as well as whether SRP's experience is transferrable to other markets, climates, customer circumstances, and supply conditions.

Keywords

Salt River Project (SRP)
M-Power Prepaid Metering Program
Energy Efficiency
Energy Consumption Information
Consumer Behavior
Residential
Consumers

CONTENTS

1 INTRODUCTION	1-1
The M-Power Story	1-1
Lessons Learned—30,000 Feet.....	1-3
2 THE M-POWER PROGRAM—AN OVERVIEW	2-1
Initial Set-Up.....	2-1
Purchasing Electricity.....	2-2
Other M-Power Features.....	2-3
Back-Office Processes.....	2-4
3 M-POWER TECHNOLOGY, SYSTEMS, AND COSTS.....	3-1
Technology.....	3-1
User Display Terminal (UDT) or In-home Display (IHD)	3-1
Meter	3-2
PayCenters (Self-service Kiosks).....	3-3
M-Power Business Systems	3-3
Customer Information and Back Office Systems.....	3-3
Revenue Reporting	3-5
M-Power Costs.....	3-5
Customer Costs	3-5
SRP Cost-Benefit of M-Power.....	3-8
4 THE CUSTOMER EXPERIENCE	4-1
Past Study Overviews and Findings	4-1
Overall Satisfaction Levels	4-2
Perceived Customer Benefits of M-Power	4-3
Perceived Disadvantages	4-5
M-Power Customer Characteristics	4-6
Customer Purchase Behavior	4-7
Customer Retention	4-7
5 INFLUENCE OF M-POWER ON ELECTRICITY USAGE	5-1
Many Reasons for a Conservation Effect.....	5-1
Managing What You can Measure	5-2
Deposit Avoidance	5-3
Accommodating Particular Circumstances	5-3
Pay-as-You Go Household Accounting.....	5-3
Arrears Financing Through a Rate Differential.....	5-3
Conservation Ethic.....	5-5
Summary of Potential Influences	5-5

SRP Impact Assessment 5-6

 Characterizing the Conservation Effect..... 5-6

 Research Design..... 5-8

 Measuring the Potential of M-Power 5-10

6 CONCLUSIONS AND RECOMMENDATIONS 6-1

A REFERENCES..... A-1

B M-POWER BACK OFFICE SOFTWARE SCREEN SHOTS B-1

C MARKET RESEARCH STUDY DETAILS C-1

LIST OF FIGURES

Figure 1-1 M-Power Program Chronology1-4

Figure 2-1 M-Power Overview (Source: Pyle, 2009)2-1

Figure 2-2 Example of Customer Credit Purchase Receipts (Left: no arrears, Right: arrears)..2-3

Figure 3-1 M-Power Meter, UDT, and Two Smart Cards.....3-1

Figure 3-2 PayCenter Interfaces (Source: SRP, 2009).....3-4

Figure 5-1 Example Price Elasticity5-5

Figure 5-2 M-Power Program Size5-8

Figure 5-3 2005/2006 M-Power Impact Analysis Timeline5-10

Figure B-1 Account Details Screens B-1

Figure B-2 Arrears Details Screens B-2

Figure B-3 Transaction History Details B-3

Figure B-4 Meter Read Data B-3

Figure B-5 Meter Credit Status B-4

Figure B-6 Self-Disconnection History B-4

LIST OF TABLES

Table 3-1 UDT Features3-2

Table 3-2 Meter Features3-2

Table 3-3 PayCenter Features.....3-3

Table 3-4 M-Power per-kWh Charges (Effective November 2009).....3-7

Table 3-5 M-Power per-kWh Charges (Effective November 2009).....3-8

Table 4-1 Past M-Power Market Research Studies4-1

Table 4-2 SRP Ratings: Comparing M-Power and Non-M-Power Customers (FY2010).....4-3

Table 4-3 M-Power Customer Demographic Trends4-6

Table 4-4 Electricity Purchase Amount and Frequency Information4-7

Table 5-1 Potential Influences of the M-Power Program on Consumption5-6

Table C-1 M-Power Market Research-related Studies Performed..... C-1

1

INTRODUCTION

As the largest electricity prepayment program in the United States with over 100,000 customers at the time of publication, Salt River Project's award-winning¹ M-Power program provides a potential wealth of experience for other utilities who are considering their own prepayment programs.

SRP personnel respond to frequent inquiries from other utilities about their program, and given that it combines a form of electricity-use feedback with a unique payment approach, the newly reinvigorated interest in behavior change-inducing feedback programs are also spurring interest in the program. Indeed, it was in response to this widespread industry interest that the idea for this report emerged. Its purpose is to capture in one report the details of the M-Power program that would be of use to other utilities considering similar endeavors. This includes an overview of how the M-Power program works (Section 2), the technology, systems, and costs associated with the program (Section 3), an examination of customer perceptions of the program (Section 4), and finally, an examination of impact analysis studies which have reported a significant conservation effect attributable to the program, and a discussion of additional impact studies that would be of use going forward to answer some outstanding research questions (Section 5).

To begin, some historical context will now be provided as a foundation for the report, including the impetus for the M-Power program and the chronological details of its inception, as outlined in Figure 1-1.

The M-Power Story²

The M-Power program began in 1993 when the Arizona state legislature proposed the development of programs aimed to assist low income consumers with bill payment. At the time, SRP sought input from various community organizations to learn what programs, in addition to federally funded weatherization programs, could be implemented to aid low income customers in saving energy—prepayment was one component of the pilot that was developed.

The prepay component began with a 100-home pilot, and one of the key findings was resounding customer support for the concept, which came as somewhat of a surprise. SRP found that customers felt that, for the first time, *they* were in control of their electricity bill, not SRP. After the pilot completion, the program expanded to other regions of SRP's service territory, and was no longer limited to low income customers.

¹ The M-Power program won the National Energy Resources Organization (NERO) first place award for energy efficiency. NERO is a non-profit organization that recognizes organizations active in the promotion of energy efficiency.

² The content for this section is based on Personal communication, Mike Lowe, Customer Services Manager, SRP, September 17, 2009; Traasdahl (2009); and Personal communication, Karen Smith, Measurement and Evaluation Manager, May 29, 2010 (forwarded email from Bonnie Temme).

From the beginning, the in-home portion of the SRP prepay configuration consisted of an in-home display, referred to at SRP as a User Display Terminal (UDT), which communicates with the customer's meter; the initial vendor of the meter and UDT was CIC Global. As with any new program there were bugs, and in the early days, the technical difficulties made it necessary to hard wire the meter to the in-home UDT, which was an expensive configuration. Nonetheless, it was in this configuration that enrollment in the program grew to 1,600.

In 1999, Motorola became the provider of both the UDT and meter, and the new configuration employed power line carrier (PLC) communication between the two. Although this configuration was an improvement, there were still communication issues in some instances when other devices in the home prevented communication between the UDT and the meter (e.g., lamps, pool pumps).

Motorola exited the business in 2002, although SRP had purchased the rights to manufacture both the meters and the UDTs. AMPY Metering Limited, a UK-based company that is now part of Landys+Gyr, was the new vendor that was eventually selected.³ In 2005 the AMPY technology was rolled out to M-Power customers, and a dual frequency approach was employed that solved the PLC performance issues. AMPY (now Landis+Gyr UK, Ltd) remains the provider of both the meter and UDT today.

Another technology component of the M-Power program is the self-service kiosk, known as a PayCenter. These are similar in nature to automated teller machines (ATMs) used by banks, and are located throughout the Phoenix area. The idea for the PayCenters was proposed early on as a cost-effective way of dealing with high volumes of power purchases—M-Power customers generally buy small quantities of power, but relatively frequently (see Section 4 for more details). Customers purchase electricity at the PayCenters through the use of a card, known as a Smart Card. The card is then inserted into the UDT at the home. As will be explained in more detail below, the Smart Card is also the conduit through which electricity consumption information is transferred back to SRP.

In the late-1990s, the first PayCenters were purchased from Diebold Incorporated, which at the time was working with Duke Power on payment machine applications for banked customers. The PayCenters were initially purchased for bill-paying customers, but SRP worked with Diebold to retrofit them to accept the M-Power Smart Cards. This configuration worked well, and enabled SRP to reduce costs by eliminating over-the-counter customer transactions altogether.

This arrangement continued until Diebold exited the business in 2000, at which time SRP contracted with AllKiosk, a division of GEICO Incorporated, an Arizona-based engineering house, to develop their own PayCenters. They also used this opportunity to address the issues they had had with the Diebold design, and the result was a less costly and more reliable system. AllKiosk is now licensed to sell the PayCenter design to others as well.

As of April 2010, there were over 100,000 customers enrolled in the M-Power program, with 95 PayCenters in the SRP customer territory.

³ Prepayment systems are prevalent in the UK, and much of their early technology was coin operated. However, rising electricity prices in the 1980s led to increased instances of home break-ins to steal the coins, and this precipitated the invention of an electronic version of prepay.

Lessons Learned—30,000 Feet

As with any new program, mistakes were made. Likely the biggest one relates to fact that SRP tried for years to treat the M-Power program like any other rate program, by forcing the back office systems to “make” monthly bills for revenue recognition purposes. Utilities and their employees are used to thinking in terms of a billing cycle, and so it was initially difficult to think of the M-Power program using a different mindset. It took quite a bit to change this mindset, and it has just been since 2007 that the system has changed to cash-based revenue recognition, rather than trying to force M-Power program accounts into the standard billing cycle.

Another lesson learned early on was that customers on the M-Power program buy power frequently. Indeed, the utility industry has forced customers to pay on a monthly basis when in fact most customers are paid weekly or bi-weekly. On average, M-Power customers purchase power in the \$20 range approximately four times a month in the winter, and seven times a month in the summer. Vending also peaks on Friday nights, likely coinciding with payday for many customers.

From a customer experience perspective, another lesson learned is to work in partnership with potential program critics to get to the root of any concerns. SRP worked directly with customer advocacy groups who were initially opposed to the idea of a prepay program due to concerns that it might unfairly force low income customers into power outage situations. SRP partnered with one such group, the Arizona Community Action Association, to design market research to assess their concerns. The ACAA is now an advocate of the M-Power program.

As technology continues to evolve, so likely will the M-Power program. Having considered the historical context of the program, the following section will now provide an overview of how M-Power works in its present-day configuration.

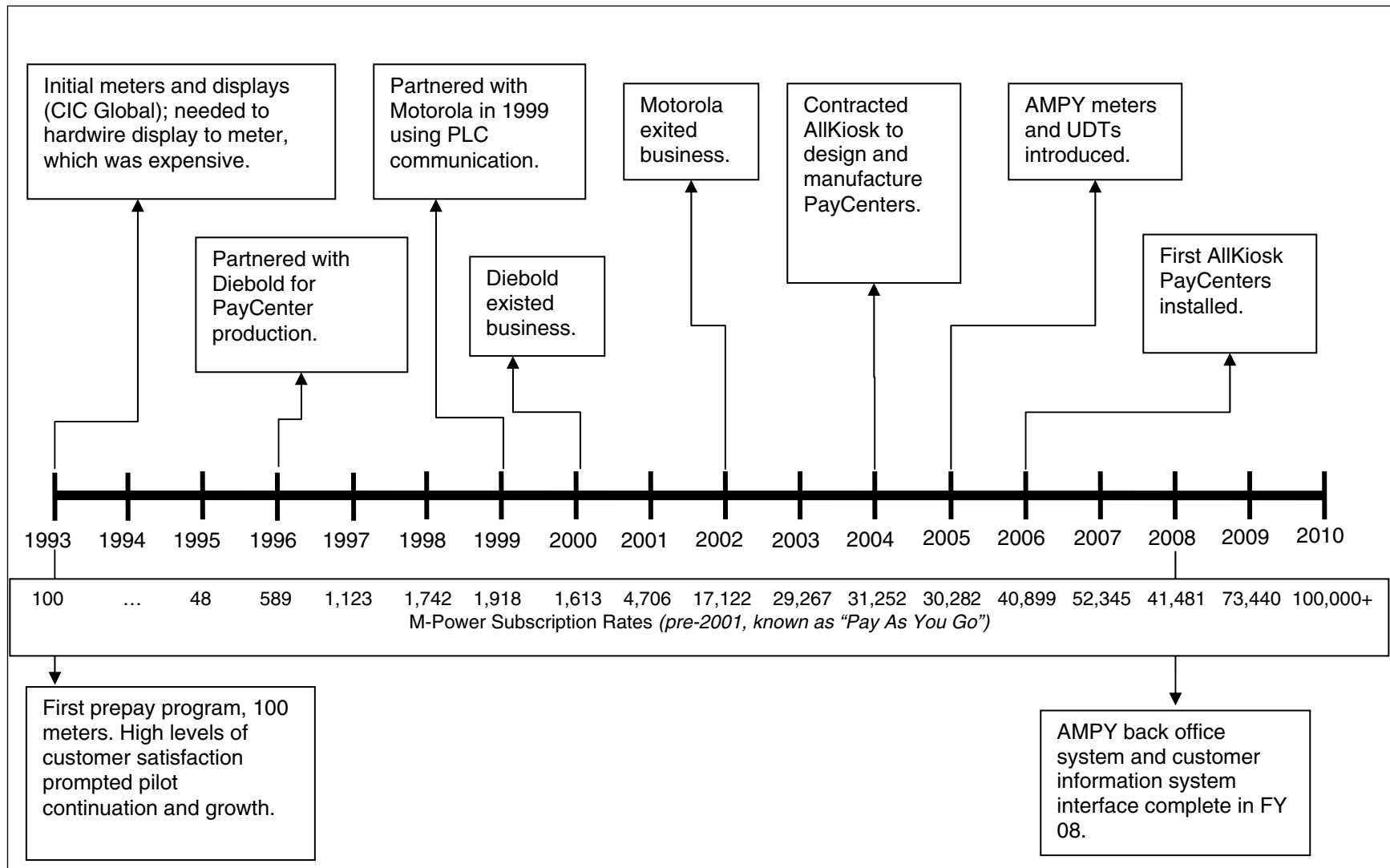


Figure 1-1
M-Power Program Chronology

2

THE M-POWER PROGRAM—AN OVERVIEW

This section builds on the previous inception story by providing an overview of the basic system functionality in its current configuration. Figure 2-1 provides a high-level illustration of system components.

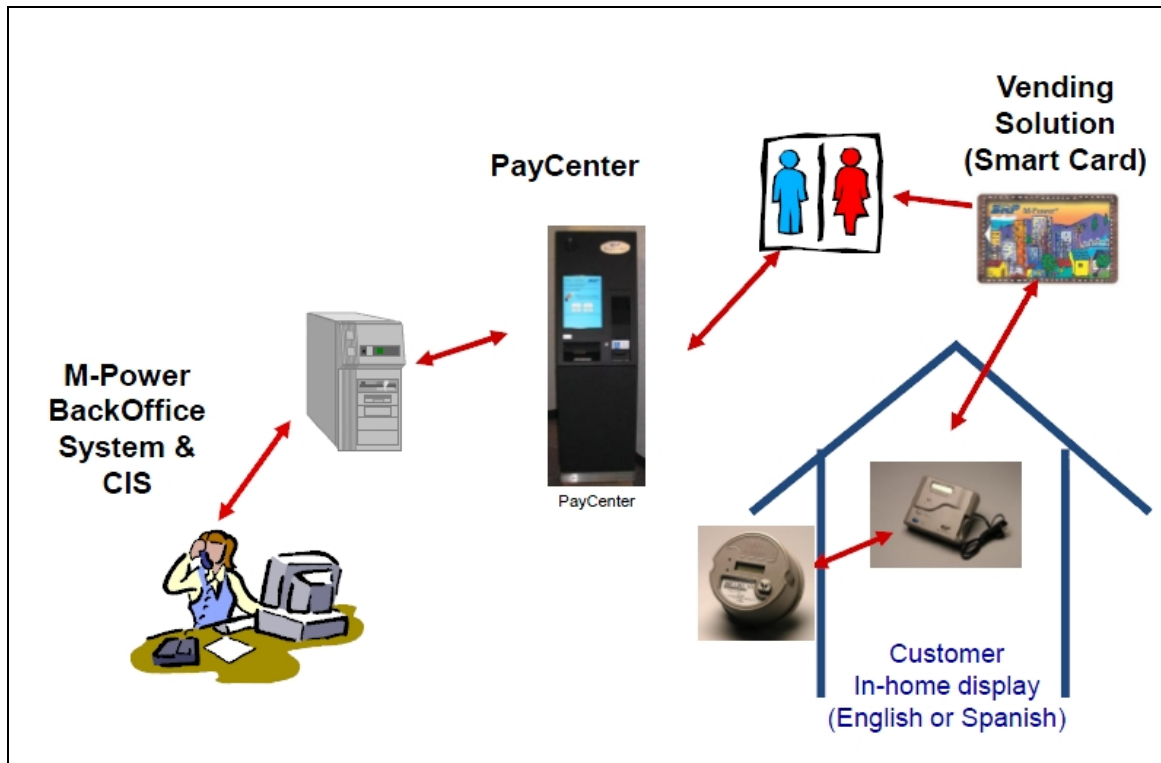


Figure 2-1
M-Power Overview (Source: Pyle, 2009)

A customer can learn about the M-Power program through a number of channels—SRP markets M-Power through direct mail, bill inserts, via email and through their web page, and through Customer Service Representative scripting upon customer call in. The general process by which a customer becomes an M-Power account, and the subsequent business process at SRP, is outlined as follows:

Initial Set-Up

- Customer calls SRP and asks to be on M-Power
- The customer pays a \$99 deposit for the UDT, \$87.50 of which is refundable upon the return of the device (this is in comparison to the \$275 deposit that is required to set up a standard SRP residential account). The customer also pays a \$28 (plus tax) service establishment fee.

- SRP back office will write two Smart Cards for the customer, one of which will be loaded with a \$30 credit.
- The credit, equipment deposit, and service establishment fee, as well as any other arrears a customer may have from their previous account, is transferred to the prepay account, so that they can be automatically paid off over time at a rate of 40% each time the customer makes an electricity purchase.
- A field order will be created to deliver the meter and UDT to the customer; the meter and the UDT need to be married.
- The meter is installed by an SRP technician, but the UDT and a Start-Up Packet (containing a UDT User's Manual,⁴ a Quick Start Guide,⁵ and a map⁶ listing all the PayCenter locations in Phoenix) are left with the customer—the technician does not enter the home. No conservation tips are provided with the Start-Up Packet, although tips are available on the SRP website, as well as the M-Power microsite (www.mysrpmppower.com) and various other communications pieces.
- The UDT is plugged in, the card loaded with the \$30 credit is inserted into it, and the UDT and meter are “married” (a one-time event); the system is then ready to go.
- When the card is inserted into the UDT, the full amount of credit that was on the card is transferred through the UDT to the meter, and the card balance goes to zero. At the same time, the meter consumption level at that time is transferred to the card, so that it may be transferred to SRP via the PayCenter the next time electricity is purchased.

Purchasing Electricity

- Electricity is purchased at any of the 95 automated PayCenters located throughout Phoenix (these PayCenters can also be used to pay non-M-Power customers' bills)
- PayCenters are located in grocery and convenience stores, some of which are accessible 24 hours a day, seven days a week. These PayCenters can be good for store business as well, as SRP's market research findings indicate that many customers report also purchasing store goods at the time of their electricity purchase.
- PayCenters take cash and “e-Chex”, an electronic checking service.
- Phone purchases can be made using credit cards and e-Chex, although credit cards can take up to three days to post to an account, and the customer must still have the credits transferred to their card by visiting a PayCenter and inserting \$1 (the minimum amount).
- Although rare, some customers pay by mailed check. When these checks are received by SRP they are input into the back office system as credit.
- The customer inserts one of their Smart Cards, and makes a payment (as low as \$1, as high as \$2,001). The customer is then issued a receipt that outlines the payment made, and any arrears deducted, and the total electricity purchased. See Figure 2-2 for receipt examples.

⁴ <http://www.mysrpmppower.com/pdfx/MPowerUserManual.pdf>

⁵ <http://www.mysrpmppower.com/pdfx/quickstartguide.pdf>

⁶ <http://myaccount.srpnet.com/paymentlocations/>

- SRP occasionally uses the PayCenters to broadcast information to customers (e.g., notification of a planned outage)

Sales Card Transaction Date Sep 04 2009 09:55 PM Transaction# 00A03593 Operator : PAY113 LAST, FIRST Account# 123456789 Starting Value of Card \$0.00 Purchase Cash \$60.00 Total Received \$60.00 Arrears Previous Arrears \$0.00 Paid to Arrears \$0.00 Arrears Remaining \$0.00 Net Credit From Purchase \$60.00 Current Card Value \$60.00 BALANCE SUBJECT TO VERIFICATION THANK YOU FOR YOUR PURCHASE	Sales Card Transaction Date Aug 31 2009 12:00 PM Transaction# 009EA1E7 Operator : PAY306 LAST, FIRST Account# 123456789 Starting Value of Card \$0.00 Purchase Cash \$10.00 Total Received \$10.00 Arrears Previous Arrears \$34.29 Paid to Arrears (\$4.00) Arrears Remaining \$30.29 Net Credit From Purchase \$6.00 Current Card Value \$6.00 BALANCE SUBJECT TO VERIFICATION THANK YOU FOR YOUR PURCHASE
--	--

Figure 2-2
Example of Customer Credit Purchase Receipts (Left: no arrears, Right: arrears)

Other M-Power Features

- **Friendly Credit:** The system can be programmed such that a customer can have power even if their credit goes negative during certain periods of time—in SRP’s case this is between the hours of 6 p.m. and 6 a.m., seven days a week. The customer must purchase more electricity by 6:00 a.m. the following day to avoid a disconnect. The friendly credit used will be added to the arrears balance, to be paid off gradually with each subsequent purchase transaction.
- **Disconnects:** When a customer’s account goes negative outside the Friendly Credit hours, the meter will disconnect the power source to the home. To reconnect the power, the customer must purchase credit at a PayCenter (or call to invoke Emergency Credit – see below). Once credits are purchased and the card is inserted into the UDT, the customer’s power automatically reconnects. There is no disconnection/reconnection fee involved (for a standard residential account, the disconnection/reconnection fee is in the \$60-\$100 range, and requires a utility truck-roll).
- **Emergency Credit:** SRP may grant emergency credit over the phone by inputting a code to reconnect the customer’s meter. This feature was added to address concerns regarding the loss of electricity in situations where a shutdown of the overall SRP communications network prevented customers from purchasing electricity.
- **M-Power customers** receive no monthly bill and pay no late fees. They do, however, receive annual letters summarizing their monthly electricity use for the previous year for information

purposes only (standard rate customers receive these reports as well). These reports are also available online.

Back-Office Processes

M-Power customer meters are not read like standard program meters (unless a customer requests this in specific situations). As such, the Smart Card is the conduit through which SRP has access to M-Power customers' consumption information.

- As previously mentioned, when the card is inserted into the UDT, the full amount of credit that was on the card is transferred to the meter through the UDT, and the card balance goes to zero. At the same time, the meter consumption level at that time is transferred to the card, so that it may be transferred to SRP via the PayCenter the next time electricity credits are purchased.
- When a customer purchases electricity credits at a PayCenter, the following information is transferred from the SmartCard to SRP's back office system:
 - Meter read (cumulative kWh and max kW)
 - Reading date/time: that is, when the card was last read by the UDT
 - Cash purchase amount
 - Transaction date/time: that is, time stamp at PayCenter when the customer made a purchase, and therefore different than the "reading date/time"
 - Status date: that is, when the card is inserted into and read by the UDT (some time after the transaction date/time)
 - A code indicating whether a disconnect occurred (i.e., the customer ran out of power)
 - Also the remaining credit on the UDT is recorded; if this is negative, this is another method of knowing if a disconnect occurred
 - Any Friendly Credit used (and corresponding date/time stamps)
- During the same transaction, data are pulled from the back office to the PayCenter in real-time, and recorded on the customer's transaction receipt:
 - Any Emergency Credit that was required (and corresponding date/time stamp): this will be added on to the arrears balance.
 - Arrears owing, arrears payment, updated arrears balance: the system accesses how much the customer owes in arrears and takes 40% of the cash purchase value to apply to that amount; the remaining 60% is used to purchase electricity credits.
 - Confirmation number if paid by e-Chex
- PayFirst: SRP can use this function to input any additional debts the customer may have, which must be paid off first at a rate of 40% before the funds can be used to purchase electricity (e.g., covering any fees and amount owing from previous NSF checks)
- GiveFirst: SRP can use this field to input funds they may owe the customer (e.g., if they have paid by mailed check the value is input in this field, if they are owed any customer service rebates)
- Other information that is transferred to the UDT from the back office via the Smart Card:
 - Rates

- Holiday dates
- Configuration changes (e.g., display changes, credit limit changes)
- Messages to customers
- Given each account has at least two Smart Cards, there may be instances when a card is used that has not been used in a long time, and therefore contains “old” meter read information; these are called “stale reads”, and they are tracked and taken into account using both the “reading date/time” stamp and the “transaction date/time” stamp. Once the card is finally used again, the consumption information is automatically re-sequenced in the back office system.
- In cases where the card or UDT becomes corrupt, the meter can be physically probed to obtain the latest consumption reading. Corruption does not affect overall revenue reporting to any extent given the infrequency of such occurrences.

This section has provided a high-level of overview of the systems and general processes by which the M-Power program functions in its current configuration. The following section will examine the technology and business processes that have been developed in more detail.

3

M-POWER TECHNOLOGY, SYSTEMS, AND COSTS

Technology

As described in Section 1, the technologies involved in the M-Power program have evolved over the years. Each component of the technology is now examined in more detail to highlight its functionality and interconnection with the overall M-Power system. Information regarding the costs to the customers is also included, although SRP's technology cost information has not been included as it is protected under non-disclosure agreements with the vendors. The meter, UDT, and Smart Cards are illustrated in Figure 3-1.



Figure 3-1
M-Power Meter, UDT, and Two Smart Cards

User Display Terminal (UDT) or In-home Display (IHD)

The UDT currently in use at SRP has not substantially changed since 2005. Its trade name is the *ecoMeter*, and it is manufactured by Landis+Gyr UK, Ltd. (formerly known as AMPY Metering Limited). Table 3-1 provides an overview of its functionality.

**Table 3-1
UDT Features**

Information Displayed (Customer toggles through screens using the “Display Cycle” button)	Current rate per hour is \$0.XX Rate Y charge is \$0.XXXX/kWh Cost today is \$X.XX Cost yesterday was \$X.XX Cost this month is \$X.XX Cost last month was \$X.XX Enough credit for XX days Remaining credit is \$XX.XX
Languages	English and Spanish
Communications with Meter	Powerline carrier (PLC)
Real-time Display Update Rate	~3 seconds
Installation	By customer (once meter has been installed by SRP)
Power Source	UDT plugs into a standard 110V outlet. Also a battery back-up for power outage situations.
Manufacturer	Landis+Gyr UK, Ltd.
Model	A version of the ecoMeter (industry name)
Cost to Customer	\$99 deposit (87.50 of which is refundable upon return of the UDT to SRP)
Customer Support Options	Customer service telephone support Trouble shooting tips on mysrpmpower.com, and in the Quick Start Card and User’s Manual

Meter

The meter is very similar in functionality to a “smart meter”, and also has disconnection capability. One main distinction from today’s smart meters which are a part of advanced metering infrastructure is that there is no real-time communication capability between the meter and the utility; as previously described, this is accomplished via the Smart Card instead.

**Table 3-2
Meter Features**

Manufacturer	Landis+Gyr UK, Ltd.
Model	5252 (latest model)
Communications with UDT	Powerline carrier (PLC)
Installation	By SRP. Must marry with specific UDT intended for the residence.
Cost to Customer	None

PayCenters (Self-service Kiosks)

As of September 2009, SRP had 95 PayCenters located throughout the Phoenix area. PayCenter attributes are listed in Table 3-3.

Table 3-3
PayCenter Features

Manufacturer	AllKiosk
Languages	English and Spanish
Payment Methods	Cash and e-Chex Non-M-Power customers can pay bills via the PayCenter as well
Communications with M-Power Network	Real-time connection to the SRP back office system (the AMPY server), PayCenter maintenance, iNovah interface (point-of-sale software), and the e-Chex server (see Figure 3-2)
Installation	By SRP; must marry with specific UDT intended for the residence
PayCenter Support	Dedicated maintenance team PayCenters can be swapped out on the spot for faster recovery time

M-Power Business Systems

Customer Information and Back Office Systems

Multiple systems are used to support M-Power, including the back office system, known as the AMPY Management System or AMS, the Customer Information System (CIS), called Phoenix, and iNovah, which is the PayCenter server. The interrelation of these systems as well as the e-Chex server (the interface with the electronic checking system) and the PayCenter support and maintenance system are illustrated in Figure 3-2.

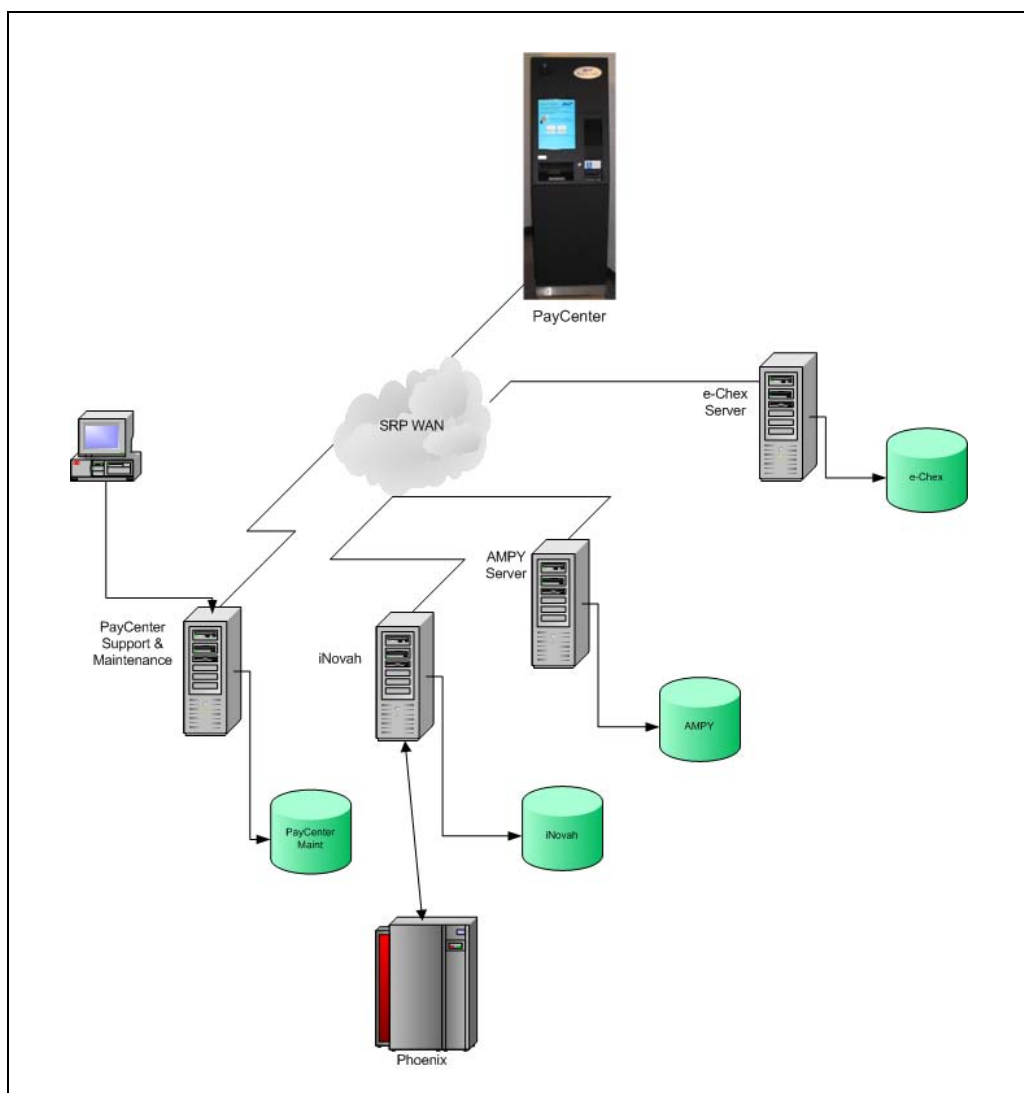


Figure 3-2
PayCenter Interfaces (Source: SRP, 2009)

Phoenix, the CIS, is now the system of record for M-Power customers, as it is for all other residential and commercial customers at SRP. All M-Power customer accounts are set up through Phoenix, and all customer information is housed in the system, including addresses, locations within the service territory, programs the customers are involved in, financial information including customer credit history, as well as records of customer interactions with SRP's customer service center. The Phoenix system was developed in-house by SRP with contractor support.

The back office system (AMS) was developed by AMPY and configured for the SRP M-Power program. It allows for the tracking of customer accounting details including customer service area and billing information, overall transaction history, arrears history, meter read details, meter credit status, and self-disconnection history. See Appendix B for various screen shots of the back office software.

The CIS (Phoenix) and the back office system (AMS) were originally completely separate systems in the early days of the M-Power program. Using this configuration, SRP would use the back office system to enroll M-Power customers, but would then need to enroll the customers in the CIS as well. This configuration entailed a lot of manual labor to ensure the two systems were reconciled and accounts were not out of balance. As M-Power customer numbers grew, so did the motivation to merge the systems. The process was complicated, taking approximately five years to complete. However, as of March 2008, the systems were synchronized, and Phoenix is now used to enroll customers, and any arrears owed by new M-Power customers on prior accounts flow into the back office system. The systems are also synchronized to reconcile when payments are made, etc. A report is run every night to reconcile the two systems, and although there are still some manual adjustments required to keep the systems synchronized, they have decreased dramatically since the initial synchronization in March 2008, and continue to decrease.

Lesson learned: use one integrated system from the beginning. The integration of the customer information and back office system took several years to develop and debug.

Revenue Reporting

Although M-Power customers do not receive bills, the systems were originally used to essentially “make” a monthly bill for M-Power accounts, so they could be “forced” into a billing cycle such that they would be consistent with the other residential accounts for revenue and tax reporting purposes, energy efficiency reporting, etc. While such a set-up was manageable when M-Power electricity purchase volumes were relatively low, recent enrollment rates have necessitated the need for an alternative approach. In the 2008 fiscal year (May 2007 through April 2008), the accounting methodology has switched to cash-based revenue recognition (i.e., revenue is recognized based on cash purchases) rather than the conventional billing cycle approach. For load forecasting purposes, the cash value is transferred back to an energy quantity. It is felt that this method of revenue recognition is much more accurate than the previous “forced billing cycle” approach. This new approach is also tied more closely to the synchronized business systems previously described as well.

M-Power Costs

Customer Costs

M-Power Start-Up Costs

As previously described, for initial M-Power account set-up, customers pay a \$99 deposit for the equipment (\$87.50 of which is refundable upon return of the UDT), as well as a \$28 (plus tax) service establishment fee. In addition, a \$30 electricity credit is placed on one card. This total amount, known as a “pay-down balance”, is uploaded as an arrears balance that the customer will pay off gradually with each subsequent purchase transaction.

M-Power Electricity Rates

M-Power customers pay a per-kWh flat rate, which varies seasonally, and is comprised of various adjustment charges. In addition, there is a monthly service charge of \$15, which is collected either through hourly or periodic deductions from the account balance. The charges

effective November 2009 are listed in Table 3-4, and are compared against the standard residential price plan (also referred to as E-23). On average, in the summer months the M-Power rates generally result in slightly lower electricity bills compared to the Standard rate beyond a threshold consumption level. In the winter months, the M-Power rate is always more expensive than the Standard rate. Using average seasonal consumption levels for M-Power customers, M-Power customers may actually pay \$38 more on an annual basis. It is, however, difficult to compare the two rates using the same consumption levels, as it is possible that a conservation effect induced through the M-Power program may result in lower overall consumption levels.

Table 3-4
M-Power per-kWh Charges (Effective November 2009)

Charge Component	Summer (May-June and September-October)		Peak Summer (July-August)		Winter (November-April)	
	M-Power*	Standard (E-23)**	M-Power	Standard (E-23)	M-Power	Standard (E-23)
Total per-kWh	\$0.0984 per kWh	\$0.1019 per kWh (≤2,000 kWh) \$0.1061 per kWh (>2,000 kWh)	\$0.1030 per kWh	\$0.1073 per kWh (≤2,000 kWh) \$0.1119 per kWh (>2,000 kWh)	\$0.0872 per kWh	\$0.0879 per kWh (≤400 kWh) \$0.0688 per kWh (>400 kWh)
Monthly Service Charge	\$15 per month	\$12 per month	\$15 per month	\$12 per month	\$15 per month	\$12 per month
Estimated Monthly Rates (excl. taxes)	Assuming 1,069 kWh/month***		Assuming 1,539 kWh/month***		Assuming 697 kWh/month***	
	\$120 per month	\$121 per month	\$174 per month	\$177 per month	\$76 per month	\$68 per month
M-Power cheaper at: (excl. taxes)	> 857 kWh/month		> 697 kWh/month		Never (Standard always less expensive)	

Sources:

* <http://www.srpnet.com/payment/mpower/pdfx/MPowerE24Nov2009.pdf>

** <http://www.srpnet.com/prices/pdfx/BasicPlan1009.pdf>

*** Based on average M-Power customer usage for FY10

SRP Cost-Benefit of M-Power

Table 3-5 provides an overview of the 2010 benefit-cost calculations for the common energy efficiency screening tests.

Table 3-5
M-Power per-kWh Charges (Effective November 2009)

	Benefits (NPV)	Costs (NPV)	Net Benefits	Benefit/Cost Ratio	Cost of Conserved
Total Resource (TRC)	\$10,960,736	\$5,574,298	\$5,386,438	1.97	\$0.037
Utility (UCT) / Program Administrator Cost Test (PACT)	\$10,960,736	\$5,574,298	\$5,386,438	1.97	\$0.037
Participant (PCT)	\$15,844,237	--	\$15,844,237	--	
Ratepayer Impact (RIM)	\$10,960,736	\$21,418,535	-\$10,457,799	0.51	\$0.144
Societal Cost (SCT)	\$10,960,736	\$5,574,298	\$5,386,438	1.97	\$0.037

The benefits in terms of electricity savings are derived using a 12% value for the conservation effect of the M-Power program, which SRP assessed through by three different conservation impact studies (see Section 5 for more details). To attribute kWh savings, SRP applies the conservation effect savings percentage to the load of current year subscribers. In a departure from conventional energy efficiency program evaluation methods, SRP does not attribute any impact beyond the current year. This is partly to ensure a conservative estimate of savings, but also because the impact studies were not constructed to resolve whether the behaviors undertaken by M-Power subscribers would persist into the future if the customer remained on M-Power, or if that customer migrated to another SRP rate. All tests pass the benefit/cost test except the Ratepayer Impact Model, which includes customer bill savings as a cost, given the savings represents a revenue shortfall. It is rare that an energy efficiency program that elicits a bill savings will pass the Rate Impact Test. The estimated program Societal Test benefit/cost ratio for 2010 is 1.97, which places it above many conventional energy efficiency programs.

This section has provided a high-level overview of the basics of the M-Power program in terms of the technologies and systems that support it and the resulting costs. Building on this information, as well as how the systems work together to provide the M-Power service to customers as outlined in Section 2, the following section outlines the results of several SRP-commissioned studies aimed at understanding customer perceptions of the M-Power program.

4

THE CUSTOMER EXPERIENCE

Past Study Overviews and Findings

SRP has dedicated significant resources to understanding what customers think about the M-Power program. This is partly in response to critics who are concerned that prepay programs may be unfairly forcing low income customers into power outage situations. Some of the initial market research studies were in partnership with the Arizona Community Action Association (ACAA), a low income advocacy group, to jointly investigate such concerns. As a result of some of the early findings that suggested high levels of customer satisfaction, and even “increased self-esteem”⁷ due to perceived financial benefits and feelings of self-efficacy in relation to bill payment, the ACAA now publicly supports the M-Power program.⁸

Many of the various studies that were performed are outlined in Table 4-1, and a more detailed review of the results can be found in Appendix C. Considering the results of these studies, some themes emerge.

Table 4-1
Past M-Power Market Research Studies

Reference	Study Title	Study Period	Subject
SRP, 2009b	CCTS M-Power Quarterly Scorecard	May-Jul 2009 (performed every quarter)	Summary presentation of telephone survey results from M-Power customer who visit the PayCenter kiosk to purchase power
PRIZM, 2009	PRIZM Analysis	Jul 2009	PRISM analysis/marketing
Traasdahl, 2009		2009	Overview presentation of program
WestGroup Research, Inc., 2007	SRP M-Power Materials Survey: Topline Report, November 2007	Oct 2007	Telephone interviews to assess salience of updated communications materials; 201 M-Power customers
WestGroup Research, Inc., 2006a	SRP M-Power Communications Focus Group Research	Nov 2006	Focus group report, 3FGs, opinions on M- Power, the Starter Kit and different M-Power communications materials; customers randomly selected from M-Power population who meet desired criteria (e.g., on M-Power for at least two months)

⁷ Personal communication, Betty Pruitt, M-Power Marketing, September 16, 2009

⁸ Anecdotally, Ms. Pruitt is a former ACAA employee who was initially a critic of the M-Power program. She was convinced through customer testimonials of its benefits, and is now an SRP employee working on M-Power Marketing.

Table 4-1 (continued)
Past M-Power Market Research Studies

Reference	Study Title	Study Period	Subject
SRP, 2006	SRP M-Power Shadow Project September 2006 – Executive Summary	Sep 2006	Executive summary of the SRP M-Power Shadow Project, which involved 8 in-depth, in-home interviews from customers from a range of credit codes, length of time on program, language, income and housing type
WestGroup Research, Inc., 2006b	SRP M-Power/AMPY Benchmark Study 2006	Mar 2006	Telephone survey results, 402 M-Power customers; purpose was to obtain baseline data on attitudes towards M-Power, with emphasis on PayCenter machines, as new machines were to be installed starting in April 2006.
Reiley & Johnson, 2006	What Determines M-Power Customer Satisfaction: How SRP Can Attract and Retain M-Power Customers	2006	University of Arizona Assessment, telephone survey conducted by WestGroup of 401 M-Power customers that had been on the program for 18 months or more. Goal was to assess customer satisfaction with the aim of understanding what would make customers stay on M-Power so as to reduce turnover rates; another goal was to understand traits of long-term M-Power customers.
WestGroup Research, Inc., 2002	SRP M-Power PayCenter Research: Summary of Findings	Nov 2002	Telephone interviews regarding convenience of PayCenters in Circle Ks (convenience store); 214 M-Power customers; interviewees had been on program for at least 2 months and had a telephone number on file.
WestGroup Research, Inc., 2001	SRP M-Power Focus Group Report—June 2001	May 2001	Focus group report, 4 focus groups, opinions on areas of process and operational improvement. One focus group was comprised of people who had left the M-Power program.
WestGroup Research, Inc., 1999a	Pay As You Go Focus Group Report	Aug 1999	Focus group report, 2 focus groups, joint between SRP and Arizona Community Action Association, opinions on M-Power program
WestGroup Research, Inc., 1999b	SRP/ACAA Pay As You Go Study	Sep 1999	Telephone survey report, 179 Pay as You Go customer (precursor to M-Power program); joint study between SRP and Arizona Community Action Association (ACAA), opinions on M-Power program.

Overall Satisfaction Levels

One obvious finding, which is consistent with every customer study, is that M-Power customers are very fond of the program. This finding was first found with the 100-home pilot discussed in Section 1, with the oldest studies reviewed for this report (circa 1999), and with the most recent studies reviewed, in the form of the Customer Contact Tracking Study (CCTS). This is an ongoing quarterly customer service market research report, which as of 2007 began to include M-Power-specific questions. For the M-Power section of the CCTS, the respondents are chosen randomly from M-Power customers who use PayCenters to purchase power, i.e., the vast

majority of M-Power customers. From the range of data available, the percent of customers who are satisfied or very satisfied with M-Power ranges from 83% to 96% (SRP, 2009b).

Overall satisfaction of M-Power customers with SRP is generally favorable as well. In the three surveys performed prior to the start of the CCTS, those who rated SRP's performance as very good or excellent ranged from 70 to 73%. When the CCTS began, the question changed somewhat, but CCTS data from FY07 to FY10 suggest M-Power customers who were satisfied or very satisfied with SRP ranged between 85 and 89%.⁹

Given the high importance SRP places on the customer satisfaction ratings it receives from its M-Power customers, it is instructive to consider how this satisfaction with the utility compares between M-Power and non-M-Power customers. As illustrated in Table 4-2, "overall performance" ratings are comparable, but statistically more M-Power customers perceive high overall value in the service SRP provides compared to non-M-Power customers. Statistically fewer M-Power customers gave SRP top ratings for "overall experience". Therefore, by some metrics M-Power customers are generally happier with SRP, but not by all metrics.

Table 4-2
SRP Ratings: Comparing M-Power and Non-M-Power Customers (FY2010)¹⁰

Percent 9/10 Rating (Out of 10)	M-Power N=337	Non-M-Power (all other rates) N=3574
Overall Performance as an Electric Company: A service quality metric, and SRP's core business measure	66%	63%
Overall Value: Value received from SRP considering amount you pay for services	46%*	37%
Overall Experience: Broad measure of service received, impressions of the company, customer experience	44%	50%*

* Statistical difference between groups

Perceived Customer Benefits of M-Power

Most of the survey and focus group reports have similar findings in terms of what M-Power customers perceive to be the advantages of the program.

One of the main advantages reported is the educational and awareness aspect of the program: the UDT provides each customer with real-time consumption information about their home (update rate of 3 seconds) allowing householders to see the electricity consumption effect of their household behaviors. Some reports included mention of extending the education to other household members, including children.

⁹ Personal communication, Dena Emary, Senior Analyst, SRP, August 16, 2010.

¹⁰ Data are from SRP's FY2010 "Customer Perspectives" survey, a marketing study that includes questions intended to track overall opinions of SRP, and include representation of all residential sectors.

Indeed, there have been several studies that report conservation effects by providing this sort of electricity use feedback in non-prepaid conditions.¹¹ In the case of the M-Power program, one can hypothesize that customers are more likely to use the UDT to educate themselves about their unique usage patterns, as the consequences are more severe if they do not do so: they are more likely to have their electricity shut off unexpectedly.

“I tell all my friends that it was the best teacher for me to teach me how to use electricity efficiently.” WestGroup Research, Inc., 2001, p. 4.

“Because I live paycheck to paycheck, it makes me more conscious of how much I’m using. I don’t let my daughters open the refrigerator because I know it’s using more electricity. It makes me more aware of what I’m using and where it’s being wasted.” WestGroup Research, Inc., 2001, p. 3.

“I found out how much my dishwasher runs, if I have to use it in the summer time, it’s cheaper to just hand wash my dishes and dry them in the sink, rather than have my air conditioning catch up for that dishwasher.” WestGroup Research, Inc., 1999a, p. 4.

Perhaps a consequence of the knowledge gained regarding a household’s electricity usage patterns, another advantage that is often reported is the sense of control the M-Power program provides customers. This includes the ability for customers to monitor their power usage, to pay for power at their own pace (e.g., daily or weekly instead of monthly), and even the ability know and be ready for a disconnection if necessary.

“It allows me to budget. Being able to see what I spent last month allows me to break it down into pay periods so I can put money aside that I know I’m going to put on the card. You don’t have that bill coming. I wish there was a way that we could refill the card over the phone because sometimes I’m going “Oh man, I’ve got to put money in, it’s late, and I’ve got a four year old so I am pulling him out of bed to go fill the card because of forgetting.” WestGroup Research, Inc., 2006a, p. 17.

“Actually for me it’s a lot better than getting a bill at the end of the month especially in summer. It’s a lot easier to pay \$40 a week because the end of the month is when all the rest of my bills are due so I’m flat broke.” WestGroup Research, Inc., 2006a, p. 17.

“You have control over how much power you are using. There might be reasons for the spikes like leaving on the air conditioning while you were gone that day and things like that. You have more control over it.” WestGroup Research, Inc., 2001, p. 3.

“You can plan your usage better.” WestGroup Research, Inc., 1999a, p. 5.

The other main advantage often reported by M-Power customers is the perception that the program saves them money. As illustrated in Section 3, kilowatt for kilowatt, the M-Power program can actually be more expensive than the standard program. However, many customers reported that their increased knowledge of consumption patterns makes them more likely to be able to use less electricity, thus resulting in an overall monetary savings as well. In addition, as reviewed in Section 3, start-up costs are less for the customers. Finally, given there are no late

¹¹ Studies involving an in-home display (IHD) in non-prepaid conditions have reported conservation savings in the 0 to 7% range.

fees or disconnection charges, this can be another source of monetary savings for customers who previously had to pay these charges through the standard program.

“An advantage is that it saves you money and you can put like \$2 if you have to, if you're low on cash or whatever. You don't have to worry about your lights going out.”

WestGroup Research, Inc., 1999a, p. 4.

Other benefits that were reported included:

- The provision of an alternative to the hassle and sometimes embarrassment of going through the conventional program's disconnection/reconnection process
- The elimination of the fear of not knowing how much a monthly bill will be

Perceived Disadvantages

Most of the M-Power disadvantages reported relate to the PayCenters. A qualitative study from 2006 found that more payment options at PayCenters would be preferred by customers, as well as the ability to pay by phone or online; also, there were complaints about the working order of the PayCenters (WestGroup Research, Inc., 2006a). Quantitative research from this era found that 71% reported encountering a PayCenter machine that was not working in the previous year (WestGroup Research, Inc., 2006b). In addition, satisfaction with PayCenters decreases the longer customers are on the program (choices ranged from <1 year to 2+ years). Another study from the same era found that 49% of survey respondents reported having had a problem with the M-Power program. Of the 401 respondents, the top complaints were the PayCenters being out of order (44%), that money sometimes does not successfully transfer to the card (14%), and that they have to go too far to get to a PayCenter (10%) (Reiley & Johnson, 2006). Somewhat inconsistently, the same study also indicates that 76% of customers had experienced an out-of-order PayCenter, and that 24% stated the PayCenter locations were inconvenient. From CCTS data, M-Power customers who are “satisfied” or “very satisfied” with the “PayCenter process” have varied between 80 and 90% since fiscal year 2007.¹² For fiscal year 2010, 84% reported this level of satisfaction. Also, 24% of all surveyed customers (not just M-Power customers) indicated experiencing PayCenters not working in the past 30 days.¹³ Although some of the 2006 findings are somewhat inconsistent and the CCTS question wording is different than the 2006 study, the indication is that the overall PayCenter problem rate has declined since 2006.

Several studies recommend addressing these disadvantages by increasing the payment options available to M-Power customers. While customers can now pay with a credit card via the telephone, they still must visit a PayCenter to have that value transferred to their Smart Card. Of course, for unbanked and/or credit-challenged customers, the M-Power configuration remains the only viable prepaid option.

¹² Personal communication, Dena Emary, Senior Analyst, SRP, July 14, 2010

¹³ Personal communication, Jennie King, Manager, SRP Market Research & Info, SRP, August 25, 2010. Note that the 24% value is not directly comparable to the others cited, as it represents all customers, not just M-Power customers; given that M-Power customers are much higher users of the PayCenters than the other customers, it is possible that the value could be higher than 24% for M-Power customers only. Also, the question wording asks for problems in the ‘last 30 days’, whereas the 2006 study asked for problems in the ‘last year’.

M-Power Customer Characteristics

SRP has analyzed their residential customer base using Claritas, Inc.'s commercially available PRIZM tool, which uses address and zip code data to segment customers into different income, age, and life stage (e.g., "single" versus "family") categories. From a 2009 PRIZM analysis, M-Power customers compared to all other residential customers were more likely to be relatively young, have families, be relatively low-income, be low electricity consumers, live in apartments, have been SRP customers for less than five years, and have unsatisfactory or "new" credit ratings (PRIZM, 2009).

Table 4-3 provides an overview of some M-Power customer demographics. The latest demographic data for the 2010 fiscal year indicate that M-Power household heads tend to be relatively young (average age 36 years), low-income (average income \$24,400), and predominantly Hispanic.

Table 4-3
M-Power Customer Demographic Trends

	1999	2006	FY07	FY08	FY09	FY10
Data Source	Phone Survey	Phone Survey	CCTS (Quarterly Phone Survey)	CCTS (Quarterly Phone Survey)	CCTS (Quarterly Phone Survey)	CCTS (Quarterly Phone Survey)
Reference	WestGroup Research Inc., 1999b	WestGroup Research Inc., 2006b	*	*	*	*
Average Age	NA	NA	35	36	36	36
Median Age	NA	NA	33	33	33	35
18-34 age range	NA	NA	54%	53%	52%	50%
Average Income	\$31,400	\$32,586	\$33,200	\$29,600	\$25,800	\$24,400
Median Income	NA	NA	\$27,600	\$19,500	\$18,300	\$17,900
Income <\$30,000	64% (<35K)	67% (<40K)	54%	71%	80%	82%
Ethnicity						
Hispanic	22%	23%	45%	48%	43%	41%
African American	24%	14%	11%	11%	13%	14%
Caucasian	50%	53%	31%	31%	29%	34%

* Personal communication, Jennie King, Manager, SRP Market Research & Info, August 25 2010. Summary of CCTS data.

When more recent CCTS data are compared to older phone survey data, the M-Power customer traits appear to have changed substantially over the years. Considering income statistics, 64% and 67% of respondents reported incomes of \$35,000 and \$40,000 or less for 1999 and 2006 respectively, as compared to 82% reporting incomes of \$30,000 or less from the CCTS data for FY10. Considering ethnicity, 22% and 23% of respondents were Hispanic as compared to 41 to 48% from the more recent CCTS data. While there is some concern in comparing the 1999/2006

studies to the more recent CCTS surveys, the overall trends suggest the make-up of M-Power customers has shifted between 2006 and 2007. Considering the more comparable CCTS data between FY07 and FY10, it appears the average income of M-Power customers is declining, the average age is increasing, and relatively fewer Hispanics and more Caucasians and African Americans are enrolling in M-Power on average. It is possible that these demographic changes are due to the economic recession and that they will change again as the economy recovers.

Customer Purchase Behavior

Table 4-4 contains a summary of some of the findings relating to average customer purchase amounts. While an older quantitative study indicates average purchase amounts are in the \$50 range, more recent data suggests purchases in the \$20 range. Also, the more recent data suggest customers may purchase roughly the same dollar amount during high use periods (i.e., the summer), but will make the purchases more frequently.

Table 4-4
Electricity Purchase Amount and Frequency Information

Study	Ave no. of purchases per month	Ave amount per purchase
Traadahl, 2009	Summer = 7.1 Winter = 3.6	Summer = \$24 Winter = \$21
WestGroup Research, Inc., 2006b	3.0	Not reported
WestGroup Research, Inc., 2002	3.0	Not reported
WestGroup Research, Inc., 2001 (focus group, not quantitative)	Ranges reported from twice a week to once a month, but generally associated with receipt of paycheck	Ranges reported between \$10 and \$100
WestGroup Research, Inc., 1999a (focus group, not quantitative)	Not reported	Amount spent per purchase between \$50 and \$100, and customers will buy more if they can
WestGroup Research, Inc., 1999b	3.7	\$56.70

Customer Retention

While survey results indicate high levels of satisfaction with the M-Power program and that customers would prefer to continue to remain on the program, the turnover rate of the M-Power program is relatively high. CCTS respondents were on the M-Power program for an average of 20 months (less than two years) as of July 2009, consistent with other CCTS data that has been hovering around the two-year mark since early 2008.

Part of this relates to the fact that, due to the very nature of the program and its minimal start-up costs for the customer, it likely attracts customers that anticipate a short-term stay in their residence in the first place. However, one study was commissioned to expressly understand how to decrease the turnover rate of M-Power customers, as this represents cost to SRP (Reily & Johnson, 2006). They report that of approximately 40,000 customers, only 11,200 had been on

the program longer than 18 months as of February 2006. Using the assumption that those customers who reported being “very satisfied” with the program would be more likely to continue on the program, they determine what customer and program traits correlated with a very satisfied customer. They found that very satisfied customers had also reported that PayCenters were conveniently located; perceived their bill would be higher on the standard rate (or that they would save money on M-Power); were between 35 and 55 (20% more likely) or older than 55 (33% more likely); or live in certain cities (Apache Junction, Glendale, Mesa, Phoenix). The probability of a customer answering that they were “very satisfied” with the program decreased for customers reporting experience with out-of-order PayCenters, who did not believe they consumed differently on M-Power compared to the standard rate, who required more frequent card refills each month, or who were African American. Traits not found to influence the probability of answering “very satisfied” included income, consumption level, number of months on program, whether the customers was Hispanic, household size, occupation, or whether the customer was a college graduate.

This section has attempted to paint a portrait of the M-Power customer and their experience with the program. Customer satisfaction is high, owing to the perceived sense of control the program offers, as well as the awareness and educational aspects relating to household electricity consumption patterns. Related to both of these is the perception that consumers are saving money on their electricity costs. The main disadvantages relate to the PayCenters: customers would like more of them, and would like them in better working order, although more recent research findings (FY10) indicate machine performance has improved for customers. M-Power customers tend to be relatively young, be relatively low income, and are predominantly Hispanic. However, customer demographics appear to have changed in recent years, likely due to the economic downturn—the program is attracting customers who are somewhat older and slightly lower income still; more Caucasian and African-American customers are becoming customers as well. Recent electric purchase behavior data suggest people make purchases in the \$20-\$25 range, and do so with a frequency that varies based on usage, about three times per month in the winter and up to seven times per month in the summer. Finally, while customers express that they are very satisfied with the M-Power program, the turnover rate is still relatively high, likely due somewhat in part to the program’s appeal to customers who intend a short-term stay. While there is a net growth rate of 10,000 customers per year on the program, the average M-Power customer stays on the program for roughly two to five years.

In addition to obtaining the above self-reported information regarding customer perceptions of the M-Power program, including perceived energy savings, SRP has also performed various savings impact evaluations of the program, which will now be examined in more detail.

5

INFLUENCE OF M-POWER ON ELECTRICITY USAGE

M-Power turns conventional electric service on its head. Instead of paying an invoice issued by the utility for recorded energy usage, the customer is responsible for making sure that there is sufficient credit in the UDT to meet his or her upcoming electric service needs. M-Power requires that consumers pay attention to when and how they use electricity.

The UDT anticipates the need for such awareness and displays the cash credit left and indicates when, under usual circumstances, the customer can expect that the device will shut service off. The service was initially intended as a way to help customers gradually work off arrears without losing electric service. Over time, M-Power has gained a wider following, and some new SRP customers, for example, choose M-Power over the conventional service because they can initiate electric service without paying the standard a cash deposit.

The most striking result that SRP reports from its M-Power experience is the reduction in overall electricity use that it associates with M-Power participation. The so-called conservation effect is substantial—SRP reports an average annual household annual reduction of almost 12%. That exceeds the reduction that many energy efficiency programs or portfolios report. Accordingly, a close examination of the M-Power conservation effect is warranted to provide others with insight into the behavioral mechanisms at work so that these findings can be extended to other circumstances.¹⁴

Many Reasons for a Conservation Effect

M-Power is fundamentally different from traditional electric service whereby consumers are billed periodically (typically monthly) for the energy (kWh) they used. M-Power is a prepaid service that requires the consumer to anticipate its rate of electricity consumption (aided by the UDT) and take action to keep the on-board balance positive. The preventative action involves a trip to a PayCenter to purchase power and then return home to transfer that balance to the meter through the UDT. Each customer decides how much to purchase at each transaction, balancing expected electricity needs with other budget imperatives. Smaller purchases require more trips to the PayCenters, but tie up less cash. As previously described, M-Power reports that the number of PayCenter transactions increases in the summer, but the amount of such purchases is only slightly higher, which suggests that careful cash management is a defining benefit.

Additionally, some consumers enroll in M-Power to avoid a service termination due to an excessive level of unpaid arrears. Because M-Power requires a heightened awareness of when and how electricity is used, some consumers may be attracted to it because it enables reducing usage and lowering the level of expenditures. Some may be more inclined because lowering

¹⁴ The discussion that follows is based on the results of analyses provided to EPRI that were undertaken by SRP analysts. EPRI did not conduct an independent assessment of the electric consumption impact of M-Power on its participants, nor did it attempt to reproduce the results of the studies conducted by SRP.

electricity consumption reduces environmental emissions to which they impute a high level of intrinsic benefit.

These dramatic changes in electric service provisions, or the perception thereof, would be expected to result in changes in how consumers use electricity. The extent and nature of those changes depend on how and to what extent they influence consumer behavior. Although the behavioral mechanisms are varied, a plausible hypothesis is that the majority of these influences will likely result in reduced energy consumption. The discussion that follows explores these influences, culminating in a discussion of how SRP has striven to quantify M-Power's influence on the level of electricity use of its subscribers.

Managing What You can Measure

A prominent feature of M-Power is that it allows customers to purchase electricity on a cash-and-carry basis. With conventional electric services, consumers benefit from periodically (after the fact) invoiced services because it transfers the working capital obligation to the service provider. But, that benefit comes at the expense of a temporal and spatial disconnect between the rate of consumption and the ultimate payment obligation. Customers may not be aware that they are consuming an abnormally high amount of electricity until they receive the bill; the immediate budget consequences are unavoidable. Making adjustments in consumption going forward, to avoid the consequences, is challenging under conventional invoicing service because the consumers can not associate specific coincident usage with the cost.

M-Power's prepayment service involves the customer continuously; it requires monitoring the available service balance, thereby providing constant feedback on the rate of electricity consumption. If the rate at which new purchases are required changes, or the level of routine purchases increases, the consumer is immediately alerted to the situation, and associating electricity usage with these circumstances involves looking back over just a few days, or at most a week or so. Was the increase due to special circumstances, like additional people in the household or weather? Was it due to a lapse of diligence in practicing conservation measures? These circumstances can more easily be diagnosed, and if warranted, corrected. M-Power facilitates drawing such associations and taking the appropriate remedial consumption change, if one is warranted.

The same sequencing of diagnosis and remedial action applies if the consumer discovers that electricity payments at current levels cannot be sustained. Changes in income or other expenditure obligations can obligate altering the allocation of income across expenditure categories. M-Power facilitates making a reduction in electricity use and payments when conditions warrant doing so. Again, the temporal connection between usage and cost is accentuated when payments are made frequently (every few days) rather than periodically and routinely (paying a monthly invoice).

Alternatively, the consumer's understanding of how it uses electricity, through M-Power enrollment, may result in an increase in consumption for specific end uses. The consumers may have adopted behaviors based on erroneous understanding of what a specific and discretionary service costs, for example air conditioning. Discovering the actual cost may cause the consumer to conclude that this service is a good buy, and increase usage up to the point the marginal value of consumption is equated to the corresponding cost.

Deposit Avoidance

M-Power requires a substantially lower deposit to initiate service than what SRP requires for its conventional residential services. The M-Power deposit of \$99 secures the UDT device—no provision for non-payment, as is the case with conventional residential electric service, is required. This feature may be especially attractive to people operating under budget limitations and lower income families. Students (and their parents) may be attracted to the lower cash outlay that comes when they already face several substantial cash outlays for rent deposits, books, and tuition.

The importance of this aspect of M-Power service is underscored with SRP's experience in administering the service over the past 10 years. It reports that changing the level of the M-Power deposit relative to the deposit for standard post-pay service measurably alters the subscription rate and level.¹⁵ Apparently, customers that are primarily, or perhaps solely, attracted to the deposit avoidance feature, and recognize that it comes at the price of some inconvenience (going to a kiosk to refresh the UDT balance) are quite sensitive to the level of that benefit. As the deposit rises, M-Power enrollment is less attractive.

Accommodating Particular Circumstances

Some customers may have subscribed to M-Power due to the circumstances of their living arrangements. As cited above, one report suggests M-Power is popular in rental housing (PRIZM, 2009), perhaps because it facilitates a smooth transition from tenant to tenant, while keeping electric service on continuously for safety and security reasons. Some of these circumstances are discussed below.

Pay-as-You Go Household Accounting

Pre-paid service has attractive features to people that do not have ready access to, or prefer to avoid, paying through checking accounts. Cash counting forces budget discipline that some customers require to make ends meet. Others value it because it gives them control over what they spend on electricity (budget-conscience), or how much electricity they use (environmentally concerned). Another important factor is that electricity must be purchased at the PayCenters; this apparent inconvenience for some may be a desired feature as it acts as another force of discipline.

Arrears Financing Through a Rate Differential

Customers that go on M-Power to avert a service disconnect pay back the outstanding arrears incrementally. Each time they purchase electricity at a PayCenter, 40% of what they pay goes to buy-down the arrears, and the rest becomes a debit balance on the card that is subsequently transferred to the customer's UDT as a positive balance. This 40% larger payment may raise the perceived cost of electricity to the M-Power consumer. This perception will be influenced by the information on actual cost provided by the UDT, however, it is not known to what extent the UDT information overrides the perception of larger payments. To some extent, it could be expected that larger payments would result in reduced electricity usage. The extent to which this results depends on each customer's price elasticity of demand for electricity. The discussion that

¹⁵ Personal communication, Mike Lowe, Customer Services Manager, September 23, 2010

follows is illustrative of how price elasticity would predict electricity consumption if consumers respond to the actual price they pay (the cost per kWh purchased) rather than the posted (at purchase) tariff rate.

Price elasticity, in this case the own-price elasticity, establishes a link between price changes and consumption levels. As the price of electricity goes up, customers readjust their budget to accommodate the fact that something has to give: electricity use goes down. Price elasticity indicates the percentage change in electricity usage that results from a one-percent change in electricity price, providing a simple way to convert price changes in consumption adjustments. For example, if the price elasticity is negative 0.10, then a doubling (100% increase) in price results in a 10% reduction in electricity usage. Studies of household electricity usage, under uniform electricity rates, report that the price elasticity of demand (expressed as absolute value percentage) is in the range of five to 10%.¹⁶ The level of price elasticity may vary by region and climate owing to greater ability to modify controllable and discretionary end uses.

How much of an adjustment in electricity use under M-Power would price response account for? Assume a customer in arrears routinely pays \$20 at a PayCenter, and receives \$12 in energy given that 40%, or \$8, applies to the arrears. This larger payment raises the effective price of electricity by 67%.¹⁷

Figure 5-1 illustrates the impact on electricity consumption at different levels of price elasticity. It plots out the percentage reduction in electricity associated with different price elasticity levels. A 5% reduction is expected based on the range of price response cited above. If an M-Power customer in an arrears situation is more price elastic, then even larger reductions in usage would be undertaken. Many uses of electricity that most households take for granted may become discretionary under severe budget pressure, which is manifest as high price elasticity, and more sharply reduce usage as long as arrear payments are being made.

¹⁶ EPRI, 2008; Faruqui, Hladik, and Sergici, 2010. Changes in the pattern and level of electricity use may be induced by time-varying rates such as time-of-use and real-time pricing owing to a more poignant incentive to modify controllable and discretionary end uses. Since M-Power accentuates awareness of the cost and price of consumption, participants may indeed be more price elastic than their conventional rate counterparts.

¹⁷ Assume that the uniform rate under M-Power is about \$0.11/kWh. A \$20 purchase would buy 181 kWh under the base tariff. If only \$12 goes toward energy, only 109 kWh are debited to the Smart Card and as a result the effective price of purchased electricity is approximately \$0.18/kWh.

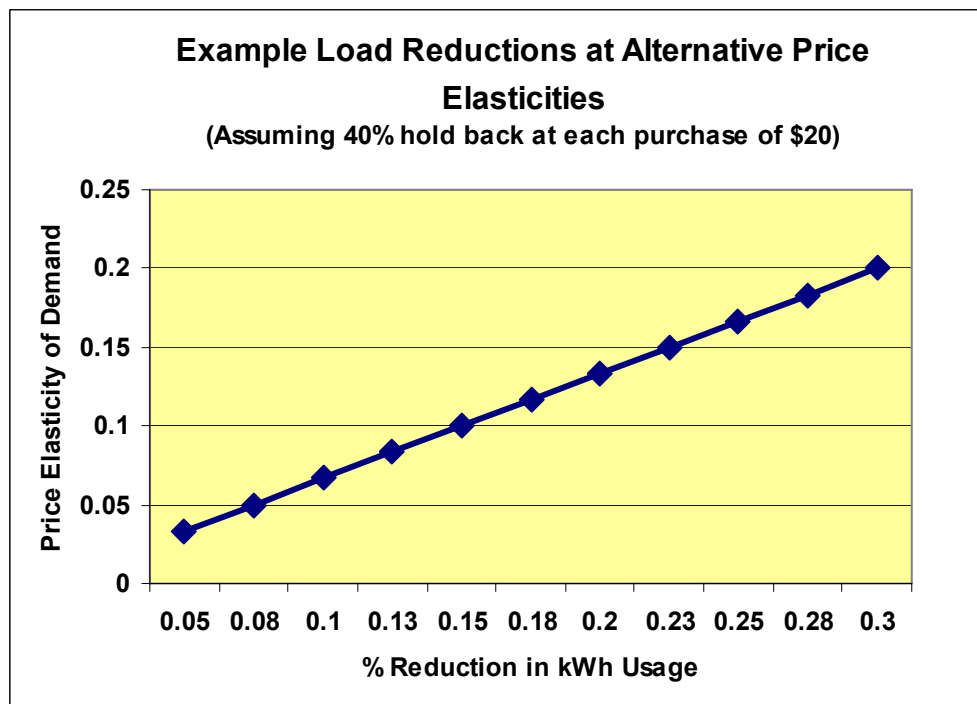


Figure 5-1
Example Price Elasticity

The price elasticity explanation is less compelling for customers that elect M-Power to avoid paying a larger cash deposit. They start M-Power service with a relatively small arrear balance (the cost of the \$99 deposit, the \$28 service establishment fee plus tax, and the \$30 electricity credit), so the higher effective price they pay per kWh is only a temporary phenomenon. However, other factors may come into play that result in lower energy usage, which will now be discussed.

Conservation Ethic

Some consumers may be drawn to M-Power because they associate the service with promoting the conservation of resources through parsimonious electricity usage. SRP's M-Power marketing efforts are specifically designed to instill this attitude and convince prospective participants that M-Power is a tool to help them to achieve a specific objective: reduce energy use. In effect, this represents a conservation ethic that embodies several of the influences discussed above.

Summary of Potential Influences

Table 5-1 summarizes the M-Power influence according to which aspects of electricity consumption are influenced along with a speculative estimate of the degree of that influence. While some of the influences are either indeterminate or may result in increased usage, overall M-Power seems to be tilted toward reduced consumption, or a conservation effect.

Table 5-1
Potential Influences of the M-Power Program on Consumption

Influence	Character of Impact on Electricity Usage	Degree of Impact
Manage what you can measure	Decrease or increase kWh and kW	Depends on the extent to which the perceived value of electricity diverged from the value realized through information
Deposit avoidance	Indeterminate, but reduced kWh and kW seem likely for pay-as-you-go feature	A lower deposit may be the attractant, but pay-as-you go comes with the bargain
Particular circumstances	Indeterminate	Agency issue: if the landlord makes the M-Power decision- does the tenant adopt
Pay-as-you-go	Decrease kWh and kW	Seems more likely that the predominant effect is that consumers discover ways to save
Arrears financing through price	Decrease kWh and kW	Price effect may be small, but its influence reduces usage
Conservation ethic	Decrease kWh and kW	Self-fulfilling outcome

SRP Impact Assessment

SRP conducts a wide range of studies to track customer satisfaction with M-Power, as reported in Section 4. SRP has also undertaken directive studies to quantify the conservation effect attributable to the M-Power program. If M-Power does demonstratively result in reduced electricity consumption, then those savings produce benefits beyond the lower bills subscribers enjoy. They lower utility supply and administrative collection costs that result in savings to all SRP customers, in the same manner and level as equivalent reductions attributed to the energy efficiency programs SRP undertakes.

SRP has undertaken three studies, designed and executed by staff analysts, to quantify the conservation effect attributable to M-Power. The first two studies, using post-treatment data from 2002/2003 and 2003/2004, produced similar results. M-Power subscribers were found to use approximately 11% and 13% less electricity respectively than their counterparts on the standard default price plan, known as E-23 (Kirkeide, 2009). The third study, completed in 2007 using post-treatment data from 2005/2006, found a similar effect of 12% (ibid). This study employed the same methodology as the other two, so a description of its design and execution serves as a foundation for understanding the results of all three.

Characterizing the Conservation Effect

Assessing how M-Power influences consumption is a particularly vexing analytical challenge, because by design and character, it appeals to several different consumer groups with different objectives or expectations. The challenge is to define a control group that includes those that are similarly inclined to subscribe, or are compelled do so because of circumstances, to serve as the counterfactual (i.e., what would have been but for the M-Power treatment) against which usage of subscribers are compared.

M-Power subscription is voluntary, selectively marketed, and attractive to consumers for a variety of reasons owing to different sources of potential benefits. This creates challenges for constructing a comparison group whose usage can be compared to that of M-Power participants. The most robust approach would be to assign customers to M-Power or standard service randomly, the conventional approach to establishing statistical inference. In cases where that is not feasible or practical, quasi-experimental protocols have been devised to develop compelling estimates of the influence.

To attribute an effect to a treatment, in this case M-Power, with a high degree of certitude requires eliminating all other possible explanations.¹⁸ This is difficult to do systematically since there are many factors that could have intervened: changes in lifestyles while on M-Power; differential weather influences; dramatic changes in economic circumstances; and unobserved factors like social influences, publicity about SRP or energy use, and level and type of M-Power marketing efforts undertaken by SRP.

One approach to establishing the M-Power effect on consumption is to construct an experiment whereby the treatment is provided to customers randomly, that is, some get it and others serve as controls, so that every customer is equally likely to have been selected for the treatment. This neutralizes, to the extent possible, all other influences on electricity consumption, and the treatment (M-Power) effect can be quantified using the differences-in-difference method; the subtraction of the difference between control customers before and during the experiment from that difference from treatment customers.¹⁹ This randomized sampling produces robust results—they have intrinsic credibility as characterized by the sampling properties (significance) and they can be validly extended to the population of customers to which the experiment was directed. However, this approach is not always practically viable in a utility's business environment.

In the case of M-Power, SRP did not find it feasible to conduct a randomly designed experiment, for a variety of reasons.²⁰ First, the program was initially offered to help a specific group of customers, those in arrears and facing shut-off of electric service. Assigning some applicants to a control group whereby they were denied M-Power service, and presumably would have had their service shut off, would have been counterproductive to the program's intent.

Second, M-Power started as a program targeted to a specific population, which had fewer than 30,000 customers at the time of the first study (Figure 5-2), which is about 3% of all residential customers. SRP determined that it needed to characterize how these customers were reacting to the service, retrospectively, in order to assess whether there were any impacts outside of improved customer service, and reduced nonpayment and write-offs. It did not anticipate in those early years that the program would grow as large as it has, with enrollment spreading to other segments of the residential customer base. Improved technology over time offered improvements

¹⁸ This discussion draws heavily from EPRI, 2010.

¹⁹ Campbell and Stanley (1963) caution that it is impossible to assure that the control and treatment groups were equal before the treatments, but conclude: "Nonetheless, the most adequate, all-purpose assurance of the lack of initial biases between groups is randomization", p. 25.

²⁰ The narrative description of the evaluation of the M-Power program was constructed from interviews with SRP staff. The assessment of the programs performance, specifically the conservation effect, was constructed using analysis materials prepared by SRP. EPRI did not undertake an independent assessment of any of the data collected for the three studies or collect any new data to support a subsequent analysis.

in scale and cost effectiveness in all facets of the program. The charter given to the program analysts was to produce an estimate of the how M-Power had affected the electricity usage of current enrollees.

Subsequent analysis in 2003/2004, when M-Power had grown to about 30,000 subscribers, was influenced by the same factors. The primary focus was to understand the sales revenue implications to support forecasting, and evaluate the business case for continuing the service. The third study, which used 2005/2006 post-treatment data, was chartered in 2007 to see if there were changes relative to the previous studies, and employed same basic methodology. However, it sought to enrich the findings by characterizing the impacts across subpopulations of M-Power subscribers and determine if the relative load reduction effects were seasonally uniform. The essence of this study's methods is described below, followed by a discussion of the findings.

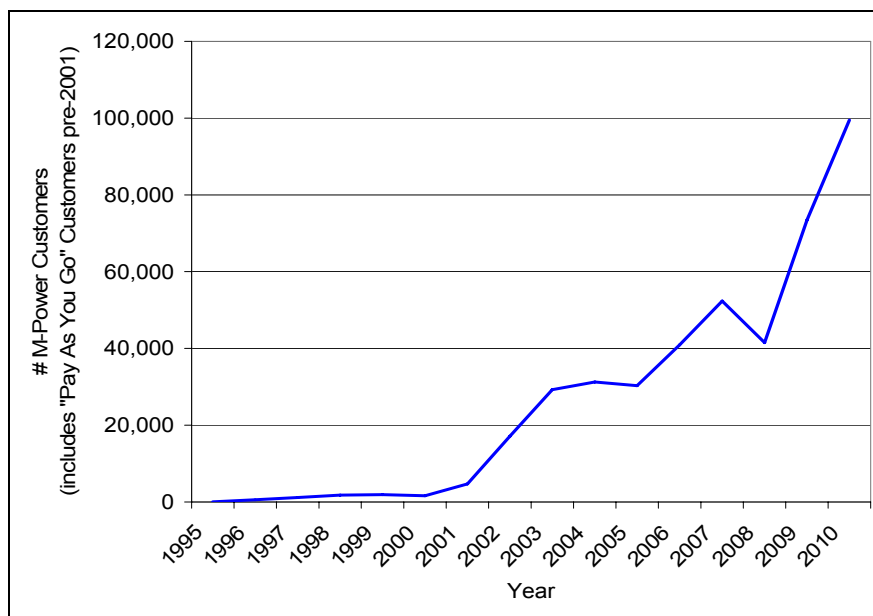


Figure 5-2
M-Power Program Size

Research Design

A retrospective, case matching methodology was undertaken in 2007 to characterize how M-Power subscribers were responding to the price, feedback, and the energy purchase aspect of the program. The population of interest was the current subscriber base. The focus was estimating how electricity usage (kWh) of M-Power subscribers differed from that of E-23 residences (standard residential service), to support sales and revenue forecasting, and to estimate the relative benefits of the program using the cost/benefit tests SRP applied to screen energy efficiency programs.

The M-Power analysis consisted of several steps:

1. A study period was selected that allowed establishing electricity usage for a treatment period (subscription to M-Power) and for a period prior to that time period when treatment customers were still on E-23. This facilitates a difference-in-difference calculation of the impacts using data from treatment and control customers.

2. Because of the possibility that the effect of M-Power on usage would vary seasonally, the study (treatment period) was defined as sequential summer and winter periods. To accommodate the seasonal design, the study period was October 2004 through October 2006, as illustrated in Figure 5-3.
3. A set of treatment customers was randomly selected from the population of all subscribers. A principle selection criterion was that for each treatment billing history could be constructed that would conform to the monthly definitions that comprise the seasons. As previously mentioned, M-Power service does not involve a typical bill issued routinely (monthly) based on metered usage, as is the case with E-23 residential service. Subscribers add to their account by making a purchase at a PayCenter. Hence, the SRP analyst had to construct equivalent monthly billing amounts (kWh) which could be compared to the equivalent usage of E-23 control customers.
4. Billing data were retrieved for treatment customers to correspond to the same periods as for the control customers. Data for the winter 2004-5 and the summer of 2005 provided a baseline for measuring changes after these customers subscribed to M-Power. The latter winter and summer billing quantities were actual usage under M-Power.
5. A control group was selected to establish the counterfactual, the level of usage that M-Power subscribers would have used but for M-Power subscription. Controls were selected as follows:
 - a) Customers located in the neighborhood of each treatment M-Power subscriber were identified.
 - b) These were then reduced to those that had M-Power billing data available to match the billing cycle they had when on E-23 billing cycles that were approximated corresponding to calendar months. This was done to avoid using data from periods that were two to three weeks before the season started and/or data for two to three week after the season period ended.²¹
 - c) Finally, a single control (E-23) customer was selected as a match to each treatment (M-Power) customer based on which of the eligible control customers had usage levels (kWh) most closely aligned with that of the treatments. Control customers matched the billing cycles of the treatment customers, since each treatment customer had a control customer in the same neighborhood with very similar energy usage.
6. E-23 control customer usage (monthly kWh) was accumulated from billing records for the winter for 2004-5 and winter of 2005-6 to establish a control baseline. Billing data was also

²¹ Utilities typically divide residences into 21 or 22 batches that correspond to days of the month. The May Batch 1 customer meters are read the first work day of the month of June (June 1) and the customers are billed on the previous 30 or 31 days' usage. For them, the May bill corresponds almost exactly with the previous calendar month (the month of May). The second batch of meters are read on the second day of June and billed issue accordingly, and so on through the 20 working days of the month. Each subsequent read batch results in an accommodation to the correspondence of the may bill month and the month for which the billing applies. The last May bill batch is read and billed in June on June 30, is mostly comprised of June usage. To prevent using data that do not correspond to the calendar months, which might inject systematic weather effect bias, control customers were selected that had batch reads that correspond to calendar months.

accumulated for the summer of 2005 and the summer of 2006, again to establish the counterfactual.

	2004			2005												2006													
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct				
Winter	Control (E-23) -- Pre															Control (E-23) -- Post													
	Treatment (Still on E-23) -- Pre															Treatment (On M-Power) -- Post													
Summer								Control (E-23) -- Pre												Control (E-23) -- Post									
								Treatment (Still on E-23) -- Pre												Treatment (On M-Power) -- Post									

Figure 5-3
2005/2006 M-Power Impact Analysis Timeline

There were 463 treatment customers selected for the 2005/2006 study: 272 treatment customers in the summer period and 191 different treatment customers in the winter period. Each treatment customer was matched with a single control customer, aligned seasonally, to establish the counterfactual. The conservation effect was estimated by constructing difference-in-differences and then applying conventional analysis of variance (ANOVA) statistical tests to ascertain if the calculated differences were significant.

The findings from the 2005/2006 study were that usage, on average, by M-Power customers was 12% less than that of the control customers, and that the difference was highly significant (Kirkeide, 2009). Separating out the differencing process, M-Power customers reduced usage, on average, 8% and control customers' usage, on average, grew 4%. Additional tests using construction for segments from the control and treatment customers indicated that the difference was not influenced by the amount of energy consumed per month (which ranged from a low of 200 kWh/month in winter months to a high of over 3,000 kWh/month in summer months) or by season.

The level of the conservation effect estimated in the 2005/2006 study for the M-Power population, which was about 40,000 in 2006, was very close to that estimated in the earlier studies (approximately 11% and 13% respectively--Kirkeide, 2009), when subscription was about 30,000.

Measuring the Potential of M-Power

Learning from Experience

SRP conducted a series of analyses to understand how electricity consumption behavior changes under M-Power service. The initial study indicated that M-Power subscribers reduced their consumption. The program was designed to help customers work off arrears balances while continuing to have electric service at their premises. As discussed above, M-Power's features provide a variety of encouragements and incentives to watch electricity consumption closely and husband its usage. Also, M-Power marketing and program materials are designed to promote these actions.

A commonly used evaluation protocol was employed to quantify the impact, matching customers with M-Power experience with others with apparently similar financial and living circumstances to establish the counterfactual. This methodology was repeated subsequently and produced consistent results—a conservation effect of about 12%.

The use of a case-matching protocol, applied retrospectively, seems prudent in light of what SRP intended at the time to learn, and how those findings were to be used. A purely randomized experimental design was determined by SRP to be impractical. It would have required denying some applicants access to M-Power to create a rigorous control group. SRP had gone to great lengths to provide an alternative to having to cut service off to customers in financial distress. Denying some that resource could have had adverse consequences not just for those customers.

Case-matching averted the need to deny service to those that M-Power was intended to help. It involved establishing control customers by finding a match for each treatment customer that would in effect serve to negate other factors that might influence electricity use, and thereby reveal the treatment (M-Power) effect (Campbell & Stanley, 1963). It is part of a class of quasi-experimental designs that were widely used at the time in circumstances where fielding a true experiment was infeasible, but nonetheless there was a need to establish, to the best extent possible, the impact of a treatment.

The character of M-Power subscriber has changed substantially since the last impact assessment, which involves customers taking service in 2004-6. As of April 2010 it has approximately 100,000 subscribers, about one in eight SRP residential customers; over twice as many as at the time of the previous study.

The character of subscribers has changed also. It still includes a core of those that chose M-Power as a means of working off an excessive arrears balance. But, SRP attributes most of the growth to customers that are attracted by the absence of a cash deposit (primarily new customers to SRP, rental premises that have a high turn-over rate), and customers that want the feedback and conservation inducement that M-Power provides. It would be reasonable to presume that the impact on consumption might differ from that of credit stressed customers, but presumptuous to accept that premise without substantiation.

A more robust approach might more fully characterize how customers with diverse circumstances, expectations, and capabilities to adjust load responded to M-Power. Several methods have been devised over the past few years that address the possible shortcomings of the conventional quasi-experimental designs. In particular, the randomized encouragement design (RED) might be conducive to characterizing how M-Power influences participants' electricity consumption level and patterns.²²

They will not, however, provide a definitive verification of the results of past studies, because the methods used can not be applied retrospectively. The goal of undertaking a new study with a new approach is to guide the future design and administration of the program. A full discussion of issues to be taken into consideration in designing such studies can be found in EPRI's Feedback Protocols (EPRI, 2010).

²² A proposed application of a randomized encouragement design is found in Fowlie & Wolfam, 2009.

6

CONCLUSIONS AND RECOMMENDATIONS

SRP has operated a prepaid electric service, M-Power, since 1993. The technology used has undergone several transformations to take advantage of new service delivery options and fulfill the participants' requirements and expectations that experience revealed. The M-Power customer population has grown to about 100,000 (approximately 12% of all residences served by SRP), expanding from the initial target population, consumers with arrears facing service terminations, to include consumers with different expectations from M-Power service.

The constant aspects of the M-Power experience have been a high level of customer satisfaction and an overall reduction in electricity use (of about 12%) reported by SRP compared to customers served on the standard residential service, despite nearly identical nominal \$/kWh rates on the two services. SRP attributes the conservation effect to a variety of factors, including the increased awareness of when and how electricity is consumed that the program has created, as well as its focus on marketing M-Power as enabling and encouraging reduced electricity usage.

The scale of M-Power participation, along with the magnitude of the change in consumer behavior (the conservation effect) that SRP attributes to the M-Power program warrant attention. This is especially so given that the M-Power delivery technology, while effective, is quaint compared to what can be accomplished with a smart meter system combined with web portal-based information delivery and payment system. Removing the inconvenience of going to a PayCenter may make prepaid service attractive to a larger number of consumers. Moreover, it may reduce attrition among those that enroll initially due to one factor or circumstance (e.g., arrears payback, avoidance of a service initiation deposit), but whose situation changes.

Because smart meter deployment is expanding, and virtually every utility is at least undertaking a comprehensive business case, it seems prudent to acknowledge the SRP experience as presenting the possibility that prepaid service will become a staple in utility service portfolios. The cost of adding the functional capabilities required to support various levels of prepaid services are most easily determined in the context of a larger smart meter business case study. Moreover, such a study provides the means for characterizing how prepaid service influences and affects consumer behavior, and for quantifying the attributable impacts.

But, if prepaid becomes very convenient -- payments can be made electronically, account balance information is available on the web or from a mobile phone -- will that undermine some of the very behavioral forces that are assumed to induce the conservation effect? Prepaid has worked well in and for SRP's circumstances, but is that experience transferrable to other markets, climates, customer circumstances, and supply conditions? These are research questions that must be addressed systematically and thoroughly in order to evaluate the costs and benefits associated with various prepaid service program designs.

A comprehensive research agenda regarding prepaid service costs and benefits would include answering the following questions:

- Consumer behavior influences
 - How does prepaid service influence consumer behavior in the short run? In the long run?
 - Does that influence vary according to customer expectations or circumstances, and if so, by how much?
 - How do those behaviors translate into kW and kWh changes?
 - Is prepaid service compatible with energy efficiency goals? With demand response program objectives? Net Zero Energy Home designs?
 - Is prepaid service compatible with diversified residential services such as on-site generation and storage? Home electric vehicle charging?
- Technology function capabilities
 - What additional measurement, communications, and computation capabilities are required in a smart metering system to support prepaid services?
 - What institutional arrangements are required to accommodate prepaid service transactions?
 - How are prepaid accounts integrated into those that follow a traditional meter-read cycle structure to support financial accounting, regulatory reporting, forecasting, energy efficiency and demand response program participation, etc.?
 - Is prepaid compatible with smart grid technologies such as home area networks?
- Overall market impacts
 - What are the amount and distribution of the benefits attributed to prepaid service?
 - How do the impacts affect wholesale market operations? Retail market operations?
 - Can prepaid service be provided by a third party (technology vendor or commodity provider) through commercial channels?

Obtaining answers to these fundamental research issues will facilitate estimating the net benefits under almost all market circumstances. It is knowledge that will be costly to obtain, but with high public value and only relatively limited corresponding private value (i.e., to an individual utility). In other words, resolving how prepaid service influences and affects consumer electricity consumption behavior is a public or collective good. Some utilities may see sufficient value to undertake some of the research, but probably not the full array of understanding and solid characterizations. An obvious solution is collaboration that spreads the cost among many parties that stand to gain and distribute the finding to everyone.

A

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B

M-POWER BACK OFFICE SOFTWARE SCREEN SHOTS

Account Details | Service Details | Billing Details | Other

Service Name

Account Number

Check Acceptance

Customer Status

PayFirst

GiveFirst

Fixed Fee

Arrears

Service Start Date

Last Transaction Date

Billing Cycle

Y

A

\$0.00

\$0.00

\$0.00

\$0.00

Account Details | Service Details | Billing Details | Other

Service Address

Region Code

District Code

Read Sequence

Coordinates

GLENDAL
AZ
85303

WMS

0791210

31

10 5/16 N 5 3/8 E

Account Details | Service Details | Billing Details | Other

Billing Name

Billing Address

Doing Business As

Business Name

GLENDAL
AZ
85303

Account Details | Service Details | Billing Details | Other

Maximum Smart Card Value

Rate Plan ID

Customer Arrears Percentage

Group Rate Type

\$2,001.00

E24

40%

RP

Figure B-1
Account Details Screens

 Get Customer Arrears Details

	Date Amended	Adjustment Value	Arrears Balance	Location	Operator ID	SC Trans ID
	9/6/2007 2:59:22 PM	(\$16.00)	\$0.00	AMS	PAY305	2531260
	9/4/2007 2:36:08 PM	(\$14.00)	\$16.00	AMS	PAY115	2516175
	9/4/2007 8:37:13 AM	\$0.00	\$30.00	AMS	kgwienan	2513566
	9/4/2007 8:36:48 AM	\$0.00	\$30.00	AMS	kgwienan	2513565
	8/30/2007 11:21:09 AM	\$0.00	\$30.00	AMS	slcooper	0

[Display Arrears Payments / Amendments](#)
[Amend Arrears Balance](#)

☐ Amend/Set Arrears Balance

Arrears Balance:

Arrears Collection Percentage: %

[Display Arrears Payments / Amendments](#)
[Amend Arrears Balance](#)

Figure B-2
Arrears Details Screens

Card Transactions		Transaction History		PayFirst		Arrears History		GiveFirst		Meter Credit		Customer Notes	
Status	Meter Number	Transaction Date	Card Issue No	Status Date	Card Status								
Active	1N	Sep 12 2009 06:51:32	3	Sep 12 2009 06:51:34	Not Used								
Active	1N	Sep 04 2009 21:54:54	3	Sep 12 2009 06:50:41	Used								
Active	1N	Sep 03 2009 05:19:38	3	Sep 04 2009 21:54:11	Used								
Active	1N	Aug 29 2009 11:33:54	3	Sep 03 2009 05:17:02	Used								
Active	1N	Aug 26 2009 16:07:04	3	Aug 29 2009 11:32:57	Used								
Active	1N	Aug 21 2009 20:38:04	3	Aug 26 2009 16:06:19	Used								
Active	1N	Aug 18 2009 05:25:16	3	Aug 21 2009 20:37:19	Used								
Active	1N	Aug 12 2009 13:32:54	3	Aug 19 2009 05:22:47	Used								
Active	1N	Aug 04 2009 05:06:39											
Active	1N	Jul 26 2009 13:26:04											
Active	1N	Jul 19 2009 19:54:17											
Active	1N	Jul 10 2009 05:30:51											
Active	1N	Jul 02 2009 15:30:51											
Active	1N	Jun 24 2009 15:30:51											
Active	1N	Jun 19 2009 05:30:51											
Active	1N	Jun 16 2009 14:30:51											
Active	1N	Jun 07 2009 12:30:51											

Card Transactions		Transaction History		PayFirst		Arrears History		GiveFirst		Meter Credit		Customer Notes	
Status Date	Card Status	+PrivCar	PmtAmt	-PayFirst	-Arrears	+Credit	+GiveFirst	CardAmt					
Sep 12 2009 06:51:34	Not Used	0.00	60.00	0.00	0.00	0.00	0.00	60.00					
Sep 12 2009 06:50:41	Used	0.00	60.00	0.00	0.00	0.00	0.00	60.00					
Sep 04 2009 21:54:11	Used	0.00	26.00	0.00	0.00	0.00	0.00	26.00					
Sep 03 2009 05:17:02	Used	0.00	25.00	0.00	0.00	0.00	0.00	25.00					
Aug 29 2009 11:32:57	Used	0.00	60.00	0.00	0.00	0.00	0.00	60.00					
Aug 26 2009 16:06:19	Used	0.00	50.00	0.00	0.00	0.00	0.00	50.00					
Aug 21 2009 20:37:19	Used	0.00	40.00	0.00	0.00	0.00	0.00	40.00					
Aug 18 2009 05:22:47	Used	0.00	60.00	0.00	0.00	0.00	0.00	60.00					
Aug 12 2009 13:31:55	Used	0.00	100.00	0.00	0.00	0.00	0.00	100.00					
Aug 04 2009 05:06:39	Used	0.00	100.00	0.00	0.00	0.00	0.00	100.00					
Jul 26 2009 13:26:04	Used	0.00	100.00	0.00	0.00	0.00	0.00	100.00					
Jul 19 2009 19:54:17	Used	0.00	100.00	0.00	0.00	0.00	0.00	100.00					
Jul 10 2009 05:30:51	Used	0.00	100.00	0.00	0.00	0.00	0.00	100.00					

Continued from above

Figure B-3
Transaction History Details

Meter Readings										Meter Readings									
History Details										History Details									
Current Selection : Last 6 Months Only										Current Selection : Last 6 Months Only									
kWh Totals										kWh Totals									
Maximum Demand										Maximum Demand									
Self Disconnect Details										Self Disconnect Details									
Emergency Time Log										Emergency Time Log									
Hardware Tamper Detectors										Hardware Tamper Detectors									
Status	Meter Number	Reading Date/Time	Total	Rate1	Rate2	Rate3	Rate4			Status	Meter Number	Reading Date/Time	Value	End Month					
Active	1NB	Sep 04 2009 00:18:03	53677	53677	0	0	0			Active	1NI	Sep 02 2009 20:44:59	9.1760000	No					
Active	1NB	Sep 03 2009 00:25:03	53577	53577	0	0	0			Active	1NI	Sep 01 2009 00:14:59	2.4160000	No					
Active	1NB	Sep 01 2009 00:18:02	53369	53369	0	0	0			Active	1NI	Aug 25 2009 10:29:59	11.2520000	Yes					
Active	1NB	Sep 01 2009 00:00:00	53368	53368	0	0	0			Active	1NI	Aug 09 2009 23:44:59	9.4240000	No					
Active	1NB	Aug 27 2009 00:58:03	52888	52888	0	0	0			Active	1NI	Aug 03 2009 19:29:59	9.1000000	No					
Active	1NB	Aug 22 2009 00:11:08	52417	52417	0	0	0			Active	1NI	Jul 16 2009 02:14:59	12.9880000	Yes					
Active	1NB	Aug 18 2009 00:19:03	52062	52062	0	0	0			Active	1NI	Jul 09 2009 01:44:59	11.0880000	No					
Active	1NB	Aug 12 2009 00:44:02	51516	51516	0	0	0												
Active	1NB	Aug 04 2009 00:22:23	50776	50776	0	0	0												
Active	1NB	Aug 01 2009 00:00:00	50495	50495	0	0	0												
Active	1NB	Jul 26 2009 00:30:03	49844	49844	0	0	0												
Active	1NB	Jul 19 2009 00:43:04	49095	49095	0	0	0												

Figure B-4
Meter Read Data

Card Transactions	Transaction History	PayFirst	Arrears History	GiveFirst	Meter Credit	Customer Notes
Meter Number	Date Inserted	Transaction Type	Transaction Number	Transaction Amount	Total Credit Inserted	Total Credit Remaining
> 1NI	Sep 04 2009 22:11:11	Transaction	00A03593	60.00	5764.97	9.75
1NI	Sep 03 2009 05:27:12	Transaction	009F9072	26.00	5738.97	2.05
1NI	Sep 01 2009 07:06:58	Transaction	009DF769	25.00	5713.97	0.27
1NI	Aug 27 2009 04:35:51	Transaction	009D01ED	60.00	5653.97	-2.48
1NI	Aug 22 2009 06:08:42	Transaction	009E98C3	50.00	5603.97	2.11
1NI	Aug 18 2009 05:30:47	Transaction	009A57B6	40.00	5563.97	4.70
1NI	Aug 12 2009 14:37:47	Transaction	009EA3D1	60.00	5503.97	4.51
1NI	Aug 04 2009 05:18:46	Transaction	0096199A	100.00	5403.97	-5.17
1NI	Jul 26 2009 21:05:50	Transaction	00932114	100.00	5303.97	-6.65
1NI	Jul 19 2009 20:01:40	Transaction	00910F39	100.00	5203.97	-17.26
1NI	Jul 10 2009 13:02:45	Transaction	008DE8D8	100.00	5103.97	5.77
1NI	Jul 02 2009 16:01:49	Transaction	008E8B06	100.00	5003.97	5.90
1NI	Jun 24 2009 23:10:39	Transaction	0088E473	100.00	4903.97	1.75
1NI	Jun 19 2009 05:18:35	Transaction	008771D2	60.00	4843.97	1.12
1NI	Jun 16 2009 14:22:49	Transaction	0086C2F9	25.00	4818.97	2.06
1NI	Jun 07 2009 21:32:52	Transaction	00849223	100.00	4718.97	-11.62

Friendly
Credit
Usage

Figure B-5
Meter Credit Status

Meter Readings				
History Details		Current Selection : Last 6 Months Only		
kWh Totals	Maximum Demand	Self-Disconnect Details	Emergency Time Log	
Status	Meter Number	Start Date/Time	End Date/Time	
Active	1N7	Jul 21 2009 06:00:00	Jul 21 2009 06:06:53	
Active	1N7	Jun 22 2009 06:00:00	Jun 22 2009 17:53:16	
Active	1N7	Jun 08 2009 06:00:00	Jun 08 2009 12:55:34	
Active	1N7	Jun 01 2009 06:00:00	Jun 01 2009 07:19:46	
Active	1N7	May 18 2009 11:19:20	May 18 2009 14:56:20	
Active	1N7	May 04 2009 06:00:00	May 04 2009 06:17:35	
Active	1N7	Apr 10 2009 11:53:50	Apr 10 2009 12:02:21	
Active	1N7	Mar 23 2009 10:24:49	Mar 23 2009 10:24:50	

Customer w/frequent disconnects

Meter Readings				
History Details		Current Selection : Last 6 Months Only		
kWh Totals	Maximum Demand	Self-Disconnect Details	Emergency Time Log	Hardware Tamper Detections
Status	Meter Number	Start Date/Time	End Date/Time	
Active	1NE	Sep 01 2009 06:43:01	Sep 01 2009 07:06:59	

Customer without frequent disconnects

Figure B-6
Self-Disconnection History

C

MARKET RESEARCH STUDY DETAILS

Table C-1
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
SRP, 2009b	CCTS M-Power Quarterly Scorecard	May-Jul 2009 (performed every quarter)	Telephone survey results from M-Power customer who use the customer service call center	87% satisfied or very satisfied with M-Power program (through July 2009) Top reason for signing up: - 72%: gives me control over electricity - 63%: avoid late fees - 60%: reduced deposit, affordable way to start Percent agree or strongly agree: - 97%: M-Power could help a lot of people - 91%: use electricity more wisely
PRIZM, 2009	PRISM Analysis	Jul 2009	Prism analysis/marketing	M-Power customers: - are more likely to live in apartments, less likely to live in single family homes (compared to Standard and TOU customers) - are newer - just over 50% have “slow” credit, unsatisfactory credit, or new customer credit ratings - ~15% receive a Spanish-language bill (more than any other rate type); most are English-speaking - tend to be lower energy users - are generally younger households

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
Traasdahl, 2009		2009	Overview presentation of program	Largest prepay program in the US Took stats from a week in August 2009, found most purchases on Friday between 4pm and 10pm (likely corresponding to payday), and most purchases in the \$11 to \$20 range. Average no of purchases per month: summer = 7.1; winter = 3.6 Average \$ amount per purchase: summer = \$24; winter = \$21 Average # of customers who disconnect per month: 20% Of the 20%, average # of disconnects per month: 2
WestGroup Research, Inc., 2007	SRP M-Power Materials Survey: Topline Report, November 2007	Oct 2007	Telephone interviews to assess salience of updated communications materials; 201 M-Power customers	Low recall of some materials, although ratings were fairly positive
WestGroup Research, Inc., 2006a	SRP M-Power Communications Focus Group Research	Nov 2006	Focus group report, 3FGs, opinions on M-Power, the Starter Kit and different M-Power communications materials; not known how FG members were recruited	Most participants believed the sign-up and start-up processes were relatively easy. Most preferred the idea of having newsletter delivered quarterly and tailored to them. Most liked the M-Power program and thought its main benefit was its educational quality. Those in difficult financial situations (most of the group) liked that SRP provided M-Power as an option. Areas for improvement included having more payment options at the PayCenters, as well as over the phone and internet. Poor working order of some PayCenters was also expressed. English speaking customers felt information included in starter kit was “overwhelming and redundant”. A recommendation was to make the information provided more concise.

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
SRP, 2006	SRP M-Power Shadow Project September 2006 – Executive Summary	Sep 2006	Executive summary of the SRP M-Power Shadow Project, which involved 8 in-depth, in-home interviews from customers from a range of credit codes, length of time on program, language, income and housing type	People generally thought of SRP and M-Power positively, and authors were surprised at the wide range of households visited (i.e., not just low income). Three had run out of power once, although this was not perceived as a serious issue. Sense is that most households visited are conservation-minded.
WestGroup Research, Inc., 2006b	SRP M-Power/AMPY Benchmark Study 2006	Mar 2006	Telephone survey results, 402 M-Power customers; purpose was to obtain baseline data on attitudes towards M-Power, with emphasis on PayCenter machines, as new machines were to be installed starting in April 2006.	Seven in 10 rated SRP's performance as excellent or very good 90% were very satisfied or satisfied with the M-Power program Reasons for satisfaction were reported as (starting from most frequently reported): the ability to pay for power at customers' own pace, having ability to monitor energy use/more aware of energy use, perception that it was cheaper/saved energy, allowed for more control, and was more convenient in general Satisfaction high for IHD (93% very satisfied/satisfied, significantly higher amongst customers with a high school education or less); relatively lower for the PayCenter machines (72% very satisfied/satisfied, with more highly educated customer reporting significantly lower vs./s ratings than those with high school or less). Satisfaction with PayCenter machines decreases the longer customers are on the program (choices ranged from <1 year to 2+ years). SRP performance rated excellent or very good by significantly more lower income and high school (or less) educated. Indication that the longer a customer is on the M-Power program (choices ranged from <1 year to 2+ years), greater likelihood to be very satisfied Significantly more Hispanic customers were likely to rate it very satisfied or satisfied; significantly more high school educated (or less) customers chose very satisfied than more highly educated customers. M-Power customers report purchasing electricity three times a month. High school educated (or less) customers purchase more frequently than more highly educated customers.

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
WestGroup Research, Inc., 2006b... Continued	SRP M-Power/AMPY Benchmark Study 2006	Mar 2006	Telephone survey results, 402 M-Power customers; purpose was to obtain baseline data on attitudes towards M-Power, with emphasis on PayCenter machines, as new machines were to be installed starting in April 2006. Customers were contacted randomly from SRP M-Power account list.	Cash most popular form of payment (choices at the time were cash, check or money order). Seventy-one percent reported encountering a PayCenter machine that was not working in the previous year. Of these respondents, the average number of problems over the year was 3.9. PayCenter machines located in grocery stores were used the most often (82%), followed by the SRP office (15%), convenience stores (2%), and the mall (1%). Ninety percent or more agreed or strongly agreed that M-Power could benefit others, learned a lot about their usage, use electricity wisely, prefer M-Power over other programs, and that helps them manage their finances. Twenty five percent were concerned about the meter shutting the electricity off, 22% felt their lifestyles were inconvenienced, and 18% said it led to household arguments. Demographics of M-Power customers surveyed: female (61%), low to moderate education (51% high school graduate or less; 28% some college), slightly Caucasian majority (51%), low income households (average income \$32,586). Last survey of this breadth was 1999

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
Reiley & Johnson, 2006	What Determines M-Power Customer Satisfaction: How SRP Can Attract and Retain M-Power Customers	2006	University of Arizona Assessment, telephone survey conducted by WestGroup of 401 M-Power customers that had been on the program for 18 months or more (sample skewed more towards recent customer, 18-24 months, than entire 'long-term' population). Goal is to assess customer satisfaction with the aim of understanding what would make customers stay on M-Power so as to reduce turnover rates; another goal is to understand traits of long-term M-Power customers. Authors note that surveying those who did drop out would be useful as well.	General conclusions: improve PayCenter quality and locations; use marketing messages such as "Take control of electricity usage." And "Save money by using less electricity"; consider providing a display with other non-M-power programs, as customers attributed benefits to it Turnover rate relatively high: as of Feb 2006, 11,200 of approximately 40,000 had been on for 18 months or less. 88% satisfied or very satisfied with M-Power 73% rate SRP as excellent or very good 92% prefer to stay on M-Power compared to E-23 Reasons for wanting to stay on: easier to manage bills, cheaper, can monitor energy usage 83% would want to keep the display 49% say they stay on M-Power as it is too much trouble to switch back ("inertia") 49% report having trouble with M-Power, although 73% have had a problem with an out of order PayCenter Biggest complaints: PayCenters out of order, money doesn't get transferred to card, have to go too far to get to a PayCenter (or not enough of them) Logistic regression analysis results: Probability of a customer answering they are "very satisfied" with the M-Power program increases for customers: reporting that PayCenters are conveniently located; that perceived their bill would be higher on E-23 (or that they would save money on M-Power); that are between 35 and 55 (20% more likely) or older than 55 (33% more likely); or that live in certain cities (Apache Junction, Glendale, Mesa, Phoenix). Probability of a customer answering they are "very satisfied" with the M-Power program decreases for customers: reporting experience with out-of-order PayCenters; that don't believe they consume differently on M-Power compared to E-23; that required more frequent card refills each month, that are African American. Traits not found to influence probability of answering "very satisfied": income; consumption level; # of months on program; whether the customers is Hispanic; household size; occupation; whether the customer was a college graduate.

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
WestGroup Research, Inc., 2002	SRP M-Power PayCenter Research: Summary of Findings	Nov 2002	Telephone interviews regarding convenience of PayCenters in Circle Ks (convenience store); 214 M-Power customers; interviewees had been on program for at least 2 months and had a telephone number on file. "Customers interviewed were M-Power participants who were on the program at least two months and had an available telephone number Customers were randomly selected and filtered based on desired criteria.	87% were very satisfied or satisfied with the M-Power program On average, customers buy power 3 times a month Customers drive 2-3 miles to purchase power, 5-7 minute one-way trips. 72% satisfied with PayCenter locations Liked idea of buying power at Circle Ks; if service fees charged for this, likelihood of buying power there dropped; at \$1, less than 50% said they'd buy there; for those that would they'd do so if at Circle K anyway (convenience) or if standard PayCenter was down Estimated that approximately 25% of users might use Circle Ks. Those who are positive towards Circle K approach: those who frequently Circle Ks often, Hispanics (versus non-Hispanics), Number of miles to Circle K or regular PayCenter not a factor in choosing one over the other Conclusions: customers are satisfied with current PayCenter locations and like the Circle K idea for emergencies; the fee would be a deterrent for some.

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
WestGroup Research Inc., 2001	SRP M-Power Focus Group Report—June 2001	May 2001	Focus group report, 4 focus groups, opinions on areas of process and operational improvement. One focus group was comprised of people who left the M-Power program.	Most customers are very happy with all aspects of the M-Power program (e.g., sign-up through equipment installation), with the only exception relating to the PayCenters. Customers identified concerns with malfunctioning equipment, the inability of some machines to take forms of payment other than checks, and the lack of machines in close proximity to their homes For those who had left the M-Power program, the main categories of reasons were “concern about running out of power, machine/equipment problems, and the expense of the program and difficulty managing the program”; some also felt that the customer service representatives were “rude”, or uncaring of their monetary situation. Some did not understand how the program worked at sign-up, and were surprised when their power went off; suggestions as to what would have encouraged them to remain on the program included a 24-hour phone line where you could purchase credits M-Power generally customers tend to be strong advocates of the program, and the study recommends marketing methods such as “refer-a-friend” Retention of customers is reported to depend on how well educated customers become regarding the program, and how it can affect their energy usage Although an “easy sell” to credit-challenged customers, the study indicates the UDT and the lower energy bills are what “hooks” the customers. The study raises the concern that M-Power could become labeled as a “low income” program, potentially acting as a deterrent for non-low income customers.

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings
WestGroup Research, Inc., 1999a	Pay As You Go Focus Group Report	Aug 1999	Focus group report, 2 focus groups, joint between SRP and Arizona Community Action Association, opinions on M-Power program	Customer very positive toward the program, which they believed gave them a sense of control. Participants also expressed it made them more aware of their electricity use patterns, and lowest instances of argument over the bill. Most had reported incidences when their power was shut off. Participants also liked that the program gave them an alternative to the “embarrassing” situation of having to go through the disconnect/reconnect process with SRP (on the standard program). The biggest negative trait expressed was the lack of payment machines that were in working order. Self-reported usage traits: power purchased when approximately one day of power left, one-way trip to payment machines approximately one to five miles, amount spent per purchase between \$50 and \$100, and customers will buy more if they can. Most customers do not store credits on their spare card for emergency purposes (advised by SRP to do so). “Pay As You Go customers felt that the program has significantly helped them manage their electric usage, save money, and would be helpful to a lot of other SRP customers”. Most participants said they preferred it to the traditional program and would stay with it in the future.

Table C-1 (continued)
M-Power Market Research-related Studies Performed

Reference	Study Title	Study Period	Subject	Overall Findings															
WestGroup Research, Inc., 1999b	SRP/ACAA Pay As You Go Study	Sep 1999	Telephone survey report, 179 Pay as You Go customer (precursor to M-Power program); joint study between SRP and Arizona Community Action Association (ACAA), opinions on M-Power program. List of 1,023 current users was provided by SRP, and had been screened to ensure they had been on the program at least one year. 160 more customers were removed for other screening (changed telephone numbers, worked for the utility, no longer a Pay As You Go customer, etc.). “The sample of 179 customers has a margin of error of +/- 6.5% at the 95% level of confidence (with finite population of 863).”	Overall, Pay As You Go customers were found to be satisfied with the program, with the biggest opportunity for improvement relating to the PayCenters. 73% of Pay As You Go customers rate SRP’s performance as excellent or very good Problems cited included not enough machines and machines out of service, although 29% reported no disadvantages with the program Approximately one third had applied for “utility assistance” prior to being on the program, and only 7% had applied since being on the program “Fewer customers recall being disconnected from their electric service since participating in the program.” Those who did have their service disconnected felt, for the most part, that their cases were handled well by the customer service representatives. Seventy-one and 69% agreed that the disconnection was handled “fairly” and “with respect” respectively, and 50% felt their case was handled with comparison. Fifty-eight percent would rather purchase power from a PayCenter rather than a customer service representative. Self-reported program statistics include 3.7 purchases per month, power purchased when 4.3 days of power on average left, average one-way trip approximately 5.6 miles, average amount spent per purchase approximately \$56.70. Other self-reported stats <table><tr><td>Ave # times machine broken</td><td>1.1</td><td>(48% reported no machine problems)</td></tr><tr><td>Ave # times needed to drive 5+miles</td><td>3.0</td><td>(45% reported never having to)</td></tr><tr><td>Ave # of times having to buy power in dangerous neighborhood</td><td>1.2</td><td>(77% reported never having to)</td></tr><tr><td>Ave # of times office was closed</td><td>1.2</td><td>(58% reported never experiencing this)</td></tr><tr><td>Ave # of times having to write more than one check</td><td>0.3</td><td>(83% reported never having to)</td></tr></table>	Ave # times machine broken	1.1	(48% reported no machine problems)	Ave # times needed to drive 5+miles	3.0	(45% reported never having to)	Ave # of times having to buy power in dangerous neighborhood	1.2	(77% reported never having to)	Ave # of times office was closed	1.2	(58% reported never experiencing this)	Ave # of times having to write more than one check	0.3	(83% reported never having to)
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The Electric Power Research Institute Inc., (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent more than 90 percent of the electricity generated and delivered in the United States, and international participation extends to 40 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

Together...Shaping the Future of Electricity



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RE: Arizona Public Service Company Home Energy Information (HEI) Pilot
Final Reports at End of Pilot
Docket No. E-01345A-10-0075

Pursuant to Decision No. 72215 dated March 3, 2011, APS is required to file:

"...a final report on the HEI pilot program by December 31, 2012,
assessing all of the gathered information and state why it believes this
program should or should not be fully implemented."

Decision No. 74406 extended the deadline for the final assessment report to February
13, 2015. Additionally, Decision No. 73223 requires APS to include:

"...information regarding bill estimation experience with prepay energy
service in the results report required by the Commission in Decision No.
72214 [sic]."

Attached are the Company's HEI final end-of-pilot reports.

If you have any questions regarding this information, please contact Gregory Bernosky at
(602)250-4849.

Sincerely,



Lisa Malagon

LM/sb
Attachment

cc: Brian Bozzo

ARIZONA PUBLIC SERVICE COMPANY

DEMAND SIDE MANAGEMENT RESIDENTIAL HOME ENERGY INFORMATION PILOT PROGRAM

END OF PILOT REPORT

FEBRUARY 13, 2015

Table of Contents

I.	Executive Summary.....	1
II.	HEI Pilot Description and Background.....	2
III.	Program Goals, Objectives and Participation.....	2
IV.	Program Implementation.....	4
V.	Evaluation and Monitoring.....	5
VI.	Results.....	6
	Group A – Critical Peak Pricing (CPP) with Customer Control Device.....	6
	Group C – Direct Load Control with enabling technology.....	9
	Group D – “Smart” Communication Devices	15
VII.	Conclusion.....	18

I. Executive Summary

Arizona Public Service Company (APS or Company) submits this end-of-pilot measurement, evaluation and research (MER) report for its Demand Side Management (DSM) Residential Home Energy Information Pilot Program (HEI Pilot or Program) approved by the Commission in Decision No. 72214 (March 3, 2011).¹ The HEI Pilot was a comprehensive residential demand response (DR) program that included the deployment of in-home devices intended to provide participating residential customers with transparent information regarding their energy use and costs.

The purpose of the HEI Pilot was to test a variety of available technologies and customer response to these technologies, to provide energy information that would assist the participant in controlling home energy usage, and to provide the Company with a working understanding of the devices, strategies, and mix of home applications that could be most effectively employed in a residential setting.

The HEI Pilot originally offered five technology assessment programs: critical peak pricing with a customer control device, an in-home energy display, direct load control, smart phone in-home display, and a residential prepaid energy conservation program. As the Commission is aware, the Company discontinued the in-home energy display program in 2012. This report addresses results of and knowledge gained from the critical peak pricing, direct load control, and smart phone in-home display technologies tested within the pilot. The residential prepaid energy conservation program is discussed in a separate report filed concurrently with this report.

The HEI Pilot was effective in providing APS with an understanding of the complexity and volatility surrounding the numerous components and requirements needed to develop a successful utility-scale in-home technology program. Within the pilot, the Company was able to test both the chosen technologies themselves, as well as implementation protocols, such as the reliability and stability of communication systems and the development and availability of industry standards.

New technologies for in-home devices are emerging rapidly and have advanced significantly from those available at the beginning of the pilot in 2011. APS's learnings from the pilot clearly identified the need for further study of advanced in-home technologies that are still evolving as the preferred means of energy information and communication in the home, such as the relatively new learning thermostats, for example. Specifically in this pilot, the Company experienced significant challenges with communications protocols required to communicate with the pilot technology, price and event signals, and participant response.

Therefore, APS has terminated the HEI Pilot effective as of October 2014, and the Company does not recommend moving forward with this Program in its current form. APS will continue to monitor available technologies, test and implement advanced communications protocols, and evaluate emerging residential demand response programs for development and deployment at a future date.

¹ APS was granted an extension of time to implement the HEI Pilot in Decision No. 73089 (April 4, 2012) and an additional extension of time in Decision No. 74406 (March 19, 2014).

II. HEI Pilot Description and Background

The APS Home Energy Information Pilot was designed to test available home area network (HAN) technologies and determine communication devices, demand response (DR) strategies, and a mix of "smart" home applications that could be most effectively employed in a residential setting. In addition, the HEI Pilot assessed customer acceptance, value, and frequency of usage of in-home energy displays or other communication devices designed to assist customers in managing their daily energy usage.

The HEI Pilot's original implementation period included the two summer seasons of 2011 and 2012, allowing APS time to choose technology vendors, solicit residential participants, install devices and communications systems, and determine measurement and evaluation techniques. APS was granted an extension of time to implement the HEI Pilot in Commission Decision No. 73089 (April 4, 2012) through 2013. APS filed a status report with the Commission on the HEI Pilot on December 31, 2012.

In APS's 2013 Implementation Plan, the Company requested the HEI Pilot be extended for an additional year, through the end of 2014. The extension was requested to allow for two full successive summers as part of its MER process in order to properly evaluate the persistence and validity of the individual technology assessments, as well as associated customer behavior patterns.

APS originally planned to deploy the following technology assessment programs as part of the HEI Pilot:

- Group A - Critical Peak Pricing (CPP) with Customer Control Device
- Group B - In-Home Energy Information Display
- Group C - Direct Load Control (DLC) with enabling technology
- Group D - "Smart" Communication Devices
- Group E - Residential Prepaid Energy Conservation Program

Of these five technology assessment programs, Groups A, C and D began implementation in 2013 and concluded in 2014. Group B was discontinued in 2012. Group E (Residential Prepaid Energy Conservation Program) was implemented in 2012 and the pilot concluded in 2014. The MER for the prepaid program is contained in a separate report which is being filed concurrently with this report.

III. Program Goals, Objectives and Participation

The HEI Pilot was developed to test available HAN technologies and determine communication devices, DR strategies, and an effective mix of home applications that can be most effectively employed in a residential setting.

The objectives of the HEI Pilot were to:

- Study advanced in-home technologies, home area network stability and communications scalability;

- Evaluate demand response and energy efficiency offerings with the use of advanced technology;
- Perform an impact study on technology for demand and conservation events, including customer participation, throughout event periods;
- Reduce peak demand and overall energy consumption through in-home technology and customer awareness; and
- Provide better information and increased awareness about how to manage energy and energy costs to customers and assess customer acceptance of the technologies employed.

No specific savings targets were set for the HEI Pilot. Instead, as noted above, APS conducted the pilot primarily to determine specific technology capabilities and customer acceptance of those technologies. However, the Company was able to identify potential demand savings and other participant impacts for each of the Groups in the pilot.

As set forth in APS's Experimental Service Schedule 16, pilot participation was approved for up to 300 voluntary participants per Program option. APS set the following requirements for participation to ensure sufficient information to perform data analysis:

- Customer must be an active residential customer with more than one year of service;
- Customer must have an average summer bill (June-September) of at least \$150.00;
- Customer must reside in a single family detached home with no more than two HVAC systems;
- Customer must be served under a time-of-use rate with no demand component (or, for Group A participants, critical peak price service);
- Customer must not participate in another Company DSM programs;
- Customer must reside in their home year round;
- Customer must own a smart device (Apple iDevice for Group D); and
- Customer must have high-speed broadband internet Wi-Fi service.

Customer interest in the HEI Pilot was high, and APS processed over a thousand applications from customers wishing to participate in the pilot. The strongest customer interest was for Group C (direct load control), while the lowest interest was for Group A (CPP with a customer control device). APS was able to successfully install approximately 700 advanced in-home devices in 370 homes throughout the duration of the HEI Pilot program.

Table 1 – HEI Pilot Program Participation and Device Count

HEI PROGRAM GROUP	PARTICIPANT COUNT	DEVICE COUNT
Group – A	12	30
Group – C	208	502
Group – D	150	161
TOTAL	370	693

IV. Program Implementation

APS selected General Electric (GE) as the HEI Pilot technology contractor to develop and deploy a demand response management system (DRMS) and HAN devices for HEI Pilot program Groups A, C, and D. GE was responsible for device procurement, installation, customer support, and system integration between the DRMS and APS's existing advanced metering infrastructure (AMI). GE provided program-level management for this pilot and established a customer call center to schedule installations and provide customer support as necessary.

APS and GE conducted extensive laboratory tests beginning in the second quarter of 2011 through the first quarter of 2012, and made a number of routine and typical modifications to the technology to support actual field deployment in the summer of 2012. From March 2012 to June 2012, APS began actual field trials with pre-pilot volunteers to demonstrate field performance prior to deployment with a larger group of customers. The pre-pilot field trial provided APS an opportunity to look closely at technology compatibility and installation, along with customer experience (including education requirements as necessary) in a real-home environment. During pre-pilot field testing, a number of deficiencies and interdependencies between GE hardware and software, APS systems, vendor support solutions, and system upgrades were revealed that had not been experienced in prior lab testing.

For example, APS expected consistent illustration of the Company's rate plans through the use of smart thermostat color light-emitting diodes (LEDs) as an indicator for each price tier in order to accurately inform the customer of the associated impact and cost of air conditioner energy usage. This did not occur. The devices were expected to produce a green LED to illustrate lower cost or off-peak time of day (Tier 1 energy indicators), an orange LED to illustrate medium to high cost or on-peak time of day (Tiers 2 and 3 energy indicators), and a red LED to illustrate highest cost or peak price time of day (Tier 4 energy indicator). The pre-pilot field trial identified limitations and non-continuous illustration of the green LED display that had not occurred in prior lab testing. This complication was only one of the technology limitations and communications constraints experienced during initial deployment.

APS and GE launched an intensive study to determine the root cause of the field difficulties experienced during pre-pilot field testing. The conclusion from those investigations revealed that, while the GE solution had worked in previous applications with other utilities and in laboratory testing prior to deployment at APS, the extent and broad diversity of APS's time-of-use (TOU) rate choices created new scenarios that exposed GE hardware and software limitations. Ultimately, it was determined that a new version (2.0) of GE's DRMS needed to be developed and deployed to address the limitations of the existing system.

Due to these enhancements, APS was not able to deploy devices and begin the pilot during the summer of 2012 as originally planned. APS therefore requested and received approval for a one-year pilot extension for Groups A, C, and D through December 2014 to allow the Company to obtain results for two summer seasons.

APS completed the second phase of factory and lab testing in February and March of 2013, followed with another pre-pilot volunteer test period in April 2013, which showed a market improvement in the effectiveness of the GE devices. APS began its

customer recruitment process in May 2013 followed by technology installation and broader pilot deployment in July 2013.

Recruitment and installation for Groups A, C, and D of the pilot began in the spring of 2013. However, in mid-September of that year, Apple released a new software platform, Apple iOS7, a major release that featured a completely redesigned user interface for iDevices, which was the device of choice for many of the participants in Group D. The Nucleus home energy management (HEM) platform developed by GE (which provided the ability to communicate with the in-home devices) and installed in all pilot participant homes encountered significant compatibility issues with this release and, as a result, participants that upgraded their smart devices to the Apple iOS7 platform were no longer able to use their devices for pilot purposes. Furthermore, even those participants that did not upgrade to the new Apple platform experienced disruptions and communication gaps. APS therefore suspended all remaining Group D technology installations at that time and returned to GE to determine the best way to move forward with the pilot under this new software platform.

After four months of rigorous testing and validations, APS and GE agreed on an HEM upgrade to restore device functionality and compatibility with iOS7. In February 2014, APS authorized a staggered and targeted release to all iDevice participants and, eventually, to the remaining pilot participants. This upgrade process continued through March 2014. It is important to note that not all pilot participants elected to perform the upgrade, which led to continued communications challenges and stability with the technology. APS began a new wave of recruitment efforts in March 2014 and resumed deployment of devices to remaining Group D participants in April 2014.

The HEI Pilot concluded on October 1, 2014 after two full summer seasons (the summer seasons of 2013 and 2014).

V. Evaluation and Monitoring

Navigant Consulting ("Navigant") was chosen by the Company to perform the MER review and evaluation of the HEI Pilot. Navigant completed an impact analysis including a process and technologies assessment of each program group within the HEI Pilot. The evaluation approach for the process and technologies focused on customer surveys in addition to a billing analysis of energy usage data for the treatment of each technology program.

Energy Impact Estimation Method

APS provided Navigant with energy usage data for active HEI Pilot participants along with non-HEI Pilot customers for the sole purpose of developing a control group analysis in order to compare results to the participant group. Navigant determined the energy impact estimation method for each pilot group as follows:

Group A - Critical Peak Pricing (CPP) with Customer Control Device; participants subject to Peak Event Pricing with an enabling technology (smart thermostat(s)). Navigant conducted an estimation approach to the energy savings impact of the Group A treatment by a matching method that draws on the set of program participants and their 1:1 non-program matches, drawn from a pool of non-

participating customers also subject to the Peak Event Pricing rate. This method is a regression with matching as nonparametric preprocessing for reducing model dependence in parametric causal inference (RPPM).² It treats matching as a "pre-processing" stage of the analysis and assumes that monthly energy use in the post-program period can be modeled as a linear regression function involving participants and matches.

Group C - Direct Load Control with enabling technology; the treatment group subject to Direct Load Control (DLC) via smart thermostat set-point adjustment. Navigant estimated demand savings using a fixed effects regression applied to participants' historical interval data. This analysis did not include a control group; the embedded assumption being that customers' electricity consumption on non-event days was a sufficient control for their use (and changes in use) on event days. This is a standard approach for estimating the demand impacts of DLC programs.

Group D - "Smart" Communication Devices; for energy information-only, an energy efficiency program. Navigant's approach used a different strategy to produce a control group. This approach is the variance- in-adoption model (VIA) method established by Harding and Hsiaw.³ This method uses only program participants to estimate savings, with late enrollees essentially serving as controls for early enrollees. It relies on the assumption that, controlling for the customer and the monthly fixed effects, neither energy use in month 't', nor energy savings 's' months into the program, is correlated with the timing of program entry.

Additionally, in order to determine the pilot participant experience including: comfort experience, reasons for enrollment into the pilot, conservation and energy management actions taken, participant use of technologies, and participants' satisfaction with the pilot, Navigant conducted a series of surveys as shown below:

- Post-Installation Web Survey
- Decliner/Drop-Out Telephone Survey
- Post-Event Telephone Survey
- End-of-Summer Web Survey
- End-of-Pilot Web Survey

The results of Navigant's MER study is provided in the Results section below.

VI. Results

Group A – Critical Peak Pricing (CPP) with Customer Control Device

Impact Analysis.

Navigant analyzed Group A participants in three impact categories:

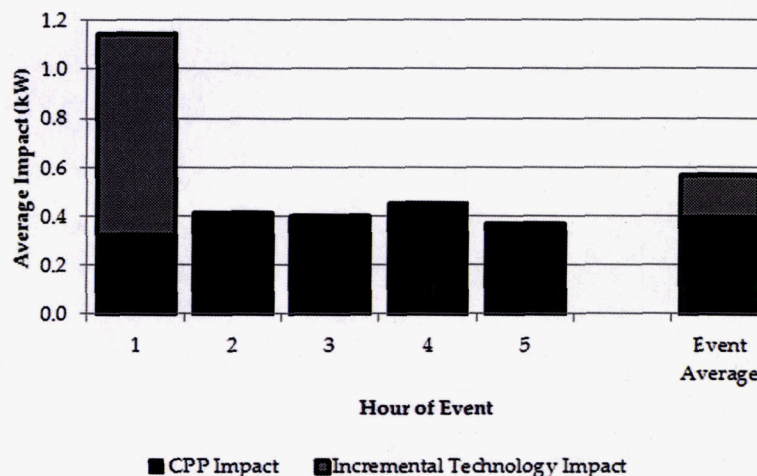
² Ho, Daniel E., Kosuke Imai, Gary King, and Elizabeth Stuart. 2007. Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis* 15(3): 199-236

³ Harding, M. and A. Hsiaw. Goal Setting and Energy Conservation. July 2013. Available at: http://people.duke.edu/~mch55/resources/Harding_Goals.pdf

- **DR Impacts:** Estimated DR demand impacts of the Peak Event Pricing events in the summers of 2013 and 2014, the incremental DR impacts of the Group A technology, and the Group A participation rate over the period of analysis.
- **Snapback Impacts:** Estimated snapback impacts of the Peak Event Pricing events and the incremental snapback impacts of the Group A technology in the summers of 2013 and 2014.
- **Energy Impacts:** Estimated energy impacts of participation in Group A.

DR Impacts: Group A delivered approximately 0.6 kW of electricity demand reduction per participating customer across all events called by APS during the period in which Group A's technology was installed. This impact is the sum of an average impact estimated from the rate itself (Peak Event Pricing) of 0.4 kW per customer per event and an average impact of 0.2 kW per customer per event from the technology itself. The average estimated impact delivered by Group A in the first hour of the Peak Event Pricing events (between 2 p.m. and 3 p.m.) was almost 1.2 kW, of which the majority (0.8 kW) was contributed by the enabling technology.

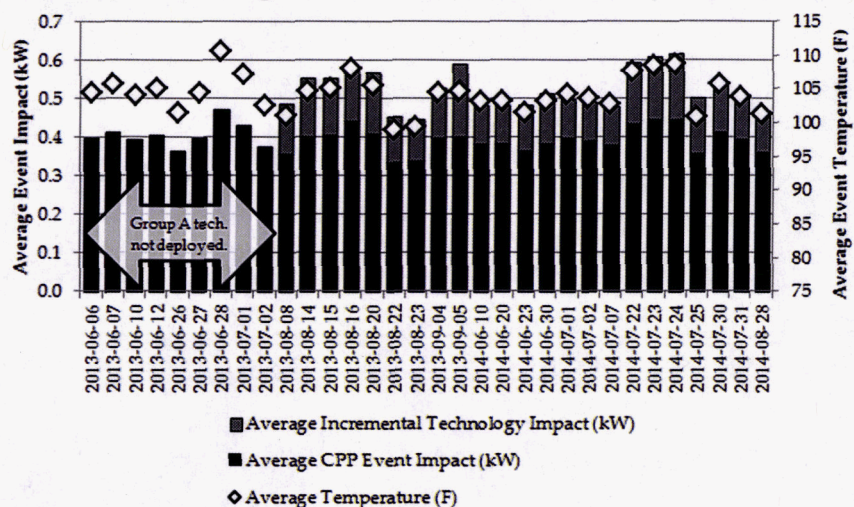
Figure 1: Group A – Average Peak Event Pricing and Enabling Technology Impacts



Source: APS interval data, GE device logs, and Navigant analysis.

No incremental technology impacts are presented for any hour but the first. Although impacts were estimated for these hours, none of them were statistically significant and so are not presented above.

Figure 2: Group A – Average Peak Event Pricing and Incremental Event Impacts

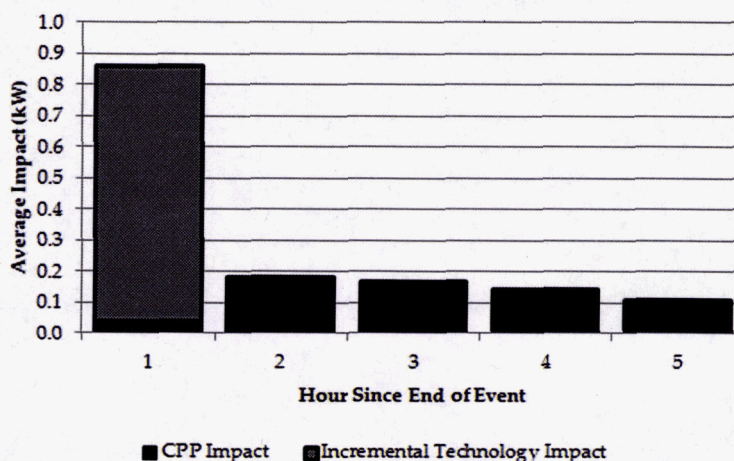


Source: APS interval data, GE device logs, and Navigant analysis.

Snapback Impacts: Snapback is a common feature of DR impacts. "Snapback" refers to the incremental additional demand in the hours immediately following a DR event that is often the result of the additional air conditioner compressor activity required to restore the given building to its set-point temperature.

Figure 3, below, shows the average snapback in each hour following the end of a Peak Event Pricing period (i.e., hour 1 in this case is the hour between 7 p.m. and 8 p.m.) that is the result of the rate alone as well as the incremental impact of the Group A enabling technology.

Figure 3: Group A – Average Hourly Peak Event Pricing and Incremental Technology Snapback Impact



Source: APS interval data, GE device logs, and Navigant analysis.

Energy Impacts: The design of the Group A program does not lend itself to energy conservation. The enabling technology permits Group A participants to respond more aggressively to a Peak Event Pricing event, resulting in greater energy demand curtailment during peak hours compared to Peak Event Pricing-only customers. This

reduction is offset by increased usage immediately following an event (snapback) when the thermostat set-point is restored to its original setting and the air conditioner compressor must work to bring down the home's temperature to this set-point. Energy savings due to the Group A technology are therefore likely to be trivial and statistically insignificant. Additionally, Navigant has estimated that participation in Group A does not deliver any energy savings that are statistically significant at any conventional level of significance.

Customer Experience and Process Assessment

Process Survey Instruments and Results. Group A participants were satisfied with all aspects of their pilot experience, and the majority found at least "some" benefits from participation. Nearly all respondents experienced some loss of comfort during DR events, with the impact of this loss felt more in 2013 than in 2014. At the end of the pilot, three-quarters of survey respondents were willing to recommend Peak Event Pricing to their friends or family and would be willing to spend at least a nominal amount to retain access to similar technology through future APS programming.

Satisfaction. In all surveys, Group A respondents expressed satisfaction with the HEI Pilot. When asked to rate their satisfaction with their pilot experience on a scale of one to ten (where one indicated "not satisfied" and ten indicated "very satisfied"), Group A respondents offered average scores of 8.3 in the Post-Installation survey; 8.0 in the Post-Event survey; 7.9 in the End-of-Summer survey; and 7.0 in the End-of-Pilot survey. This gradual decline over time is likely the novelty of the pilot that has run its course, and these customers have begun to view their Smart Thermostat as a standard technology feature of their home.

Perception of Technology. Positive perceptions of functionality declined over time. When asked if the pilot technology functioned as expected, respondents offered an initial average rating of ten out of ten in the Post-Installation survey followed by a 7.6 average rating in the End-of-Summer survey, finally ending with a 5.4 average rating in the End-of-Pilot survey.

Initially, the majority of Group A respondents claimed that they and members of their household had found the Smart Thermostat easy to use. Group A respondents rated the Smart Thermostat's ease of use as an 8.0 (on a scale of one to ten) in both the Post-Installation and Post-Event surveys, and a 7.8 out of 10 in the End-of-Summer survey. In the End-of-Pilot survey, however, the average rating declined to 5.8 on the same scale.

Group C – Direct Load Control with enabling technology

Impact Analysis.

Navigant analyzed Group C participants in the following impact categories:

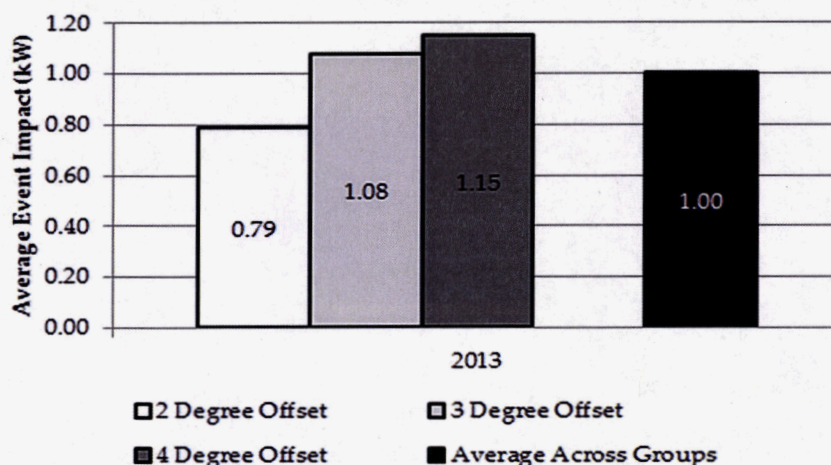
- Demand Response Impacts: Estimated DR demand impacts of the DLC events in the summers of 2013 and 2014.
- Participation: The impact of participation rate on average event impact and the observable downward trend in participation over the period of analysis.
- Event Scheduling: Describes why DR impacts are highest for a given participant in the first hour of an event and discusses APS' experimentation with "staggered" curtailment to smooth the DR profile.

- Snapback Impacts: Estimated snapback impacts of the DLC events in the summers of 2013 and 2014.

Group C is subject to a form of DLC and the DR activation begins with the increase of participants' thermostat(s) set-point by two, three, or four degrees Fahrenheit.

Demand Response Impacts: Group C participants delivered approximately 1 kW per customer of DR on average across the events called by APS. Figure 4 provides a graphic summary of average event impacts by degree offset group. (Altogether, 180 Group C participants were included in the estimation sample that delivered the estimates below. There are 55 participants in the two degree offset group, 63 in the three degree offset group and 62 in the four degree offset group.)

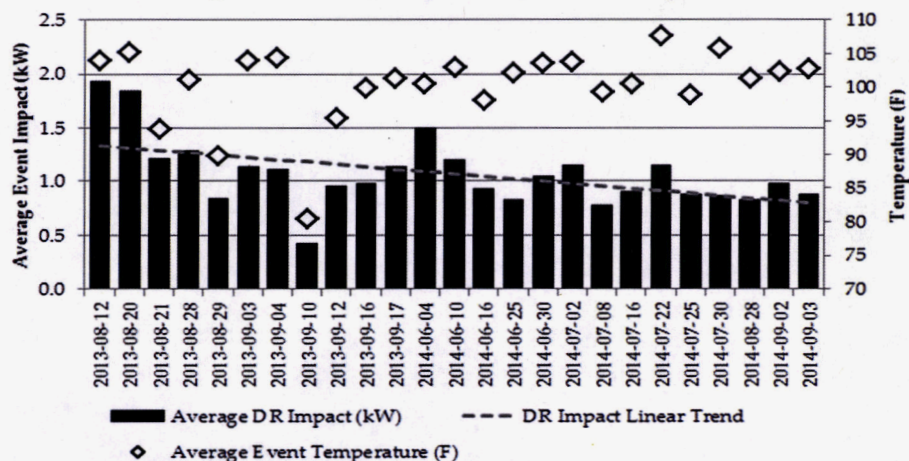
Figure 4: Group C – Average DR Impact by Degree Offset Group



Source: APS interval data, GE device logs, and Navigant analysis.

Figure 5 presents the average individual event impacts (across all offset groups). Also shown in this graphic (plotted against the right axis) is the average temperature observed across each event and an estimated linear trend in DR impacts over the length of the period of analysis.

Figure 5: Group C – Average Event Impacts



Source: APS interval data, GE device logs, and Navigant analysis.

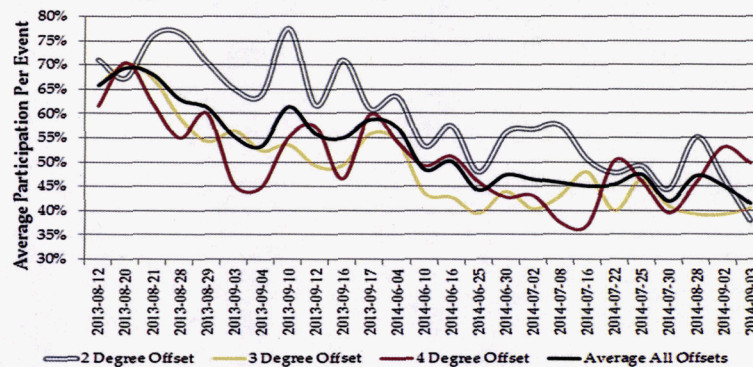
Event impacts are highly correlated with temperature. Other factors that significantly affect the average event impact include the length of the event and the level of participation.

Event length is a driver of average event impact due to the approach used for DLC in this program. This approach to DLC means that the first hour of curtailment will always have a much higher impact than subsequent hours, meaning that average event impacts will be inversely correlated with event length. Short events will have a higher average event impact.

The effect of participation on event impacts is more intuitive as lower rates of participation lead to reduced impacts. Declining participation over the period of analysis is discussed further below, but Figure 6 illustrates the effect of that declining event participation over time on event impacts.

Participation: As noted above, the average impacts appear to have declined materially from the 2013 events to the 2014. This is, in large part, due to the declining trend in Group C event participation observed over the period of the pilot. Figure 6 illustrates participation level by offset group for each event (the partially transparent blue, red, and yellow lines) and on average across all groups for each event (the solid black line).

Figure 6: Group C – Event Participation by Event and Offset Group



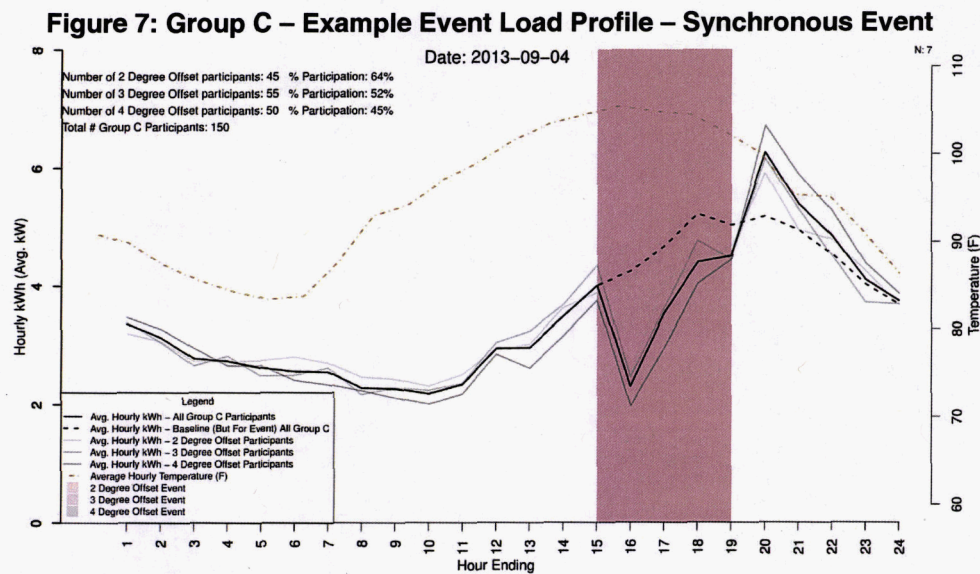
Source: APS interval data, GE device logs, and Navigant analysis.

Although there is considerable variation in the level of participation from one event to the next, the overall trend is downward across the period of analysis, per Figure 6. There are two possible reasons for this downward trend: participant exhaustion and technical difficulties.

Navigant believes the downward-trending participation rate is the result of technical difficulties associated with the device control technology. APS controls participants' thermostat(s) remotely via a "bridge" device provided by GE. Approximately 30 to 50 percent of Group C participant devices relied, for functionality, on a connection with the given participant's Apple iOS device. A conflict between Apple devices and the firmware arose in September 2013 when Apple deployed iOS7, resulting in decreased functionality of Group C devices and translating into lower participation rates and thus lower impacts.

Event Scheduling: Event length for the average event impact is important since it relates directly to APS' decision to experiment with "staggered" events. This effect is a direct result of the approach to DLC that APS carried out in 2014 of this pilot.

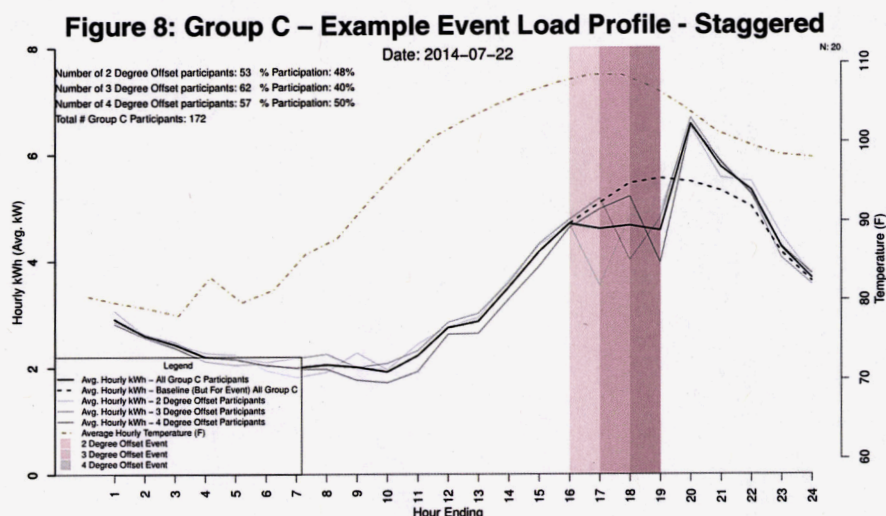
Figure 7 shows the average event day load profile (on September 4, 2013) of each offset group (semi-transparent gray lines) and of the average across offset groups (solid black line). The "counterfactual" demand (i.e., what demand would have been absent the event) is represented by the dashed black line. The difference between these two lines represents the demand impact of the event. For reference, hourly temperature is shown as the dashed yellow line, to be read against the right axis. This event is described as "synchronous" because all offset groups are curtailed over the same window of time.



Source: APS interval data, GE device logs, and Navigant analysis.

The mechanism used to implement DLC results in a large impact in the first event hour, followed by a rapid decay to a much lower impact. The impact decays more slowly the more aggressive is the thermostat adjustment (per the difference between the darkest gray line with the lightest gray line, representing the four and two degree offset groups, respectively). Given the effect of averaging, this means that the average demand impact of a short event will inevitably be higher than the average demand impact of a longer event.

This effect also has important program design implications. System planners expecting to use DR as a resource will generally prefer a more consistent DR impact over the length of the event. However, synchronous event scheduling cannot deliver this consistency. In response to these implications, APS experimented in the summer of 2014 with "staggered" events. For these six events, the beginning of the curtailment period varied by offset group. The two degree offset group was curtailed first, followed an hour later by the three degree offset group, and then an hour after that the four degree offset group. The solid black line in Figure 8 shows this effect.



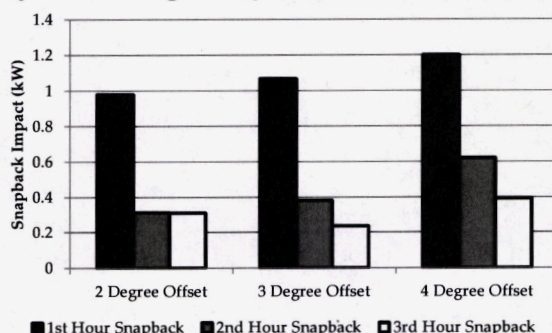
Source: APS interval data, GE device logs, and Navigant analysis.

Figure 8 shows that by staggering the offset group curtailment start times, the overall load profile may be flattened over the entire event period, delivering a more consistent DR impact, and one that tends to be positively correlated with increases in baseline demand because of the order in which the offset groups are curtailed.

Navigant believes that, should APS wish to proceed with a wider roll-out of thermostat-adjustment-type DLC programs, this experiment with staggered events has provided important intelligence to allow APS to maximize its value from such deployment.

Snapback: A well-understood characteristic of all DLC programs (whether they use thermostat control or cycling) is snapback. "Snapback" refers to the sharp increase in participant demand immediately following the end of a curtailment event as the air conditioning unit works to restore the home to its set-point temperature. Figure 9 provides the relative magnitude of average snapback impact by degree offset group.

Figure 9: Group C – Average Snapback Profile by Degree Offset Group



Source: APS interval data, GE device logs, and Navigant analysis.

Navigant estimated snapback impacts for the six hours immediately following the end of each event, but concluded, based on the statistical significance (at the 90 percent confidence level), that snapback lasts only three hours for the two and three degree offset groups, and five hours for the four degree offset group.

Snapback is the recovery of energy that would otherwise have been consumed in the first hour of the curtailment event (quite a bit since the compressor was likely not active in that hour due to the thermostat adjustment) as well as each subsequent hour (just the difference between the energy required for the compressor to provide an additional two, three, or four degrees of cooling). Each incremental hour of curtailment beyond the first, therefore contributes relatively little energy to the pool that may "snap back" following the end of an event.

This has important implications for program administrators, as participants experience minimal loss of comfort, there is relatively little cost in extending the curtailment period to later hours. One ever-present concern for DLC programs is that snapback could result in a shifting peak. This is only a concern at the system level when deployment is widespread, but even without high levels of penetration, if program participation is concentrated geographically it could be a concern at the distribution level. It is therefore important and useful to understand that extending a curtailment event in order to reduce the likelihood of shifting the peak will not result in much larger snapback.

Customer Experience and Process Assessment

Process Survey Instruments and Results. The majority of Group C participants expressed satisfaction with their pilot experience and found the technology easy to use. Regarding comfort, a majority of the respondents experienced a loss of comfort during peak events but did not identify it as a hardship. While the majority of survey respondents would recommend DLC to their friends and families, only a small minority would be willing to pay any amount to have access to this technology.

Satisfaction. In all surveys, Group C respondents reported consistently high levels of satisfaction with the HEI Pilot. In the Post-Installation survey, respondents offered an average satisfaction rating of 8.3 out of ten (where one indicated "very dissatisfied" and ten indicated "very satisfied"); an average rating of 8.0 in the Post-Event survey; an average rating of 7.6 in the End-of-Summer survey; and an average rating of 7.9 in the End-of-Pilot survey. Fluctuations in overall satisfaction from survey to survey do not necessarily reflect changes in program quality over time but instead show that participant satisfaction remained in a fairly tight range over the pilot period.

Perception of Technology. When asked to what extent the Smart Thermostat functioned as expected, Group C respondents gave an average score of 9.0 out of ten in the Post-Event survey (on a scale of one to ten, where one indicated "not as expected" and ten indicated "as expected"). This rating dropped slightly to 8.0 in the End-of-Summer survey and to 8.1 in the End-of-Pilot survey. Again, this limited decline does not seem to reflect an actual change in functionality but rather a reduction in "newness" over time.

The majority of Group C respondents viewed the Smart Thermostat as easy to use throughout the pilot period. On a scale of one to ten (where one indicated "not at all easy to use" and ten indicated "very easy to use") respondents gave the Smart Thermostat an average rating of 8.4 in the Post-Installation survey; 8.0 in the Post-Event survey; and 7.9 in the End-of-Summer and End-of-Pilot surveys. The consistency of the scores illustrates the absence of any significant difficulty in operating the Group C Smart Thermostat.

Group D – “Smart” Communication Devices

Impact Analysis.

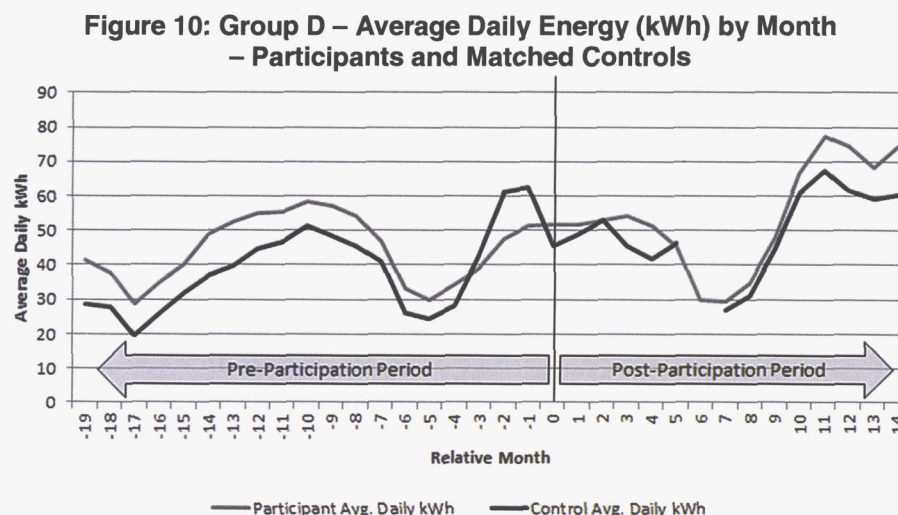
Navigant analyzed Group D participants in the energy efficiency program through the use of smart device technology in three evaluation categories:

- **RPPM Approach:** The results of participant matching and the impact of these results on the impacts estimated using the RPPM estimation method.
- **VIA Approach:** The impacts estimated using the VIA method.
- **Comparison of Impacts:** The comparison of the impacts estimated using both approaches and provides some additional context regarding the implications of these results.

RPPM Approach: The RPPM approach relies on drawing control customers from a pool of non-participants. This approach matched a participant to a non-participant with whom that participant has the most similar pre-participation electricity consumption patterns.

For this evaluation, Navigant used a pool consisting of 555 customers. For each program participant with at least 12 months data before program enrollment, energy consumption in each month in the period was compared to that of all customers in the available control group pool with data over the same 12 months.

Figure 10 below presents the average energy use of participants and their matches over the period 't'-12 to 't'+10. The period to the left of the vertical line is the pre-participation period that was used to match the data. The period to the right of the line represents the post participation period, and it is effectively a comparison of the control and treatment group data in this period that drives the estimated impacts. Areas without a line represent periods for which no data are available.



Source: APS interval data and Navigant analysis.

In addition to a relatively small pool of control group customers, the data series for these customers was incomplete due to data gaps, technology stability and the length of time that some participants were enrolled in the pilot.

A final challenge for this analysis was the fact that due to a conflict with iOS7, the technology for this group was effectively inoperable to any participant that updated an Apple device between September 2013 (when iOS7 was deployed) and February 2014 (when a patch was deployed to restore operation). This greatly reduced the length of time in which the treatment could be observed to have had an effect on participant consumption, reducing the number of post-treatment observations and thus the likelihood of Navigant being able to estimate a statistically significant impact.

Given the handicaps identified above, in addition to relatively subtle savings effect, the results of the RPPM approach yielded no practically or statistically significant estimated demand savings.

VIA Approach: In this case, one of the principal data limitations was the inoperability of the Group D technology that occurred between September 2013 and February 2014. Prior to the release of iOS7, approximately 50 Group D participants enrolled with the Group C technology. However, three-quarters of these participants had been enrolled for only six weeks when the technology became inoperable and none had been enrolled for more than ten weeks. This means that there is a narrow window within which the VIA approach can be applied and thus fewer data points that can be included in the analysis. This contributed to Navigant being unable to estimate practically or statistically significant impacts.

Comparison of Impacts: Neither of the two approaches undertaken by the Navigant was successful in estimating practically or statistically significant energy savings. This finding does not indicate the absence of energy savings, but simply that there were insufficient data to allow Navigant to measure them. Navigant believes that even had there been a more populous pool of non-participants from which to select matched controls it is likely that the end result may have been the same.

This conclusion is driven by the fact that the effect that the analysis is attempting to isolate is likely to be relatively modest. Most information-only energy conservation programs tend to report annual energy savings of less than four percent, and many of these make use of a much larger participant group than was available to APS in order to evaluate impacts.

Given the results of the evaluations (and because of the order in which the offset groups are curtailed), large-scale informational energy-only energy conservation programs, as well as the self-reported energy savings actions reported by Group D participants in the survey, Navigant believes that it is likely that Group D participants did realize energy savings as a result of their participation, but that the data are simply insufficient to allow those savings to be measured.

Customer Experience and Process Assessment

Process Survey Instruments and Results. The technology over time offered additional functionality, as it securely gathered energy and cost information, allowing participants to see real-time hourly, daily, monthly, and annual energy use and energy cost. This also offered participants the ability to perform usage and cost comparisons by day of the week or by month, providing further insight into their home energy management. In spite of the operating system challenges, satisfaction increased over the pilot period, but a minority of participants still had frustrations with customer service associated with the technology. Similarly, survey respondents expressed a growing regard for the functionality of the Smart App.

Participants noted during a non-summer portion of the pilot, September 2013 through February 2014, many participants had difficulties using the Smart App due to compatibility issues between GE Nucleus and their Apple iDevices (iPhones/iPads) that were on Apple's iOS7 operating system.

Satisfaction. Unlike participants in the other groups, Group D respondent satisfaction actually increased slightly over the pilot period. Post-Installation survey respondents offered an average rating of 6.1 (on a scale of one to ten, where one indicates "very dissatisfied" and ten indicates "very satisfied"), while End-of-Summer respondents rated their overall satisfaction with the pilot at 5.9 on the same scale. Given the challenges with the Group D Smart App, these moderate satisfaction scores are understandable. However, the average overall satisfaction score in the End-of-Pilot survey was 6.9.

Perception of Technology. Due to operating system issues, the Group D application did not meet the expectations of many participants. However, by the end of the pilot period, the respondents' perception of the app's functionality increased. In three surveys, when asked if the Smart App functioned as expected, Group D respondents gave the application a positive rating. Post-Installation respondents gave the Smart App an average rating of 5.6; End-of-Summer respondents gave the application 5.9; and End-of-Pilot respondents a 6.7.

In the End-of-Summer survey, Group D respondents reported that they used their pilot technology inside the home (48 percent) or both inside and outside the home (39 percent). Group D respondents also reported accessing the Smart App through a number of channels. When asked how they typically accessed their Smart App, 42 percent of respondents identified their computer; 29 percent their phone; and 19 percent their tablet/iPad. These respondents also reported using their Smart App frequently; the majority of respondents checked their Smart App either daily (45 percent) or weekly (36 percent).

Operating system issues caused a slight decline regarding ease of use but, by the end of the pilot period, this perception reversed. The majority of Post-Installation survey respondents reported that they had found the Smart App easy to use with an average rating of 8.0 (on a scale of one to ten, where one indicates "not easy at all" and ten indicates "very easy"). End-of-Summer survey respondents offered a slightly lower average rating of 7.5, but End-of-Pilot respondents offered the highest average rating of 8.3.

Regarding the usefulness of the Smart App for energy management, perceptions of effectiveness increased over time. The majority of End-of-Summer survey respondents found the Smart App somewhat helpful in managing energy use, reporting an average rating of 5.7 (on a scale of one to ten, where one indicates "not helpful" and ten indicates "very helpful"). At the end of the pilot period, Group D respondents offered a higher average rating of 6.6 on the same scale.

VII. Conclusion

The Home Energy Information Pilot provided useful information regarding various advanced in-home technologies, energy management systems and consumer energy behaviors. However, emerging technologies, communication protocols and interoperability standards have evolved at an unprecedented pace in the last several years and are expected to continue to evolve rapidly. As noted in this report, in-home device technologies existing at the time the HEI Pilot was initiated showed considerable incompatibility with APS communications networks and protocols and the consistency of program offerings proved to be difficult to maintain. For all these reasons, APS terminated the HEI Pilot in its current form in October of 2014 and does not recommend moving forward with this pilot, as previously designed.

However, APS did gain considerable knowledge through the pilot which will allow the Company to better design, implement, and deploy an in-home demand response program in the future, when feasible. In the meantime, APS will continue to monitor the industry as emerging technologies mature in the field of residential demand response programs and will continue to participate in industry forums and network with utilities and industry representatives in order to advance the development of industry standards and communications protocol for energy information and remote application devices.

ARIZONA PUBLIC SERVICE COMPANY

DEMAND SIDE MANAGEMENT RESIDENTIAL PREPAID ENERGY CONSERVATION PILOT PROGRAM

END OF PILOT REPORT

February 13, 2015

Table of Contents

I. Executive Summary	1
II. Arizona Public Service Residential Prepaid Energy Conservation Program Description and Background	1
III. Program Goals, Objectives and Participation	2
IV. Evaluation and Monitoring Activities	3
V. Results	4
A. Energy and Demand Savings	4
B. Costs and Cost Effectiveness	8
C. Customer Surveys	10
D. Disconnections	18
E. Estimated Reads	23
VI. Plan for the Future	23
VII. Conclusion	24

I. Executive Summary

Arizona Public Service Company ("APS" or "Company") submits this measurement, evaluation and research ("MER") report for its Demand Side Management (DSM) Residential Prepaid Energy Conservation Pilot Program ("Prepay" or "Program") as required by Arizona Corporation Commission ("ACC" or "Commission") Decision No. 72215. The Program was filed and reported on as one of the options of the Home Energy Information Pilot, which was approved in Decision No. 72214 in March 2011.

Navigant Consulting ("Navigant") reviewed and evaluated the process and impact results of the Program. The evaluation approach focused on customer surveys, conducting a pre and post billing evaluation compared to a control group to analyze the Program energy and demand savings impact, evaluating the Program's impact on customer participation in other Company DSM programs and analyzing the pattern of customer service disconnections.

The pilot provided valuable information that will be used to inform future program design and to optimize the customer experience and cost effectiveness of this program. The pilot concluded that customers used 7.5% less energy annually (or a deemed savings value of 1,235 kWh/year based on average annual usage of pilot participants), on average, after removing the impacts from disconnections and participation in other DSM programs. Customers also had high satisfaction with the program and felt they were given greater control and flexibility in their electric utility spend.

Because there are operational and scalability challenges with moving from a monthly to a daily billing system and managing the alert technology, APS recommends the program remain at approximately its current size until systems and the technologies involved evolve.

Given these findings, APS recommends that the program move from a pilot to be fully implemented as a standard DSM program and be continued at the current level of approximately 2,000 customers participating in the program. Also, due to statewide customer interest in the program, APS recommends offering this as an option to customers throughout the APS service territory.

II. Arizona Public Service Residential Prepaid Energy Conservation Program Description and Background

The Residential Prepaid Energy Conservation Program is a 'pay as you go' daily billing program that provides participants with energy efficiency and conservation information to help them better understand and manage their electric utility budget. Customers periodically prepay for electric service in lieu of paying a monthly bill after they have already consumed the energy.

Prepay was filed as one of the options in the Home Energy Information Pilot and was approved by the ACC in March 2011 in Decision No. 72214.¹

APS launched the Prepay pilot program on July 17, 2012 to qualifying customers who had expressed an interest in Prepay. Since launch, APS filled the 2,000 customer pilot enrollment level and has maintained close to 2,000 customers.

Prior to enrolling a customer in the pilot, APS ensures that the customer adequately understands the program by reviewing the Prepay Service Agreement with the customer. Customers must clearly state consent on each item in the agreement before being enrolled. APS also provides a welcome packet to each new participant that includes the Prepay Program Guidelines, the Prepay Service Agreement, information on how the program works and tips on how to save energy with APS Prepay.

Customers have 24-hour, 7-day a week access to their account balance by calling the APS automated phone system, speaking with an associate or checking their aps.com 'My Prepay' web portal. APS provides customer account balance information by sending proactive alerts to help customers manage their account. Customers identify their preferred alert mechanism (email, phone or text message) and frequency of communication (daily or low balance). Customer contact information for alerts may be changed as often as desired at no charge.

Prepay participants can add funds to their account at any time by using any of the current APS payment options that already exist for standard billed customers. A chart included in the welcome brochure clarifies the processing fees (if any) and lag time for posting payments for each option. Payment options include APS offices, aps.com, APS automated payment system via phone, kiosks at local retailers, electronic funds transfer, authorized pay stations, and by U.S. mail.

There are no late payment, door hanger, disconnect or reconnect fees for customers participating in APS Prepay.

III. Program Goals, Objectives and Participation

The rationale for the Program is to provide customers with an opportunity to save energy as well as have more control over their energy usage and electric bill with Prepay. Based on the results of the pilot and echoed by similar results at other utility deployments across the country, the Program proved to be a vehicle for cost effective energy savings and therefore should be a program in the APS DSM portfolio.

¹ APS was granted an extension of time to implement the HEI Pilot in Decision No. 73089 (April 4, 2012) and an additional extension of time in Decision No. 74406 (March 19, 2014).

The objectives of Prepay are to:

- Provide a convenient energy feedback and interaction system for customers;
- Provide better information and increased awareness about how to manage energy costs; and
- Reduce peak demand and overall energy consumption through customer awareness and account balance feedback.

While industry experience suggests substantial savings with prepay programs at other utilities, the pilot did not outline any specific savings targets for APS customers. Instead, APS conducted the pilot to determine savings levels from our specific technology, program design, and unique service territory to inform future Program design, implementation and deployment. Results of the APS pilot indicate that energy savings from this program can be significant with an average of 7.5% annual savings per participant. This finding is consistent with prepay deployments at other utilities which indicate that frequent energy usage feedback saves the average participating customer between 4-12% on their electric bill annually.

Per Experimental Service Schedule 16 for the Home Energy Information Pilot, Prepay participation was limited to 2,000 customers with a potential to oversubscribe participation to allow for potential dropouts during the pilot period. Enrollment in the pilot was strong and customer interest in the program was high. APS maximized customer enrollment and has maintained near 2,000 customers.

IV. Evaluation and Monitoring Activities

Navigant completed a full process and impact analysis of the program. Both will be described in detail in this report. The evaluations were based on surveys of participating customers, as well as a detailed billing analysis comparing monthly energy usage of Prepay participants (treatment group) to a matched sample of similar customers who were not on Prepay (control group). The analysis compared energy usage data for a period of time before the customer went on Prepay to energy usage data for a period of time after the customer went on Prepay for those customers in the treatment group.

The impact findings address the overall participant population as well as, where possible, specific life stage and income subcategories of participants per four types of effects:

- The *Conservation Effect* - The total reduction in energy consumption associated with average participant enrollment in the Prepay pilot
- The *Disconnection Effect* - The average reduction in energy consumption associated with the number of hours in a day a pilot participant has been disconnected from service
- The *DSM Program Effect* - The average reduction in energy consumption associated with pilot participants' enrollment in other APS demand-side management (DSM) programming. This is an absolute reduction, calculated regardless of when a given participant enrolled in a particular program.
- The *Behavioral Effect* - The net reduction in energy consumption associated with enrollment in the Prepay pilot. This effect is the conservation effect less

the disconnect effect and less the DSM program effect. The behavioral effect was also converted to a "peak demand" value representing the average load reduction between 4 and 6 p.m. on non-holiday weekdays in July and August.

Energy Savings Estimation Method

APS provided Navigant with enrollment data for 2,131 unique pilot participants. These participants enrolled in the pilot between July 2012 and October 2013. Upon initial review, Navigant removed 11 customer records because they moved from one location to another during this time period. Further review determined that pre-enrollment consumption data were available for 610 of the remaining 2,120 participants.

Navigant initially conducted a difference-in-differences analysis on the consumption data of these 610 participants. The result was an estimate of the energy impact, net of disconnections and net of DSM program influence, of a 7.9 percent reduction in annual energy consumption. While this analysis provided a point of reference for the evaluation, it did not offer insight into any of the life stage, income or seasonal subcategories. Further, standard evaluation practice is to determine savings through regression modeling.

In developing a regression model, data cleaning revealed that 86 of the 610 had sufficient pre- and post-enrollment data for adequate matching of participants to a control group of non-participating APS customers. While these 86 participants and their matched non-participating customers offered limited data, Navigant was able to develop a regression model that met evaluation practice standards and provided a credible degree of rigor.

Navigant used this regression model to estimate the conservation effect and used average kWh/Year impacts to estimate the disconnect and DSM effects. The combination of the regression results and the average impacts of disconnections and DSM participation yielded the final estimate of the behavior effect. The following section describes the methodology that Navigant used to estimate each effect individually.

V. Results

A. Energy and Demand Savings

Conservation Effect

The conservation effect is the average reduction in kWh consumption associated with participant enrollment in the Prepay pilot. Navigant analyzed a sample of 610 participants using a difference-in-differences approach and estimated a conservation effect of 7.9 percent. Using data from a representative sample of 86 participants from the larger set of 610, Navigant developed a regression model to refine the original difference-in-differences result.

The regression model yielded the results in Table 1 which lists estimates for the overall pilot population as well as for participants, as categorized by their income and life stage.

Table 1. Conservation Effect

	Point Estimate of Percent Reduction of Annual Household Energy Consumption	90% Confidence Interval	Recommended Planning Estimate
All Participants	7.6%	± 4.2%	7.6%
Low Income	24.0%	± 17.3%	
Mid Income	5.1%	± 4.7%	
High Income	9.2%	± 12.5%	
Young Life Stage	6.4%	± 5.6%	
Family Life Stage	10.0%	± 8.0%	
Mature Life Stage	5.7%	± 11.2%	
Summer	9.2%	± 6.2%	
Winter	5.6%	± 5.5%	

Source: Navigant analysis

The point estimate for the conservation effect is 7.6 percent reduction in annual consumption but, at the 90 percent confidence level, could be as high as 11.8 percent or as low as 3.4 percent. The point estimates for the life stage, income, and seasonal subcategories are not statistically distinguishable from those of "All Participants", since the confidence interval for each subcategory included the point estimate for "All Participants."

While this is still true for the Low Income subcategory, the point estimate and the confidence interval for this subcategory suggests that its conservation effect is more likely to be greater than that of the overall pilot population; however, current data are not sufficient to quantify how much greater.

Note that these estimates are statistically indistinguishable from the point estimate from the difference-in-differences approach using data from the 610 participants, but the regression methodology is more rigorous.

Disconnect Effect

Navigant estimated the average reduction in annual energy consumption due to disconnections by examining 2013 disconnection data for the 610 participants used in the savings analysis above. This required 1) estimating the share of hours that each participant was disconnected and 2) multiplying that estimate by the average annual consumption.

Not all Prepay customers were enrolled for the full year in 2013, so Navigant extrapolated the hours disconnected during the period of time that customers were

enrolled to reflect annualized hours disconnected. For example, if a customer is in the pilot for 6 months and was disconnected twice for a total of ten hours, then that customer's annualized number of disconnects would be four and their annualized hours disconnected would be twenty hours. Of the 610 customers with data available for evaluation, 18 (3%) were disconnected during their Prepay enrollment period for a total of 329 hours. After weighting to account for enrollment duration, the extrapolated annual hours of disconnection for these 18 customers amounted to 4,346 hours, or an average of 241 hours per disconnected customer per year. Given that the other 592 customers were not disconnected during their period of enrollment, the average Prepay customer was disconnected for 7.1 hours per year (4,346 hours divided by 610 participants), or 0.08 percent of the total hours in a year. Given an average pre-pilot annual energy consumption of 16,488 kWh/year and applying a 0.08 percent reduction for disconnects, the resulting reduction in energy consumption due to disconnections is 13 kWh/year per participant.

This estimate is based on disconnect frequency and duration data from early in the pilot and from only a subset of all program participants for which data were available. Descriptive statistics included later in this report on all participating customers suggest that the disconnect frequency is somewhat higher than the preliminary estimates used in this analysis. However, APS does believe that the decrease in usage from the disconnect effect is small compared to the conservation effect. Going forward, it will be important to monitor the disconnect effect over time through ongoing MER and continue to refine this estimate.

DSM Program Effect

The DSM program effect is the average reduction in kWh consumption associated with pilot participants' involvement in other DSM programs during the time of their participation. APS provided Navigant with the deemed savings associated with DSM programs for pilot participants. APS provided Navigant with 35 records of Prepay customers with participation in other DSM programs. Navigant matched 24 of these 35 records to Prepay enrollment data.

Participation in another DSM program prior to enrollment in the pilot affects pre and post-enrollment consumption equally so any savings from participating in another DSM program prior to enrollment in the Prepay pilot are not attributable to the DSM effect during pilot participation. Therefore, only savings from customers who began participation in another DSM program after enrollment in the pilot are associated with the DSM effect. Of those 24 Prepay customers who took part in another DSM program, 16 began their involvement after they enrolled in the Prepay pilot. The sum of the deemed savings from these latter 16 participants totaled 11,275 kWh/year. Extrapolated across the 2,131 participants for whom Navigant had enrollment data, the average savings per participant was 5 kWh/year. This equates to 0.03 percent of average annual energy consumption for the Prepay participants in this data set.

Behavior Effect (Conservation Effect Less Disconnect and DSM Effects)

The behavioral effect is defined as the conservation effect less the disconnect effect and the DSM program effect. The combination of these two effects, after rounding to the first decimal, is 0.1 percent. Table 2 details the behavior effect for "All

Participants" and the subcategories, calculated by subtracting this 0.1 percent from the point estimates in Table 1.

Table 2. Behavior Effect

	Point Estimate of Percent Reduction of Annual Household Energy Consumption	90% Confidence Interval	Recommended Planning Estimate
All Participants	7.5%	±4.2%	7.5%
Low Income	23.8%	±17.3%	
Mid Income	4.9%	±4.7%	
High Income	9.0%	±12.5%	
Young Life Stage	6.3%	±5.6%	
Family Life Stage	9.9%	±8.0%	
Mature Life Stage	5.6%	±11.2%	
Summer	9.0%	±6.2%	
Winter	5.4%	±5.5%	

Source: Navigant analysis

Since the behavior effect is the conservation effect minus the disconnect and DSM effects, the confidence intervals in Table 2 are the same as the confidence intervals in Table 1. As such, the behavior effect confidence intervals do not reflect any variance associated with disconnection events or DSM participation.

As discussed in the derivation of the conservation effect, Navigant recommends using the behavior effect for "All Participants" for all life stage and income subcategories because this estimate is statistically indistinguishable from the behavioral effect estimated for each subcategory.

Demand Savings

Regarding peak demand impacts, Navigant determined peak demand impacts using the average of two approaches. The first approach assumes the average per participant annual energy savings impact net of disconnects and DSM programs (i.e., 1,240 kWh) is distributed equally throughout every hour of the year, as determined by the following equation.

$$\Delta kW = \Delta kWh / 8760 = 1,240 \text{ kWh} / 8760 \text{ hours} = 0.14 \text{ kW}$$

This is consistent with approaches used to characterize demand savings for other programs and measures in APS' DSM portfolio. Navigant believes this is a conservative estimate, as savings likely vary with the participant's usage pattern, and a participant's usage is likely higher than average during the peak period due to increased cooling loads. To account for this, Navigant employed a second approach that assumes the percent savings effect is consistent through every hour of the year. Peak demand savings due to the pilot is determined by multiplying peak demand

prior to pilot participation by the behavioral effect savings percentage, as depicted in the following equation.

$$\Delta kW = kW_{\text{peak}} \times \% \text{saved}_{\text{behavior}} = 3.29 \text{ kW} * 7.5\% = .246 \text{ kW}$$

The 3.29 kW denoted as the peak demand was determined by analyzing pre-enrollment hourly interval data for pilot participants for the coincident peak period, (i.e., weekdays July-August, from 4-6 p.m.). Navigant recommends using the average of these two approaches (i.e., 0.194 kW), as it provides a balanced estimate between a lower and upper bound.

Deemed Savings

Navigant developed a deemed savings estimate for Prepay participation based on average annual participant consumption. Average pre- and post-pilot annual consumption was estimated from the sample of 86 Prepay participants for whom there was sufficient pre- and post-enrollment data for an unbiased estimate of savings. Table 3 shows that consumption declined after enrollment from 16,488 kWh/year to 15,924 kWh/year.

Table 3. Pre- and Post-Enrollment Average Annual Energy Consumption

	Average Consumption (kWh)	
	Pre-Enrollment	Post-Enrollment
Annual Mean Consumption	16,488	15,924

Source: Navigant analysis of APS enrollment and consumption data

While it may seem intuitive to take the arithmetical difference between the pre- and post-enrollment periods as an estimate of energy savings, this approach would not control for differences in environmental conditions between the two periods. Instead, the appropriate approach is to analyze difference in energy consumption trends, as Navigant has done, first with the difference-in-differences analysis of 610 participants and then with the regression analysis of 86 participants.

Navigant estimated the behavioral effects of Prepay by first estimating energy savings from participation, then adjusting for the effects of disconnections and DSM program participation. Based on the application of the conservation effect to the pre-pilot annual energy consumption of 16,488 kWh, Navigant calculates the conservation effect to be 1,252 kWh. After subtracting 17 kWh/year derived above to account for the disconnect and DSM effects, the behavior effect deemed savings is 1,235 kWh/year—7.5 percent of average annual consumption.

B. Costs and Cost Effectiveness

Costs Incurred

The ACC approved this pilot in Decision No. 72214 in March 2011. The costs detailed below in Table 3 are all of the costs spent designing, developing and implementing the pilot program since 2011. The capital costs indicated below were one time startup costs and are not indicative of costs for full scale deployment to our service territory in 2015 and beyond.

Table 3. – Total Prepay Pilot Costs

O&M Expenses	2011	2012	2013	2014	Total
Training & Tech Assistance	\$0	\$0	\$0	\$0	\$0
Consumer Education	\$0	\$0	\$0	\$0	\$0
Program Implementation	\$60,501	\$2,515	\$47,649	\$7,229	\$117,894
Program Marketing	\$0	\$67,733	\$6,887	\$1,865	\$76,485
Planning and Administration	\$0	\$0	\$69,256	\$76,311	\$145,567
MER	\$0	\$0	\$105,194	\$10,001	\$115,195
Cust. Participation Reward*	\$0	\$0	\$2,147	\$99	\$2,246
Total	\$60,501	\$70,248	\$231,133	\$95,505	\$457,387

Capital Expenses**	2011	2012	2013	2014	Total
Total	\$956,281	\$2,201,784	\$537,891	\$0	\$3,695,956

*Pilot participants that completed at least two MER surveys were eligible for a free home energy audit (\$99 value) or comparable offer.

**Only capital carrying costs are recovered through the DSMAC surcharge.

The proposed budget for 2,000 customers in 2015 is \$83,500 and is broken out in the categories indicated in Table 5 below.

Table 5 - 2015 Prepay Program Budget

	2015
Training and Tech Assistance	\$5,000
Consumer Education	\$2,000
Program Implementation	\$8,000
Program Marketing	\$5,000
Planning and Administration	\$63,500
Total	\$83,500

Benefit Cost Analysis

Given the deemed savings results detailed above and the projected annual spend at 2,000 customers (\$83,500), APS Prepay has a cost benefit ratio of 1.03. The full cost benefit analysis will be detailed in the next APS DSM portfolio filing.

C. Customer Surveys

To evaluate the customer experience in the pilot, Navigant completed a process evaluation of the pilot. The analysis included three surveys: a pre-summer survey, a post-summer survey and a drop out survey. The pre-summer and post-summer surveys were designed to measure changes in sentiment during the summer cooling season. The drop out survey was a survey of customers who enrolled in APS Prepay and subsequently disenrolled and returned to standard billing. This section provides details of all three surveys.

Dialing Statistics and Disposition Reports

In order to determine how the summer months of 2013 would affect the participant experience, Navigant conducted two waves of surveys. The first wave collected data regarding customer satisfaction, pilot involvement and household actions prior to the heat of summer. The second wave collected data on the same subjects from the post-summer perspective.

Table 6 provides the dialing statistics and disposition report for the Wave 1 participant telephone surveys that Bellomy Research conducted (under Navigant's direction) in June 2013. For Wave 1, Bellomy made 4,466 calls to complete 150 surveys. Telephone surveyors made at least one attempt for all participants and prioritized low-income and senior participants in their calling efforts. The target number of completes for this survey was originally 200, but was reduced to 150 due to lower than expected response rates. This completion target was also applied to Wave 2.

Table 6. Wave 1 Participant Survey Disposition Report

Dialing Statistic	Total
Sample	1717
Total Dialings	4466
Disposition Statistic	Total
Completes	150
Refused	302
Disconnected/Wrong Number/Blocked	433
Business/Gov't	7
Deaf/Language Barrier ²	39
Screened Out ³	31
Called Up to 7 Times (No Response)	755

Source: Navigant Wave 1 Participant Surveys

² "Language Barrier" indicates that the survey call was connected to a person but that person did not speak English or Spanish. Bellomy Research provided a Spanish-language interviewer for all respondents who preferred to answer in that language.

³ "Screened Out" indicates that the person answering the telephone surveyor's call denied that anyone in the household were participants in the pilot.

Table 7 provides the summary sample sizes of the 150 completed telephone surveys from Wave 1. "Low-Income (E-3)" respondents are those that have an E-3 rate with APS. "Low-Income (<150% Fed. Pov.)" respondents are those whose self-reported income and household size would place them at less than 150 percent of the Federal Poverty Line. All of the "E-3" Low-Income respondents are also respondents in the "Low-Income (<150% Fed. Pov.)" sub-sample. This convention applies to all tables in this report.

In order to thoroughly describe the responses from senior citizens, this report provides their answers in two categories. The first, "Mature – Over 55 (Respondent) OR Over 65 (HH)" includes all respondents who were over 55 years of age or those respondents who reported that their household included one or more members over 65 years of age. The second, "Mature – Over 65 (Respondent) OR Over 65 (HH)" includes all respondents who were over 65 years of age or those respondents who reported that their household included one or more member over 65 years of age. All the respondents in the latter sub-sample are included in the former sub-sample. This convention also applies to all tables in this report.

Table 7. Sample Sizes for Wave 1 Respondent Groups

Total Sample	Low-Income (E-3)	Low-Income (<150% Fed. Pov.)	Mature Over 55 (Respondent) OR Over 65 (HH)	Mature Over 65 (Respondent) OR Over 65 (HH)
n	n	n	n	n
150	13	104	21	11

Note: Since "E-3" is a subset of "<150% Federal Poverty Level" and "Mature Over 55" is a subset of "Mature Over 65,"the "n's" do not sum to 150

Source: Navigant Wave 1 Participant Surveys

Table 8 provides the dialing statistics and disposition report for the Wave 2 participant telephone surveys that Bellomy conducted in September 2013. For Wave 2, Bellomy Research made 6,066 calls to complete 151 surveys. Telephone surveyors again called each participant's telephone number at least once and prioritized low-income and mature participants. Surveyors spoke with 66 re-interview respondents, who had participated in the Wave 1 round of surveys, as well as 85 respondents who had not taken part in previous survey activity related to Prepay. The sample sizes of Wave 2 respondent groups are shown in Table 9 and have the same definitions as those of Wave 1 in Table 7.

Table 8. Wave 2 Participant Survey Disposition Report

Dialing Statistic	Total
Sample	2089
Total Dialings	6066
Disposition Statistic	Total
Completes	151
Refused	340
Disconnected/Wrong	651

Number/Blocked	
Business/Gov't	29
Deaf/Language Barrier	4
Screened Out	72
Called Up to 7 Times (No Response)	842

Source: Navigant Wave 2 Participant Surveys

Table 9. Sample Sizes for Wave 2 Respondent Groups

Total Sample	Low-Income (E-3)	Low-Income (<150% Fed. Pov.)	Mature Over 55 (Respondent) OR Over 65 (HH)	Mature Over 65 (Respondent) OR Over 65 (HH)
n	n	n	n	n
151	8	95	16	9

Source: Navigant Wave 2 Participant Surveys

Drop-Outs

Table 10 provides the dialing statistics and disposition report for the Drop-Out telephone surveys. For the Drop-Out surveys, Navigant made 90 calls to reach 10 completes. The target number of completes for this survey was 10 due to the limited sample size.

Table 10. Drop-Out Customer Survey Disposition Report

Dialing Statistic	Total
Sample	68
Total Dialings	90
Disposition Statistic	Total
Completes	10
Partial Completes	2
Refused	3
Disconnected/Wrong Number/No Answer	19
Business/Gov't	0
Deaf/Language Barrier	2
Other	4

Called Up to 3 Times (No Response) ⁴	28
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Source: Navigant Drop-Out Surveys

Demographics

Wave 1 Participant Demographics

Of Wave 1 respondents, the largest segment of participants was low-income, Caucasian individuals between the ages of 25 and 44 years old. This was true across all respondent groups, although the low-income respondents showed a slightly higher percentage of Hispanic respondents. Most respondents were renters (83 percent) who had lived in their homes for less than one year (63 percent). Over 60 percent of total respondents had fewer than four people in their household, and another close to 30 percent had between four to six people. Eighty-eight percent of respondents claimed that their household had no members over 65 years of age.

The majority (68 percent) of total respondents reported a household income of less than \$50,000, and of those respondents, 68 percent reportedly made less than \$25,000 per year. This suggests that the program is reaching the low-income audience. However, of the 17 percent of households who earn over \$50,000 per year, roughly half earned over \$65,000 per year, suggesting that low-income customers are not the only households taking advantage of the program.

Wave 2 Participant Demographics

Wave 2 respondents were relatively similar to those from Wave 1 in that most were low-income individuals between 25 and 44 years old with "Caucasian" the most often identified ethnicity. Again, the low-income respondents showed slightly higher percentage of Hispanic respondents. Nearly half of the respondents had lived in their homes for less than one year, and an additional 43 percent had lived in their homes for less than five years. Over half of the respondents had fewer than four people in their household, and 40 percent had between four to six members in their household. Again, 88 percent of respondents had no household members over the age of 65, confirming that the "mature" audience did not make up a significant portion of the program's participants.

A slightly higher number of Wave 2 respondents were low-income, with about three-quarters of respondents claiming to earn less than \$50,000 per year for their household. About 64 percent of those households reportedly earn less than \$25,000, which was comparable to the Wave 1 findings. About 44 percent of those households earning more than \$50,000 per year earned over \$65,000, which was also comparable to Wave 1 responses. The consistency of these responses suggests that while low-income customers make up a major part of program participants, a number of participants are well above the poverty line.

⁴ Navigant was able to reach the target of 10 completed surveys with only three attempts to Drop-Out customers that did not respond.

Drop-Out Respondent Demographics

Of the Drop-Out respondents, about a third were Caucasian, another third were African American, and about 20 percent were Hispanic. Two respondents refused to answer. The majority of respondents (70 percent) rented their homes and half claimed that this was their primary, year-round residence. Most respondents claimed that fewer than four people lived in their household for at least half of the year, and 70 percent of respondents claimed that their household did not include anyone over the age of 65. When asked the respondents' age, 40 percent reported to be between 45 and 50 years old, while the rest of the responses varied. Similar to the participant surveys, 70 percent of respondents reported a household income of less than \$50,000 per year, further confirming that low-income individuals were the most prevalent participant group in the Prepay pilot.

Summary Demographics Findings

In general, the survey responses indicate that the pilot appealed to low-income customers who rented their homes. Further, a majority of participant and Drop-Out respondents live in their current residence for less than one year. The preponderance of low-income, rental abodes and short terms of residence suggests that the pilot has attracted a market segment with high mobility. Future research could determine how this mobility affects participant satisfaction and energy savings.

Satisfaction

Throughout this section, tables include the term "Top Box" as a category for responses of eight, nine, or ten to variations on the question "on a scale of one to ten, where one indicates 'very dissatisfied' and ten indicates 'very satisfied,' how satisfied were you with . . . ?" Per this convention, the "Top Box" category indicates the highest levels of satisfaction. The tables in this section also provide a more general category of satisfaction as scores greater than five ("6-10"). Dissatisfaction is defined as scores of five or less.

Participant Overall Program Satisfaction

Both waves of respondents were very satisfied with the pilot, overall. About 71 percent of Wave 1 respondents and 78 percent of Wave 2 respondents replied with satisfaction scores of eight to ten out of ten, as shown in Table 11. There was very little change in overall satisfaction with the pilot from Wave 1 to Wave 2; average satisfaction scores from both low-income groups rose by one to two points, while scores from both mature groups dropped by one point (from nine to eight). Although the majority of mature respondents were never dissatisfied, this post-summer decline occurred in overall satisfaction, as well as for nearly every other type of satisfaction covered by the survey.

Table 11. Overall Pilot Satisfaction for Wave 1 and 2

Question	Wave 1					Wave 2				
"On a scale of 1 to 10, where 1 indicates 'very dissatisfied' and 10 indicates 'very satisfied,' how satisfied are/were you with APS Prepay so far?"	n*	Ave	Std. Dev.	Top Box	6-10	n*	Ave	Std. Dev.	Top Box	6-10
Total Sample	150	8	2.77	71%	82%	151	9	2.3	78%	89%
E-3	13	7	3.67	54%	69%	8	9	1.1	88%	100%
150% of Federal Poverty Limit	104	8	2.92	71%	80%	95	9	2.4	82%	91%
Mature: 55+	20	9	1.94	90%	90%	16	8	3.2	75%	81%
Mature: 65+	11	9	1.96	91%	91%	9	8	3.6	67%	78%

*Satisfaction values were taken only from respondents who offered a score - respondents who answered "Don't Know" or who refused to answer the question were not included

n's listed here exclude "Don't Know" or "Refused" responses

Source: Navigant Participant Surveys

When asked their reasons for enrolling in the pilot, most respondents cited financial reasons, such as the program could be used to better manage their budgets and that there was no security deposit. This was true for all respondent groups in both waves. Non-financial reasons, such as the ability to track energy usage or to save energy were rarely mentioned, with only a few percent of respondents mentioning these as their primary reasons for enrolling in the pilot. Few respondents gave any other reasons for enrolling in the pilot, indicating that financial factors were the primary drivers of pilot participation. The full list of responses can be found in Table 12 and Table 13.

Table 12. Wave 1 Reasons for Enrollment

Question					
What was the MAIN REASON you chose to enroll in APS Prepay?	Total (n=150)	E-3 (n=13)	150% (n=104)	Mature : 55+ (n=21)	Mature : 65+ (n=11)
To save money	19%	8%	19%	19%	9%
To better manage finances/budget	12%	8%	12%	14%	27%
No deposit	10%	15%	9%	10%	18%
To avoid huge monthly bills	9%	15%	13%	14%	9%
Ability to pay amount at any time	3%	0%	3%	0%	0%
To track energy usage	6%	8%	6%	10%	0%
To save energy	2%	0%	2%	0%	0%
Other	37%	46%	35%	29%	36%
Don't know/Not sure	3%	0%	3%	5%	0%

Source: Navigant Wave 1 Participant Surveys

Table 13. Wave 2 Reasons for Enrollment

Question					
What was the MAIN REASON you chose to enroll in APS Prepay? (New Respondents Only)	Total (n=124)	E-3 (n=7)	150% (n=94)	Mature : 55+ (n=16)	Mature : 65+ (n=9)
To save money	8%	14%	7%	0%	0%
To better manage finances/budget	27%	57%	28%	44%	44%
No deposit	21%	14%	19%	38%	33%
To avoid huge monthly bills	6%	14%	6%	0%	0%
Ability to pay amount at any time	6%	0%	5%	0%	0%
To track energy usage	4%	0%	4%	0%	0%
To save energy	0%	0%	0%	0%	0%
Other	24%	0%	26%	13%	22%
Don't know/Not sure	4%	0%	4%	6%	0%

Source: Navigant Wave 2 Participant Surveys

Sacrifice of Comfort

In comparison to their experience before the Prepay pilot, significantly fewer participants in all Wave 1 groups had to forego comforts or necessities to pay for their electricity during the Prepay pilot. As shown in Table 14, nearly one-third of total Wave 1 respondents had to forego necessities such as food; use of appliances; had to tighten their budget; or had to keep their home at uncomfortable temperatures to pay for electricity prior to the pilot. This number dropped to 17 percent after respondents enrolled in the pilot, indicating that the Prepay pilot significantly helped respondents to better manage their energy use or budgets without sacrifice. Each of the other respondent groups experienced similar reductions of numbers.

Table 14. Wave 1 Sacrifice of Comfort

Question				
Respondent Group	n - Prior	Sacrificed Comfort Prior	n - Since	Sacrificed Comfort Since
Total	86	30%	150	17%
E-3	9	56%	13	38%
150%	59	29%	104	19%
Mature: 55+	14	29%	22	23%
Mature: 65+	9	44%	11	36%

Source: Navigant Wave 1 Participant Surveys

Wave 2 respondents also showed a decrease in the necessity to forego household comforts when compared with their experience prior to pilot participation. In particular, the percentage of the mature respondents over 65 who forewent household comforts dropped by nearly 30 percent. The E-3 customers were the only group who indicated that they had to forego more household comforts since participating in the pilot, with an increase from zero to 13 percent⁵ of the group. The general decrease across all groups suggests that the pilot did have some influence on customers' ability to manage their electricity budgets.

Table 15. Wave 2 Sacrifice of Comfort

Question				
Respondent Group	n - Prior	Sacrificed Comfort Prior	n - Since	Sacrificed Comfort Since
Total	68	18%	151	15%
E-3	6	0%	8	13%
150%	49	20%	95	17%
Mature: 55+	8	25%	16	13%
Mature: 65+	4	50%	9	22%

Source: Navigant Wave 2 Participant Surveys

Behavior Influence

When asked how influential the pilot was on their actions to manage their energy use, respondents offered an average score of eight on a one to ten point scale, indicating that they thought the pilot had a great deal of influence on their energy usage behavior. This influence appeared to have grown from the first wave (pre-summer) to the second (post-summer), as indicated in Table 16 and 17.

Table 16. Wave 1 Behavior Influence

Respondent Group	n	Average	% Rated Top Box
Total	150	8	72%
E-3	13	7	62%
150%	104	8	73%
Mature: 55+	21	8	84%
Mature: 65+	11	8	82%

Source: Navigant Wave 1 Participant Surveys

⁵ E-3 respondents provided no context for this change in their survey responses and the small sample size limits the scope of any inference.

Table 17. Wave 2 Behavior Influence

Respondent Group	n	Average	% Rated Top Box
Total	144	8	79%
E-3	8	10	100%
150%	91	9	81%
Mature: 55+	15	9	87%
Mature: 65+	8	9	88%

Source: Navigant Wave 2 Participant Surveys

Drop Out Survey Results

Drop Out Overall Program Satisfaction

Drop-Out customer responses were evenly divided regarding their satisfaction with the pilot. Four of the ten Drop-Out respondents stated they were very satisfied (scores of nine or ten out of ten) with the primary reason for departing the pilot as having left the pilot because they relocated outside APS's service territory. Of the remaining six respondents, the majority gave middle to low satisfaction scores (one to six). When asked the reason they were less than satisfied, most respondents cited high costs or fees.

Reasons for Leaving the Pilot

The Drop-Out respondents were asked their main reasons for leaving the pilot. Of the ten Drop-Out respondents, half dropped out because they relocated outside APS's service territory. A full list of responses is shown in Table .

Table 18. Drop-Out Customer Reasons for Leaving Program

Question	
What was the MAIN reason you choose to stop participating in APS Prepay?	n=10
Relocated	5
Inconvenient to recharge my account	2
It did not help with budgeting	2
Too many disconnects	1
Can't monitor energy usage in real-time/can't see usage right away	1
Too many balance notifications	1

Multiple Responses allowed

Source: Navigant Drop-Out Surveys

D. Disconnections

This section of the report provides the descriptive statistics associated with disconnection of electric service (as a result of pilot participant's credit balance falling to zero or below), as well as disconnect timing and the related impact on on-/off-

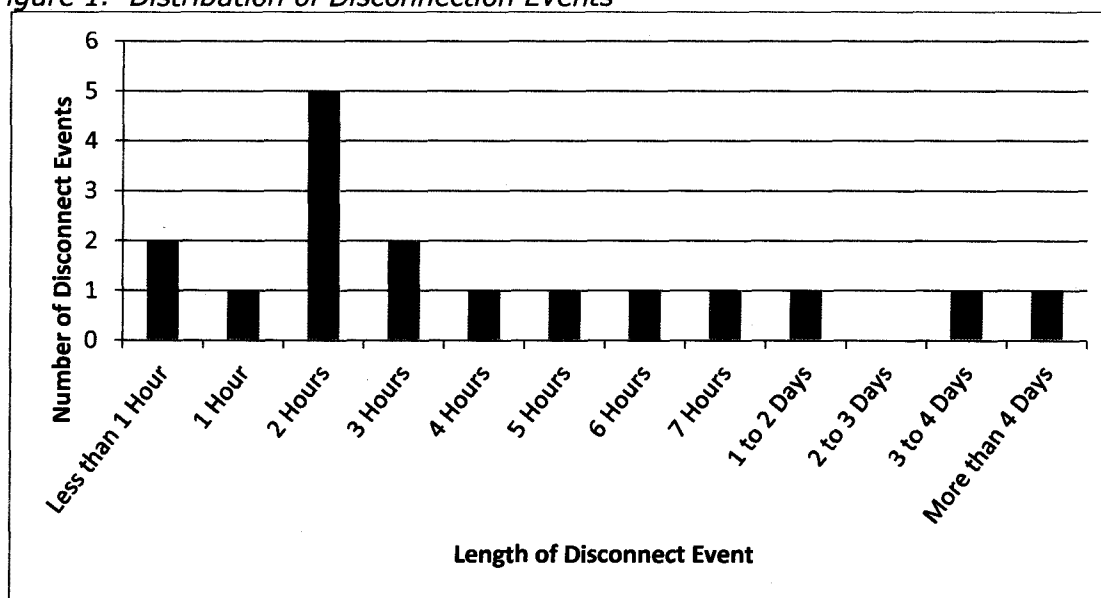
peak summer and winter load shapes. Statistics are based on the same set of data used in the analysis of savings from disconnections. Additionally, further analysis of disconnections has been conducted on the entire Prepay customer base at the recommendation of the APS Prepay Stakeholder group using queried data from the APS system.

Disconnect Statistics

APS provided disconnect and reconnect data for 357 participants enrolled in the Prepay pilot from September 2012 through October 2013. Analysis of the data showed 331 of the 357 participants had both a disconnection and reconnection event. This limited data for disconnections did not support analysis of disconnections by sub-group.

Of these 331 participants, 33 had pre-enrollment consumption data (i.e., the 33 were a subset of the 610 participants mentioned earlier in this report). Of these 33 customers, 18 were disconnected while enrolled in the Prepay pilot program, with an average enrollment duration of 53 days. These 18 customers experienced 20 disconnects while enrolled; 16 customers were disconnected once while two customers were disconnected twice. The average disconnection duration was 16.4 hours per event. For these 18 participants, the duration of disconnect events is plotted in Figure .

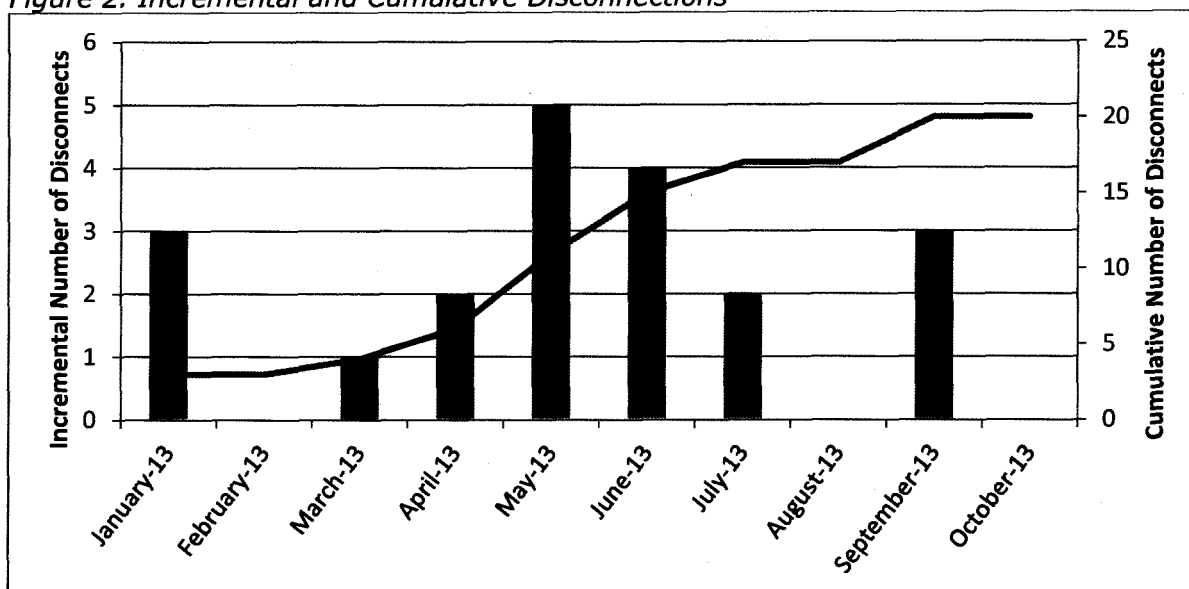
Figure 1. Distribution of Disconnection Events



Source: Navigant analysis

For these same 18 participants, Figure shows the number of disconnects per month. The bars in this figure represent disconnections by month while the line represents the cumulative number of disconnections. Disconnect events were most common in the spring and summer months of 2013. Forty percent of all disconnection events occurred between March and May 2013 and thirty percent occurred between June and July 2013.

Figure 2. Incremental and Cumulative Disconnections



Source: Navigant analysis

Disconnect Timing and Impact on On-/Off-Peak Summer and Winter Load Shapes

Navigant assessed the seasonal impact of the disconnect effect on annual energy savings by analyzing the number and duration of disconnects in 2013 occurring during the following time periods:

- Summer On-Peak: May-October, Weekdays, 12 p.m. -7 p.m.
- Summer Off-Peak: May-October, All Other Hours
- Winter On-Peak: November-April, Weekdays, 12 p.m.-7 p.m.
- Winter Off-Peak: November-April, All Other Hours

Table provides the seasonal disconnect statistics for the 18 participants who were disconnected during their enrollment period, and Table 20 provides these statistics for the larger participant set of 610—most of whom were not disconnected at all during their period of enrollment.

Table 19. Seasonal Disconnect Effect for the Disconnected Customers Analyzed (18)

	Total hours disconnected	Average number of hours disconnected per participant	Percent Reduction in Consumption due to Disconnects	Average Reduction in Annual Energy Consumption due to Disconnect (kWh)
Summer On-Peak	662	36.8	0.4%	69

Summer Off-Peak	1125	62.5	0.7%	118
Winter On-Peak	905	50.3	0.6%	95
Winter Off-Peak	1654	91.9	1.0%	173
Total	4346	241.4	2.8%	454

Table 20. Seasonal Disconnect Effect for All Prepay Customers Analyzed (610)

	Total hours disconnected	Average number of hours disconnected per participant	Percent Reduction in Consumption due to Disconnects	Average Reduction in Annual Energy Consumption due to Disconnect (kWh)
Summer On-Peak	662	1.1	0.01%	2.0
Summer Off-Peak	1125	1.8	0.02%	3.5
Winter On-Peak	905	1.5	0.02%	2.8
Winter Off-Peak	1654	2.7	0.03%	5.1
Total	4346	7.1	0.08%	13.4

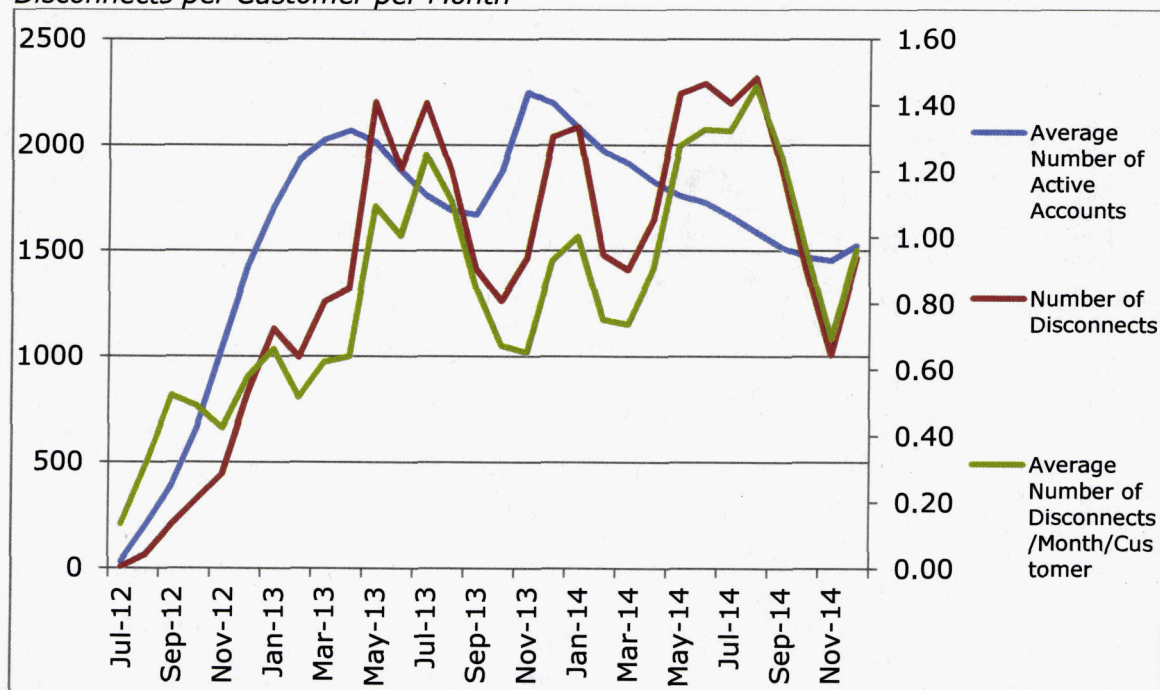
Source: Navigant analysis

Additional Pilot Disconnect Data

In addition to the data Navigant analyzed that included rigorous pre and post data from a smaller population, additional information about the disconnections for the entire Prepay customer base is indicated below.

Using the raw disconnect order history and the average numbers of customers in the Prepay pilot per month during the length of the pilot, Figure 3 highlights the trends of the enrollment levels, the number of disconnects and the average number of disconnects per customer per month. The figure shows that the highest enrollment count during the pilot was in November 2013. It also shows that on average, there are 0.8 disconnections per customer per month. The highest ratio was 1.46 disconnections per customer per month in August 2014. These numbers include customers that have disconnected due to debit balances, customers who choose to be disconnected and customers that have left the APS service territory and have let their credit balances run out instead of terminating service by contacting APS.

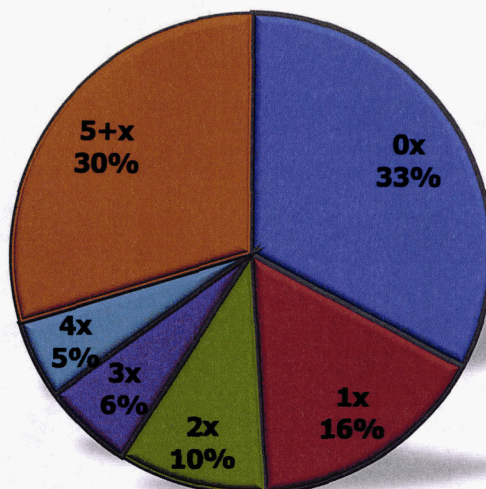
Figure 3. Active Accounts, Number of Disconnects and Average Number of Disconnects per Customer per Month



Source: APS

Figure 4 provides additional detail on the disconnect picture by indicating the percentage of customers who have disconnected by number of times.

Figure 4. Percentage of Customers Who Have Disconnected by Number of Times



Source: APS

Thirty three percent (33%) of the customers have never disconnected and an additional 16% disconnected only once. The other half of the customers has disconnected two plus times.

When looking at these disconnections and looking deeper into disconnection duration, Prepay customers were disconnected 7.5 hours on average. This takes into account all disconnections and averaged the time disconnected for all Prepay customers for all disconnections. This is a much shorter disconnection period than standard billed customers. This is likely due to the fact that Prepay customers only need to establish a credit balance and do not need to pay disconnect, reconnect and late fees to re-establish service.

E. Estimated Reads

APS has implemented the estimated read process outlined in Service Schedule 8: Bill Estimation. This includes:

- Estimating missing data using the most recent day for which adequate information is available for the site. Missing weekday information is estimated with the most recent available weekday information. Missing weekend and Holiday information is estimated with the most recent available weekend day information.
- If historic daily meter information is not available for the site, the estimates will be based upon the class average data and the on-peak factors if applicable.
- If a customer's usage is estimated for 3 days, APS works to obtain the actual meter information and determine the reason for the estimated read. APS also calls the customer and informs them about the estimated reads.
- APS does not disconnect customers who have a negative balance caused by an estimated read that has not been trued up with an actual read.

Per Decision No. 73223 requiring a report on Prepay bill estimation, APS analyzed one year of data (2013). There were 647,109 total reads and of those, 6,857 (1.06%) were estimated. Of the 6,857 estimated reads, only 418 (0.06%) were estimated for three days or more. Data in 2014 suggests that the percentage of estimated reads has dropped to 0.57% and of those 0.10% were estimated for three days or more.

Additionally, of the reads estimated in 2013, APS underestimated the estimated read 86.4% of the time when compared to the actual read.

VI. Plan for the Future

Based on the results presented in this report, including the proof of verified energy efficiency savings from Prepay, APS plans to continue this cost effective program. At this time, APS is proposing to continue at the 2,000 customer level and remove the program's pilot status while claiming ongoing verified savings toward the Energy Efficiency Standard. While current participants are highly satisfied with the program, APS believes that refinements can be made to enhance the operations of the program before it is expanded. Within the 2,000 participant limit, APS proposes that customers throughout the APS service territory could be eligible to participate rather than limiting the program to Phoenix metro area customers only. APS will continue to monitor and report on the effectiveness of the Prepay program through the DSM measurement and evaluation process and will consider expansion of the program at a later date in a future DSM portfolio filing.

VII. Conclusion

The results from this program evaluation indicate that the average Prepay customer saves 7.5% annually or a deemed savings value of 1,235 kWh/year when compared to a statistically similar control group and after removing the impact from disconnects and other DSM program participation. The average annual disconnect effect and the DSM program participation effect were both found to be very small relative to the conservation effect. The impact to different customer segments (life stage and income level) was also analyzed and was found to be statistically no different than the overall population based on the available sample size for this analysis.

The process survey results indicated that customer satisfaction was high, that customers sacrificed comfort less in Prepay than standard billing and there are areas that have been identified for improvement before expanding the Program.

Based on the impact results and projected costs for the program moving forward, APS Prepay is cost effective with a benefit/cost ratio at 1.03 and a projected annual budget of \$83,500 for 2,000 participating customers.

APS recommends the Residential Prepaid Energy Conservation Pilot be moved from pilot to a fully implemented standard DSM program for approximately 2,000 customers throughout the APS service territory in 2015.



RESEARCH



Home Candle Fires

Marty Ahrens
May 2020

Candle fires

In 2014–2018, US fire departments responded to an average of 7,610 home¹ structure fires that were started by candles per year. These fires caused an annual average of 81 civilian fire deaths, 677 civilian fire injuries, and \$278 million in direct property damage.

Overall, candles caused 2 percent of the reported home fires, 3 percent of the home fire deaths, 6 percent of the home fire injuries, and 4 percent of the direct property damage in reported home fires during this period.

On average, 21 home candle fires were reported per day.

Candle fire seasonality

December was the peak month for candle fires, followed closely by January. Eleven percent of these incidents occurred in each of the two months.

Candle fires appear to be related to holiday decorations. Twelve percent of December candle fires began with decorations. Only 4 percent of candle fires in January to November began with such items.

Almost three times as many fires started by candles were reported on Christmas (average of 58 Christmas fires) as the daily average.

Candle fire victims

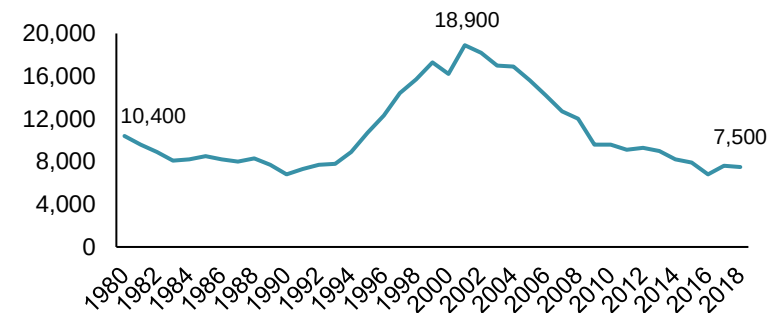
Fifty-eight percent of the candle fire fatalities and 54 percent of the non-fatally injured were female. This is the opposite of overall home fires in which 57 percent of the fatalities and 55 percent of the non-fatally injured were male.

More than one-third of the people who succumbed to candle fires were at least 65 years old (36 percent). Nearly one-fifth were 55–64 years of age (18 percent).

Trends in home candle fires

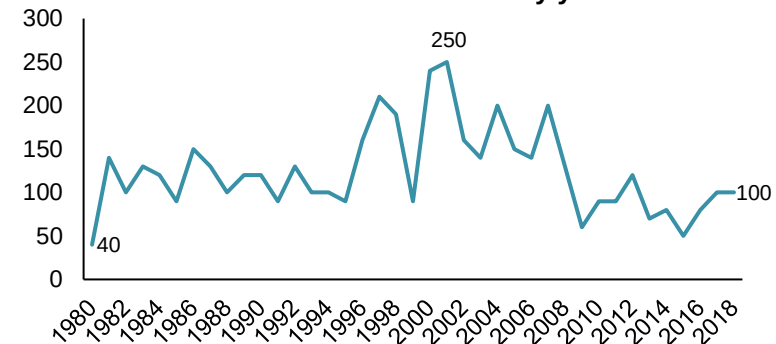
While overall home fires declined through the 1980s and most of the 1990s, candle fires increased sharply through the 1990s as the popularity of candles climbed. These fires peaked in the early years of the 20th century and then started on a downward trend.

Home candle fires by year

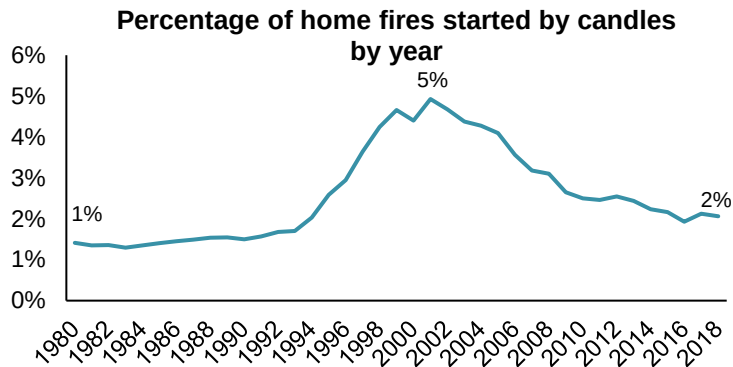


While annual deaths from fires involving candles fluctuate more than candle fires, deaths, too, were higher in the late 1990s and the beginning of the 21st century.

Home candle fire deaths by year



The share of home fires caused by candles increased from 1 percent in the early 1980s to 5 percent in the early years of the 21st century before falling back down to 2 percent.



No standards for candles existed in the 1990s. The Consumer Product Safety Commission (CPSC) requested that ASTM develop candle fire safety standards, a request that the National Candle Association (NCA) supported. An ASTM Consumer Product subcommittee wrote standards addressing safety labels, glass candle containers, maximum flame height, secondary ignitions, end-of-useful-life and tip over requirements.^{2,3} The subcommittee has a task group that reviews publicly available reports of candle fires and recalls to ensure that the circumstances are addressed by the ASTM standards. CPSC's [saferproducts.gov](https://www.saferproducts.gov) is a primary source of candle fire reports and recalls.

Causes and circumstances of home candle fires

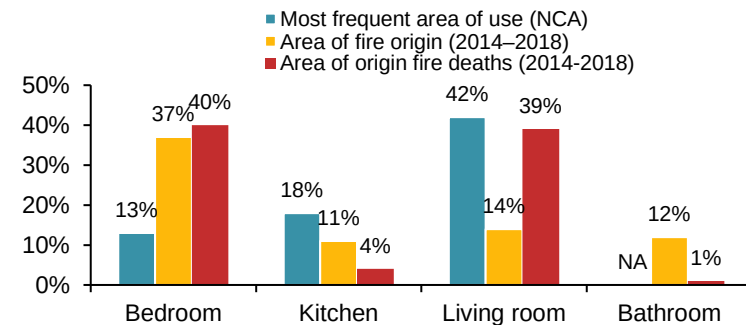
Three of every five (60 percent) candle fires started when something that could burn—such as furniture, mattresses, bedding, curtains, or decorations—was too close to the candle. In 16 percent of the fires, the candles were unattended or abandoned.

Sleep was a factor in 10 percent of the fires, 15 percent of the fire deaths, and 22 percent of the injuries. Drug or alcohol impairment was also a possible factor in 15 percent of the deaths. Only 3 percent of candle fires were intentional.

Based on information on the NCA's website on where candle fires are most frequently used,⁴ candles in the bedroom cause a disproportionate number of fires and fire deaths.

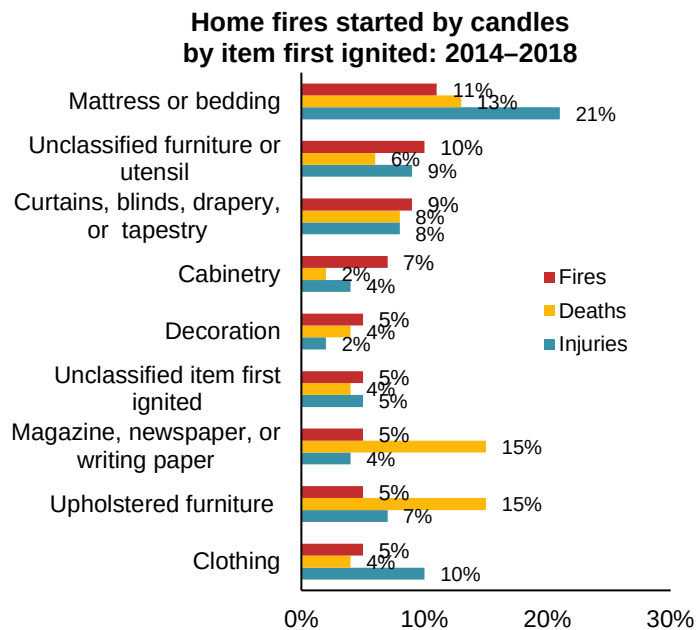
The leading items first ignited are consistent with the leading areas of origin. While upholstered furniture and mattresses and bedding are the leading items associated with overall home fire fatalities,⁵ it is unusual to see 15 percent of deaths resulting from fires associated with magazines, newspapers, or writing paper. Although the data are not sufficiently robust to confirm this, it is likely that in fires that began with items such as paper and curtains, the initial fire spread to other items such as furniture and bedding or into the walls.

Home candle fires by leading areas of use and fire origin



Smoke detectors alerted occupants of a 25-story California apartment building to a fire that began in the living room of a 12th floor unit when a candle ignited window treatments. The fire was able to spread from the 12th to 16th floor through voids. Property damage was estimated at \$8 million to the structure and \$2 million to the contents⁶.

The fire was confined to the object of origin in 22 percent of home candle fires and only 1 percent of candle fire deaths. Thirty-two percent of candle fire deaths resulted from the three-quarters (74 percent) of fires that were confined to the room of origin.



Candles used for light

While candles are typically used for mood, decoration, or scent, the situation is different when candles are used for light due to power outages or shutoff.

Several years ago, NFPA reviewed news clips and files on 117 fatal candle fires that caused 177 deaths between January 2005 and December 2010. Unless power was specifically mentioned, it was assumed to be operational. According to reports from the fire service, fire investigators,

or and the newspapers, the home was without power in one-quarter (26 percent) of the fatal candle fires studied and in one-third (34 percent) of the associated deaths. Percentages were based on incidents in which the reason for the lack of power was known. In 68 percent of the fires resulting in 62 percent of the deaths, the power had been shut off or the home lacked utilities. In six fires (24 percent) resulting in six deaths (12 percent), candles were used during a temporary power outage. In two fires (8 percent) resulting in 13 deaths (26 percent), new occupants were moving in and the power had not yet been turned on.

Texas apartment fire claimed the life of an elderly man and injured his wife after a candle started a fire on a bedroom nightstand during a power outage. The deceased had a mobility disability, and his wife had left the candle on the nightstand for him. Her attempts to rescue him and to extinguish the fire were unsuccessful. The fire was confined to the unit of origin.⁷

For more information

The fire estimates in this analysis were derived from the US Fire Administration's National Fire Incident Reporting System (NFIRS) and NFPA's annual Fire Experience Survey. See "[How the NFPA National Estimates Are Calculated for Home Structure Fires](#)" for more information.

For more details about candle fires, see the [companion supporting tables](#).

To learn more about research at NFPA, visit [nfpa.org/research](https://www.nfpa.org/research).

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NFPA No. PKG34

¹ Homes include one- or two-family homes, including manufactured homes, and apartments or other multi-family housing.

² National Candle Association, "Key ASTM standards for candles," accessed March 5, 2020, <https://candles.org/industry-standards/>

³ Doug Clauson, "Increasing Candle Safety," *ASTM Standardization News*, March/April 2013, <https://www.astm.org/standardization-news/?q=features/increasing-candle-safety-ma13.html>. Accessed March 5, 2020.

⁴ National Candle Association. "Facts and Figures: Consumer Preferences," accessed March 5, 2020, <https://candles.org/facts-figures-2/>.

⁵ Marty Ahrens, *Home Structure Fires*, Quincy, MA, 2019, 12.

⁶ Stephen G. Badger, "Large-Loss Fires for 2018," *NFPA Journal*, November/December 2019.

⁷ Richard Campbell, "Firewatch," *NFPA Journal*, March/April 2017.

Nine die in house fire caused by candles

BALTIMORE (AP) — A fire that engulfed a row house, killing seven children and two adults, was caused by candles they were burning for light because their electricity had been cut off, fire officials said Sunday.

A 21-year-old woman dropped her 2-year-old son to safety from a second-floor window and then leaped herself, suffering a broken ankle, fire officials said.

The only other survivor was a 14-year-old boy who told investigators he was awakened by the heat and screamed to wake the others upstairs. All of the dead were found upstairs.

Investigators believe the fire late Saturday was started in the downstairs living room by candles left burning on a table beside a sofa bed where the boy slept, said fire department Capt. Paul Geoghegan.

Power was shut off Oct. 11 after the electric bill for the row house had mounted to \$1,400, said Baltimore Gas & Electric Co. spokesman Kevin Thornton.

The home in one of the city's poorer neighborhoods apparently also had no heat. It had a gas stove, but the oil furnace required electricity, he said.

Thornton said state funds that help the poor pay for utilities contributed \$384 to the electric bill. The company offered to al-

low the bill to be paid off over a one- to four-year period, but the residents never responded, Thornton said.

"We're willing to do anything to help, but we need some reciprocation," Thornton said. The last payment was \$100 in September 1993, he said.

There were no smoke detectors.

So far this year, 25 people have died in Baltimore fires, compared with 33 for all of 1993, fire department spokesman Hector Torres said.

When firefighters arrived, the block was so filled with smoke that firefighters had difficulty determining which house was burning, Torres said. It took 30 firefighters about 20 minutes to control the blaze.

Some of the children, who ranged in age from 8 months to 12 years, were found crouched on the floor or hiding under clothes and blankets, Geoghegan said.

"When kids get scared, they'll pull the blankets up, they'll put something over top themselves thinking it's going to protect them. What they can't see, they think can't hurt them," he said.

Also killed were a 24-year-old man found at the top of the stairs and a 28-year-old woman.

THE BANNER

With 59 lost to heat, 2026 was Maryland's deadliest summer on record

Adam Willis

9/4/2026 5:30 a.m. EDT



At least 59 people have died because of complications from heat since the start of May, according to the health department. (Kylie Cooper/The Banner)

In late May, state officials reported heat's first victim of the year, an older man in Calvert County.

The man, whose name and age weren't disclosed, would be the first of dozens killed by heat in Maryland this

summer, a record-breaking toll.

At least 59 people have died because of complications from heat since the start of May, according to the health department — a sharp jump from the 36 reported heat deaths last year, which was the state's deadliest year for heat in over a decade. The Maryland health department reports heat deaths from May to September going back to 2012.

And, as Marylanders prepare for Labor Day weekend and mark the unofficial end of summer, the death toll could climb. The heat index in the Baltimore and Washington areas [climbed to 100 degrees Thursday afternoon](#).

Ben Zaitchik, a Johns Hopkins University professor researching the impacts of climate change on urban neighborhoods, said this year's spike was surprising — even with everything he knows about the effects of global warming.

There are no clear answers to what caused this jump, but the toll shattered the state record of 46 heat-related deaths in 2012, when [a June derecho storm](#) knocked out power for nearly 2 million Marylanders, [many for more than a week](#). Unlike that “black swan” event, Zaitchik said, this summer's losses don't seem to have stemmed from one obvious incident.

Still, it's been hot.

Through the end of July, Maryland experienced six more days than normal of what state climatologist Alfredo

Ruiz-Barradas classifies as “hot”: 86 degrees or higher. Maryland also saw two more heat waves — or two or more such hot days in a row — than typical, Ruiz-Barradas said.

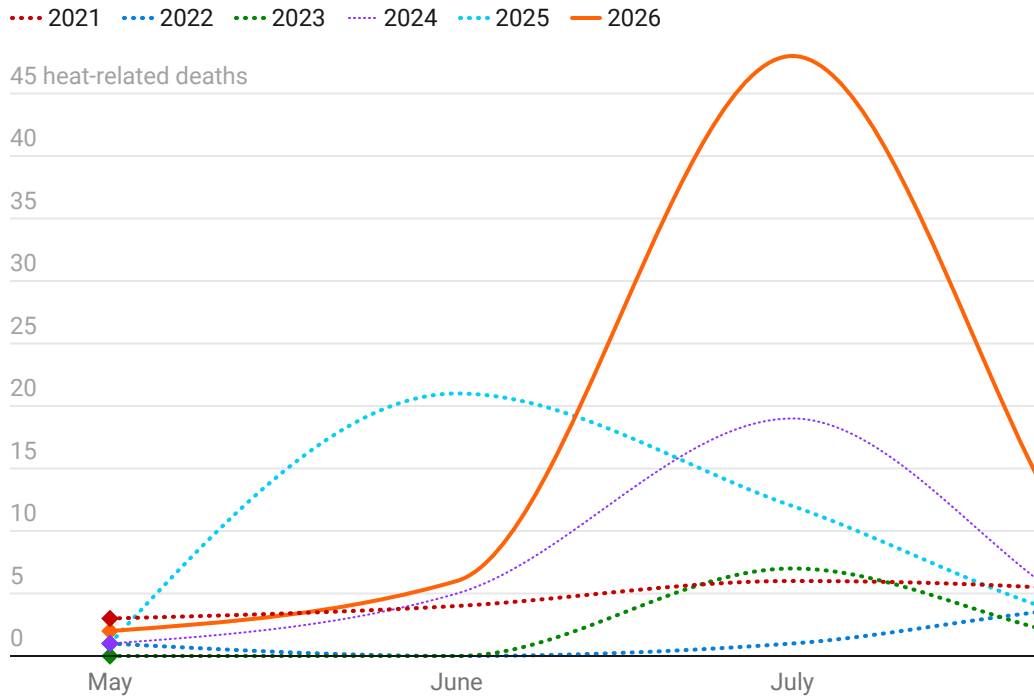
July was especially bad. A heat wave over the Fourth of July weekend brought triple-digit temperatures to Baltimore and much of Maryland. The climatologist's tracking found overnight temperatures remained above 68 degrees for more than a week straight.

Even if a day in the high 80s doesn't sound extreme, hot afternoons followed by warm nights are a dangerous combination for people who work outdoors or lack access to reliable air conditioning, Ruiz-Barradas said.

By the end of July, state officials reported 48 people had died — a total that on its own would have set a state record.

This July set a record for Maryland heat deaths

July alone saw 48 heat-related deaths, surpassing the death tolls from every other summer since the state started counting in 2012.



The Maryland Department of Health tracks heat-related deaths between May and September. Experts note that heat-related fatalities can be difficult to track, and official reported figures often do not capture all deaths.

“It’s been real hot,” said April Vincent, a 49-year-old resident of the Douglass Homes public housing complex near the Johns Hopkins Hospital. Vincent, who sat barefoot on her stoop Thursday afternoon, said she’s noticed more stifling heat in Baltimore than she remembers from her childhood.

“The heat is different for our city,” she said.

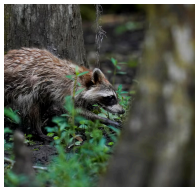
As climate change fuels longer and hotter summers in Maryland, Baltimore has borne the brunt. According to [a July report](#) by Ruiz-Barradas, Baltimore temperatures have increased at a rate of more than 3 degrees per century in the last 130 years — a faster clip than any other part of the state.

Baltimore officials operate cooling centers throughout the summer. City Health Commissioner Michelle Taylor said they drew around 4,900 visitors. The city also distributed thousands of water bottles.

Still, Baltimore saw 11 heat deaths, more than any other jurisdiction in the state — but a total Taylor said is average for the city's summers. Taylor and other health officials cautioned that older people, pregnant people, infants and people with underlying conditions are especially vulnerable.

Statewide, the majority of people who died were 65 or older, a population that tends to be more susceptible to the health hazards of heat and more likely to live alone or without reliable air conditioning.

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Sep 14, 2026

Of Maryland's total deaths this summer, 28 happened indoors and 37 were of people 65 or older.

For years, landlords across most of Maryland [weren't required to provide air conditioning to tenants](#), even as the state mandated they provide heat in the winter.

That changed June 1, when [a law](#) took effect imposing mandatory air conditioning in all new buildings with 10 or more units. The law also says existing buildings must

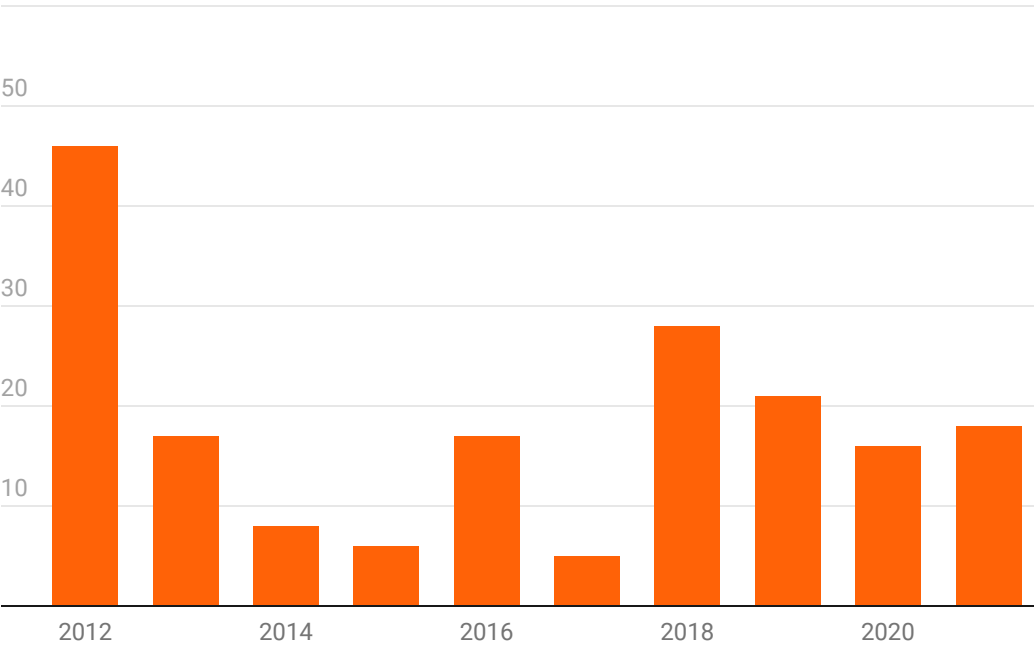
outfit their units with air conditioning the next time they undergo significant maintenance to their electrical or heating systems.

Democratic Del. Mary Lehman sponsored that legislation in Annapolis and modeled it on ordinances in Prince George's and Montgomery counties that have mandated air conditioning for years. Lehman, who represents Prince George's County, said she was stunned by this summer's death toll and worries how long it could take to ensure older buildings are equipped with sufficient air conditioning.

Maryland heat deaths spiked to a record high this summer

This year's toll surpassed a previous high set during mass power outages from a June storm in 2012.

60 heat-related deaths



The Maryland Department of Health tracks heat-related deaths between the beginning of May and the end of September for each year since 2012. Data for September 2026 is incomplete.

Among the landlords that could have to supply air conditioning under that new law is the Housing Authority of Baltimore City.

Vincent, the Douglass Homes resident, bought her own window unit for her living room but said she can't afford to get another for her bedroom.

Leo Brown, 57, joined a group at a picnic table in the shade nearby Thursday afternoon. He's lived in the public housing complex Latrobe Homes for six years.

"A lot of people are out here just to be cool," Brown said.

In many cases, it's not just about how hot it is during the day but whether things cool off enough at night, said Clifford Mitchell, director of the Maryland Department of Health's Environmental Health Bureau. If people don't have a chance to recover from scorching afternoons, the tax on their bodies can be fatal.

Even during extreme heat waves, Mitchell said, simple steps such as checking in with neighbors and older relatives should save lives.

"We know what to do to prevent every single one of these deaths," he said.

Why this summer's heat was so deadly isn't clear, but power outages could have something to do with it.

Tens of thousands of people were left without power at least temporarily when a torrential storm tore through Baltimore Gas and Electric's territory during the July 4

heat wave. [According to reporting by the Baltimore Brew](#), residents of Baltimore's Upper Fells Point neighborhood experienced periodic outages for much of the first half of July.

Still, many heat-induced deaths go unreported, and Zaitchik said some of this year's increase may be driven by better identification as awareness about the dangers of heat grows.

Zaitchik and his research team monitor micro climates at more than 50 weather stations across the city and have found that, during heat waves, some East Baltimore neighborhoods can hit highs close to 10 degrees greater than leafy neighborhoods such as Roland Park.

These heat hazards have worsened faster than Maryland communities have been able to adapt, Zaitchik said. Still, the Hopkins professor said heat deaths can be stopped relatively easily, by getting struggling people into air conditioning and supplying them with water.

"This is solvable," he said. "We know what to do. Now we just need to do it."

Adam Willis

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Unhealthy Consequences: Energy Costs and Child Health

A Child Health Impact Assessment of
Energy Costs and the
Low Income Home Energy Assistance Program

Prepared by the Child Health Impact Working Group
Boston, Massachusetts
April 2007

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Table of Contents

EXECUTIVE SUMMARY

INTRODUCTION 1

THE IMPACT OF HIGH HOME ENERGY COSTS ON CHILD HEALTH 2

HIGH ENERGY COSTS FORCE BUDGET TRADE-OFFS THAT PUT CHILD HEALTH AT RISK 2

FOOD INSECURITY ADVERSELY AFFECTS CHILD HEALTH 3

HIGH ENERGY COSTS FORCE THE USE OF RISKY ALTERNATIVE SOURCES OF HEAT 4

THE COMBINATION OF HIGH ENERGY COSTS AND UNAFFORDABLE HOUSING FORCES FAMILIES TO
ENDURE UNHEALTHY HOUSING CONDITIONS 6

HIGH ENERGY COSTS RESULT IN UNPAID ENERGY BILLS, ARREARAGES AND UTILITY DISCONNECTIONS
THAT CAN LEAD TO EVICTION AND HOMELESSNESS 7

HEALTH IMPACTS OF HIGH ENERGY COSTS HAVE SIGNIFICANT ECONOMIC IMPLICATIONS 9

THE LOW INCOME HOME ENERGY ASSISTANCE PROGRAM (LIHEAP) AND AFFORDABLE ENERGY IN MASSACHUSETTS 10

AN OVERVIEW OF THE LOW INCOME HOME ENERGY ASSISTANCE PROGRAM (LIHEAP) 10

LIHEAP IN MASSACHUSETTS 12

OTHER ENERGY ASSISTANCE PROGRAMS IN MASSACHUSETTS 15

THE IMPACT OF HIGH ENERGY COSTS ON LOW-INCOME FAMILIES IN MASSACHUSETTS 18

LOW-INCOME FAMILIES FACE SUBSTANTIAL ENERGY BURDENS 18

LOW-INCOME FAMILIES CAUGHT IN THE GAP BETWEEN RISING ENERGY PRICES AND LAGGING LIHEAP
BENEFITS 19

THE IMPACT OF RISING ENERGY PRICES & INCREASING ENERGY BURDEN ON MASSACHUSETTS FAMILIES 22

DECREASING ENERGY AFFORDABILITY MEANS MORE UTILITY ARREARAGES AND DISCONNECTIONS 24

SUMMARY & RECOMMENDATIONS 27

APPENDICES 30

I. CHILD HEALTH IMPACT ASSESSMENT: RATIONALE AND METHODOLOGY 30

II. HOME ENERGY INSECURITY SCALE 32

III. NATIONAL ENERGY ASSISTANCE DIRECTORS ASSOCIATION (NEADA) TEMPLATE FOR ARREARAGE
& DISCONNECTION DATA COLLECTION 34

IV. THEMES FROM ENERGY ASSISTANCE STAKEHOLDER INTERVIEWS 35

V. LOCAL AGENCIES THAT ADMINISTER LIHEAP IN MASSACHUSETTS 38

Executive Summary

Substantial and compelling medical and public health evidence indicates that non-medical factors, such as home energy costs, profoundly influence child health and well-being. Child Health Impact Assessment offers an evidence- and experience-based method through which to evaluate the implications of policy, regulations, and legislation for children's health and well-being.ⁱ Our Child Health Impact Assessment of home energy costs reveals that unaffordable home energy has important and preventable adverse consequences for children's health.

High Home Energy Costs and Child Health

The available evidence reveals that unaffordable home energy has preventable, potential consequences on the health and well-being of the more than 400,000 Massachusetts children living in low-income households.¹ Low-income families are caught in the gap between rising energy prices and available energy assistance. Energy assistance falls far short of the need, especially when there is a spike in energy prices, such as following Hurricane Katrina in 2005. In addition to the exceedingly high housing costs in Massachusetts, our climate means low-income families spend more of their income on home energy (energy burden) to keep warm than families in other regions of the U.S.

- **Low-income families facing disproportionately high energy costs are forced to make household budget trade-offs that jeopardize child health.** Families with a high energy burden often spend less money on food and health care. Seasonal food insecurity resulting from high energy costs has a substantial impact on child health. In addition, families may miss rent or mortgage payments to pay energy bills, resulting in housing instability.
- **Families facing high heating costs resort to alternative heat sources that jeopardize child health and safety.** In an effort to reduce home heating costs, families use alternative heat sources, such as kerosene space heaters or fireplaces. Up to 25% of families that lose their primary source of heating use space heaters or ovens and stoves, risking contact burns, carbon monoxide exposure, and especially deadly house fires.
- **High energy costs combined with unaffordable housing create important budget constraints that force low-income families to endure unhealthy housing conditions that threaten child health.** The constraints that high energy costs place on low-income families reduce their ability to afford appropriate housing, increasing the likelihood that they and their children experience unhealthy housing conditions, such as rodent infestation, water leaks, mold, and lead paint.
- **The growing gap between rising energy prices and LIHEAP benefits means more Massachusetts families accumulate substantial unpaid utility bills, leading to arrearages and disconnections that adversely affect child and family well-being.** As the gap between energy prices and LIHEAP benefits increases, Massachusetts families struggle to pay their utility bills. While utility shut-off protections in the Commonwealth are strong, the limited data available suggest

ⁱ See Appendix I for a more detailed description of the Child Health Impact Assessment concept and methodology.

that arrearages are growing dramatically for low-income families. Families eligible for shut-off protection face substantial debt and disconnections when their protections expire.

- **The negative child health impacts of unaffordable home energy extend well beyond the winter heating season.** Due to overwhelming utility arrearages, families' difficulty in paying their home energy bills becomes a year-round problem. Although families may avoid utility disconnection during the winter, they face it in the spring when the moratorium on shut-offs is lifted. Similarly, families make budget trade-offs even in warmer months, spending less on food, medical care, and housing, so they can pay down arrearages accumulated during the winter.

Recommendations

This report documents the compelling evidence that unaffordable energy costs adversely affect the health of low-income children. The next step is for policy makers, agency officials, local service providers, and other key stakeholders to take action to protect children from these preventable unhealthy consequences. The following recommendations offer strategies to avoid the public health impact of unaffordable energy through expanding outreach and access to energy assistance programs and increasing relevant information available to policy makers and energy program directors.

Funding Recommendations

1. **Given the continued gap between energy costs and LIHEAP funding, the federal government should fully fund LIHEAP at the maximum authorized level of \$5 billion to allow an increase in both participation and benefit level.** Because energy benefits play an important role in buffering low-income children from the adverse health effects of high energy costs, we should encourage increased participation in LIHEAP, which will certainly require additional funding. Recognizing that LIHEAP is not an entitlement program, if increased participation is not matched by a corresponding increase in funding, benefit levels would be reduced to an inadequate level.
2. **To increase LIHEAP benefit levels for vulnerable Massachusetts families, the Massachusetts state government should allocate supplementary funds for LIHEAP.** In 2005 and 2006, the Massachusetts legislature wisely decided to supplement federal funding with a state appropriation, allowing benefits to be increased to a more meaningful level. For the benefit of the Commonwealth's children, they should continue to do so.

Programmatic Changes

3. **To highlight the connection between high energy costs and child health, LIHEAP should extend outreach to clinicians and health care settings.** Currently, there is inadequate data to explain why more eligible families do not apply for important LIHEAP benefits. However, it is our clinical experience that many low-income families who face substantial energy burdens are not aware that they are eligible for LIHEAP or other energy assistance. Health care settings would be important sites to identify potentially eligible low-income families with children. As part of a complete social history designed to uncover potential risks to child health, health care providers should screen for home energy insecurity and make appropriate referrals to energy assistance programs. In addition, the programs that administer LIHEAP should enroll families at clinical sites, such as neighborhood health centers, that serve the vulnerable populations specifically targeted by LIHEAP.

4. **LIHEAP administrators should consider an initiative to provide energy and utility assistance, through LIHEAP or other energy assistance programs, to low-income families who are eligible for housing subsidies but spend years on waiting lists before they receive them.** These families are clearly economically vulnerable since they have already met eligibility standards for housing subsidies. Subsidizing their energy costs while they await housing assistance would help buffer their children from the double jeopardy of both unaffordable housing and energy costs that threatens their health and well-being.

Data Collection

5. **The state should enforce the existing requirement that utility commissions collect and report data on arrearages and utility disconnections to the Department of Telecommunications and Energy to address the important gaps in these data that undermine the state's ability to request the release of emergency LIHEAP funds.** The National Energy Assistance Directors Association (NEADA) together with the National Consumer Law Center (NCLC) have highlighted the importance of collecting these data to document the trends in arrearages and disconnections, useful in establishing an emergency situation as defined in the LIHEAP statute.⁹ NEADA and NCLC have outlined a template of three tiers of data that could be obtained - some should be immediately available from utilities, whereas others may take additional resources.ⁱⁱ Local service providers could use this information to assess the full impact of this problem on low-income families and their children.
6. **Energy assistance programs should explore the utility of a home energy insecurity scale, such as the one proposed by the Division of Energy Assistance, the office within the U.S. Department of Health and Human Services that administers LIHEAP.¹⁰** Such a scale would allow energy assistance programs to assess initial and subsequent energy self-sufficiency of households before and after receipt of energy benefits, providing a useful evaluation of the impact of these benefits.

ⁱⁱ See Appendix III.

Table 1. Pathways of the Impacts of Unaffordable Energy on Low-Income Households

Mechanism	Short-Term Impacts	Medium & Long-Term Impacts
High energy costs force budget trade-offs that jeopardize child health. Families spend less on food, medications, and housing in order to pay high energy costs.^{2,3,4}	- <i>"Heat or eat"</i> - food insecurity & other nutritional risk due to trade-offs between energy and food expenditures - Seasonal food insecurity	- Poor growth - Malnutrition - infection cycle leading to increased illness - Cognitive, developmental deficits of malnutrition affecting school performance
High energy costs force the use of risky alternative sources of heat. Families use ovens, stoves, space heaters, or fireplaces to replace or augment primary heating systems.^{5,6,7}	- Increased risk of contact burns - Increased risk of carbon monoxide poisonings - Increased risk of house fires	- Possible long-term health consequences of burns, carbon monoxide exposure - Economic impact of preventable hospitalizations
High energy costs combined with unaffordable housing force families to endure unhealthy housing conditions. High energy costs contribute to budget constraints limiting families' ability to afford appropriate housing, resulting in exposure to unhealthy housing conditions: - Rodent & cockroach infestation - Water leaks and mold - Peeling paint and lead paint⁸	- Increased incidence & severity of asthma - Increased incidence of lead poisoning - Preventable injuries from fires, burns, falls - Increased rates of infectious diseases, such as diarrhea and respiratory conditions	- Increased health care utilization, including emergency department visits and hospitalizations - Missed school due to illness - Cognitive and developmental deficits due to lead poisoning
High energy costs result in unpaid bills, arrearages and utility disconnection. Families make partial rent or mortgage payments or miss entire payments because of unaffordable energy bills.	- Potential cold exposure - Increased use of alternative heating sources (see above) - Possible loss of utilities required for basic health and safety: light, refrigeration, cooking, water heating - Increased risk of housing instability due to utility disconnection	- Adverse physical health impacts, including lack of primary care, untreated or undertreated medical conditions, growth delay - Adverse mental health impacts, including anxiety, depression, behavioral disorders - Adverse behavioral, developmental and educational impacts, including developmental delay, grade repetition

Introduction

Substantial and compelling medical and public health evidence indicates that non-medical factors, such as energy costs, profoundly influence child health and well-being. Concerned about the health effects of these non-medical factors, a multidisciplinary working group of pediatricians, public health researchers, health economists, and attorneys from several universities, medical schools and hospitals in the Boston area developed a **Child Health Impact Assessment (CHIA)**. The emerging process of Child Health Impact Assessment offers an evidence- and experience-based method through which to evaluate the implications of policy, regulations, and legislation for children's health and well-being.ⁱⁱⁱ

The evaluations undertaken through CHIA are particularly focused on policy arenas outside the traditional realms concerned with health -- medicine, public health and health policy. Child health impacts are usually not considered in domains such as housing, energy or transportation, making the effects on children of policy choices in these domains invisible to policy makers. However, policies in these and other areas such as education, employment and income supports all affect child health and well-being.

During the aftermath of Hurricane Katrina in 2005 and the ensuing dramatic increases in fuel prices, this multidisciplinary group became concerned about the potential impact of these increased fuel costs on low-income children. This report is the result of their decision to focus on the influence of high energy costs on child health in order to provide specific information to policy makers. This paper presents the findings of a child health impact assessment of energy costs and the Low Income Home Energy Assistance Program (LIHEAP), the federally funded program designed to help low-income families pay their energy bills. This analysis remains relevant since energy prices have remained high, even one year after Katrina. The report is comprised of 4 sections:

Section 1 summarizes the evidence on the numerous mechanisms through which high home energy costs impact child health.

Section 2 outlines the components of the current LIHEAP program in the context of the broader issue of affordable home energy in Massachusetts.

Section 3 presents an analysis of the likely child health impact of unaffordable energy prices in Massachusetts, based on available data.

Section 4 provides a summary of health impact findings and recommendations that can be used to inform public discussion of LIHEAP and other energy assistance policies.

ⁱⁱⁱ See Appendix I for a more detailed description of the Child Health Impact Assessment concept and methodology.

1

The Impact of High Home Energy Costs on Child Health

The high costs of home energy place a substantial burden on many families, especially low-income families and the 400,000 children in Massachusetts who live in these families.¹ There is evidence supporting several important pathways through which this energy burden can have an impact on child health:

- Low-income families facing disproportionately high energy costs are forced to make **household budget trade-offs that jeopardize child health**. Families with a high energy burden spend less money on food and health care, and may miss rent or mortgage payments, resulting in housing instability.
- Families that face high heating costs resort to **alternative heat sources**, such as space heaters, ovens and stoves that jeopardize child health and safety.
- High energy costs, combined with unaffordable housing, means low-income families are forced to endure **substandard housing conditions**, including homelessness, that threaten child health.
- High energy prices means more Massachusetts families accumulate substantial unpaid utility bills, leading to **disconnections and heat shut-offs** that adversely affect child and family well-being.

It is beyond the scope of this report to describe the research literature in detail. Rather, we will summarize the overarching themes of evidence that form the basis for the premise that affordable home energy has a substantial impact on child health.

We will address the impact of the costs of both **home heating** and **total home energy** (including electricity, water heating, and cooking) for low-income families. While many studies focus primarily on home heating, it is can be difficult to uncouple the effects of high home heating costs from those of total home energy costs. For this reason, when we examine home heating, we will do so within the larger context of total home energy.

High energy costs force budget trade-offs that put child health at risk

High energy costs place increased economic demands on low-income households with limited budgets. These demands result in trade-offs between fixed costs, such as housing and heating, and other basic needs. Nationally, low-income families spend approximately 14% of their budget on home energy compared to 3% for more well off families.^{3 11}

According to a survey performed by the National Energy Assistance Directors Association (NEADA) in 2005, a significant proportion of LIHEAP participants in the Northeast reported making precisely these kinds of budget trade-offs due to high energy costs:

- 73% reported that they reduced expenditures on household necessities because they did not have enough money to pay their energy bills;
- 20% went without food;
- 28% went without medical or dental care; and
- 23% did not make a full rent or mortgage payment at least once.⁵

These data illustrate that current LIHEAP benefits, targeted to especially vulnerable populations, are clearly helpful but not sufficient in buffering families from the impact of high heating costs. These data also suggest that their situation would be even more precarious without this important assistance.

Food insecurity adversely affects child health

Budget trade-offs between energy costs and food expenditures result in **food insecurity**, the uncertain or limited availability of adequate supplies of nutritious food. There is substantial evidence indicating that food insecurity poses a substantial threat to child health and well-being. Food insecurity is especially harmful for young children because they are in a period of rapid growth and brain development and are sensitive to even brief periods of nutritional deprivation.¹² Among food insecure families with children, half reported that they were sometimes not able to feed their children balanced meals and 25% reported that their children did not have enough to eat because the family could not afford adequate food.¹³ A quarter of Eastern Massachusetts families using food banks reported that their children had skipped meals because there was not enough money for food.¹⁴

A nutritionally inadequate diet makes children susceptible to an “**infection-malnutrition cycle**” by impairing children’s immune function, making them more prone to infection and illness.¹⁵ An inadequate food supply prevents children from fully recovering from weight loss or interrupted growth during illness episodes, leading to poor nutritional status that puts them at risk for a subsequent illness, creating a cycle of poor growth and increased risk of illness. In addition to poor growth,^{16,17,18,12} food insecure children:

- Are 2-3 times more likely to be in fair or poor health or chronically ill;^{15,19,20}
- Are 30% more likely to be hospitalized by age 3 years;¹⁵
- Score lower on measures of physical and psychosocial functioning;²¹ and
- Have deficits in cognitive and behavioral development that affect school performance.^{22,23,24,25,26,27,19,28}

A five city (Baltimore, Boston, Little Rock, Minneapolis, and Washington, DC) study of predominantly low-income young children under 3 years of age seen in primary care clinics and emergency departments found significant associations between not receiving LIHEAP and important health and growth indicators:

- Young children not receiving LIHEAP were 30% more likely to be admitted to the hospital.

- Young children not receiving LIHEAP were 20% more likely to be at nutritional risk for growth problems.²

High heating costs result in seasonal food insecurity

There is compelling evidence that when faced with higher energy costs in the winter, low-income families are forced to choose between paying energy bills and purchasing food. In 2003, the U.S. Department of Agriculture's (USDA) Economic Research Service investigated this issue using recent data from USDA, the Bureau of Labor Statistics and weather data from the National Oceanic and Atmospheric Administration. These researchers merged data on heating degree-days, reflecting the energy necessary to heat a home based on the outside temperature, with data on household food insecurity, income, employment and other characteristics. They found that "households with incomes below the poverty line were substantially more vulnerable to hunger during the winter and early spring than during the summer."²⁹ Other reports support the conclusion that children in low-income families are nutritionally at-risk during the winter and early spring, because they take in fewer calories and other micronutrients.^{4,3,2}

"Heat or Eat": The stark choices of low-income families affect child growth

Several recent studies document specific seasonal variation in nutritional status of children resulting from budget trade-offs:

- A study of Boston children between 6 months and 2 years of age presenting to Boston Medical Center found that the proportion of children who were underweight increased significantly during winter months. Families without heat, or threatened with utility disconnections, were also twice as likely to have children experiencing hunger or be at-risk for hunger.³⁰
- Dropping temperatures and increased winter heating costs resulted in decreased food expenditures and decreased calories consumed by low-income children, compared to increased food expenditures among richer families. These children also had diets of lower quality, with increased rates of anemia and other vitamin deficiencies. The authors state "poor parents are only imperfectly able to protect their children from cold-weather resource shocks."³

High energy costs force the use of risky alternative sources of heat

Faced with high energy costs, low-income families resort to using risky alternative sources of supplemental heat to warm their homes, such as portable space heaters (often in bedrooms), kitchen stoves, or fireplaces. This is especially true when these families lose their home heating service because of an inability to pay their energy bills. The Centers for Disease Control states: "High oil and gas prices and power outages during the winter months can contribute to consumer use of improperly vented heating sources."³¹ Nationally, in 2001, home heating equipment fires injured 1,120 people and caused 220 fatalities.³² Prior data indicates that 20% of deaths are of children less than 10 years of age.³³ Those who are poor, living in substandard homes and children younger than 4 years of age are at higher risk.^{34,35}

A survey of low-income service providers, including state LIHEAP directors, weatherization assistance program directors, community action administrators, and public utility commissions reported that low-income families respond to unaffordable energy bills by relying on alternative heating sources.³⁶ The use of these alternative sources of heat is risky because they are associated with house fires, burns and carbon monoxide poisoning. The 2005 survey by the National Energy Assistance Directors Association found that 22% of LIHEAP households in the Northeast used the kitchen stove or oven to heat their homes due to not having enough money for their energy bill in the past year.⁵ This is consistent with national data indicating that 14.5% of low-income households used stoves or ovens for heat, compared with 6% of higher income households.³⁷

- The U.S. Fire Administration reports that 40% of residential fire injuries and 50% of residential fatalities occur during the winter months, even though these months only comprise one-third of the year. Nationally, these fires cause \$3 billion in property loss, 1,900 deaths and almost 8,000 injuries.³⁸
- Portable heater fires are the most deadly type of heating fires. While they cause less than 10% of residential heating fires, portable heaters are responsible for 30% of heating fire injuries and 40% of heating fires fatalities.³⁹

In addition to the obvious serious health consequences of home fires, the use of these alternative heating sources is also associated with increased risks of burns and carbon monoxide poisoning. Unintentional, non-fire or automobile related carbon monoxide poisoning, which can cause seizures, coma and death, sends 15,000 people to emergency departments and results in 500 deaths annually. Not surprisingly, the incidence of both fatal and non-fatal carbon monoxide poisoning increases during the fall and winter months.³¹

- A recent California study found that the number, extent and severity of heater-related burn injuries increased significantly during a power shortage that resulted in 10-17% utility price increases and rolling black outs. There was no change in mean temperature during this time to explain the increased number of burn injuries.⁴⁰ The authors conclude: "The economic stresses of the power shortage had societal costs that extended far beyond the price of electricity."⁴⁰
- There are well described cases of surges in carbon monoxide poisoning after a major storm resulted in power outages forcing people to use alternative sources of heat.⁴¹ However, low-income families faced with utility disconnections turn to these risky sources of heat even when there is not a major storm.

Winter Fire Danger

Unaffordable utilities are a major risk factor for fires. Every year, there are tragic cases of deadly fires and carbon monoxide poisonings, often killing children, related to use of alternative sources of heat and loss of utility service:

- In 2000, two young boys were killed in a house fire in Mattapan started by a space heater.⁴²
- In 2005, a first grader whose family's electricity was disconnected due to outstanding bills was killed in a fire started by candles.⁴³

Low-income families facing high energy costs, utility arrearages and the loss of heating service are at particular risk when they resort to alternative heating sources because they:

- May not be able to afford smoke detectors;
- Live in less fire resistant housing and do not have the resources to invest in fire safety; and
- Are less likely to have telephone service to report a fire.⁴⁴

The combination of high energy costs and unaffordable housing forces families to endure unhealthy housing conditions

The constraints that high energy costs place on low-income families reduce their ability to afford appropriate housing, increasing the likelihood that they and their children experience unhealthy housing conditions, such as rodent infestation, water leaks, mold, and lead paint.⁴⁵ In a recent study, children in families reporting two or more housing hazards were 2.5 times more likely to be in fair or poor health compared to children in families reporting fewer hazards. Almost half of parents in the study reported that their children had suffered health consequences due to these housing conditions.⁴⁵

It is well documented that unhealthy housing conditions are associated with many common chronic diseases of childhood. The most common of these are **asthma, lead poisoning, unintentional injuries and infectious diseases**.

- There is substantial evidence linking childhood **asthma** to conditions such as infestations of cockroaches, rats and mice, poor ventilation, and excess moisture and mold.^{46,47,48,49,50} Children exposed to these conditions experience more symptoms, miss more school, and have more frequent emergency room visits and hospital admissions due to asthma.^{51,52} If these conditions were eliminated, an estimated 800,000 cases of childhood asthma and an estimated \$800 million could be saved in asthma health care costs of children under 16 years of age.^{49,48}

- **Lead poisoning** has been associated with cognitive deficits, aggressive behavior, hearing dysfunction, tooth decay, delinquency, attentional problems, and low birth weight.⁵³ On average, studies show persistent effects of lead exposure, with an estimated 2.5 point drop in IQ for an increase from 10 µg/dl in blood lead to 20 µg/dl in blood lead.⁵⁴ This resulted in a loss of an estimated 2.5 million IQ points in children between the ages of 1 and 5 in the United States.⁵⁵
- The leading cause of morbidity and mortality for U.S. children less than 20 years of age is **unintentional injuries**.^{56,57} Injuries accounted for 37% of all childhood mortality in 2002 and 4,995 deaths in U.S. children ages 1 to 15 years.⁵⁸ The majority of injuries among U.S. children occur in and around the home.^{59,60} Leading residential mechanisms of injury in children are falls, injury from fires related to improper wiring or lack of smoke detectors, burns from uncovered radiators, and inappropriately high hot water heater temperatures.⁶¹
- Homeless and poorly housed children experience significantly higher rates of **infections**, such as upper respiratory infections, diarrhea, ear infections, and skin infestations, such as lice and scabies.^{62,63,64,55,51,65}

High energy costs result in unpaid energy bills, arrearages and utility disconnections that can lead to eviction and homelessness

It is well documented that high energy costs can result in unpaid bills, leading to substantial arrearages and subsequent utility disconnections. These high energy costs can lead to eviction and homelessness in two major ways. First, families may not be able to pay both their energy bills and their entire rent or mortgage. The 2005 survey by NEADA reported that 25% of the LIHEAP-recipient households surveyed had made a partial rent or mortgage payment or missed an entire payment altogether because of unaffordable energy bills.⁵ This situation is even more dire among respondents in the Northeast:

- 42% reported not paying or paying less than their entire home energy bill because of not having enough money; and
- One in four reported receiving a notice of disconnection of electricity or heating fuel in the past year.⁵

Second, families who have unpaid energy bills develop substantial arrearages that can result in utility service disconnection. Once this occurs, a family whose utility service is disconnected may be evicted for failure to maintain the habitability of their home.^{66,67} Although many states, including Massachusetts, prohibit winter utility disconnection for households experiencing financial hardship, these shut-off protections usually end in the spring, resulting in disconnections in late spring.⁶⁸ During the shut-off moratorium period, families continue to accrue debt for their utility bills.

In addition to imposing general hardship, disconnected utilities make it difficult to manage chronic conditions such as asthma or diabetes, which require electricity to operate medical equipment or to refrigerate medications, such as insulin.

Children experiencing homelessness and housing instability related to unaffordable energy bills suffer specific consequences in their physical health, mental health and development

Housing instability refers to *involuntary* moves that result from inability to pay rent or other circumstances. Homelessness is the extreme end of housing instability, since those in unstable housing situations are never far away from being homeless. The evidence indicates that the children with unstable housing experience substantial adverse outcomes in many domains of health - physical health, mental health and behavioral development, and education.

- Housing instability and homelessness pose well-documented **threats to child physical health**. These children are more likely to: be rated as having poor health;^{55,51,63} lack regular primary care, such as immunizations and tuberculosis screening;^{51,69,70,63} have untreated or undertreated conditions like asthma;^{71,51} be seen in the emergency room and be hospitalized;⁶³ and have 10 times more dental caries than housed children.^{72,63}
- There is substantial evidence that children experiencing housing instability or homelessness suffer substantial **adverse mental health consequences**. These children are more likely to experience anxiety, depression and alcohol dependency.^{73,74,72,75,76,77} For example, half of all children in shelters show signs of anxiety and depression.⁷³
- The majority of the evidence suggests that homeless children experience adverse **developmental and behavioral effects**.⁷⁸ These children are also at risk for adverse **educational consequences** of their frequent moves and household disruptions. They show increased rates of missed school,^{62,55,65,74} and poor academic performance.^{62,73,63,74,79} They are more likely to need to repeat a grade^{73,79,65,80,81,74} and demonstrate an increased need for special education.^{73,65,82}

A study from Worcester, Massachusetts compared 293 homeless children with 223 low-income, housed children who had never been homeless. The researchers found the homeless children suffered.⁵¹

- Double the risk of having two or more emergency room visits in a year;
- Twice as many hospitalizations; and
- Significantly worse overall health status.

Health impacts of high energy costs have significant economic implications

The adverse impacts of unaffordable energy described in this section can have potentially devastating and preventable health consequences for children and their families. These health consequences can also create substantial economic costs for society at large through lost productivity and increased education and health care spending. Although these costs are often difficult to measure, one example is the substantial cost of preventable hospitalizations, borne by low-income families, payers and health care providers. At a time of rapidly rising health care costs, these hospitalizations have significant economic implications. Table 1 gives one set of examples of these costs. As shown, the cost of a pediatric burn hospitalization in Massachusetts is approximately \$7,500, and a hospitalization for carbon monoxide poisoning averages almost \$11,000. These economic costs are 5 to 8 times the average cost of heating a home in the Northeast, and 7 to 10 times the maximum home heating benefit from the LIHEAP program in 2006.^{83,84}

Table 1. Average Pediatric Hospitalization Costs for Burns, Carbon Monoxide Poisoning, and Bronchitis & Asthma

	Massachusetts		Nationwide	
	Average length of stay	Average hospitalization charges	Average length of stay	Average hospitalization charges
General pediatric hospitalization	4.2 days	\$9,989	3.6 days	\$9,945
Burns	3 days *	\$7,505 *	6.6 days	\$28,235
Carbon monoxide poisoning	**	**	1.8 days	\$10,728
Bronchitis & Asthma	2.4 days	\$5,272	2.6 days	\$7,386

*Numbers do not include hospitalization for patients less than one year of age.

** No data available.

Source: Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. Available at <http://www.ahrq.gov/HCUFnet/>

Summary

The evidence summarized in this section makes a strong case that unaffordable energy has significant consequences for child health and well-being through four primary pathways: household budget trade-offs between energy bills and other necessities, such as food; the use of risky alternative sources of heat, such as stoves or space heaters; enduring unhealthy housing conditions because of budget constraints; and finally, utility arrearages and disconnections that can result in housing instability and homelessness.

With the connection between high energy costs and child health established, the next section focuses on the Low Income Home Energy Assistance Program (LIHEAP) and the status of affordable energy, particularly in Massachusetts.

2

The Low Income Home Energy Assistance Program (LIHEAP) and Affordable Energy in Massachusetts

The importance of affordable energy for child health and well-being outlined in the previous section highlights the need for a consideration of the health effects of policies made outside the medical and public health realms. Because policy makers do not always recognize the impact of such policies on children, they miss the opportunity to protect children's health and well-being. The new approach of a Child Health Impact Assessment provides a framework for such a consideration.

Current volatility in energy prices offers an opportunity to evaluate these child health impacts using this new approach. The Low Income Home Energy Assistance Program (LIHEAP) is the main federal program designed to provide home heating assistance for low-income Americans. There are additional heating assistance programs in Massachusetts, including the Salvation Army Good Neighbor Fund and Citizens Energy Oil, and other programs that address overall energy costs. This analysis focuses on LIHEAP, but the other energy assistance programs will be briefly reviewed to place LIHEAP within the overall context of such programs.

An overview of the Low Income Home Energy Assistance Program (LIHEAP)

In 1981, Congress created the Low Income Home Energy Assistance Program (LIHEAP) by consolidating a number of programs created to address increased energy prices resulting from the 1973 Organization of the Petroleum Exporting Countries (OPEC) oil embargo. Administered by the Division of Energy Assistance within the U.S. Department of Health and Human Services (HHS) Administration for Children and Families, LIHEAP is a block grant program that gives states annual funding to provide home heating, cooling, and weatherization assistance to low-income households.⁸⁵

Eligibility for LIHEAP is based on household income and size. Under federal rules, the maximum eligible income is 200% of the federal poverty level and/or not to exceed 60% of median state income. Each state sets its own income eligibility requirements within these guidelines, and most set limits as a certain percentage of federal poverty level. In states with relatively high incomes and high costs of living, the median state income is much higher than 200% federal poverty level, which does not vary by geographic location (except for Alaska and Hawaii).

LIHEAP is not an entitlement program; there is no legal mandate to provide benefits to all eligible households. Federal funding fluctuates from year to year, resulting in changes in benefit levels and numbers of households served. Nationwide, 13% of income-eligible

households received LIHEAP benefits in fiscal year 2002, the latest year for which HHS has published data.¹¹ In 2003 the average home heating benefit was \$258.⁸⁶

In 1994 LIHEAP legislation, Congress created permanent authorization for the release of up to \$600 million in contingency funds in addition to the main annual LIHEAP appropriation, "to meet the additional home energy assistance needs of one or more States arising from a natural disaster or other emergency."⁸⁷ Subsequent legislation expanded the definition of "emergency" to include a significant increase in:

- Home energy supply shortages or disruptions,
- The cost of home energy,
- Utility disconnections,
- Participation in a public benefit program such as the Food Stamp Program, or
- Unemployment or layoffs.⁸⁸

In addition, the 1994 legislation amended LIHEAP to specifically target the most vulnerable households, defined as those with at least one member who is either:

- A child under age five,
- An individual with disabilities, or
- An adult over age 65.⁸⁹

Notably, the legislation also required that states "give priority to those households with the highest home energy costs or needs in relation to household income."⁹⁰ This means that states can target families with the highest energy burden.

LIHEAP is targeted to families with highest energy burden

Energy burden is defined as the percentage of income a household spends on total energy costs. For example, if a family has an income of \$30,000, and spends \$3,000 a year on energy costs, the household's energy burden is 10%.

- Low-income families in the U.S. have an average energy burden of 13.6%
- Families that receive LIHEAP have an average energy burden of 18.9%¹¹

LIHEAP in Massachusetts

In Massachusetts, the Department of Housing and Community Development (DHCD) oversees LIHEAP, often referred to as Fuel Assistance (see Table 1). DHCD awards sub-grants to 21 local agencies that administer the program at the community level. Most of these grantees are community action agencies – non-profit organizations that provide both referrals and direct services to low-income individuals to help meet their immediate needs and increase their long-term self-sufficiency.^{iv}

Massachusetts LIHEAP provides funds for: home heating assistance, year-round energy crisis assistance, and weatherization assistance.

Table 1. An Overview of LIHEAP in Massachusetts

Program Component	Description
Heating Assistance	-Payments made directly to utility vendors, based on household benefit level and program fund availability. -Covers partial cost of oil, electricity, natural gas, propane, kerosene, wood, coal.
Weatherization Assistance (Home Emergency Assistance Retrofit Task Weatherization Assistance Project)	-Grants averaging \$1,600 are awarded to households to repair or replace broken or inefficient heating systems. -Priority funding given to households with elderly, disabled, children, or high-energy users. -Designed to serve mainly homeowners.
Crisis Assistance	Fast-track assistance for households experiencing heating emergencies (no heat, imminent loss of heat due to less than 3-day supply of fuel, final notice of utility termination, threatened eviction within 72 hours for renter whose rent includes heat).
Eligibility	-Income must not exceed 200% of federal poverty level. -Renters in non-subsidized housing whose rent includes heat are eligible to receive 30% of monthly rent. -Renters in public housing/subsidized housing who pay directly for heat AND receive heat allowance from their subsidy source are eligible for 50% of benefit level for income range.
Benefit Level Determination	-Baseline benefit determined by income and household size. -High energy benefit determined by household vulnerability to high energy costs. LIHEAP creates expenditure thresholds for each type of fuel based on annual reporting of LIHEAP household energy consumption. Households above the threshold receive an additional high energy benefit.
Application Process	-New applicants must apply in-person at their local administering agency (21 around the state, some with satellite offices). Returning applicants receive re-certification letter in the mail. -Applicants must document previous four weeks of income of all household members over the age of 18. Must also provide latest heating bill.
Program Dates	-The program year runs from October 1st to September 30th. -Applications for heating and crisis assistance are accepted from November 1st through April 30th. -Applications for weatherization assistance are accepted year round.
Sources: Department of Housing and Community Development; LIHEAP Detailed Model Plan, Public Law 97-35, As Amended; Interviews with energy directors at community action agencies, conducted from March to August 2006.	

^{iv} See Appendix V for a list of agencies that administer LIHEAP and other energy assistance programs in Massachusetts.

First-time applicants must apply in person at their local community action agency, and prior recipients are automatically mailed re-certification forms in the fall. Eligibility is based on household size and income, which cannot exceed 200% of federal poverty level. While some states issue benefit checks to participants, in Massachusetts the local community action agency administering the program makes payments directly to the recipient's utility or fuel vendor.

Setting the LIHEAP benefit level

The annual process of determining the LIHEAP benefit is characterized by substantial uncertainty, as noted by both energy advocates and utility companies.⁹¹ Each fall, DHCD sets the LIHEAP benefit levels for the coming program year based on the projected federal LIHEAP appropriation (see Table 2). In addition to regular federal funding, the program may receive federal contingency funds or supplemental state funds during the program year. Massachusetts received federal contingency funds in 1994, 1995, 1997, and 2001-2004. In addition, the state added supplementary LIHEAP funds in 2005 and 2006.

Table 2. Massachusetts Final LIHEAP Benefit Levels (by Income) for 2006

Household income (% of federal poverty level)	Household income for family of four	Baseline benefit: Non-subsidized housing tenants	Baseline benefit: Subsidized housing tenants	High energy use benefit	Maximum benefit
At or below 100%	\$18,850	\$1,049	\$625	\$75	\$1,124
At or below 125%	\$23,563	\$945	\$575	\$65	\$1,010
At or below 150%	\$28,275	\$855	\$530	\$55	\$910
At or below 175%	\$32,988	\$775	\$490	\$50	\$825
Up to 200%	\$37,700	\$775	\$490	\$50	\$825
Source: FY 2006 Low Income Home Energy Assistance Program Maximum Income and Benefit Levels, Massachusetts Department of Housing and Community Development. Available online at http://www.mass.gov/dhcd/components/cs/1PrgApps/LIHEAP/chart.pdf					

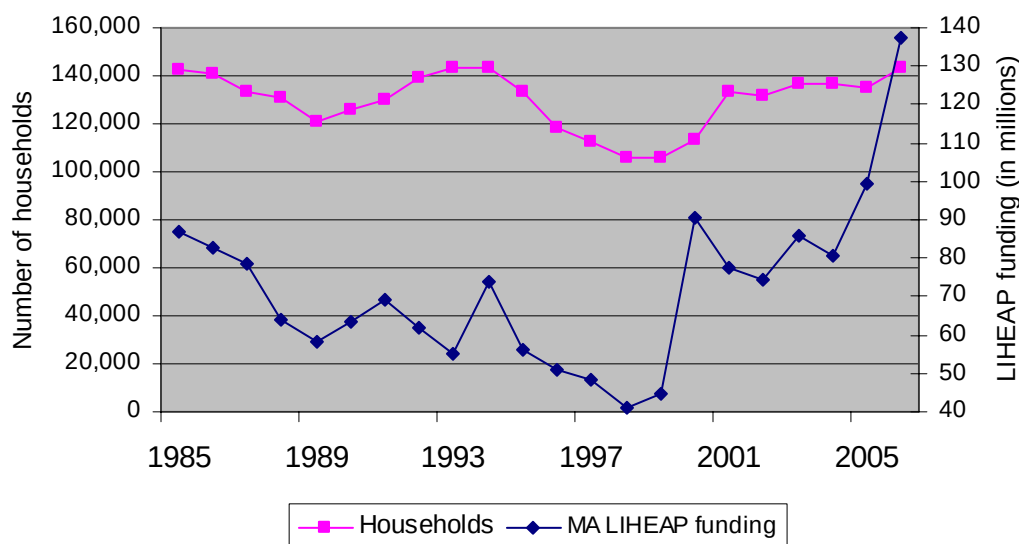
The benefit level often changes throughout the program year because when DHCD initially sets the benefit level, it must do so without knowing the actual federal funding amount, if the state will contribute funds, or if the federal government will release contingency funds. For example, DHCD initially set the maximum benefit level at \$684 for fiscal year 2006, based on the projected federal appropriation. When the Massachusetts legislature passed the 2005 Energy Bill, providing an additional \$20 million in LIHEAP funding, DHCD was able to increase the maximum benefit to \$840. Finally, when the federal government released contingency funds to Massachusetts in March of 2006, the maximum benefit increased to \$1,124.⁸⁴

LIHEAP funding and benefit level determine the maximum number of recipients

Because LIHEAP is not an entitlement program, the amount of total program funding combined with the benefit level determines how many people the program can serve. Setting a high benefit level means that the program can serve fewer households, but those who participate will receive more assistance in paying their energy bills. If the benefit level is low, the program can serve more people, but each participating household receives less substantial assistance. DHCD and its LIHEAP advisory group aim to strike a balance between these two objectives—serving a large number of households, and giving households a significant amount of assistance—when they set the LIHEAP benefit level.

Figure 1 shows the trends of LIHEAP participation and combined federal and state funding in Massachusetts. Participation roughly follows program funding, with the exception of a sharp increase in funding in 2004 that was not accompanied by an increase in participation. Clearly, factors in addition to funding levels must contribute to participation rates. However, throughout this period, only a proportion of eligible families have actually sought this benefit.¹¹

Figure 1. LIHEAP Funding and Number of Participating Households in Massachusetts, 1985-2006



Note: Funding includes federal funds, both regular and contingency, as well as state funds.

Source: Massachusetts Department of Housing and Community and Development.

Who receives LIHEAP benefits in Massachusetts?

In the 2006 program year, 143,309 Massachusetts households received heating, weatherization, or crisis assistance from LIHEAP (see Table 3). The majority are deemed vulnerable by one or more of the federal program criteria. More than one third have an elderly member, more than 20% have a disabled member, and a significant number have young children. Over two-thirds, or 106,049, are female-headed households.

In Massachusetts there are also many vulnerable families with children who do not receive LIHEAP. There are approximately 189,600 low-income households with children in Massachusetts who are likely LIHEAP eligible. Similarly, there are over 400,000 children in low-income families, 173,099 of whom live below the poverty line, and 56,715 who are five years old and younger.¹

Table 3. Characteristics of Massachusetts LIHEAP Participants, 2006

Household Characteristics	Number of Households
Total households served	143,309
Household Types	
- Headed by a female	106,049
- With at least one elderly member	49,551
- With at least one disabled member	32,749
- With at least one child 2 or under	16,627 *
- With at least one child 3 to 5	17,996 *
Household Income levels	
- 0 - 100% of federal poverty level	57,302
- 101 - 125% of federal poverty level	26,105
- 126 - 150% of federal poverty level	23,995
- 151 - 200% of federal poverty level	35,907
Household Income	
- Social Security (SS, SSI, EADC)	97,426
- Wages	48,041
- Pension	15,050
- TANF	14,390
- No income	1,057
Housing Type	
- Renters	92,661
- Homeowners	50,648
- Subsidized housing tenants	32,588
* Households that include both children under 2 and between 3 and 5 may be counted in both categories.	
Source: Year-to-date numbers from Massachusetts Department of Housing and Community Development, 9/8/06.	

Other energy assistance programs in Massachusetts

Massachusetts families seeking home heating assistance who do not meet the income criteria for LIHEAP, or who have exhausted their LIHEAP benefits, have several other energy assistance options. Some, like LIHEAP, address only home heating, while others address total energy needs.

Non-profit home heating assistance

The primary non-profit organizations that provide heating assistance in Massachusetts are the Salvation Army Good Neighbor Fund and Citizens for Energy. Table 4 provides an overview of these programs, both of which provide a one-time benefit per heating season.

Table 4. Private Heating Assistance Programs

Program Component	Salvation Army Massachusetts Good Neighbor Fund	Citizens Energy Oil
Description of Benefit (Winter 2005-2006)	- \$275 maximum benefit per winter. - Benefit level fluctuates year to year depending on program funds.	- One delivery of up to 200 gallons of home heating oil at 40% discount per winter. - Customer must pay cash on delivery. - Benefit fluctuates year to year based on negotiated discount with vendors.
Eligibility	Household income between 200-250% federal poverty level.	No strict income limits. Households must be facing financial hardship, and either not be eligible for LIHEAP or have used up all LIHEAP benefits.
Enrollment	Usually via referral from community action agency.	- LIHEAP households that have exhausted their LIHEAP benefit are automatically sent a letter authorizing delivery of discounted oil. - Non-LIHEAP households usually referred via community action agencies.
Number of households served	Disbursed \$12.6 million to 62,500 households over last 11 years, or approximately 3,125 households per year (no annual data available).	In 2006, about 8 million gallons available at discount, enough to supply 40,000 families with one 200-gallon delivery.

Sources: <http://http://www.magoodneighbor.org>, <http://www.http://www.citizensenergy.com>.

Some community action agencies also disburse small grants from the Federal Emergency Management Agency (FEMA) for home heating assistance. These grants provide one-time payments to households that are facing heat or utility shut-offs and have exhausted all other types of assistance. In addition, community action agencies may have access to other small grants or funds provided by private, municipal, or other local programs.

Utility discounts

Any Massachusetts resident who is eligible for LIHEAP is also eligible for discounted electricity, gas, and telephone rates from investor-owned utilities. (Municipal-owned utilities do not offer low-income discounts.) These discounts vary among the utility companies, but are generally between 20 and 35% of a household's bill. The discount applies to distribution or transition charges, and not to the actual cost of the fuel. Thus, these discounts are eroded by rising energy prices. Usually, those who receive LIHEAP are automatically enrolled in discount programs by the community action agency administering their LIHEAP benefits. Also, some public assistance programs such as Temporary Assistance for Needy Families and Food Stamps allow participants to enroll simultaneously for discounted utility rates.

Weatherization assistance program

There is also a state-run program, the Low Income Weatherization Assistance Program, that provides households with comprehensive energy conservation services. These may include air sealing to reduce infiltration, insulation, and limited energy-related repairs. Families also receive an evaluation of the heating system in their homes, as well as health and safety testing of all combustion appliances. All services are delivered at no cost to participants. Homeowners and renters with their landlord's permission are eligible to participate in the program. Priority is given to those households whose members are elderly, disabled, young (6 years and under), LIHEAP high-energy users, and Native Americans.

Arrearage management programs

Though not a cash benefit, another strategy to assist low-income families is arrearage management. An arrearage is an unpaid utility debt, often accumulated over a series of months or even years.^v The 2005 Massachusetts Energy Bill required all investor-owned utilities to design and implement arrearage management programs.⁹² Energy advocates and many utility companies have worked together to develop these programs, which vary considerably among utility companies. An important feature of each of these plans is arrearage forgiveness, in which a family pays a specified amount of their bill on a regular basis, and eventually part of the debt is forgiven by the utility company.

Energy directors at community action agencies assist families with arrearages in setting up arrearage management plans. Appropriate guidance about what the plans entail and the importance of making regular payments is crucial because if families default on their plan, it is very difficult to obtain one in the future.

Summary

LIHEAP and other energy assistance programs provide valuable home heating and energy assistance to low-income families in Massachusetts. Because LIHEAP funding fluctuates from year to year, so do the benefits available to families. Many Massachusetts families who receive LIHEAP have young children, elderly, or disabled members, and many are female-headed households. The next section describes the growing gap between energy prices and LIHEAP benefits, and the impact of high energy costs on vulnerable, low-income families.

^v For a detailed discussion of arrearages, see Section 3.

3

The Impact of High Energy Costs on Low-Income Families in Massachusetts

Low-income families face substantial energy burdens

In the northeastern U.S., home heating makes up about 44% of a household's total energy expenditures, which includes space and water heating, space cooling, refrigeration, and other electric appliances.¹¹

Table 1 illustrates that the heating expenditures of low-income families are proportionally much higher than those of higher income households. Of note, families in the Northeast have substantially higher energy burdens compared to the rest of the country. Low-income families in the Northeast receiving LIHEAP, who are even more vulnerable than their other low-income peers, spend an average of 11.6% of their income on heating their homes.

Table 1. Total Energy and Home Heating Burden and Expenditures by Income Level, 2003

	NORTHEAST				NATIONWIDE			
	Average total energy burden	Average total energy expenditure	Average home heating burden	Average heating expenditure	Average total energy burden	Average total energy expenditure	Average home heating burden	Average heating expenditure
LIHEAP households	22.9%	\$1,816	11.6%	\$869	18.9%	\$1,515	8.6%	\$646
Low-income households	17.2%	\$1,543	8.2%	\$685	13.6%	\$1,304	5.1%	\$463
Higher income households	8.1%	\$1,999	1.5%	\$867	3.0%	\$1,631	1.0%	\$533

Source: LIHEAP Home Energy Notebook for Fiscal Year 2003.

Making Ends Meet?

Four out of 10 Massachusetts households that receive LIHEAP live below the poverty line, meaning they live on less than \$20,000 for a family of four per year. To put these numbers in context, Table 2 shows estimated basic living expenses for a family of four in three

Massachusetts cities.^{vi} They show that a Massachusetts family of four with an income of 200% poverty level has between a \$345 and \$1,326 monthly deficit in meeting basic needs. Using similar methods, the Economic Policy Institute, estimated monthly deficits to be between \$1,400 and \$2,100 for families living in the same three Massachusetts cities in 2004.⁹³

Table 2. Basic Living Expenses vs. Income in Three Massachusetts Cities

	Boston	Worcester	Springfield
2-bedroom apartment (including utility costs)	\$1,343	\$ 785	\$ 674
Food	\$ 554	\$ 554	\$ 554
Child Care	\$ 1,226	\$ 1058	\$ 942
Transportation	\$ 114	\$ 433	\$ 444
Health Care	\$ 267	\$ 244	\$ 248
Other necessities	\$ 350	\$ 307	\$ 286
Taxes	\$ 876	\$ 692	\$ 602
Tax Credits	-\$180	-\$180	-\$180
Monthly total	\$ 4,551	\$ 3,893	\$ 3,570
Monthly income for family of four at 200% of poverty level	\$ 3,225	\$ 3,225	\$ 3,225
Deficit	-\$ 1,326	-\$ 668	-\$ 345
Sources: Pearce, D. and Brooks, J. The Self-Sufficiency Standard Report for Massachusetts. The Women's Educational and Industrial Union, 2003.			

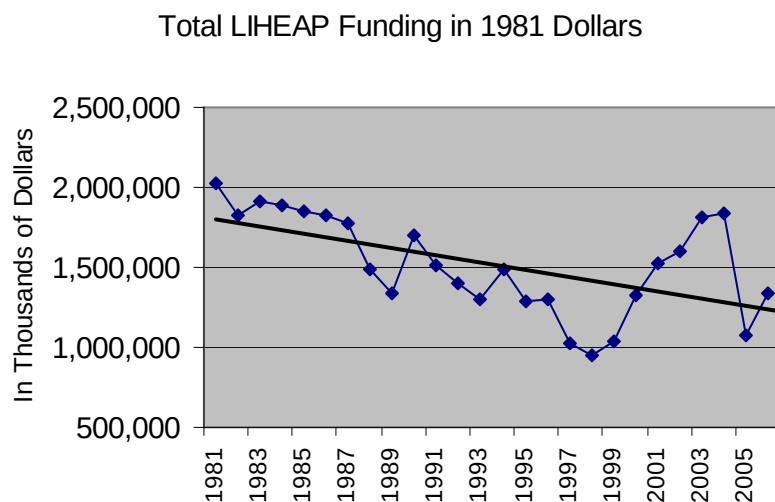
Substantial energy burdens add to the gap between income and basic needs, placing families in the precarious position of having to make budget trade-offs that affect child health.

Low-income families caught in the gap between rising energy prices and lagging LIHEAP benefits

Low-income families in Massachusetts and around the country are in critical need of assistance to pay their continually increasing energy bills. Since LIHEAP began in 1981, energy prices have risen steadily, with more substantial increases from 2002-2006.⁸³ Yet, when adjusted for inflation, LIHEAP funding has decreased 34% from 1981 to 2006 (Figure 1). While Congress authorized \$5.1 billion in federal LIHEAP spending for each fiscal year from 2005-2007, it appropriated only \$ 2.2 billion in 2005 and \$ 3.2 billion 2006.⁹⁴ In Massachusetts, the price of heating oil in June 2006 was twice what it was 3 years ago.⁹⁵ Although heating oil prices have decreased somewhat since June, the projected energy costs for low-income families are still substantial. As calculated by the Energy Information Administration within the U.S. Department of Energy, the average projected cost of heating a home with oil in the Northeast for winter 2006-2007 is \$1,559, up \$105 from the previous winter.⁸³

^{vi} These figures are based on 2003 Fair Market Rents, USDA guidelines for a low-cost food plan, the National Travel Household Survey (transportation costs), child care costs reported by the 2000 Child Care Market Rate Survey, estimated insurance costs, Medical Expenditure Panel Survey, the Consumer Expenditures Survey (for transportation, and for other necessities like clothing), and tax rates and credits for 2003.⁹³

Figure 1. Total Federal LIHEAP Funding in 1981 Dollars, 1981-2005



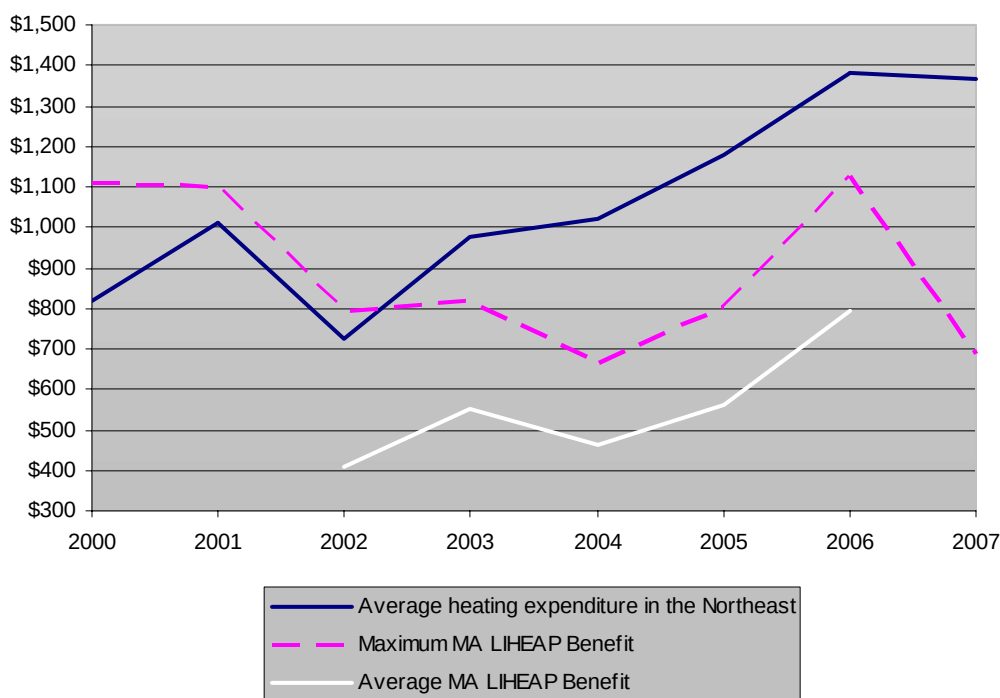
Source: Low-Income Energy Programs Funding History, 1977-2006, available at <http://www.liheap.ncat.org/Funding/lhhist.htm>

How are LIHEAP benefits holding up against rising energy prices in Massachusetts? Figure 2 shows the average annual home heating expenditure in the Northeast from 2000-2007, as well as the maximum LIHEAP benefit. The average benefit that participants received is also provided for years 2002-2006, the years for which these data are available. After 2002, the maximum LIHEAP benefit dipped below the average heating expenditure in the Northeast. Of note, the average LIHEAP benefit from 2002-2006 was:

- One-third less than the maximum benefit amount, and
- About half of the average heating expenditure in Massachusetts.

Many families who participate in the program receive less than the maximum benefit, and only receive enough money to cover half of the average home heating costs. These families exhaust their LIHEAP benefit well before the end of winter.

Figure 2. Massachusetts LIHEAP Benefit and Average Home Heating Costs in the Northeastern U.S., 2000-2007



Note: Expenditures for 2007 are estimated based on projected fuel prices and weather. Average heating expenditures are weighted by types of heating fuel used in the Northeastern U.S. per the Residential Energy Consumption Survey, 2001.

Sources: Average and maximum LIHEAP benefit: Massachusetts Department of Housing and Community Development. Average home heating expenditures: Short-Term Energy Outlook, October 10, 2006. Energy Information Administration.

The LIHEAP benefit gap widens in 2007?

The maximum benefit level for Program Year 2007 is currently set at \$684, a sharp decline from the 2006 maximum of \$1,124.

- The 2007 benefit is based on the projected federal appropriation for the program, and it assumes that no additional funds will be provided by Massachusetts or by federal contingency funds.
- Without additional funds, the gap between the average home heating expenditure and the maximum LIHEAP benefit will be \$682, the largest it has been since LIHEAP began.

The need for a home energy insecurity scale to measure the complete picture of energy burden

There is a need for a reliable, easy-to-use measure of the impact of energy costs on family well-being. One example of such a measure has been proposed by the Division of Energy Assistance, the office within the U.S. Department of Health and Human Services that administers LIHEAP. Their Home Energy Insecurity Scale would “allow the [energy assistance] program manager to capture all aspects of low-income affordability.”¹⁰ This scale would enable energy assistance programs to assess initial and subsequent energy self-sufficiency of households before and after receipt of energy benefits, providing a quantitative evaluation of the impact of these benefits. The proposed scale is comprised of 11 questions that have been adapted from the measures of food insecurity developed by the U.S. Department of Agriculture.^{vii} The questions are organized into 5 basic categories that contribute energy insecurity:

- Receipt of outside assistance, including from friends and family, to pay energy bills.
- Constraints on energy usage, such as whether families turn off hot water or heat to certain rooms because of high energy bills.
- Constraints on household necessities, including involuntary disruption of energy service or reduction in expenditures on basic needs like food or medicine.
- Nonpayment of energy bills, including whether a family has received disconnection notices or experienced discontinuation of fuel deliveries.
- Financial strain, including families’ worry and concern regarding not being able to pay their bills.¹⁰

Information obtained in these 5 categories would be combined to assess families along a continuum of home energy self-sufficiency that includes the following 5 statuses - **thriving, capable, stable, vulnerable, in-crisis**. Energy assistance programs can then monitor how families change their status, depending on whether energy benefits were received. This scale may not be the one ultimately utilized by all key stakeholders, but it illustrates the feasibility of such a measure.

The impact of rising energy prices & increasing energy burden on Massachusetts families

The growing gap between energy costs and LIHEAP benefits has a significant negative impact on Massachusetts families and their children. As outlined in Section 1 of this report, the substantial energy burden experienced by many low-income families has impacts on child health in several important ways, even after the winter heating season is over. Table 3 summarizes these effects:

^{vii} See Appendix II for a list of individual items that comprise the Home Energy Insecurity Scale.

Table 3: Pathways of the Impacts of Unaffordable Energy on Low-Income Households

Mechanism	Short-Term Impacts	Medium & Long-Term Impacts
High energy costs force budget trade-offs that jeopardize child health. Families spend less on food, medications, and housing in order to pay high energy costs.^{2,3,4}	- <i>"Heat or eat"</i> - food insecurity & other nutritional risk due to trade-offs between energy and food expenditures - Seasonal food insecurity	- Poor growth - Malnutrition - infection cycle leading to increased illness - Cognitive, developmental deficits of malnutrition affecting school performance
High energy costs force the use of risky alternative sources of heat. Families use ovens, stoves, space heaters, or fireplaces to replace or augment primary heating systems.^{5,6,7}	- Increased risk of contact burns - Increased risk of carbon monoxide poisonings - Increased risk of house fires	- Possible long-term health consequences of burns, carbon monoxide exposure - Economic impact of preventable hospitalizations
High energy costs combined with unaffordable housing force families to endure unhealthy housing conditions. High energy costs contribute to budget constraints limiting families' ability to afford appropriate housing, resulting in exposure to unhealthy housing conditions: - Rodent & cockroach infestation - Water leaks and mold - Peeling paint and lead paint⁸	- Increased incidence & severity of asthma - Increased incidence of lead poisoning - Preventable injuries from fires, burns, falls - Increased rates of infectious diseases, such as diarrhea and respiratory conditions	- Increased health care utilization, including emergency department visits and hospitalizations - Missed school due to illness - Cognitive and developmental deficits due to lead poisoning
High energy costs result in unpaid bills, arrearages and utility disconnection. Families make partial rent or mortgage payments or miss an entire payment because of unaffordable energy bills.	- Potential cold exposure - Increased use of alternative heating sources (see above) - Possible loss of utilities required for basic health and safety: light, refrigeration, cooking, water heating - Increased risk of housing instability due to utility disconnection	- Adverse physical health impacts, including lack of primary care, untreated or undertreated medical conditions, growth delay - Adverse mental health impacts, including anxiety, depression, behavioral disorders - Adverse behavioral, developmental and educational impacts, including developmental delay, grade repetition

Decreasing energy affordability means more utility arrearages and disconnections

Low-income families' struggles to pay high energy bills do not end when the warm weather returns. The arrearages low-income families face at the end of the heating season mean that the health impacts of high energy costs will continue throughout the year. With the decreasing buying power of the LIHEAP benefit, even Massachusetts families who receive LIHEAP are facing increasingly large arrearages. Many of the community action agencies that administer LIHEAP report that a growing number of clients are in arrears, and these arrearages are increasing in amount, up to \$5000 in some cases.

A Massachusetts family faces growing arrearages

A single mother of four children, Ms. T transitioned from public assistance to a job as a hair-dresser, earning \$960 a month. Frequent doctor appointments and emergency room visits for her two children with asthma prevent her from working more than 20 hours a week. Her income, along with food stamps and supplemental security income for one of her sons, is insufficient to cover her rent, child care costs, car insurance, and energy bills. She pays some part of her utility bills every month, even if she cannot pay the entire bill, but has accrued a \$6,000 arrearage for her gas service. LIHEAP benefits together with utility shut-off protection, which she must keep current by submitting appropriate documentation every 90 days, prevent her from losing her gas service. LIHEAP benefits are crucial in allowing her to make payments against her arrearages and keep the gas service on for her vulnerable family.

Shut-off protections

As described in Section 1, households that accumulate large arrearages are in danger of having their utilities disconnected. Energy advocates and fuel directors work with their clients to prevent these disconnections, which can have devastating effects on the health and safety of the household. Massachusetts has some of the most comprehensive shut-off protection statutes in the country. These include:

- Protection from disconnection any time of year for households that demonstrate “financial hardship” and have a member who is seriously ill or under 12 months old (provided that service has not been shut-off for non-payment before the birth of the child). A family seeking protection due to illness must obtain documentation from their physician.
- Protection from disconnection from November 15th to March 15th, regardless of payment status. (This shut-off “moratorium” is often extended to April 1st.) This protection also requires proof of financial hardship.
- Protection from disconnection any time of year for households in which all members are over the age of 65, regardless of financial status.^{96,97}

Of note, families that are able to secure shut-off protection continue to accrue unpaid bills during the protection period. When the protection period ends, they are left with significant debt and face almost certain utility disconnection.^{viii}

Energy directors at the community action agencies that administer LIHEAP describe a vicious cycle of arrearages. Families who experience arrearages and subsequent utility disconnections in the prior winter often use their entire LIHEAP benefit for the current winter to pay down the arrearage in order to have their service restored. This leaves them without assistance for the remainder of the heating season, setting them up to accrue more arrearages. When the shut-off moratorium ends in the spring, their utilities are disconnected again, leaving them without gas for cooking, hot water, or heat.

No shut-off protection for oil heat

The comprehensive shut off protections in Massachusetts do not apply to oil companies and therefore, they are not required to deliver fuel to a household that has unpaid arrearages.

Almost 30% of Massachusetts LIHEAP recipients heat their homes with oil.⁹⁸ These families are at risk of going without any heat if their LIHEAP benefits are depleted and they cannot afford more oil.

Lack of data on arrearages and shut-offs prevents tracking their impact

There are no reliable data on the number or size of arrearages experienced by Massachusetts households, making it difficult to assess fully the impact of this growing problem. The Massachusetts Department of Telecommunications and Energy (DTE), which regulates the investor-owned utilities, does not enforce existing requirements for companies to report these data. Some utilities report arrearage and disconnection data, but none report them consistently.

In its report “Tracking the Home Energy Needs of Low-Income Households through Trend Data on Arrearages and Disconnections,” the National Energy Assistance Directors Association together with the National Consumer Law Center recommend collecting the following data from each utility company:

- Number of residential customers, and number who are low-income;
- Number of residential customers in arrears, and total dollar amount of arrears;
- Number of low-income customers in arrears, and total dollar amount; and
- Number of residential disconnections and low-income disconnections.⁹

If these data were reported regularly to DTE, then aggregated and made publicly available, public officials would be better able to estimate how many families in Massachusetts are facing potential negative health impacts resulting from unaffordable energy. The state might use these data to lobby for the release of Federal LIHEAP contingency funds,

^{viii} This type of energy assistance is unique among benefit programs because it creates a “safety-net debt.” Families are left with a substantial unpaid bill after receiving assistance to pay for a basic need—home energy.

designed to address increases in utility shut-offs. Also, service providers, such as community action agencies and doctors, could anticipate better the needs of their clients and patients. For these reasons, it is critical that DTE enforce requirements for reporting of arrearage and shut-off data from the utilities.

Summary

Low-income families face a substantial home energy burden, which puts their children's health and well-being at risk. These families are caught in the gap between sharply rising energy prices that are outstripping LIHEAP benefits. The child health impact of this increasing energy burden occurs through four primary pathways: 1) shifts in family budget from basic needs like food and medicine toward energy costs; 2) the use of risky, alternative heat sources to offset high energy bills; 3) the combined strain of high housing and energy costs limiting choices for acceptable housing conditions, and 4) the accumulation of large unpaid energy bills that result in utility disconnections. A lack of sufficient data on utility arrearages and disconnections makes it difficult to track the risks we know families face. The next section summarizes our findings and offers recommendations for changes in energy assistance that might help protect low-income families and their children.

4 Summary & Recommendations

The available evidence reveals that unaffordable home energy has preventable, potential consequences on the health and well-being of the more than 400,000 Massachusetts children living in low-income households.¹ Low-income families are caught in the gap between rising energy prices and available energy assistance. Energy assistance falls far short of the need, especially when there is a spike in energy prices, such as following Hurricane Katrina in 2005. In addition to the exceedingly high housing costs in Massachusetts, our climate means low-income families spend more of their income on home energy (energy burden) to keep warm than families in other regions of the U.S.

- **Low-income families facing disproportionately high energy costs are forced to make household budget trade-offs that jeopardize child health.** Families with a high energy burden often spend less money on food and health care. Seasonal food insecurity resulting from high energy costs has a substantial impact on child health. In addition, families may miss rent or mortgage payments to pay energy bills, resulting in housing instability.
- **Families facing high heating costs resort to alternative heat sources that jeopardize child health and safety.** In an effort to reduce home heating costs, families use alternative heat sources, such as kerosene space heaters or fireplaces. Up to 25% of families that lose their primary source of heating use space heaters or ovens and stoves, risking contact burns, carbon monoxide exposure, and especially deadly house fires.
- **High energy costs combined with unaffordable housing create important budget constraints that force low-income families to endure unhealthy housing conditions that threaten child health.** The constraints that high energy costs place on low-income families reduce their ability to afford appropriate housing, increasing the likelihood that they and their children experience unhealthy housing conditions, such as rodent infestation, water leaks, mold, and lead paint.
- **The growing gap between rising energy prices and LIHEAP benefits means more Massachusetts families accumulate substantial unpaid utility bills, leading to arrearages and disconnections that adversely affect child and family well-being.** As the gap between energy prices and LIHEAP benefits increases, Massachusetts families struggle to pay their utility bills. While utility shut-off protections in the Commonwealth are strong, the limited data available suggest that arrearages are growing dramatically for low-income families. Families eligible for shut-off protection face substantial debt and disconnections when their protections expire.

- **The negative child health impacts of unaffordable home energy extend well beyond the winter heating season.** Due to overwhelming utility arrearages, families' difficulty in paying their home energy bills becomes a year-round problem. Although families may avoid utility disconnection during the winter, they face it in the spring when the moratorium on shut-offs is lifted. Similarly, families make budget trade-offs even in warmer months, spending less on food, medical care, and housing, so they can pay down arrearages accumulated during the winter.
-

Recommendations

This report documents the compelling evidence that unaffordable energy costs adversely affect the health of low-income children. The next step is for policy makers, agency officials, local service providers, and other key stakeholders to take action to protect children from these preventable unhealthy consequences. The following recommendations offer strategies to avoid the public health impact of unaffordable energy through expanding outreach and access to energy assistance programs and increasing relevant information available to policy makers and energy program directors.

Funding Recommendations

1. **Given the continued gap between energy costs and LIHEAP funding, the federal government should fully fund LIHEAP at the maximum authorized level of \$5 billion to allow an increase in both participation and benefit level.** Because energy benefits play an important role in buffering low-income children from the adverse health effects of high energy costs, we should encourage increased participation in LIHEAP, which will certainly require additional funding. Recognizing that LIHEAP is not an entitlement program, if increased participation is not matched by a corresponding increase in funding, benefit levels would be reduced to an inadequate level.
2. **To increase LIHEAP benefit levels for vulnerable Massachusetts families, the Massachusetts state government should allocate supplementary funds for LIHEAP.** In 2005 and 2006, the Massachusetts legislature wisely decided to supplement federal funding with a state appropriation, allowing benefits to be increased to a more meaningful level. For the benefit of the Commonwealth's children, they should continue to do so.

Programmatic Changes

3. **To highlight the connection between high energy costs and child health, LIHEAP should extend outreach to clinicians and health care settings.** Currently, there is inadequate data to explain why more eligible families do not apply for important LIHEAP benefits. However, it is our clinical experience that many low-income families who face substantial energy burdens are not aware that they are eligible for LIHEAP or other energy assistance. Health care settings would be important sites to identify potentially eligible low-income families with children. As part of a complete social history designed to uncover potential risks to child health, health care providers should screen for home energy insecurity and make appropriate referrals to energy assistance programs. In addition, the programs that administer LIHEAP should enroll families at clinical sites, such as neighborhood health centers, that serve the vulnerable populations specifically targeted by LIHEAP.

4. **LIHEAP administrators should consider an initiative to provide energy and utility assistance, through LIHEAP or other energy assistance programs, to low-income families who are eligible for housing subsidies but spend years on waiting lists before they receive them.** These families are clearly economically vulnerable since they have already met eligibility standards for housing subsidies. Subsidizing their energy costs while they await housing assistance would help buffer their children from the double jeopardy of both unaffordable housing and energy costs which threatens their health and well-being.

Data Collection

5. **The state should enforce the existing requirement that utility commissions collect and report data on arrearages and utility disconnections to the Department of Telecommunications and Energy to address the important gaps in this data that undermine the state's ability to request the release of emergency LIHEAP funds.** The National Energy Assistance Directors Association together with the National Consumer Law Center have highlighted the importance of collecting these data to document trends in arrearages and disconnections, useful in establishing an emergency situation as defined in the LIHEAP statute.⁹ NEADA and NCLC have outlined a template of three tiers of data that could be obtained - some should be immediately available from utilities, whereas others may take additional resources.^{ix} Local service providers could use this information to assess the full impact of this problem on low-income families and their children.
6. **Energy assistance programs should explore the utility of a home energy insecurity scale, such as the one proposed by the Division of Energy Assistance, the office within the U.S. Department of Health and Human Services that administers LIHEAP.¹⁰** Such a scale would allow energy assistance programs to assess initial and subsequent energy self-sufficiency of households before and after receipt of energy benefits, providing a useful evaluation of the impact of these benefits.

^{ix} See Appendix III.

Appendices

I. Child Health Impact Assessment: Rationale and Methodology

Child health is inherently dependent on the social well-being of the family. Social or non-medical factors influence both the development of childhood disease and the severity of disease once it develops. Public health and health care are crucial vehicles for promoting child health and well-being. However, many of the social determinants of child health are not under the explicit purview of pediatricians or public health officials. Rather, there are many local, state and national agencies and departments that exert regulatory and programmatic control over these social determinants, and thus have a significant impact on child health. It is unclear to what extent these non-health related agencies consider the implications of their policies and regulations for child health and well-being.

In order to make the relationship of public policy to child health, especially socially or economically vulnerable children, more comprehensible to policy makers, and the public, in the fall of 2004, the Department of Pediatrics at Boston Medical Center, Boston University School of Medicine convened an interdisciplinary, inter-institutional working group to develop a Child Health Impact Assessment strategy (CHIA). This working group, which includes representatives from Boston University School of Medicine, Boston University School of Public Health, Brandeis University, Children's Hospital, Boston, Harvard Medical School, Harvard School of Public Health and University of Massachusetts, Boston, discussed the need to provide a formal Child Health Impact Assessment on various policies being proposed in the Commonwealth of Massachusetts. A CHIA is conceptualized as analogous to an environmental impact assessment, which is a required step in any project that might have a direct or indirect impact on the environment. The goal of a CHIA is to provide a mechanism to evaluate the impacts and implications of policy, regulations and laws on children's health and well-being, with a particular focus on policy arenas outside the traditional realm of public health and health policy, including: education, housing and landlord/tenant laws, immigration and naturalization, criminal justice, and employment and income supports.

Drawing on the expertise of a wide range of stakeholders in the university as well as the public and private sectors of the Commonwealth, The CHIA Working Group is committed to carrying out health impact assessments on public policies that impact children's health and exacerbate health inequalities. The CHIA process involves a practical, inexpensive, timely review of research evidence, a policy appraisal with participation of key stakeholders, and a report to the Commonwealth on the findings of the research and analysis, with recommendations. After reviewing many health impact assessment models previously developed in Canada and Europe, the CHIA Working Group decided to modify the European policy Health Impact Assessment for its purpose.^{99,100,101} Although the health impact assessment concept has been implemented abroad, it has only been used sporadically in the United States.^{102,103}

Child Health Impact Assessment - Pilot Analysis of the Massachusetts Rental Voucher Program

The CHIA Working Group recognized the need to demonstrate the utility and feasibility of the CHIA concept and therefore initiated a pilot analysis process. The criteria for the issue to be analyzed included: potential impact on children, availability of rigorous research and clinical data, saliency for policy makers and relevance to the Commonwealth. After careful review of potential topics, the CHIA Working Group chose as its first topic, affordable housing for the pilot analysis. The Working Group determined that highlighting the connections between affordable housing and child health and well-being would illustrate the function of a child health impact assessment. The CHIA Working Group's report, *Affordable Housing and Child Health: A Child Health Impact Assessment of the Massachusetts Rental Voucher Program*, was released in June 2005.

Child Health Impact Assessment Methods

The goal of CHIA is to provide compelling, quantifiable, objective evidence to policymakers about the potential child health and well-being impacts of a policy, to influence the consideration of child health impacts in general, and to reduce negative impacts on child health in the Commonwealth. The CHIA analysis is based on previously collected data and best available scientific evidence. The type of data collected includes: academic and other research, government databases, advocacy websites, as well as interviews with key stakeholders.

During data collection, the CHIA working group collected evidence on LIHEAP, home energy costs and their effects on a child's basic needs including education, housing, food, access to health care, safety and stability, and the physical environment. A thorough literature search for appropriate evidence was conducted through Medline, PubMed, Web of Science, First Search, and Science Direct. The literature review was followed by extensive key stakeholder interviews to gather evidence from the experience, knowledge, opinions and perceptions of people with expert knowledge in the energy assistance area, including representatives of relevant national, state, and community government and non-profit agencies and advocacy groups. These interviews provided a broader picture of health determinants affected by energy assistance, including how stakeholders and experts think energy assistance impacts children's health outcomes and why. For an overview of themes from stakeholder interviews, see Appendix IV.

II. Home Energy Insecurity Scale

The following questions were developed by the Division of Energy Assistance within the Administration for Children and Families, U.S. Department of Health and Human Services, to gauge energy self-sufficiency.¹⁰ The responses to these questions are used to place families within the scale of energy self-sufficiency: **thriving, capable, stable, vulnerable, in-crisis**. The questions are meant to refer to the prior 12 months and have 3 possible responses: “often true”, “sometimes true” and “never true.”

1. I/We worried whether my/our home energy bill would become overdue before I/we could get money to pay it.
2. Our home energy bill became due, and I/we didn't have the money to pay it without somebody's help.
3. I/We couldn't afford to heat or cool our home to the temperature we wanted it to be, or to use our water or appliances to the extent we wanted to use them.
4. I/We reduced our energy consumption to uncomfortable or inconvenient levels because I was/we were running out of money to pay our home energy bill.
5. I/We could not use our entire home because we could not afford to heat or cool it.
6. In the last 12 months, did you ever leave your home for all or part of the day because there wasn't enough money for the home energy bill, or, did you ever turn off your hot water because there wasn't enough money for the home energy bill?

6a. If Yes above - How often did one or the other of these happen -- almost every month, some months, but not every month, or only in 1 or 2 months?
7. In the last 12 months, did you ever not pay your home energy supplier because there wasn't enough money for the home energy bill?

7a. If Yes above, How often did this happen -- almost every month, some months, but not every month, or only in 1 or 2 months?
8. In the last 12 months, did you ever use your kitchen stove or oven to provide heat because there wasn't enough money to pay your home heating bills?

8a. If Yes above, How often did this happen -- almost every month, some months, but not every month, or only in 1 or 2 months?
9. In the last 12 months, did you ever reduce your expenses for what you consider to be basic household necessities because there was not enough money to pay for these and to pay your home energy bill?

9a. If Yes above, How often did this happen -- almost every month, some months, but not every month, or only in 1 or 2 months?

10. In the last 12 months, did you have a supplier of your electric or home heating service threaten to disconnect your electricity or home heating fuel service, or discontinue making fuel deliveries because you could not afford to pay a past-due home energy bill?

10a. If Yes above, How often did this happen – almost every month, some months, but not every month, or only in 1 or 2 months?

11. In the past 12 months, did you have a supplier of your electricity or home heating fuel disconnect or discontinue your energy supply because you were unable to pay for a past-due home energy bill?

11a. If Yes above, How often did this happen – almost every month, some months, but not every month, or only in 1 or 2 months?

For additional information on how to use and score this scale, see the full report, *Measuring the Outcomes of Low-Income Energy Assistance Programs Through a Home Energy Insecurity Scale*.¹⁰

III. National Energy Assistance Directors Association (NEADA) Template for Arrearage & Disconnection Data Collection

In a 2004 report, *Tracking the Home Energy Needs of Low-Income Households Through Trend Data on Arrearages and Disconnections* NEADA proposed the following 3 tiers of data collection that would allow states to make the case for emergency situations when they arise, enabling the release of additional LIHEAP funds.⁹ Each of the higher tiers requires utility commissions commit progressively more resources.

Tier	Availability	Data to be collected
1	Immediate with no additional resources	- Total number of residential accounts - Total number of residential accounts in arrears - Total dollar amount of accounts in arrears - Total number of residential disconnections
2	Available, but requires some additional time and resources	- Total number of low-income residential accounts - Total number of low-income residential accounts in arrears - Total dollar amount of low-income accounts in arrears - Total number of low-income residential disconnections
3	Helpful, but not essential to arguing for additional LIHEAP funds	- Total number of residential accounts written off as uncollectible - Total number of low-income residential accounts written off as uncollectible - Total number of residential accounts having service restored - Total number of low-income residential accounts having service restored - Total number of residential accounts sent notice of disconnection - Total number of low-income residential accounts sent notice of disconnection - Total number of low-income customer deferred payment agreements

Source: *Tracking the Home Energy needs of Low-Income Households Through Trend Data on Arrearages and Disconnections*, May 2004, NEADA.

IV. Themes from Energy Assistance Stakeholder Interviews

From March to August 2006, the CHIA Energy Assistance Subcommittee interviewed a number of key stakeholders in the energy assistance field, including state and federal LIHEAP program officers, energy assistance program directors at Massachusetts community action agencies, and numerous energy advocates and researchers at the local, state, and federal levels. Below is a summary of central themes from these interviews.

Federal LIHEAP Funding Level

There was general consensus that federal LIHEAP appropriations have not kept pace with rising energy prices. Energy directors at local community action agencies reported that most families receiving LIHEAP use up their benefits by January, two to three months before the winter heating season ends. Similarly, in the past, Massachusetts LIHEAP benefits were sufficient to buy three tanks of oil but now cover only one. To address these problems, some suggested that federal LIHEAP appropriations be tied directly to regional prices for fuel. Others noted that Congress has authorized up to \$5.1 billion for LIHEAP, but only appropriated \$ 2.2 billion in FY2005 and \$ 3.2 billion in FY2006.⁹⁴

Timing of Releasing Program Funds

Many remarked on the challenges posed by the annual fluctuation of program funding, and the delay of federal LIHEAP appropriations until late in the program year. Often the main federal LIHEAP appropriation is not finalized until January or much later, making it difficult for state LIHEAP officers to set benefit levels on October 1, the beginning of program year.

The delay in federal appropriations also poses a challenge to low-income families and the community action agencies that serve them. Staff from community action agencies provide families a number of services with the aim of increasing overall self-sufficiency, including job training and financial counseling. They emphasize the importance of budgeting year round for seasonal expenses, like home heating. Without knowing the LIHEAP benefit level, however, they are unable to provide concrete information to families on how much assistance they will receive, which makes it difficult for already struggling households to budget their expenses.

The release of federal contingency funds later in the program year, while a welcome boost in funding, also poses a challenge for the agencies that administer LIHEAP. Agency staff must be aggressive in spending down these funds, tracking down LIHEAP recipients and vendors to pay down outstanding utility balances. If the state has contributed funds to LIHEAP, these funds are not spent until the federal dollars are expended. So the agencies are under pressure to spend down these contingency funds, which often come late in the program year, to make sure they can utilize state funds to obtain the maximum assistance for their clients.

LIHEAP Eligibility and Certification

Energy directors reported that many families in need of energy assistance do not qualify for LIHEAP because of the income cut-offs for eligibility, which some stakeholders consider to be too low. Because the cost of living in Massachusetts is high relative to the rest of the country, some argue for basing eligibility on 60% of median state income, rather than federal poverty guidelines.

For those families who do qualify, certifying a household's application for LIHEAP can be a lengthy process, taking six weeks on average. The application requires documentation of four week's of income along with a utility bill. First time applicants must apply in-person at a community action agency or one of its designated satellite offices. To simplify this process,

some energy advocates support moving toward categorical eligibility, a system by which households eligible for public assistance programs such as Food Stamps for Temporary Assistance for Needy Families (TANF) would be automatically eligible for LIHEAP.

Utility Arrearages

Many of those interviewed provided compelling evidence that low-income families' arrearages have increased dramatically over the past few years. There was consensus that an unprecedented number of families were facing unpaid utility bills, and that these arrearages were growing unmanageably large. One energy director reported that between 90 and 100% of her clients are in arrears, many owing \$1,500 or more. There are a significant number of households who have large unpaid utility bills at the beginning of the heating season and use their entire LIHEAP benefit to pay down their arrearages and have their utility service reinstated. This leaves them with no LIHEAP assistance to pay the coming year's heating bills, ensuring that their arrearages will continue to grow.

While many stakeholders praised the creation of arrearage management programs, they also highlighted the limitations of these programs. Currently, the maximum amount that can be forgiven under an arrearage management program is \$599; larger amounts would be considered income for the customer and would require tax documentation. Also, arrearage management requires budgeting and planning, and works best for households with variable incomes and some flexibility in how they spend their earnings. A family with a fixed income well below what they need to meet their basic needs will be unable to make sufficient adjustments in their household budget to meet the terms of the arrearage management plan.

In creating arrearage management programs, stakeholders emphasized that many of the Massachusetts utility companies have become crucial partners in addressing the challenges facing low-income households. The utilities have worked with energy advocates to create arrearage management programs. An additional suggestion for how utility companies can play an important role would be to make sure each utility has a designated, trained contact person who community action agencies and energy advocates can contact on behalf of their clients who are in need of arrearage management.

Overcoming Barriers to LIHEAP Participation

According to recent estimates, only 25% of eligible households receive LIHEAP benefits in Massachusetts.^{1,98} Many stakeholders we interviewed believe that the actual proportion is higher because the number of eligible households is inflated by including households for whom energy assistance is unnecessary, such as those living in subsidized housing units where utilities are included in the rent, those living in nursing homes and similar institutions, and college students with little or no income.

Many stakeholders we interviewed reported that efforts to study barriers to LIHEAP participation in Massachusetts have been extensive, as have outreach efforts. However, there is still not a complete understanding of what prevents more eligible families from participating in LIHEAP. Some stakeholders cited a lack of awareness of the different types of energy assistance in Massachusetts as a potential barrier. A significant effort to change this is the Energy Bucks program, a collaboration between local utilities and energy and community advocates to raise awareness about energy assistance, utility discounts, and weatherization programs available to low-income Massachusetts families. Likewise, individual community action agencies reported considerable outreach efforts to increase LIHEAP participation, including distributing informational materials at schools, parent-teacher organizations, and local health fairs.

Despite these efforts, some acknowledged there are significant barriers to participation, especially for working families who are not accustomed to receiving assistance and who

may not realize they are eligible for the benefit. For working families with limited work flexibility, such as vacation leave, going to the office to apply may be difficult. Also, they may worry about the stigma of receiving assistance and are reluctant to ask for help.

Some stakeholders acknowledged the potential implications of increasing participation rates in a program that is not an entitlement program, and in which an increased number of participants would likely reduce the overall benefit level that could be offered to each household.

Redefining the Purpose of LIHEAP

Stakeholders agreed that LIHEAP is a very effective program for those who need temporary assistance in paying for home heating due to unemployment or other financial difficulty. However, many noted that it might be insufficient for those who are truly unable to pay even a portion of their energy bills. It is very difficult for low-income families on fixed incomes to absorb higher costs of home heating, even with the modest assistance provided by LIHEAP. Many stakeholders noted that home energy is a basic need, like food and shelter, and should be subsidized for very needy families. Because home energy is a basic need, many stakeholders also believe that LIHEAP should be an entitlement program, and not one that depends on annual appropriations.

V. Local Agencies that Administer LIHEAP in Massachusetts

Action for Boston Community Development, Inc. (ABCD)
178 Tremont Street, Boston, MA 02111
(617) 357-6012

Action, Inc.
47 Washington Street, Gloucester, MA 01930
(978) 281-3900
1-800-696-9276 - Toll Free

Berkshire Community Action Council, Inc. (BCAC)
1531 East St., Pittsfield, MA 02101
(413) 445-4503 - Pittsfield
(413) 663-3014 - North Adams
(413) 528-1947 - Great Barrington

Citizens for Citizens (CFC)
264 Griffin St., Fall River, MA 02724
(508) 679-0041 - Fall River
(508) 823-6346 - Taunton
(508) 676-7397 Information

City of Cambridge, Department of Human Services
51 Inman St., Cambridge, MA 02139
(617) 349-6252

Community Action, Inc. (CAI)
25 Locust St., Haverhill, MA 01832
(978) 373-1971 - Haverhill
1-800-332-9004 - Toll Free

Community Action Program Intercity, Inc. (CAPIC)
100 Everett St., Unit 14, Chelsea, MA 02150
(617) 884-6130

Community Teamwork, Inc. (CTI)
517 Moody St., Lowell, MA 01854
(978) 459-6161 - Lowell
(781) 643-2358 - Arlington
1-877-451-1082 - Toll Free

Franklin Community Action Corporation (FCAC)
393 Main St., Greenfield, MA 01301
(413) 774-2310
1-800-370-0940 - Toll Free - Hampshire County

Greater Lawrence Community Action Council, Inc. (GLCAC)
350 Essex St., Lawrence, MA 01840
(978) 681-4950 - Lawrence
(781) 942-9061 - Reading
(978) 664-6011 - North Reading

Lynn Economic Opportunity, Inc. (LEO)
156 Broad St., Lynn, MA 01901
(781) 581-7220, ext. 283

New England Farm Workers Council (NEFWC)
435 Main Street, Suite 3040, Fitchburg, MA 01420
(978) 342-4520

North Shore Community Action Programs, Inc. (NSCAP)|
98 Main St., Peabody, MA 01960
(978) 531-8810 Information only
(978) 531-0767, ext. 136

People Action in Community Endeavors Inc. (PACE)
166 Williams St., New Bedford, MA 02740
(508) 999-9920

Quincy Community Action Programs, Inc. (QCAP)
1509 Hancock Street, 3rdFloor, Quincy, MA 02169
(617) 479-8181 x101

Self Help, Inc. (SHI)
Fagan Drive, Avon, MA 02322
(508) 588-5440 - Avon
(508) 584-1414 - Brockton
(508) 226-4192 - Attleboro
1-800-255-0875 - Toll Free

South Middlesex Opportunity Council, Inc. (SMOC)
300 Howard St., Framingham, MA 01701
(508) 620-1230 - Framingham
1-800-286-6776 - Toll Free outside Framingham

So. Shore Community Action Council, Inc. (SSCAC)
265 So. Meadow Road, Plymouth, MA 02360
(508) 747-7575 x210 - Plymouth
(508) 778-0870 - Hyannis (Nov - April)
(508) 746-6707 Information only

Tri-City Community Action Programs, Inc. (TRICAP)
341A Forest Street, Malden, MA 02148
(781) 322-6284

Valley Opportunity Council (VOC)
300 High St., Holyoke, MA 01040
(413) 552-1548

Worcester Community Action Council, Inc. (WCAC)
484 Main St., 2nd Floor, Worcester, MA 01608
(508) 754-1176 x110 - Worcester
1-800-545-4577 - Toll Free

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DISCLAIMER

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Abstract

This report is designed to investigate the potential for prepaid electricity plans to operate as energy efficiency within Minnesota's conservation improvement programs. Like prepaid cell phone customers, prepaid electricity customers pay for service in advance of receiving it. When customers' prepaid credit runs out, their electricity is remotely turned off at the next legally permissible time (usually following a short grace period and low-balance warning, often not during specific times like extremely hot or cold days). This differs from the current standard payment plan in many respects and remains controversial among key stakeholders.

We conducted a literature review, program evaluation analysis, stakeholder interviews, and a simulation of potential Minnesota-specific scenarios.

Customers on prepaid electricity plans likely use less electricity than they would otherwise. On average, the estimated electricity usage reduction is approximately 9%, with six evaluations suggesting savings under 7%, one (a small sample study) finding nonsignificant reductions, and five suggesting reductions of more than 10%. This suggests that prepay programs influence energy use, but more research is necessary to determine the degree of influence and to rule out alternative explanations. In particular, many of the evaluations included savings from residential power being shut off,¹ and most evaluations could not adequately control for self-selection bias. More research is needed regarding the actions that households take to reduce consumption and whether or not those actions lead to deprivation.

Mindful of these caveats, we estimate that Minnesota prepay participants could reduce their consumption by 8.5% in a standard prepay program, or 2% in a program that includes a key consumer protection: removal of automatic shutoffs. These are fragile estimates. Research to date includes only programs with automatic shutoff and does not address whether elements that are not unique to prepay, such as enhanced motivating feedback, are responsible for most of the savings. Therefore this report offers a framework for interested utilities to design a prepay pilot program that can answer these important questions while addressing consumer protection concerns.

¹ Some stakeholders argue that energy reductions from disconnection should be included as savings because disconnections could be used as a deliberate action to control usage. We do not agree. Evidence is insufficient to state that most customer disconnections occur deliberately, without affecting quality of life. Customers using prepay could deliberately self-disconnect without experiencing deprivation, for example while traveling, but in current evaluations, this type of disconnection has not been accounted for separately from other disconnections. Based on our research, we tentatively conclude that most self-disconnection occurs while customers are at home and represents some degree of deprivation as opposed to efficiency behavior (conservation). More research on this question could change this conclusion.

Table of Contents

Abstract.....	1
Table of Contents.....	2
List of Tables.....	5
Definition of Terms and Acronyms.....	6
Executive Summary.....	7
Overview	7
Background.....	7
Methods	7
Results	8
Recommendations	10
Conclusions.....	10
Introduction	11
Key Research Questions	12
Structure of this Report.....	12
Prepaid Electricity: Background	13
History and Prevalence of Prepaid Electricity.....	14
Prepay Programs in Minnesota	15
Methods.....	17
Prepay Electricity Impact on Energy Use	18
Prepay Elements That May Cause Energy Reduction.....	25
Feedback	26
Uncertainty about the Most Important Influences	28
Prepay Considerations from Opponents and Advocates	30
Motivations for Implementing Prepaid Electricity Programs.....	30
Research-Related Themes.....	33
Customer-Related Themes.....	33
Customer Satisfaction	33
Customer Control.....	34
Voluntary Program.....	34

Utility-Related Themes.....	34
Utility Costs	34
Utility Savings.....	35
Prepay instead of Other Efficiency Measures.....	35
Consumer Protection–Related Themes	36
Automatic Shutoff.....	36
Deprivation or Energy Efficiency Behavior	37
Targeting Low-Income Customers	39
Equity Concerns and Consumer Protections	40
Regulatory Concerns	40
Minnesota Regulation.....	41
A Note on Prepay Programs for Natural Gas Utilities	41
Potential Energy Efficiency Impacts of Prepay in Minnesota.....	42
Estimating Impacts	42
Recommendations	45
A Framework for Designing a Pilot Program	45
Implementation Decision Making.....	45
Research Design.....	46
Regulatory Considerations.....	49
Cost-Effectiveness Evaluations	49
Other Program Design Considerations	50
Summary and Conclusions.....	51
References.....	52
Appendix A: Interviews	57
Interviewees	57
Interview Procedures	58
Summary of Themes from Interviewees	58
Appendix B: Prepay Elements That May Cause Energy Reduction	66
Feedback	66
Fast Shutoff	66
Cost.....	67
Usually Frequent Payment	68

Active Payment..... 69

Paying in Advance 69

Appendix C: State Regulatory Orders/Actions Regarding Prepay71

Appendix D: Recommendations to Address Consumer Concerns74

Appendix E: Detailed Assessment of Evaluations.....76

List of Tables

Table 1. Annual energy savings estimates and assumptions	9
Table 2. Comparison of prepaid electricity plans and postpaid plans.....	13
Table 3. Prepay electricity evaluations and findings	19
Table 4. Prepaid electricity plan elements that may cause energy reduction	25
Table 5. Prepay program costs and benefits to customers	31
Table 6. Prepay program costs and benefits to utilities	32
Table 7. Common themes from interviews about prepaid electricity plans	32
Table 8. Description of assumption for Program One and Program Two	42
Table 9. Annual energy reduction estimates and assumptions	44
Table 10. Summary of themes from interviewees on topic of more research needed	59
Table 11. Summary of themes from interviewees on topic of customer satisfaction	59
Table 12. Summary of themes from interviewees on topic of customer control	60
Table 13. Summary of themes from interviewees on topic of customer voluntary program	60
Table 14. Summary of themes from interviewees on topic of utility costs (lost revenues)	61
Table 15. Summary of themes from interviewees on topic of utility savings	61
Table 16. Summary of themes from interviewees on topic of prepay as a utility efficiency program.....	61
Table 17. Summary of themes from interviewees on topic of general consumer protection concerns.....	62
Table 18. Summary of themes from interviewees on topic of consumer protections and disconnection as a main motivator for energy savings	63
Table 19. Summary of themes from interviewees on topic of consumer protections and equity concerns.....	63
Table 20. Summary of themes from interviewees on topic of program design and the importance of program structure.....	64
Table 21. Summary of themes from interviewees on topic of program design and ideas for prepay pilots/program models	64
Table 22. Summary of themes from interviewees on topic of program design and barriers to prepay	65
Table 23. Summary of themes from interviewees on topic of program design and natural gas considerations.....	65
Table 24. Summary of themes from interviewees on topic of program design and Minnesota-specific ideas	65

Definition of Terms and Acronyms

AMI: Advanced metering infrastructure

Arrears: Money that is owed and should have been paid earlier

CIP: Conservation improvement program

Conservation: The act of reducing energy consumption without reducing quality of life

Deprivation: A reduction in quality of life

DEFG: Distributed energy financial group

Energy efficiency investment: The act of reducing energy consumption by purchasing physical devices or home upgrades

Energy efficiency behaviors: An umbrella term referring to both conservation and energy efficiency investment

GWh: Gigawatt hours

IOU: Investor-owned utility

kWh: Kilowatt hours

LIHEAP: Low-income home energy assistance program

NCLC: National consumer law center

Quality of life: A combination of a person's subjective and objective life circumstances, including both subjective measures of well-being and satisfaction and objective measures of health, costs of living (relative to income), and other factors.²

² Authors such as Diener and Suh (1997) cite these measures as potentially useful for measuring quality of life. We recognize the ongoing debate among health researchers regarding this term.

Executive Summary

Overview

Prepay electricity plans require customers to pay for their electricity in advance of receiving service. These plans reconceptualize the electricity provision system and turn it from a service paid for after the fact to a service paid for in advance. This program model is controversial because low-income customers represent a sizable proportion of participants in such programs, and consumer advocates have raised concerns regarding potential negative effects on this vulnerable population. Nevertheless, prepay advocates suggest that these programs could reduce electric consumption while increasing utility revenues and customer satisfaction. To determine the potential in implementing prepaid electricity plans as energy efficiency programs in Minnesota, we set out to answer eight research questions:

1. What is the history and prevalence of prepaid electricity programs?
2. Why is prepay implemented?
3. What are the potential usage reduction impacts of prepaid electricity?
4. What might be the usage reduction potential from prepaid programs in Minnesota?
5. What are the considerations of prepay advocates and opponents regarding prepay programs?
6. Which elements of prepay cause the reduction in energy use?
7. Is the reduction in consumption a result of energy efficiency behavior (i.e., conservation), home upgrades, or deprivation?
8. What is a recommended framework for establishing a prepaid electricity program in Minnesota?

Background

Prepay electricity plans allowing multiple payment options have existed since the 1980s and are prevalent in many areas of the world. In Minnesota, only one utility (an electric cooperative) currently offers a prepaid electricity option. Another Minnesota utility previously offered a prepay plan option that they have since discontinued due to concerns from consumer advocates and regulators. A third utility recently filed to include a new pilot program in their energy efficiency portfolio, but the program was rejected by the Department of Commerce.

Prepay electricity plans typically differ from traditional postpay plans in several ways: payment arrangements, energy consumption feedback, disconnection, and overall costs. A number of these features could, in themselves, reduce energy consumption and may be applied to current postpaid plans. Others could be eliminated from prepaid plans to increase consumer protections, but the energy savings impacts of doing so are yet unknown.

Methods

We conducted this study in five steps: a literature review, a summary and assessment of program evaluations, interviews with stakeholders and experts, calculation of potential Minnesota energy

savings, and framework development for utilities to create prepaid electricity pilot programs that address consumer protection issues and answer key research questions.

Results

Customers on prepaid electricity plans likely use less electricity than they would otherwise. On average, the estimated electricity usage reduction is approximately 9%, with six evaluations suggesting savings under 7%, one (a small sample study) finding nonsignificant reductions, and five suggesting reductions of more than 10%. This suggests that prepay programs influence energy use, but more research is necessary to determine the degree of influence and to rule out alternative explanations. In particular, many of the evaluations included savings from power being shut off, and most could not adequately control for self-selection bias.³ More research is needed regarding the actions that households take to reduce consumption and whether those actions lead to deprivation. One report examined the persistence of savings and noted that energy reductions from prepay continued during the programs but also diminished over time.

Stakeholders and experts we interviewed raised a variety of concerns regarding prepaid electricity. These included a need for additional research to address unanswered questions, customer and consumer protection issues (especially for low-income customers), and uncertainty about utility costs and savings. Of these, possible consumer deprivation resulting from more frequent shutoffs was the most commonly cited issue. However, prepay advocates note that current postpay plans are also imperfect. They allow customers to accrue arrearages, and if shut off, the power outage is longer and more difficult to remedy. Nevertheless this report examines prepaid electricity specifically and whether it can reduce electricity use without causing deprivation. Stakeholders generally agreed that more research was required on this and other consequential topics. The state regulatory decisions outside Minnesota that we reviewed revealed a common concern by regulators regarding consumer protections.

A significant issue of whether prepaid electricity plans should be considered energy efficiency programs also remains. Most existing prepay plans we reviewed were proposed as programs to provide customer bill payment alternatives, not as energy efficiency programs. Importantly, based on the Minnesota definition of energy efficiency, a prepay electricity program would not be considered efficiency if it reduces “the quality or level of service provided to the energy consumer.”⁴

Prepay customers sometimes pay more for electricity than postpay customers and tend to go without electricity more often. However, in surveys by prepay program administrators and university

³ Some stakeholders argue that energy reductions from disconnection should be included as savings because disconnections could be used as a deliberate action to control usage. We do not agree. Customers using prepay could potentially deliberately self-disconnect without experiencing deprivation, for example while traveling, but in current evaluations, this type of disconnection has not been separated from other disconnections. Based on our research, we tentatively conclude that most so-called self-disconnection occurs while customers are at home and, as such, represents some degree of deprivation. More research on this question could overturn our conclusion.

⁴ We have been informed that some utilities are considering packaging structural energy efficiency measures with prepaid electricity plans but, as yet, do not have details of these plans.

researchers, most prepay customers reported being satisfied with their plans (and sometimes preferred them to postpay). Minnesota regulators or legislators will have to decide whether these programs cause consumer deprivation and/or a reduction in quality of service to determine whether they may qualify as energy efficiency measures.

Leaving aside the issue of whether usage reduction is energy efficiency, we estimated the total potential electricity usage reduction impact of prepaid electricity in Minnesota. To accomplish this, we developed two scenarios, one in which the program follows current norms (including automatic disconnect shortly following a zero balance) and the other with no disconnection threat (i.e., customers move back to a traditional payment plan when their balance is zero or have some other incentive for avoiding a \$0 balance). Programs without disconnection have been proposed but, as yet, have not been piloted. We present annual energy savings estimates and assumptions for each scenario in Table 1.

While these estimates represent our best judgement of relevant data and how they may apply to the Minnesota landscape, we emphasize that they are based on a limited data set that often includes a large proportion of low-income and payment-challenged customers. In addition, more research is needed to estimate savings potential under different scenarios (e.g., to understand potential energy reductions if the program design had no disconnection threat). In the second scenario, with no threat of disconnection, we hypothesize that through high levels of customer feedback and engagement, we would still see energy reduction as compared to traditional postpay plans (but less than from standard prepay plans). This is an area where further research would strengthen the accuracy of the estimates in Table 1.

Table 1. Annual energy savings estimates and assumptions

Scenario	Baseline residential energy consumption (GWh)	Annual usage reduction	Total potential statewide usage reduction (GWh) ⁵
Customers can be disconnected after payment lapse	10,627	8.5%	9 GWh
Customers will not be disconnected after payment lapses but will be moved to traditional payment plan	10,627	2%	2.1 GWh

⁵ This assumes a 1% participation rate. See the Estimating Impacts section of the report for details.

Recommendations

We offer a framework to utilities interested in designing prepaid electricity pilot programs that would help fill the knowledge gap while addressing consumer protection concerns.

Programs that fully address potential consumer deprivation may reduce potential energy savings (e.g., by eliminating threat of remote shutoffs). Consumers (especially low-income customers) will be better protected, but electricity savings may decrease or become nonsignificant. Our recommended pilot program design framework specifically addresses this possibility. We recommend using several alternative treatment groups (in addition to standard postpay control groups), quasi-experimental methods, and creative sampling strategies.

Conclusions

Previous evaluations suggest that electricity consumers use less electricity when on a prepaid electricity plan. However, this observed usage reduction may in part be due to factors that reduce customer quality of life, such as going without electricity more often. We do not argue that customers on prepay necessarily experience more deprivation than those on postpay plans. Those on postpay plans that accumulate large arrearages and experience extended disconnections may have equal or diminished quality of life and greater deprivation than those on prepay. Rather we note that one factor that may strongly motivate behavior change (threat of fast disconnection) may also reduce quality of life and, thus, may be integral to the program's electricity reductions. Therefore more research on the cause of electricity reductions in prepay programs is necessary.

We also note that further research may highlight elements of prepaid electricity plans that are not unique and may account for a substantial proportion of the energy savings. In particular, advanced real-time feedback about electricity use, along with metrics and messages that motivate behavior change, could be one such key factor.

Introduction

The state of Minnesota's Next Generation Energy Act (2007) established the importance of cost-effective energy reduction.⁶ The act focused on energy conservation as the primary strategy for meeting this goal and established an energy use savings target of 1.5% (electricity and natural gas) each year through cost-effective conservation improvement programs. The Minnesota Department of Commerce, Division of Energy Resources sponsored this white paper to examine the viability of prepaid electricity services as a potential energy efficiency program that could help conservation improvement programs reach their annual savings targets.

To examine potential program savings, we addressed whether customers using prepaid electricity reduce their electricity consumption and, if so, whether this reduction can be considered energy efficiency.⁷ To do this, we examined the potential of prepay programs to change behavior, attempted to determine which behaviors might be changed, and assessed which elements of the program might cause that change.

The question of whether prepaid electricity payment plans should be considered energy efficiency programs hinges on more than whether the programs reduce consumption.⁸ Minnesota's statutory definition of energy efficiency requires that the measures or programs save energy "without a reduction in the quality or level of service provided to the energy consumer." Consumer behaviors that are changed, the subjective experience of the participants, and the objective outcomes for those participants dictate whether the program causes energy savings through energy efficiency behaviors (i.e., conservation or energy efficiency investment) or deprivation (see Glossary for definition of these terms). Minnesota should not consider a program that causes deprivation to be an energy efficiency program. In the section Prepay Considerations from Opponents and Advocates, we examine the research on the deprivation question and suggest future research avenues.

A small number of states and utilities recently proposed prepaid electricity as an energy efficiency measure. Because of the limited implementation to date, empirical evaluations of prepay's effectiveness to reduce energy consumption are few. We therefore combined our review of program evaluations, academic literature, regulatory decisions, and other non-peer-reviewed reports with interviews of key actors and stakeholders who are familiar and/or involved with prepay electricity programs. With this complete picture of programs, literature, and interviews, we were able to distill the current state of

⁶ The details of the Next Generation Energy Act can be found on the Minnesota government [website](#).

⁷ Minnesota defines energy efficiency as follows: *Energy efficiency* means measures or programs, including energy conservation measures or programs, that target consumer behavior, equipment, processes, or devices designed to produce either an absolute decrease in consumption of electric energy or natural gas or a decrease in consumption of electric energy or natural gas on a per unit of production basis without a reduction in the quality or level of service provided to the energy consumer. The full definition can be found on the government [website](#).

⁸ We use the term *prepay plan* to indicate a payment option and *program* to indicate a strategy to change behavior, such as an energy efficiency program. Minnesota regulators and legislators may wish to decide whether prepay plans should be considered conservation improvement programs.

knowledge and identify ideas for future pilot programs and empirical research on prepay as energy efficiency.

Importantly, this report takes examples from national and international programs and combines them with Minnesota-specific interests, cultures, and requirements. We propose Minnesota-specific recommendations and estimate potential savings for Minnesota prepaid electricity programs using assumptions derived from our research.

Key Research Questions

This research report serves to answer key questions to help Minnesota decide whether the state should incorporate prepaid electricity plans into the Minnesota Conservation Improvement Program (CIP):

1. What are the history and prevalence of prepaid electricity programs?
2. Why is prepay implemented?
3. What are the potential usage reduction impacts of prepaid electricity?
4. What is the usage reduction potential from Minnesota prepaid programs?
5. What are the considerations of prepay advocates and opponents regarding prepay programs?
6. Which elements of prepay cause reduction in energy use?
7. Is the reduction in consumption a result of energy efficiency or deprivation?
8. What is a recommended framework for a prepaid electricity program in Minnesota?

This report provides answers to these questions using previously gathered reports and studies, along with interviews with key stakeholders. In some areas, our analysis and recommendations are limited due to a lack of strong research and pilot program evaluations.

Structure of this Report

This report begins with a basic description and background of prepaid electricity plans (highlighting Minnesota context) and then continues with four primary sections. The first section, Prepaid Electricity Impact on Energy Use (along with [Appendix E](#)), is an analysis of currently available evaluations of energy reductions from prepaid programs. In this section, we also delve briefly into what elements of the prepay plans may cause changes in behavior (with more details provided in [Appendix B](#)). The second section, Prepay Considerations from Opponents and Advocates, discusses why utilities usually offer prepay plans, why some stakeholders may be concerned, and what regulatory bodies have decided regarding prepay proposals. The third section, Potential Energy Efficiency Impacts of Prepay in Minnesota, is a calculation of potential energy reductions from prepaid programs in Minnesota. The last section, Recommendations, provides a framework for utilities interested in implementing a prepaid pilot program.

Prepaid Electricity: Background

Prepay electricity plans, like prepay cellphone plans, require customers to pay in advance of receiving service. When customers' prepaid credit runs out, their electricity is remotely turned off at the next legally permissible time (usually following a short grace period and low-balance warning, often not during specific times like extremely hot or cold days). Conversely, electricity is immediately restored when the customer purchases additional credit. This differs from the current standard payment plan in many respects. Although customers purchase other necessities in advance of use, such as groceries or gasoline, using this system for electricity remains controversial.

Although plans vary, prepay electricity plans typically differ from postpaid plans in several characteristics. The differences that may be relevant for affecting behavior are summarized in Table 2.

Table 2. Comparison of prepaid electricity plans and postpaid plans

Characteristic	Prepaid plan	Postpaid plan
Payment arrangements	Customers pay for their electricity before using it. Newer programs allow paying for credit using a variety of payment systems.	Customers typically pay for their electricity <i>after</i> using it, usually with a delay of about three weeks to two months. Paying in advance rarely occurs. Most programs allow for payment using a variety of payment systems.
Feedback on energy consumption	Customers receive frequent feedback about their electricity use.	Customers typically receive feedback infrequently, usually in monthly bills (which may be ignored if a customer subscribes to autopay). Sometimes customers also receive home energy reports from a third party. This varies depending on the utility.
Rapid disconnection	Customers are remotely shut off from electricity services shortly after running out of credit. This usually follows a short grace period, and often not during restricted times that mirror restrictions for postpay (e.g., extreme weather days). ⁹	If customers do not pay their bills, they can accumulate arrears for a longer period before being shut off. Customers receive multiple written warnings and often cannot be disconnected during restricted times (e.g., extreme weather days or extended heating/cooling seasons).

⁹ As with postpay plans, if power was disconnected before these times, it will not be reconnected during these events. To our knowledge, two programs have proposed returning customers to postpay after a grace period of a few days, rather than disconnecting them. However they have not been approved by regulators.

Characteristic	Prepaid plan	Postpaid plan
Costs and deposits for initiating services	These vary among plans. Sometimes prepaid plans offer lower fees (or no fees) for connection or reconnection of electricity services, relative to postpay. Sometimes prepaid plans require no deposit (or reduced deposit) for initiating service.	Postpay plans often require a deposit or credit card before service can be initiated.
Rate structure and overall costs	Prepaid plans generally have different rates and fees than postpay plans. Sometimes various fees are waived. In other cases, programs add equipment rental fees, access charges, transaction fees (e.g., for credit card payments), or mandatory repayment of existing arrearages. Sometimes, prepaid customers can receive the same access to time-of-use rates as postpay customers. American prepaid kWh rates are not usually lower than postpay rates.	Postpay plans often have tiered or time-of-use rate designs that are different from prepaid. In the United States, overall costs are usually the same or lower than prepaid, but they are somewhat comparable. When utilities charge transaction fees for certain payment methods, customers using those methods who are paying only once per month will have lower overall costs than those paying more frequently.

History and Prevalence of Prepaid Electricity

United Kingdom utilities are credited with the earliest versions of prepaid electricity plans, using coin-operated electricity systems in the early 1900s. In 1988, South Africa's Eskom public utility operated the first prepaid electricity plan that allowed more payment options. That plan, and others that followed, used cards, keys, or key codes that could be recharged at a kiosk or over the phone (Esteves et al. 2016). Following the South Africa program, utilities rolled out prepaid electricity plans throughout other regions of Africa, Europe, South America, Asia, and more recently, North America.

In this way, prepaid electricity plans became a common electricity payment method in many countries. In Mozambique, 80% of customers in 2011 used prepaid meters (Esteves et al. 2016). In South Africa, approximately 4.3 million electricity customers use prepaid.¹⁰ In China, an estimated 34% of customers across all provinces and urban/rural districts use prepaid (Du, Guo, and Wei 2017). New Zealand, India, and Argentina are also leading countries in terms of prepaid usage (Oseni 2015). In all these cases, prepaid electricity began as pilot projects that grew slowly over 10 to 20 years into established programs that are now widely accepted as a common form of electricity payment.

Prepaid is also a prevalent form of bill payment in many European countries. In the United Kingdom, 16% of electricity consumers subscribed to a prepaid program in the first quarter of 2018, including 38% of

¹⁰ Eskom data on its prepaid customers in South Africa are available on the [Eskom website](#).

customers in Northern Ireland (Ofgem 2018). These regions have prepay consumers from all income brackets (Oseni 2015).

Prepay electricity programs in the United States have grown in number over the past decade. The Distributed Energy Financial Group (DEFG), a management consulting firm that focuses on energy and has promoted prepay electricity, maintains a database of prepaid programs across the country. In 2018, the DEFG database included 17 prepaid electric utility programs with the status “pilot” or “full scale,” 12 programs with the status “planning,” three with “canceled” or “suspended,” and seven that are unknown (and not public), for a total of 40 programs (N. Treadway, Managing Partner, DEFG, pers. comm., July 12, 2018). Most of these programs launched after 2009, while one launched in 1998.

North American programs rely on advanced metering infrastructure (AMI)—also known as smart meters—which is more powerful and flexible than earlier keypad, card, or key code prepay systems. AMI allows utilities to track customer use and provide real-time feedback over multiple personal devices. Other technological advances also allow customers to add account credit online or via other methods.

Around the world, low-income customers are enrolled in prepaid plans more frequently than customers in other income brackets (e.g., Boardman and Fawcett 2002; Brutscher 2012; Darby 2010; Graham and Marvin 1994; Howat and McLaughlin 2012). Although other demographics may be a potential future market for prepay in North America (e.g., tech-savvy millennials; Wimberly 2018), this is currently also true in the United States. Among programs that have disclosed customers’ income information, low-income consumers usually compose the largest group of enrolled customers in prepaid plans (e.g., APS 2015; Doble 2010).¹¹ In some regions, such as the Netherlands, Ghana, and some areas of the United States, utilities market prepay to all income levels, but low-income customers are nevertheless the primary participants (Azila-Gbettor, Atatsi, and Deynu 2015; Esteves et al. 2016; APS 2015). Therefore when considering whether prepaid electricity plans are behavior-change programs, implementers should pay attention to impacts on this customer class in particular.

Prepay Programs in Minnesota

Minnesota Valley Electric Cooperative (MVEC) is the only Minnesota utility that currently offers customers an option to prepay their bills. Their program, called “PayGo,” allows customers to pay smaller daily and weekly increments. Customers also have an option to add account funds to cover their electric needs for months in advance. According to MVEC, approximately 400 of around 40,000 members (i.e., customers) are part of this program. The utility’s website reports that nearly all (95%) the 400 MVEC members in the PayGo program said it allows them to fit their electric bill more easily into their monthly budget. In addition, when asked about their energy usage, 59% of MVEC PayGo members said their electric costs were noticeably lower. However this value was self-reported and these findings have not been independently evaluated to demonstrate energy savings. MVEC offers the PayGo payment option to a small number of customers as an alternate arrangement to monthly billed

¹¹ Most utilities in the United States with prepay programs have small programs and either do not collect or do not share data on the income levels of their participants. Nevertheless, based on available data and interviews with prepay experts, it is reasonable to believe the United States is similar to other countries in that prepay customers are more likely than non-prepay customers to be low income.

payments. It is not intended to be an energy efficiency program. Program participants can be disconnected from service if they do not make their payments. However, to prevent surprise, MVEC provides notifications when the account balance is nearing zero (E. Webster, Vice President Corporate Services, MVEC, pers. comm., August 20, 2018).

Nearly 25 years ago, Ottertail Power, an investor-owned utility (IOU) that provides electricity service in Minnesota, had a pilot program for their employees that included a prepayment option. These participants had an in-home device that would take credit card payments. While some customers liked the option, consumer advocates and regulators had concerns, and so the program was discontinued (J. Grenier, Market Planning Manager, Ottertail Power, pers. comm., June 14, 2018).

Recently, MN Power, another IOU in the state, submitted a request to include a prepay pilot in their 2017–2019 Triennial CIP filing. The pilot was described briefly in the filing, including their work with ESource to develop the pilot. However, the Minnesota Department of Commerce ultimately rejected this pilot program because it did not contain enough detail about program design and consumer protection elements (J. Burdette, State Energy Officer, Minnesota Department of Commerce, pers. comm., July 2, 2018).

Methods

We conducted the research and writing of this report in five steps:

1. Conducted a thorough literature review of 30 peer-reviewed academic articles, eight regulatory decisions, and 24 non-peer reviewed reports (from utilities, advocates, consumer rights organizations, and news media organizations)
- 1) Located, assessed, and summarized 16 prepaid electricity program evaluations, which were described in 10 reports
2. Conducted interviews with 21 different stakeholder groups, including five Minnesota utilities, two prepay implementation companies, six consumer advocate organizations, three organizations that advocate prepay (among other issues), two Minnesota government offices, and three academic researchers working at various universities, summarized the themes from the interviews in [Appendix A](#), and integrated those themes into the report, alongside the literature review, where appropriate
- 2) Established scenarios for prepaid programs in Minnesota and calculated potential savings from those scenarios
3. Produced framework recommendations, noting where the knowledge gaps resided and how pilot programs could be designed to address these knowledge gaps and provide service that protects consumers

Prepay Electricity Impact on Energy Use

In our search for high-quality electricity consumption evaluations for prepay programs, we found 10 reports containing results from 16 evaluation efforts of varying rigor. Table 3 summarizes information about these program evaluations and [Appendix E](#) provides more-detailed explanations (with references). To assess each study and/or evaluation, we sought information on

- The percentage change in electricity use and whether the change was statistically significant
- The evaluation method and what type of control group was used (if any)
- The number of participants
- The length of time participants' energy use was observed before and after enrolling in a prepaid plan
- What participant actions appear to account for reduced electricity consumption
- Whether the savings evaluations excluded time during which customers' power was turned off¹²
- Whether total electricity costs to prepaid program customers were different from those in the postpay control groups¹³
- The year the evaluation was conducted
- The region where the programs were implemented

The reports in Table 3 include statistics and research methods that were used in the evaluated programs. However these varied significantly in their levels of transparency and quality. We rated the quality of evaluations as “acceptable” or “limited.” Acceptable evaluations included most of the data we were looking for. Limited evaluations were difficult to assess because they lacked transparency or information (e.g., we were not provided full evaluation reports, but short summaries of the evaluations). More details regarding the evaluation classifications is available in [Appendix E](#), along with specific findings from those evaluations.

¹² Customers turn off electricity service more frequently when enrolled in prepay than when enrolled in postpay (Howat and McLaughlin 2012). Therefore evaluators should calculate how much of the electricity savings (if any) can be attributed to power being completely turned off. To our knowledge, no evaluation has attempted to differentiate between power being off while residents are at home as opposed to away (when it would be less likely to affect quality of life).

¹³ In some cases, consumers prepaying for electricity may pay higher electricity costs (rates, transaction fees, enrollment costs, reconnection fees, and so on) than comparison consumers (e.g., Martin 2014). Although consumer price sensitivity is typically low, this could nonetheless be one part of the reason that prepay customers reduce their electricity consumption. Higher costs could take the form of monthly access fees or reconnection fees, but they could also take the form of third-party vendor fees (e.g., charged at a kiosk or for payment by check) that may be incurred more frequently by prepay consumers because they pay for electricity more often. Many programs also include a debt-repayment component in which a portion of top-up credits that are purchased (sometimes as much as 40%) first go to paying down previously incurred debt. Debt repayment while receiving service is a benefit of prepay that some customers appreciate; however it could also reduce the available income for customers to purchase electricity. Thus a debt repayment requirement could be a factor that influences consumption.

Table 3. Prepay electricity evaluations and findings

Program	Scope of evaluation	Prepay program duration	Electricity savings	Number of prepay participants	Number in control group	Savings control for disconnect	Costs, compared to postpay ¹⁴	Evaluation design	Reference
Eskom, Cape Town, South Africa	Acceptable	~16 months	13%	4,246	No control group	No	Similar	Pre-post, control for selection bias ¹⁵	Jack and Smith (2016)
Salt River Project (SRP) 2008–2009, Arizona	Acceptable	1 year	12%	1,641	1,641	No	Higher	Matched control group, pre-post	Qiu, Xing, and Wang (2016)
Arizona Public Service, Arizona	Acceptable	~1 year	7.50%	86	86	Yes	Higher	Matched control group, pre-post	APS (2015)
Direct Energy, Texas	Acceptable	3 years	9.60%	Unclear	Unclear	Yes	Similar	Non-matched controls, instrumental variable approach	Eryilmaz and Gafford (2018)
Duke Energy, North and South Carolina	Acceptable	2 years	Not statistically significant	74	74	No	Higher	Matched control group, post only	Duke Energy Carolinas (2017)
Glacier Electric	Acceptable	< 1 year	14%	1,240	No control group	Yes*	Not available	No control group, pre-post	DEFG (2014)

¹⁴ For details regarding this variable, see [Appendix E](#).

¹⁵ This evaluation controlled for selection bias by including only participants who were involuntarily switched to a prepay plan. The researchers observed 27 separate groups that switched from postpay to prepay, and randomly determined when each switch would occur.

Program	Scope of evaluation	Prepay program duration	Electricity savings	Number of prepay participants	Number in control group	Savings control for disconnect	Costs, compared to postpay ¹⁴	Evaluation design	Reference
Cooperative, Montana									
Kentucky Association of Electric Cooperatives	Acceptable	~1 year	11.10%	574	No control group	No	Higher	No control group, pre-post	Martin (2014)
Oklahoma Electric Cooperative	Acceptable	~22 months	10.40%	1,217	No control group	Yes*	Higher	No control group, pre-post	Ozog (2013)
Pacific Northwest PenLight, Washington	Limited	~1 year	5.50%	154	No control group	Yes*	Not available	No control group, pre-post	DEFG (2014)
Salt River Project 2003–2006, Arizona	Limited	1 year	12%	463	463	No	Higher	Matched control group, pre-post	EPRI (2010)
TVA 1, Tennessee ¹⁶	Limited	~1 year	5.60%	350	Unclear	No	Unclear	Matched control group, only post	DNV GL (2016)
TVA 2, Tennessee	Limited	~1 year	6.70%	184	Unclear	No	Unclear	Matched control group, only post	DNV GL (2016)
TVA 3, Tennessee	Limited	~1 year	5.00%	201	Unclear	No	Unclear	Matched control group, only post	DNV GL (2016)

¹⁶ Six implementations of prepay by utilities in the Tennessee Valley Authority (TVA) were separately evaluated within one report. The utilities chose to remain anonymous.

Program	Scope of evaluation	Prepay program duration	Electricity savings	Number of prepay participants	Number in control group	Savings control for disconnect	Costs, compared to postpay ¹⁴	Evaluation design	Reference
TVA 4, Tennessee	Limited	~1 year	6.90%	183	Unclear	No	Unclear	Matched control group, only post	DNV GL (2016)
TVA 5, Tennessee	Limited	~1 year	11.70%	145	Unclear	No	Unclear	Matched control group, only post	DNV GL (2016)
TVA 6, Tennessee	Limited	~1 year	6.80%	76	Unclear	No	Unclear	Matched control group, only post	DNV GL (2016)

*The author controlled for the effects of disconnection in the regression analysis but used a procedure that could be debated. See [Appendix E](#) for details.

Overall we found 16 individually evaluated programs within 10 reports. Most of the evaluations contained enough information to assess, but eight of these program evaluations were difficult to assess because they provided little information on which we could draw conclusions. Most evaluations had sample sizes below 600 (eight of 16 had fewer than 201 participants) in the prepay intervention group (four had over 1,000), and the duration of data collection from most customers while on prepay was approximately one year (four were longer, one was shorter). Most studies used a pre-post evaluation method or included a matched control group. Therefore many evaluations could be somewhat influenced by a potential self-selection bias and contained somewhat small sample sizes.

The program evaluations listed in Table 3 show that customers who prepay for electricity likely use less electricity than they would otherwise. On average, the estimated energy reductions are approximately 9%, with seven evaluations suggesting reductions under 7% (plus one study that reported only statistically nonsignificant reductions) and five evaluations suggesting reductions of more than 10%. However, the programs cannot be directly compared to one another because they include different elements (e.g., fees, rates, and payment options) and evaluation methods (e.g., control groups and calculation of savings). Many evaluations do not report one or more critical pieces of information (e.g., whether debt repayment is automatically deducted from top-up payments, total costs to consumers, and the size of the control group). Only one evaluation (Kentucky) examined the potential persistence of energy reductions over time, and the author of that report noted that these reductions generally persisted during the program but also diminished over time. This finding concurred with the TVA evaluations, whose authors tentatively concluded that savings were highest for new programs and lower for more mature programs.

We compared customer costs between prepaid and postpaid programs. While it was rare to see a different electricity (kWh) rate between the two payment plans, it was common (in the programs in Table 3) to see additional fees that could make overall prepay costs higher. For some programs, these fees included monthly access charges, third-party vendor fees (such as kiosk or bank fees), or reconnection fees. It was difficult to calculate exact costs to customers because program evaluations did not provide in-depth examination of these details. However, we suspect at least two programs (Texas and South Africa) had negligible differences in costs for customers between prepay and postpay plans.¹⁷

The South Africa program was one with similar costs (except for some participants who were switched from a lifeline electricity fee when moved to prepay), and it demonstrated an estimated 13% savings. Although the methodology for this program's evaluation was stronger than any other in our review (reducing self-selection bias by only examining involuntary switching to prepay), the context and program type were qualitatively different from those offered in the United States. That evaluation did not exclude savings from customer disconnections, and it was applied in poor regions of South Africa. A Texas prepay program was also likely to have similar costs between prepay and postpay (although exact rates were not disclosed) along with an estimated 9.6% savings. However this evaluation included a nonmatched control group with an unverified number of participants. For the remaining 14 evaluations, six reported likely higher costs (due to fees, transactions costs, and so on) and eight did not provide

¹⁷ See [Appendix D](#) for a discussion of costs in each program.

information. Although consumers are not extremely price sensitive, the possible cost difference could help explain some of the reductions in consumption, especially among budget-constrained customers.

Five evaluations excluded savings resulting from customer shutoffs. These programs took place in Arizona APS (7.5% savings), Texas (9.6% savings), Montana (14%), Oklahoma (10.4%), and Washington (5.5%). However, as explained in [Appendix E](#), the procedure used to account for shutoffs in the latter three locations (Montana, Oklahoma, and Washington) may be considered suboptimal by some experts. The other 11 evaluations may have overestimated savings from prepay because they included “energy saved” from disconnections in their savings estimates.

Several factors contribute to our assessment of the quality of evaluations. These include sample size, evaluation time (and, by extension, amount of data used for the evaluation), and evaluation design. In general, a larger sample size and more data lead to more-accurate evaluations as results can apply to the greater population. Most evaluations lasted approximately one year and often included usage data from one year prior to prepay implementation, which is a reasonable length of time and number of data points (assuming monthly billing data were used). Six Tennessee evaluations had short, but borderline reasonable, evaluation periods (approximately one year), and one Montana evaluation had approximately nine months of prepaid usage data, but also some additional (unspecified number of) months prior.

Eight of the 16 evaluations had small sample sizes (201 or less), including five in Tennessee, one in Washington state, one in the Carolinas, and one in Arizona. Small sample sizes can make finding significant results more difficult and make results less generalizable. Savings from all but one of these programs (Carolinas) were statistically significant, but the generalizability of the results to the broad residential customer population from these non-randomly selected (and sometimes small) samples remains a fundamentally unanswered question. This makes it difficult to estimate what the energy usage reduction potential might be from such programs if applied in any broader context.

In terms of methodology, the ideal evaluation would rule out as many extraneous variables as possible to offer the strongest argument that prepay causes reduced energy consumption. As is typical of empirically based energy efficiency evaluations, none of the studies employed a fully random or quasi-random experimental design, which would offer the strongest evidence that prepay causes a change in behavior and energy use. A pre-post evaluation with no control group offers the weakest evidence for causation because it fails to account for possible confounding variables, such as temperature, general economic conditions, and so forth. Four programs used this type of evaluation (with some of the highest savings figures: Montana 14%, Kentucky 11.1%, Oklahoma 10.4%, and Washington 5.5%). A stronger pre-post evaluation includes a matched control group (prepay customers matched to similar non-prepay customers). Seven programs used this type of evaluation, including all those in Tennessee (5.6%, 6.7%, 5.0%, 6.9%, and 11.7% savings) and one from the Carolinas (which was not statistically significant). An even stronger evaluation would combine a pre-post evaluation and a matched control group using a difference-in-difference analysis (examining the difference in usage before and after the time that prepay began and comparing that difference between control and prepay customers). Three evaluations used this strategy, including all three Arizona evaluations (12%, 12%, and 7.5% savings).

The two remaining evaluations used unconventional methods. One of the strengths of the South Africa evaluation is that it ruled out one important potential extraneous variable, self-selection bias, by including only participants who were involuntarily enrolled in prepay. This evaluation used a pre-post evaluation method but observed 27 groups of prepay enrollments that were enrolled on a random schedule, thus strengthening its case for causality. Although the Texas evaluation used a nonmatched control group, evaluators attempted to compensate for self-selection bias statistically. Even so, the method of implementing this compensation could be argued to be not as effective as the inclusion of a control group (see [Appendix E](#) for details).

Some of the reported energy reductions could have been the result of deprivation as opposed to energy efficiency behaviors. Only one of the evaluations that we reviewed measured the energy-reduction actions of prepay customers (Oklahoma). This report found that customers self-reported numerous specific behaviors, such as turning off lights, lowering water heater temperatures, and changing appliance usage. Of the reported behaviors, two correlated with actual usage reductions: (1) purchasing a new thermostat and (2) allowing electricity to be remotely disconnected (which could be associated with deprivation). In New Zealand and Mozambique, in-depth interviews with prepay customers complemented these findings (O’Sullivan, Viggers, and Howden-Chapman 2014; Baptista 2015). Increased feedback while on prepay plans facilitated learning about electricity use from different appliances and subsequent rationing of their usage. However the New Zealand study also noted that prepay plans “encouraged householders experiencing severe hardship to take extreme measures when restricting their energy use” (O’Sullivan, Viggers, and Howden-Chapman 2014, p. 1).¹⁸ The question of deprivation, therefore, remains unanswered, and we examine it in more detail later in this report.

The generalizability of these results to a broad Minnesota residential customer population could be problematic. Prepay plan evaluations that reported participant information had customers that were not representative of the general population, and sometimes a small numbers of participants.¹⁹ This could make estimation of savings in a broader context difficult.

Overall, the 16 evaluations demonstrate that customers on prepaid electricity programs on average reduce their consumption relative both to their previous usage on postpay and to other customers who stayed in postpaid programs. However, current evaluations make the degree of expected savings difficult to quantify. To date, few studies offer high-quality evaluations that have large sample sizes and long durations, exclude energy reductions from disconnections or deprivation, and effectively control for self-selection bias.

Several explanations exist as to why prepay programs reduce consumption, and some of these are not unique to prepay. In the following sections of this report, we delve further into these questions and explain why each element or possible cause of savings needs to be examined independently (with additional details provided in [Appendix B](#)).

¹⁸ For example, extreme measures may include self-disconnection while residents are at home.

¹⁹ In many cases, prepay participants have low incomes or have difficulties with payment under postpay billing plans.

Prepay Elements That May Cause Energy Reduction

As outlined in the previous section, most current evaluations do not examine which prepay program elements cause electricity use reductions. Pilot designs that isolate the effects of each program element can determine the exact influence each element has on behavior change and electricity consumption. Isolating prepay and postpay differences is important because some elements are criticized for causing deprivation among vulnerable populations, some can be added to postpay programs, and some are unique to prepay. If the effects of these elements are known, program designers can customize programs to effectively save energy while avoiding negative impacts on participants. Evaluations that isolate elements would also determine whether specific elements of prepay could save energy on their own or must be couched within a complete prepay program. We examine these issues because the goal of this report is to investigate energy savings potential of prepay as opposed to general acceptability.

Given the lack of experimental evidence or high-quality quasi-experimental research, we are left with hypotheses about key program elements that, based on previous research, could explain the reduction in consumption attributed to prepaid programs. Some of these elements could be added to postpaid programs, and some are best introduced only as parts of a prepaid program. In Table 4, we review six key elements that differ between prepaid and postpaid programs that can reduce energy consumption on their own, as demonstrated by behavioral science research. Each of the following program characteristics may contribute in varying degrees to prepaid electricity program estimated savings. Only one of these elements is unique to prepay—paying in advance. Active payment, inconveniences, costs to customers, and quick disconnections may be added as elements in postpay programs, though they may be more difficult to include. Postpay programs can easily incorporate feedback elements, especially in areas where smart meters are installed. In [Appendix B](#), we explain how and why these elements work to save energy independent of prepaid programs.

Table 4. Prepaid electricity plan elements that may cause energy reduction

Element	Explanation
Feedback	Prepay plans come with real-time (or near-real-time) feedback about remaining credits and/or energy use. The feedback is described in metrics the customer can understand and facilitates learning and empowerment to make changes to behavior. This feedback helps customers understand how behavior, electricity use, and cost are linked. People who receive feedback about electricity use generally reduce their consumption. Although this effect may be increased when it is provided in the context of prepay, feedback also exists independently of prepaid plans. Notably, this element can be implemented in postpay.
Fast shutoff	Customers (particularly those with constraints on income) may defer action on electricity bills until there is an immediate risk to health, safety, or well-being. By making disconnection immediate, customers are more likely to act quickly to keep their power on, even if they are struggling to pay for other necessities. In addition, the savings from some programs can be partly accounted for by service disconnections, as opposed to energy efficiency behavior change. Implementing faster and stricter disconnection policies would be difficult for postpay plans, as customers pay after receiving service.

Element	Explanation
Costs to customers	Some evaluated prepay plans are slightly more expensive for customers than equivalent postpay plans. This slight difference in costs may explain a small part of the difference in consumption. Some of the evaluated programs include built-in debt repayment measures, so part of a top-up payment goes to arrearage reductions. Although this may be a benefit for customers, it nevertheless leaves them with less money to spend on electricity. At least one program we are aware of had a large number of customers in this situation (EPRI 2010). In many cases, top-up payments also have transactions fees. Therefore the overall program costs may be higher for all customers, which impacts income-constrained consumers. These higher costs can partly explain electricity savings. Using this method—increasing costs to reduce electricity consumption in postpay plans—is not recommended, especially for programs that typically target low-income customers.
Usually more frequent payments	In currently available program evaluations, consumers on prepaid plans usually pay for electricity more frequently than those on postpay plans. Paying more frequently could increase the chances of missing a payment or, especially for customers traveling to a kiosk, increase the overall effort required to pay for electricity. This overall effort could act as a slight barrier to topping up and could, therefore, on average across all participants, slightly reduce electricity consumption. Conversely, postpay customers usually pay only once per month, at a time that is convenient (within the span of several weeks after receiving the bill), or they can subscribe to autopay, which automatically pays their bills each month, further decreasing effort. Consumers in an SRP evaluation traveled an average of two to three miles to a kiosk to purchase electricity credits three to four times per month. This potential behavior-influencing factor cannot be easily applied to postpay.
Active payment	Individuals who are made to actively decide how much credit to add to their electricity account may subsequently pay more attention to the electricity they are using. Prepay customers typically purchase credits more frequently than postpay customers pay their bills. Each time prepay customers reload, they must choose how much to add. This increased attention and decision making may subsequently lead participants to pay more attention to how much electricity they are using. One Texas prepay program sent customers energy bills each day. It would be challenging for utilities to use this strategy of active payment methods with postpay customers, and if prepay implementers create an autopay option then this factor may become less important and behavior change might be slightly reduced.
Paying in advance	All else being equal, people spend more money when using credit cards than when using cash. Loading up prepay meters in advance of using the electricity is like the process of getting cash from the bank before spending it. Conversely, paying for electricity after using it is like spending credit and then paying the balance later. Possibly the same mechanism that works to reduce spending with cash also works to reduce spending on electricity for prepaid program participants. This is likely a limited effect and one that requires additional research. Although postpay customers can pay in advance, the requirement to do so is unique to prepay, and therefore few postpay customers take up that option. Utilities are unlikely to save much electricity by using this strategy within a postpay context.

Feedback

Although an in-depth discussion of most of these behavioral influences can be found in [Appendix D](#), we elaborate here on one specific factor, feedback. One universal aspect of prepaid electricity programs is the inclusion of some sort of feedback mechanism that allows consumers to learn how much energy they are consuming. In some cases, this may be in-home displays that provide real-time information

(Faruqui, Sergici, and Sharif 2010), and in others it might be text, email, or phone alerts when customers' balances are low (Martin 2014). Modern programs that use smart meter technology also have the option of providing feedback on the web, in mobile phone apps, or through other integrated devices. As recommended by psychology researchers, new prepay software companies present their feedback in metrics that matter to consumers (e.g., dollars rather than kilowatt hours), and they use messages that are motivational and empowering. Prepay customers, even without smart meters, have reported using this feedback to systematically test appliances in their homes to learn how much electricity each one uses (O'Sullivan, Viggers, and Howden-Chapman 2014). International examples of prepay programs rarely use smart meters and instead usually provide feedback through a wall-mounted in-home device (often called a *keypad*) that is used to control the home's electricity and facilitate recharging of the account (see Esteves et al. 2016 for photos of some common devices). Nevertheless feedback is important in all contexts.

Feedback is a behavior change strategy that is supported with a large body of evidence from the field of psychology and can reduce energy consumption on its own, without the need to pay in advance (e.g., Karlin, Zinger, and Ford 2015). However feedback within the context of prepay may be more powerful than within postpay. Aside from using effective messaging and metrics that empower customers, they also come bundled with other motivators that encourage customers to attend to the feedback. One Japanese study found that the amount of attention participants paid to their feedback (i.e., the frequency of use of their in-home displays) affected their demand elasticity for energy (Matsukawa 2004). This suggests that participants who are motivated to pay attention to their feedback devices might be more likely to conserve electricity. If other aspects of prepay programs (e.g., rapid shutoff) can motivate this increased attention, then feedback might have a stronger impact on behavior. This hypothesis has yet to be directly tested, but it could explain why feedback alone might not reduce electricity usage as much as within a prepay context.

Another difference between prepay and postpay feedback is the presentation of loss as opposed to gain. Feedback in prepay programs usually takes the form of information about the amount of electricity that consumers have remaining in their accounts, as opposed to the amount of electricity that they have spent so far (i.e., consumed from a specific point in time). This counting down in prepay as opposed to counting up in most feedback research could somewhat invalidate a comparison between the feedback research to date and prepay feedback. Although some nonexperimental evidence indicates that in-home display programs with prepay might, in some cases, encourage consumers to use less electricity than programs that use only in-home displays without prepay (Faruqui, Sergici, and Sharif 2010), this evidence is equivocal and no program has yet tested the effects of a counting-down feedback approach without prepay. Feedback that is presented as a countdown might be innately more effective than feedback that counts up because of a loss aversion effect (Tversky and Kahneman 1991).²⁰ Therefore future studies comparing the effectiveness of feedback in conjunction with prepay and postpay plans should use the same (countdown) type of information with both types of plan to get an accurate understanding of the potential additive effects of prepay.

²⁰ *Loss aversion* refers to the general tendency for people to prefer avoiding losses to acquiring equivalent gains.

Effective feedback (with messages that motivate and empower customers) may be a primary reason that prepay plans reduce electricity consumption, and this is not a feature that must be unique to prepay. However, more research is needed to learn whether feedback is more powerful within the context of prepay than with postpay. Tests are needed that explore feedback devices with and without prepay and with information that is presented in an equivalent manner.

Uncertainty about the Most Important Influences

Without experimental trials to test prepaid electricity program elements independently and together as one program, we cannot say with certainty which elements are required for prepaid programs to change behavior and reduce electricity consumption. The full suite of influences working together may be required to change behavior. However, if savings can be achieved without fast shutoffs or increased costs, implementers may wish to create prepay programs that exclude these factors. If energy efficiency is the goal of the program, then examining these influences independently is important.

Some evidence from qualitative interviews with prepay participants indicates that the combination of prepay program factors, especially feedback and disconnection, work together to reduce consumption (e.g., O’Sullivan, Viggers, and Howden-Chapman 2014). Prepay program customers learn from the feedback they receive and are motivated to pay attention to that feedback to avoid using up their credit and getting electricity shut off. They are also more motivated to understand how much behavior affects electricity usage because they are more engaged in paying electric bills. Customers do not claim that the increased costs associated with prepaid electricity programs affect their behavior, but as with any qualitative interview-based study, answers that are explicitly provided may not explain all behavior variances. This may require additional examination.

Could these behavioral influence elements be incorporated into postpay plans to achieve the same conservation effects? For some aspects, the answer may be yes. Postpay plans could include enhanced feedback devices that provide understandable and motivating information to customers (more than provided by traditional feedback devices). If most of the prepay conservation effect is the result of this type of feedback, then the result could be replicated with postpay customers as well. Further research would be needed to determine whether clear feedback on a declining available account balance has more impact on consumption than feedback on how much energy has been used. For example, customers could be alerted to a pattern in their usage and predicted bill amount, e.g. “You have \$x of electricity usage left this month before you reach your average for this time of year.”

Other elements are more difficult to apply. Postpay plans could have stricter (and faster) disconnection policies, they could encourage customers to pay small amounts more often or in advance, they could be made more expensive, and they could require active payment (rather than allowing autopay). However, these policies would likely be unwelcomed by regulators, consumers, and utilities alike. Prepay programs could likewise have less-strict disconnection policies (or no disconnections, which some have proposed), could have identical costs (which some do), and could allow autopay (which some do). Even so, this full combination of user-friendly practices has yet to be tested for electricity savings. Prepay

programs with and without these elements would need to be systematically tested to understand which elements are most important to achieve energy savings.

Prepay Considerations from Opponents and Advocates

The case for prepaid electricity as an energy efficiency program has both strong proponents and opponents from across a variety of sectors. Through our interviews and additional research, we identified a variety of considerations raised by both sides. As Minnesota stakeholders contemplate prepay programs as a potential part of the state's energy efficiency strategy, they should examine these considerations. We begin with an examination of why prepay programs are usually implemented and then move to a discussion of themes that are raised by opponents and advocates of prepaid electricity.

Motivations for Implementing Prepaid Electricity Programs

Most utilities implement prepay programs for reasons other than energy savings. In many cases, evidence points to the expansion of prepaid electricity options internationally (Esteves et al. 2016) and domestically (Prepaid Energy Hub 2015) without an energy efficiency focus. In countries such as Australia, New Zealand, and the United Kingdom (and especially Northern Ireland), utility companies implement prepay options to reduce debt collection issues and nontechnical electricity losses (primarily caused by fraud activities), as well as to help low-income households avoid high bills (Esteves et al. 2016).

Although US prepay programs are less established, DEFG has collected information on the initial US programs. In their database of 40 programs (N. Treadway, Managing Partner, pers. Comm., July 12, 2018), implementers claim their primary reasons for implementation are²¹

- Providing customers an additional payment option (18 programs)
- Reducing debt, offering debt recovery options while keeping electricity on, reducing write-offs (8 programs)
- Providing energy efficiency, demand-side management (DSM), or conservation programs (8 programs)
- Increasing customer satisfaction or customer service (7 programs)
- Avoiding deposit required for postpay (7 programs)
- Leveraging installed AMI technology (3 programs)

The potential costs and benefits of prepaid electricity plans include both direct and indirect considerations. In Table 5 and Table 6 we summarize these costs and benefits, based on our stakeholder interviews and literature review (in particular DEFG 2016).

²¹ Some programs have multiple reasons.

Table 5. Prepay program costs and benefits to customers

Potential costs	Potential benefits
Potential additional monetary costs for²² - Higher kWh rates - Program fees - Security deposit (for in-home display) - Reconnection or disconnection fees - Transaction fees from third-party vendors, such as payment kiosks - Communication costs (e.g., text messaging) Required payment of - Outstanding debts with every top-up (up to 40% of top-up payment can sometimes be required to go toward arrearages) - Minimum amount for top-up purchases Time spent - Paying for electricity (typically several times per month) - Commuting to a location more frequently to pay for electricity, especially if paying by cash or check²³ - Learning about household behavior and electricity use Potential health or safety effects from going without electricity more frequently²⁴	Reduced electricity usage Increased knowledge about how behavior relates to electricity use and electricity costs Increased sense of control from - Electricity budget being set in advance - Allowing more convenient payment options than postpay - Having a larger selection of electricity plans from which to choose - Allowing small incremental payments, when cash becomes available Allow budget-constrained customers to continue getting power by - Providing an option that does not require an initial deposit - Providing a way for customers to pay off arrearages over time while still receiving electricity service

²² Many new programs waive these additional fees.

²³ An estimated 11% of Americans pay electricity bills in person (Albertazzi 2017).

²⁴ Prepay customers may go without electricity more frequently, but some evidence suggests that disconnection periods may be shorter than in postpay (APS 2015). The difference in health effects from disconnections under both plans requires additional research.

Table 6. Prepay program costs and benefits to utilities

Potential costs	Potential benefits
Investment in - Advanced metering infrastructure - Communications - Meter data management - Customer information system - Systems build/integration - Call center (staffing, training) - Prepay software	Increased revenue from - Better revenue recovery - Sometimes higher rates - Avoided costs for paper billing - Avoided collections and termination costs - Fewer nontechnical losses (usually fraud activities and theft)
Payment for - Transaction fees (if third-party charges are covered by the utility) - Legal - Marketing	Improved customer satisfaction from - Reduced customer abandonment - Improved customer experience - Providing additional plan options
Effort and time for - Business change - Regulatory approvals	Improved business practice outcomes from - Possible higher call center morale because customers may call less frequently about high bills and shutoff complaints
Reputational effects from - Perception that utility is motivated by revenue recovery - Consumer advocate criticism - Negative media attention	- Utility meeting its mandate to leverage advanced metering infrastructure technology

Table 7 provides a brief overview of each prepay consideration or theme we identified through interviews and research. [Appendix A](#) contains more detailed information about each interview theme.

Table 7. Common themes from interviews about prepaid electricity plans

Category	Theme	Description
Research	Lack of research	Current research does not adequately explain why prepay energy leads to energy savings. More and better studies should be conducted to provide better program evaluations.
Customer	Customer satisfaction	Many prepay programs highlight high customer satisfaction.
	Customer control	Prepay allows customers to control their energy use and save on their energy bills.
	Voluntary	Prepay should be a voluntary opt-in program.
Utility	Utility costs	If prepay is not counted as an energy efficiency program and customers do see an energy reduction, utilities may face lost revenues.
	Utility savings	Utilities can recoup customer payments that may have been lost in arrearages through payment options in a prepaid plan.
	Prepay instead of other efficiency measures	Some advocates argue that utilities should spend their money on typical energy efficiency programs, and using prepay plans as energy efficiency programs could be a distraction or divert resources.

Category	Theme	Description
Consumer protections	Disconnection as main motivation for energy savings	While disconnection is a contentious issue for consumer advocates, disconnection likely is a strong motivator of energy savings.
	Deprivation	Some are concerned about whether prepay motivates customers to save energy through efficiency actions or deprivation actions.
	Quality-of-life concerns	Some believe that prepay will improve quality of life, while others are concerned that it will reduce quality of life.
	Targeting low-income customers	Many prepay programs tend to target low-income customers either overtly or indirectly. Given the vulnerability of this group, consumer protection concerns are particularly important.
	Equity concerns	Concerns center on ensuring that prepay programs maintain consumer protections.
Regulation	Regulatory concerns	Some regulatory decisions have rejected prepay programs for several reasons.

Research-Related Themes

Prepay electricity program evaluations do demonstrate energy savings. However most interviewed stakeholders—including both prepay advocates and consumer advocates—indicated that more research is needed to determine whether prepay should become a utility efficiency program offering. Researchers suggested that evaluations should parse out different elements of prepaid programs to determine what leads to energy savings. Pilots could also see what impact disconnection has on energy savings by testing financial motivators such as late-pay penalties or rewards for on-time payments. Interviewees also suggested collecting information on self-disconnection statistics to better track and calculate prepay electricity savings. In addition, one consumer advocate felt so strongly against prepay programs as an energy efficiency measure as to believe it was unethical to even study prepay as a pilot program. Even so, with proper oversight, consumer protections, and strong evaluation design, prepay pilot programs can provide important information to help regulators determine whether prepay is an ethical approach to energy efficiency.

Customer-Related Themes

Customer Satisfaction

Existing program evaluations suggest that prepay program customers feel a high sense of satisfaction. In some cases they may prefer prepay to postpaid plans despite some of the potentially punitive characteristics (e.g., Baptista 2015; O’Sullivan et al. 2013). Our interviews with one prepaid program proponent cite anecdotal evidence of customers calling utilities to thank them for the program. An academic expert who had interviewed low-income customers also mentioned that some Arizona interviewees specifically chose to live in regions that had a prepay program. Some consumer advocates

claim that satisfaction surveys from utilities and prepay advocates are not made public, and therefore questions asked cannot be scrutinized. However, we found that these surveys do tend to align with peer-reviewed research and our interviews with nonaffiliated parties. Minnesota utilities also found the customer satisfaction research to be very compelling and worth closer examination. These utilities felt that prepay payment options provided customers and members with a convenient and transparent way to handle utility bills.

Customer Control

Stakeholders often cited customer control as a prepay program benefit because customers can reduce the surprise of a high bill by setting their energy budget and paying in advance. They can also understand how behavioral choices and actions affect their utility bill on a near real-time basis versus waiting a month to see their use over a long period. One Minnesota utility felt that because customers will not be surprised by big bills—one of the main reasons customers call—prepay programs can be a carrot rather than a stick. For customers without much financial flexibility, having transparent and real-time data will allow for better bill management. Although this was a clear theme in discussions with stakeholders, we note that at least one report suggested that customer control may not necessarily be a characteristic that must be unique to prepay (Howat and McLaughlin 2012).

Voluntary Program

Most, if not all, stakeholders indicated that prepay programs should be voluntary opt-in programs. The majority of US prepay programs are voluntary in that they allow customers to switch to other payment methods if they are unhappy. While many stated that prepay programs are currently opt-in, some consumer advocates argued that prepay is not always voluntary due to barriers, such as high deposits or accumulated arrearages, that may prevent a customer from enrolling in another payment plan.

Utility-Related Themes

Utility Costs

Although customers enrolled in a prepaid program may have potential energy savings, some utilities have regulatory concerns that prepay programs cannot be counted toward efficiency. Regulatory-sanctioned energy efficiency programs allow a utility to count savings toward their efficiency portfolio. However, if programs are not considered efficiency, savings may lead to reduced revenue over time. One consumer advocate suggested that prepay programs could be added to utility decoupling models separately from energy efficiency so that costs can be recovered from reduced revenue without counting prepay toward utility efficiency requirements.

In addition, utilities incur associated prepay program infrastructure costs, such as the installation of AMI. While many utilities are moving toward AMI, Minnesota has been slow to increase penetrations across

the state, with smart meters accounting for less than 20% of all residential meters (EIA 2017). Although programs in other regions of the world have operated prepay programs for decades without AMI, these meters are the North American standard for their ability to provide granular data on real-time energy use through in-home displays and smart devices. One Minnesota utility said they would not want to move forward with prepaid programs without AMI because real-time data impact customers the most. AMI also allows utilities to communicate via multiple channels.

Utility Savings

Prepay programs often address arrearage repayment issues by incorporating debt repayment into each bill top-up payment. This payment option may be more manageable for customers in debt, potentially allowing them to stay out of future arrears. Utility stakeholders and other prepay proponents have suggested that this process helps both the customer and the utility in terms of reducing overall arrearages and, in turn, decreases associated accumulated debt costs for the utility.

Interviewees cited additional utility cost savings associated with disconnections. AMI with a prepay program structure allows for these savings as the utility can disconnect customers remotely and reconnect them quickly—often within hours and with no need to send a technician to the home. Opponents argue that this benefit may not be unique to prepay but rather to AMI implementation.

Prepay instead of Other Efficiency Measures

As noted earlier, whether prepay programs should be considered for energy efficiency program portfolios is subject to debate. Current evaluations suggest that prepay programs can gain significant energy savings. However, several consumer advocates voiced concerns that these savings accrue at the cost of consumer comfort or basic needs. Some felt that the savings were primarily from deprivation and disconnects. One advocate felt that while prepay did allow customers increased control over energy bills, more research is needed to determine the effectiveness of prepay as an efficiency measure. Many consumer advocates felt that utilities should spend money and resources on traditional energy efficiency program measures, such as retrofits and weatherization, rather than on prepay infrastructure.

Utilities, especially those in Minnesota, expressed strong interest in having prepay as both a payment option and a behavioral efficiency program, like home energy reports. They felt that having prepay included as an energy efficiency program would allow them to offer a service that customers want, save energy, and recuperate costs. This becomes especially important as the market transforms for other efficiency measures.

While this topic is still debatable, it is important that it be resolved. In our recommendation sections, we provide a path to building consensus on this issue in Minnesota.

Consumer Protection–Related Themes

Automatic Shutoff

While likely a significant contributor for high energy savings from prepay programs, disconnection is also the most contested prepay program design element. Prepay program advocates highlight the ease with which customers can be disconnected and reconnected without additional fees. Consumer advocates tend to oppose the automatic shutoff element of prepay programs and voice concerns around proper disconnection notification, energy assistance program access, and potential for shutoffs without adequate warning or emergency assistance. One consumer advocate said that disconnection was the core issue, stating that customers can receive feedback and other prepay program benefits without automatic shutoffs—which can lead to higher personal and societal costs such as food and medication loss from refrigerator thawing. Another consumer advocate indicated being less concerned about automatic shutoffs if customers received adequate warning, such as through an in-home display or a live phone application. In addition, most new prepay programs exclude customers who require electricity for medical reasons to avoid life-threatening impacts from disconnection.

Some Midwest stakeholders indicated they were concerned about the automatic shutoff aspect of prepay programs and were interested in exploring ways to avoid disconnection. Some evidence suggests that prepay customers may experience more-frequent disconnections than those on postpay, but two American evaluations found the average amount of time on prepay without electricity is usually about seven hours or less (DEFG 2014; APS 2015).²⁵ Conversely, a peer-reviewed New Zealand study on prepay found that one-third of respondents self-reported disconnections lasting over 12 hours in the past year (O’Sullivan et al. 2013). In general, while some disconnections result from budget constraints, most customers claim they occur due to forgetfulness or lack of time (Mummery and Reilly 2010; O’Sullivan, Viggers, and Howden-Chapman 2014). However one interviewee pointed out that embarrassed customers may understate the frequency of shutoffs due to budget constraints.

We spoke with two Minnesota utilities that were reluctant to include remote disconnects as part of the program yet would seek regulatory guidance on the appropriate path forward. One method by which a program could be implemented without remote disconnects is providing the customer a short grace period, followed by a transfer to a traditional postpay structure.²⁶ For Minnesota, a particular issue will be avoiding or minimizing disconnections during the prime heating season.

²⁵ Based on a limited comparison of 16 people, one evaluation found that the duration of disconnection was significantly shorter on prepay than on postpay (APS 2015).

²⁶ One example of this procedure was proposed by a Midwest utility for a new prepay pilot program (that has since been withdrawn). Under the proposed program, low-income consumers who reach a \$0 balance could accrue arrears for eight days before being transitioned to a postpay plan. Any arrears accrued before being transferred would be paid back by garnishing prepay customers’ top-up payments by 25%. The prepay plan would not require a deposit for initiating service.

Deprivation or Energy Efficiency Behavior

Minnesota lawmakers define *energy efficiency* as a reduction of energy consumption “without a reduction in the quality or level of service provided to the energy consumer.”²⁷ Therefore a program that reduces quality of life or causes consumer deprivation would not be considered effective energy efficiency. Quality of life is primarily a subjective concept, but it also has some objective components (see Glossary for further details). Examining prepay plan effects on participants’ specific behaviors and perceptions may help shed light on whether prepaid electricity plans reduce or enhance quality of life and therefore should (or should not) be considered energy efficiency. In this section, we combine our interview data with information from available literature to evaluate whether prepay plans may negatively or positively influence quality of life.

Improving Quality of Life

Most peer-reviewed academic research on international prepay examples (e.g., Baptista 2015; Mioyogo, Nyanamba, and Nyangweso 2013; O’Sullivan, Viggers, and Howden-Champan 2014; O’Sullivan et al. 2013), along with most other domestic and international prepay reports (e.g., CER 2011; Z2Solutions 2014; DOE 2015; Wimberly 2014), agree that customers on prepaid electricity plans are satisfied with the service and may, therefore, experience a slight improvement in their subjective quality of life. O’Sullivan and colleagues (2013, 2014) interviewed and surveyed prepay customers to understand what they think of the program and how it has changed their behavior. She found that, despite a few concerns, such as the physical location of the meter in their homes and the accessibility of payment kiosks, consumers liked the program. Her participants were in New Zealand and, despite higher per-kWh rates for prepay (at the time) and higher likelihood of disconnection, they nevertheless felt that the benefits of prepaid electricity outweighed the costs. Interviews by Professor Diana Hernandez at Columbia University of prepay program participants in Arizona found that they generally favored having prepay meters, as it allowed them to “closely monitor consumption, manage costs, and avoid large bills.” Some participants mentioned choosing where they lived based partially on the availability of prepay (D. Hernandez, professor, Columbia University, pers. comm., July 12, 2018).

Similarly, program evaluations such as those in rural US cooperatives report customer satisfaction rates of 80% or higher (Z2Solutions 2014; DOE 2015). Consumers like prepay programs because they help participants budget and control their bills (e.g., Wimberly 2014), avoid large deposits required for postpay plans (Z2Solutions 2014), and provide flexibility for controlling use (e.g., topping up with frequent small payments when cash is available; D. Hernandez, Columbia University, pers. comm., July 12, 2018).

Prepay customers also learn about how much electricity each household behavior uses in ways that most postpay customers do not. Those with limited incomes can then ration and budget electricity use for what is most important to them (O’Sullivan, Viggers, and Howden-Chapman 2014; Baptista 2015). For example, consumers may cut back on ironing their clothes because they learn how much electricity

²⁷ Office of the Revisor of Statutes, 2017 Minnesota Statutes, section 216B.241, subdivision 1 is available [online](#).

that small task can use (Baptista 2015). They may also prioritize a variety of activities that add to a rich quality of life. Limited-income individuals who must choose between necessities appreciate the flexibility of prepaid electricity plans. Prepay electricity will not alleviate poverty issues or reduce energy burdens, but it allows these customers to control electricity usage without going into debt. For those with debt, prepay allows customers to pay down the balance while keeping the lights on.

According to the few surveys and available interviews, prepay program participants are satisfied with the program and do not indicate they feel deprived of energy use. Notably, however, some surveys are conducted by proponents of prepaid electricity (e.g., Wimberly 2014, 2018), and none include participants who chose to switch from prepay back to postpay. Therefore, although the overall evidence suggests that customers like prepay plans, this finding could be somewhat influenced by a selection bias.

Reducing Quality of Life

Despite evidence that points toward improved subjective well-being, consumer advocates argue that prepay electricity plans reduce quality of life for three primary reasons:

- They increase the number of disconnections.
- They may reduce customer protections.
- They can be more expensive.

In response, most modern proposed or planned prepay electricity plans attempt to address these concerns. Nevertheless several recent state regulatory decisions have gone against applications for prepaid programs and pilots because of consumer protection issues (see [Appendix C](#) for a review of these decisions).

Subjective well-being and objective well-being may not always align. Although subjective well-being and satisfaction are important to consider, objective measures of fairness and health are also worth examining. For example, consumers may be willing to spend more to participate in a prepaid electricity program and may experience increased subjective well-being, but from a macro perspective those additional costs may nonetheless reduce quality of life (especially given that prepay consumers usually have lower incomes), and more objective health measures might be useful to examine. Prepaid electricity plans may be appreciated by plan members, but advocates argue that other programs may reduce electricity use while better protecting low-income customers.

Few studies investigate the health outcomes of low-income prepaid electricity plan customers. Professor Diana Hernandez recently interviewed several low-income residents in Phoenix, most of whom were using prepaid electricity plans, and found that while the prepay participants she interviewed liked the program on a widespread basis, they also described depression, anxiety, and worry over their inability to pay bills as well as physical health conditions that emerged due to this stress (D. Hernandez, professor, Columbia University, pers. comm., July 12, 2018). One New Zealand study found that prepaid electricity customers sometimes reported cold housing, with 57.2% claiming they could see their breath condensing inside at some point and 67.5% stating that they were shivering on at least one occasion

(O’Sullivan et al. 2013). Nevertheless more studies of objective health outcomes of prepaid electricity customers are needed.

In New Zealand in 2011, elderly and those with chronic obstructive pulmonary disease (COPD) on prepay plans reported in interviews that they were concerned they might be left without power for required medical devices (O’Sullivan, Howden-Chapman, and Fougere 2011). Responding to concerns that low-income prepay consumers may engage in extreme self-rationing that can prove a health and safety risk, most prepay plans now include consumer protection clauses and do not allow customers with certain medical histories to participate. Traditional postpay plans include consumer protections that require sufficient notice before disconnection.

According to research conducted in New Zealand, prepaid electricity programs may not be an effective method of alleviating fuel poverty for the poorest customers (O’Sullivan, Viggens, and Howden-Chapman 2014).²⁸ Although low-income customers may feel empowered by prepay, they simultaneously put themselves at risk from disconnection-related problems. These customers are most likely to ration their electricity use but have fewer rationing options than others and less money to invest in energy upgrades. Therefore they are more likely to self-disconnect and experience other negative health and quality-of-life impacts (O’Sullivan, Viggens, and Howden-Chapman 2014). Notably, disconnection can also be a problem for some customers in postpay plans.

According to the current Minnesota application for the federal Low-Income Home Energy Assistance Program (LIHEAP), low-income prepay customers would likely qualify for the seasonal benefit, but the crisis benefits might need to be revisited in the context of prepay (because one of the criteria is that electricity is about to be shut off, which may happen more frequently under a prepay plan).²⁹ LIHEAP seasonal benefits are provided to families based on energy cost, household size, and income (MN Department of Commerce 2018). However, LIHEAP applications are not consistent across states, and some agencies may find it difficult to provide prepay customers with bill assistance subsidies through LIHEAP or other bill payment programs. Some states require high bills or arrearages to award a LIHEAP grant, which is not possible on a prepaid plan (LIHEAP Clearing House 2014). Prepay customers in those states who benefited from LIHEAP may, therefore, experience a reduced quality of life. Notably, even if LIHEAP crisis funds are made available to prepay customers, they may not arrive quickly enough to avoid shutoff (Utility Bill Assistance 2018).

Targeting Low-Income Customers

Low-income customer impacts are important to consider. Some consumer advocates are concerned about how prepay and automatic shutoffs affect customers already strapped for resources and susceptible to disconnections. Some propose denying these customers access to prepaid programs, while others advocate state-level customer protections for enrollees. As an example, programs can

²⁸ *Fuel poverty* is defined by [Hills \(2012\)](#) as a state in which a household’s required fuel costs are above the median level, and after paying the energy bill the household is below the official poverty line.

²⁹ The application is available online at the Minnesota government [website](#).

ensure that prepay customers receive adequate notice and have access to bill payment assistance programs or receive discounted kWh rates.

While most prepay programs do not indicate that they are directly targeting low-income customers, many are either indirectly enrolling or attracting them. According to our literature review and interviews, part of the reason that low-income customers are drawn to prepaid electricity program participation is that they prefer not to pay or are unable to pay the deposit required for postpaid plans. In other cases, these customers have arrearages that must be settled before they can re-enroll in postpaid plans (Howat and McLaughlin 2012). Low-income customers with constrained budgets sometimes like the predictability and control they get from prepaid electricity plans (e.g., Wimberly 2014). Budget-constrained consumers may also reduce their consumption more than any other income group in response to enrolling in prepaid electricity plans (APS 2015; Jack and Smith 2016).

Equity Concerns and Consumer Protections

Interviewees stressed that prepay programs may pose some equity concerns in terms of program design and implementation. Some program design costs, such as topping-up transaction fees or text messaging fees, are borne by the customer. Utilities sometimes charge prepay program customers a higher rate as well. These factors may make the program more expensive than other payment options, which is particularly concerning for low-income program participants.

Regulatory Concerns

State regulatory decisions regarding prepay programs are few. This is largely because electric co-ops, not typically subject to state rate regulation, implement most prepay programs. State regulators are usually bound by extensive consumer protection rules and have expressed concerns about consumer protections when faced with prepay program proposals from state commission–regulated investor owned utilities (IOU). Regulators also find it more difficult to approve waivers of shutoff rules and are often challenged by consumer advocate groups during IOU prepay proposal proceedings.

We reviewed seven recent state regulatory decisions pertaining to the following utilities: Arizona Public Service (2015), PECO (PA PUC 2018), Duke Energy Ohio (OH PUC 2010), Progress Energy Carolinas (NCUC 2012, 2018), Ameren Missouri (MO PSC 2017), Westar (KA CURB 2016), and SDG&E (CA PUC 2014). We briefly summarize each of these decisions in [Appendix C](#). These utility applications for prepaid electricity pilots or program expansions were denied for several reasons. The most common was a concern that the proposed programs would not provide sufficient consumer benefits and, in some cases, might cause consumer deprivation. Another common reason for denial was an insufficient argument for the programs' cost effectiveness as a customer billing option. Energy efficiency was rarely positioned in these proceedings as a key benefit of prepaid electricity programs.

Minnesota Regulation

The long heating season in Minnesota is also an important factor in regulatory reviews of prepay programs. Under postpay plans, customers' unpaid use of electricity during especially cold months is accumulated as arrears. Under a prepaid system, customers who run out of electricity credits generally cannot accumulate arrears. In some regions, such as Northern Ireland, this problem is addressed by the provision of small amounts of emergency credits that can be used by customers whenever they like and then paid back through garnishing of top-up payments. This may not work in a region that could have extended peak cold events. Minnesota regulators should specifically address the issue of cold-weather shut-offs in any future discussion of prepay.

A Note on Prepay Programs for Natural Gas Utilities

While our study is focused on prepaid electric programs, a few are offered in natural gas service territories. During our stakeholder interviews, we spoke with a Minnesota natural gas utility to understand their perspective on the feasibility of prepay programs in their service territory. While natural gas and electrical prepay programs have some similar issues, natural gas consumption is fundamentally different from electricity consumption. Consumer protection issues during disconnects are especially important for natural gas utilities due to Minnesota's cold weather rule, but a safety issue also needs to be addressed. If gas is shut off, pilot lights would also go out. For a home without electronic ignition, each pilot would have to be relit manually. If they were not relit, they would pose a serious safety hazard.

An additional issue is around the AMI installations. The natural gas utility representatives that we spoke to did not expect any future AMI installations, and any potential program savings would not justify expensive new meter installation costs.

Potential Energy Efficiency Impacts of Prepay in Minnesota

Estimating Impacts

Given the limitations regarding the available evaluations on this subject, estimating the potential impacts if Minnesota utilities were to offer customers prepayment options is difficult. We are unaware of any other state that has attempted to calculate such an estimate. In producing the estimates contained herein, we made several assumptions on both prepay program structure and technical infrastructure required for a robust program. We provide more description of necessary program design elements in our recommendations section. We would also note that in preparing this estimation, we make no assertion that prepay should necessarily qualify as a conservation improvement program in Minnesota.

We developed two scenarios (Table 8).

Table 8. Description of assumption for Program One and Program Two

Scenario	Program One	Program Two
AMI	In place	In place
Selection	Voluntary / Opt-in	Voluntary / Opt-in
Savings from disconnection	Savings from disconnections are excluded from final evaluation	Savings from disconnections are excluded from final evaluation
Disconnection	Upon reaching a \$0 balance, customer receives notification of imminent disconnection. Disconnection occurs at the next legally permissible time	Upon reaching a \$0 balance, customer receives notification but continues to receive electricity for a short grace period. After grace period, customer is transferred to a postpay plan
Feedback	High levels via an in-home display, smartphone app, text message, or website	High levels via an in-home display, smartphone app, text message, or website
Savings estimate	Average of the strongest evaluations that exclude savings from disconnection	Typical savings value from customers who have participated in an opt-in program with a similar interface

Program One allows for immediate disconnect upon missed payments. Program Two carries no threat of disconnection (e.g., after a grace period, customers simply move back onto a traditional payment plan if they miss a payment). The reason behind breaking out the savings in this way is that the disconnection

threat may be a strong motivator for saving energy, and some recent program proposals have suggested removing it. While some evaluations analyzed savings excluding energy saved during disconnected times, we believe the programs' influence would be qualitatively different in a scenario without the disconnection threat. Both scenarios assume the following:

- Advanced metering infrastructure is in place.³⁰
- Real-time information can be provided to the customer through several modes of communication (i.e., text, web, and phone).
- The program is voluntary or opt-in.
- The savings rate does not include savings from disconnection.

For the second scenario, we hypothesize that through high levels of feedback and engagement, we would still see energy reductions. DTE Energy Insights is a smartphone feedback app program that provides near real-time feedback on customers' usage. The initial pilot programs demonstrated electricity savings between 1.1% and 3.2% (Sussman and Chikumbo 2016). A similar study of the myMeter app also found 1.8% to 2.8% savings (Dougherty 2014). A prepay program with no threat of disconnect may function in a similar way; however, we feel this area is one where further research would strengthen the ability to produce useful estimates.

We determined our baseline energy consumption from residential sector values recently developed for the Minnesota Demand Side Potential Study as shown in Table 9. Without research that substantiates the specific ways participants reduce energy, we assume that savings can be achieved across all end uses.

The Program One savings rate is derived from an average of the strongest evaluations that control for savings from disconnect. The savings rate for Program Two is based on a typical savings value from customers who have participated in an opt-in program with similar interface, such as the DTE Energy Insights or myMeter smartphone feedback app (Sussman and Chikumbo 2016; Dougherty 2014).

In both scenarios, we assume that every Minnesota utility would offer a prepayment option as an opt-in program. Because of the opt-in nature, the assumed participation rate is low (1%) across all state utilities. The participation number for both programs is based on the participation rates of the only Minnesota utility with a prepayment option (around 400 out of 40,000 members; E. Webster, Vice President Corporate Services, MVEC, pers. comm., June 15, 2018). Other utilities have seen participation rates closer to 5%.³¹ Absent other Minnesota-specific data on similar levels of participation, we kept our assumption at a conservative 1%.

³⁰ At this time, this may be the most significant infrastructure hurdle facing the state. According to the US Energy Information Administration ([EIA](#)), less than 20% of residential Minnesota customers had smart meters installed as of 2016.

³¹ This was reported by a prepay advocacy organization, DEFG, webcast on July 18, 2018.

Table 9. Annual energy reduction estimates and assumptions

Scenario	Baseline residential energy consumption (GWh)	Annual usage reduction	Total potential statewide annual savings (GWh)³²
Program One: Customers can be disconnected after payment lapse	10,627	8.5%	9 GWh
Program Two: Customers will not be disconnected after payment lapse but moved to traditional payment plan	10,627	2%	2.1 GWh

³² This assumes a 1% statewide participation rate. The preceding text presents additional reasoning behind that assumption.

Recommendations

Given the current state of knowledge, to say whether prepay plans should qualify as energy efficiency under Minnesota's conservation improvement programs would be premature. The number of North American prepay program evaluations is insufficient, and they do not adequately explain why consumers save energy. Some prepay elements that may reduce consumption, such as feedback about use, could potentially be implemented in postpaid programs. Other prepay plan aspects that may negatively affect consumers, such as rapid shutoff, could be removed. However, current evaluations do not attribute savings to features that are not unique to prepay (such as feedback) or potential saving levels without the shutoff threat. Prepay programs save energy possibly due to the entire suite of behavioral influences working together. More research is needed to support this conclusion.

Our Minnesota utility interviews reveal considerable interest in prepayment program concepts. A well-designed pilot program could be a first step to addressing questions and determining whether prepaid electricity plans could be implemented as energy efficiency programs. Should a Minnesota utility be interested in launching a prepaid electricity pilot program, they should design it with consideration of (1) consumer protection issues and (2) evaluation of individual components of the program.

A Framework for Designing a Pilot Program

When designing a prepaid electricity pilot program to encourage energy efficiency, the pilot should both test the importance of key elements and incorporate known structural energy efficiency measures. The pilot program results can help identify which program elements can and cannot be eliminated while still maintaining energy savings. We therefore make recommendations regarding (1) implementation consultations, (2) research design methods, (3) regulatory considerations, and (4) cost-effectiveness evaluations.

Implementation Decision Making

Implementing a prepay electricity program comes with a host of technical, social, and monetary issues that are important to consider. Each of these issues involves stakeholders (e.g., utilities, consumers, and local government agencies) with diverse and equally important perspectives. Prepay pilot programs often fail regulatory review because they have not adequately considered the perspectives of all stakeholders.

One of the most important stakeholder groups is consumers, who are often represented by consumer advocates. Consumer advocates suggest that prepaid electricity programs should always be voluntary (even for consumers with arrearages or severe budget constraints), should not be more expensive than postpay (and arguably should be cheaper), should allow for bill assistance programs to be maintained (e.g., LIHEAP), and should be subject to the same consumer protections as postpay plans (e.g., no disconnections on extremely hot or cold days). [Appendix D](#) provides the National Consumer Law

Center's (NCLC's) complete list of consumer protection recommendations for prepay programs, many of which are addressed in new utility prepay pilot proposals.

Some US not-yet-public prepay programs have been recently proposed (and withdrawn) with alternatives to automatic shutoffs, such as reverting customers to postpay after a short grace period of non-top-ups.³³ Others have implemented a no-fee policy (e.g., no third-party vendor fees, reconnection fees, or deposits). In other regions of the world, some governments mandate that prepay plans have discounted kWh rates (usually 2% lower than postpay; e.g., Ireland and Bangladesh; Esteves et al. 2016; Darby 2006).³⁴ Minnesota stakeholders can consider these policy options for prepay. However, energy savings impacts have yet to be tested and measured under these modified consumer protection conditions.

Utilities offering rate-payer-funded efficiency programs have an additional set of concerns—that efficiency programs demonstrate cost effectiveness. Although preliminary studies indicate that prepay may increase utility profits, utilities may also need to consider upfront investment costs. This issue has come up during some prepay regulatory hearings. To date, only one evaluation we reviewed measured cost effectiveness (APS 2015), and it reported a cost-benefit ratio of 1.03.

We recommend convening a stakeholder advisory group to meet, discuss issues, and propose solutions. This step will adequately consider all stakeholders and viewpoints regarding a prepaid electricity pilot program. Consensus from all stakeholders would be a key piece of the program design process. Stakeholders should include representatives of utilities, consumers, and local government and other experts, such as academic researchers or evaluators.

Research Design

Another key piece of the design process is hiring a third-party evaluator to inform the program design. This dedicated neutral organization is critical to determine the nuts and bolts of program design and evaluation elements that will yield statistically significant and defensible results, such as sample size, duration, and methods. Ensuring neutrality is important for credibility and quality of the final program evaluation.

All acceptable programs must be designed with evaluation in mind. The evaluation should test the hypothesis that prepay electricity programs cause consumers to change behavior and reduce consumption in appropriate, measurable, and cost-effective ways. In other words, the evaluation should test whether the program influenced customers' electricity usage. However, to properly consider whether a prepay program is suitable for use as an energy efficiency program under CIP, the evaluation should do more than simply answer this question. The evaluation should also identify why these savings are likely to have occurred (i.e., isolate specific effects of elements such as feedback and disconnection)

³³ The authors of this report have been contacted to discuss these proposals, but were not authorized to present them publicly.

³⁴ The rationale for this decision is that utilities benefit financially from moving customers onto prepay and should, therefore, pass those benefits back to the customer.

and should provide information on what customers do that results in reduced usage (e.g., install EE measures, engage in constructive behaviors to reduce waste, or engage in actions that represent deprivation or reduced quality of life). The results should come from a large enough and appropriately representative sample, over a sufficiently long period, to be both accurate and generalizable. Due to real-world constraints, one pilot program is unlikely to achieve all these goals. Nevertheless well-designed programs may achieve some of these objectives and, over time, provide sufficient evidence to understand and assess. We therefore offer a few recommendations that will help achieve as many as possible.

Sample Size

Prior to program launch, utilities should work with a third-party evaluator to determine the appropriate sample size. The sample size is critical to this evaluation as it will determine the power of the program to find a statistically significant result. The sample-size calculation will be affected by several factors. Each additional study group will require more participants, but more consumption data per participant will reduce the number of required participants (e.g., fewer participants are required if each is able to provide 12 monthly bills as opposed to one annual average, or 24 monthly bills as opposed to 12 monthly bills). Utilities should assume that some participants will drop out of the program before the pilot is complete and therefore recruit more than are needed for the final analyses. In one evaluation, the implementer noted a 26% attrition rate (Duke Energy Carolinas 2017), which supports the suggestion to over-recruit for a study.

Control and Comparison Groups

The third-party evaluator should suggest an appropriate pilot program control group to determine whether the prepay electricity program (as opposed to other factors, such as changes in weather or economic conditions) caused a change in electricity use. Allowing only two groups (customers with prepaid electricity and control customers with postpaid electricity), as some previous programs have done, enables evaluators to learn whether customers on a complete prepay program consume less electricity than customers on a standard postpay arrangement. However, it does not inform evaluators about other important questions regarding what program features are affecting behavior. By including additional comparison groups, evaluators can learn about these specific issues.

A pilot prepay program can include several potential comparison groups in addition to customers on standard prepay and postpay plans. As more of these groups are included, the results become more informative. Additional comparison groups to consider include

- Postpay plan customers receiving feedback equivalent to prepaid customers (e.g., an app or in-home display that counts down remaining electricity to a set goal or average monthly level using effective metrics and empowering messages)³⁵

³⁵ The type of feedback to include is discussed in greater detail in the *Feedback* subsection of this report (found in the *Prepay Electricity Impact on Energy Use* section).

- Prepay plan customers with an alternative to immediate shutoff (e.g., move to postpaid after a grace period or pay a higher rate to top-up if account goes to \$0 balance)
- Prepay customers with an automatic top-up option (autopay)
- Prepay customers who specifically qualify (and do not qualify) as low income³⁶
- Prepay customers receiving physical efficiency measures such as low-cost home energy kits (with faucet aerators, LED bulbs, and so on) to enhance the energy efficiency aspects of the program (particularly for low-income participants)

Quasi-Random Design

Key to the control and comparison groups is that they are appropriately equivalent to the intervention group. That is, members of these groups should be as similar to the members of the primary prepay group as possible. That way any difference in electricity consumption can be attributed to the differences between programs (and specifically the elements within them). One major problem with most studies featuring nonrandom control groups is self-selection bias. This occurs when customers self-select into the intervention and any reduction in consumption could be attributed to some inherent characteristic of the participants rather than to the program (e.g., they are the type of people who would reduce their consumption anyway).

One South Africa evaluation eliminated self-selection bias by only including participants who were involuntarily enrolled in prepay. Ethical implications make this approach untenable in North America. We recommend using a wait-list control procedure instead. Using this procedure, a limited number of customers interested in the prepaid payment option would be allowed to enroll. Once that maximum participation level is reached, subsequent customers requesting to enroll would be informed that enrollment is full for the year, but they could be enrolled later. In the interim, they could participate in the study as control group customers. These customers in the control group could be provided with incentives to participate in the study, such as entering them into a drawing or some sort of honorarium. Depending on the program design (and future evaluation requirements), they could be offered a free home energy kit or a device that provides energy use feedback (equivalent to prepay).

Customers who are enrolled in the prepaid group could then be randomly assigned to receive the traditional prepay plan or one of the alternative prepay plans described.

Should this quasi-random assignment procedure be unfeasible, program designers could consider using a matched control procedure. This may offer marginally weaker evidence but nevertheless a useful piece of information regarding prepay electricity savings.

³⁶ Comparison groups composed of various demographic segments, such as low income, are not assigned into those groups like other comparison conditions. Instead they are duplicates of other conditions but containing only group members with those specific demographics.

Outcome Measures

Although customer electricity usage is the most important outcome measure with regard to consumption, surveys and interviews with customers will be important for understanding consumer responses and whether the program causes deprivation. Utilities should work with the third-party evaluator to design unbiased, informative, and transparent surveys.

Regulatory Considerations

As explained earlier (and in [Appendix C](#)), no prepay electricity programs to date have been proposed primarily as energy efficiency programs. They are proposed as utility offerings that provide bill payment options for customers, offer debt recovery options, increase consumer choice, and meet utility obligations to leverage AMI installation. Because prepay programs have implications for factors such as billing procedures and shutoff protection rules, the Minnesota Public Utilities Commission would need to be involved in decision making regarding any prepay pilot proposal. Should a prepaid electricity program be proposed as an energy efficiency program under CIP, then the Department of Commerce would also be involved in considering whether that proposal was appropriate under the CIP statute and framework. A utility interested in proposing a prepaid electricity program as part of CIP would need to coordinate the application with each of those Minnesota regulatory bodies.

Cost-Effectiveness Evaluations

Determining the cost effectiveness of prepaid electricity programs can prove challenging because costs and savings are not always directly related to the same budgets within an organization. For example, upfront investment in prepay software may come from a capital investment budget, whereas benefits from decreased arrearages and fewer nontechnical losses may go to operational budgets. Furthermore, nonmonetary benefits such as call center morale and nonmonetary costs such as health risks to customers are difficult to quantify. See Table 5 and Table 6 for our list of potential costs and benefits.

Program planning should involve preparing for evaluation of both monetary and nonmonetary costs and benefits. In Minnesota, this specifically means assessing the costs and benefits to society, the utility, and the participant. The societal costs and benefits are of particular interest and importance for evaluation of Minnesota utility programs.³⁷ To date, only one of the reviewed North American evaluations assessed prepay costs and benefits (APS 2015). It did not include an assessment of societal costs and benefits.

³⁷ For more details, see Minnesota Department of Commerce [website](#) or refer to the recently developed [National Standard Practice Manual](#).

Other Program Design Considerations

In addition to the high-level design, evaluation, and regulatory considerations, utilities considering a prepay pilot program will need to navigate the on-the-ground details of implementing a radical new customer-facing program.

Effective customer outreach and communication are essential for ensuring transparency and understanding. Nearly all the research we reviewed (peer reviewed and proprietary) suggests that customers like prepay services. Nevertheless the costs and risks may be higher for prepaid customers. Thus utilities must carefully plan and budget for a communication campaign that explains the potential benefits of prepay, while also educating customers on potential drawbacks. These could be large-scale media campaigns or direct marketing to target customers, or a combination of both. A discussion with stakeholder groups as well as communications specialists (well before the campaign) could ensure a smooth pilot program launch.

Given the radical shift in the fundamental process of notification and payment, utilities should plan to receive initially higher volumes of customer questions about the service. This may require specialized call center training and additional staff. Some reports from prepay advocates suggest that call center complaints may decrease over time to below baseline and may become less severe.

The new payment system will also require technological enhancements to databases and payment systems. Accuracy and reliability of these systems are vital to the success of the program. If the new system does not work correctly, then customer complaints will increase, trust will erode, and enrollment will decrease.

Summary and Conclusions

Minnesota's decision as to whether prepaid electricity plans could be used as energy efficiency behavior change programs rests on a combination of three interacting elements:

1. The program's ability to cost-effectively reduce electricity consumption
2. Program elements that cause electricity reduction
3. The nature of the customer actions that result in the usage reduction (i.e., reducing consumption without reducing level of service)

Previous evaluations suggest that electricity consumers likely use less electricity if transferred to prepaid electricity plans. However, this effect may be in part due to factors that reduce customer quality of life, such as going without electricity more often, or to factors that can be easily applied to postpaid programs, such as feedback.

Programs that optimally address the possibility of consumer deprivation may reduce potential energy savings. When the risk of shutoff is removed and costs are reduced, consumers (especially low-income consumers) will be better protected, but electricity savings may decrease or become nonsignificant. More research is needed to determine the impact of removing shutoffs and changing pricing in prepaid program designs and energy savings calculations.

In examining previous research, assessing current evaluations, and interviewing diverse groups of stakeholders, the clearest conclusion is that more research is required to understand how prepay programs work in North America. Minnesota utilities interested in conducting pilot prepay programs can help fill this knowledge gap. While we neither endorse nor condone prepay electricity programs, we offer a program design framework for interested utilities that addresses consumer deprivation concerns and provides answers to key program questions. Any such effort would have to be compatible with the applicable Minnesota regulatory framework.

Prepay electricity offers a possible additional payment option for Minnesota consumers—one that has the potential to change behavior and reduce energy consumption. We recommend that more research be conducted on this new type of program.

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Appendix A: Interviews

Interviewees

Mattias Bell, Xcel MN
Raquel Berg, Connexus
Todd Berreman, Centerpoint
Mark Brown, MyMeter
Jessica Burdette, Minnesota Department of Commerce
Elizabeth Chant, Independent Consultant
Liz Coyle, Georgia Watch
Dave Elve, PayGo
Rob Elwood, Minnesota Legal Services Advocacy Project
Pamela Ferris, Texas Ratepayers' Organization to Save Energy (ROSE)
Anthony Fryer, Minnesota Department of Commerce
Jason Grenier, Ottertail Power
Diana Hernandez, Columbia University
Ed Houn, MyMeter
John Howat, National Consumer Law Center
Kelsey Jack, Tufts University
Tina Koecher, MN Power
Bill LeBlanc, ESource
Kim O'Sullivan, Otago University (New Zealand)
Nick Mark, Centerpoint
Geoff Marke, Missouri Office of Public Council
Kristen Munsch, Citizens Utility Board of Illinois
Laura Silver, Minnesota Department of Commerce
Eddie Webster, Minnesota Valley Electric
Jamie Wimberly, Distributed Energy Finance Group (DEFG)
Cynthia Zwick, Arizona Community Action Agency (ACAA)

Interview Procedures

For each interview, we used a set interview methodology. We began the interviews by explaining the purpose of the project, funders, and project goals. We then asked each interviewee a set of predetermined questions:

1. Please describe your knowledge and/or experience with prepay electricity programs. What do you think about them generally?
2. In our report, we are aiming to paint the picture of the pros and cons of prepay programs. Could you please describe what you consider to be the benefits and what you perceive to be the concerns regarding prepay?
3. In your experience, how have you seen customers react to prepay programs?
4. What are your thoughts on using a prepaid electricity plan as a method to encourage people to save energy?
5. Are you aware of any evaluation reports on prepay pilot programs that would be useful for us to explore in our research?
6. Do you think prepay programs should be implemented at a large scale? What are the barriers that prevent prepay programs from being more widespread today?
7. *(Optional question for utilities with programs)*
 - a. If you count energy savings from your program, how do you count it? Do you use third-party evaluators? Do you have evaluation reports that you could share with us?
8. *(Optional question for Minnesota stakeholders)*
 - a. Do you think prepay is a viable option for utilities in Minnesota, either as a payment option or as an efficiency measure? What are some key considerations?
9. Do you have any final comments or thoughts you'd like to share with us?

Summary of Themes from Interviewees

We reviewed the main arguments and statements from the interviews and developed summary tables of interview themes that are more in-depth, relative to the single table presented earlier in the report. In addition to the four themes summarized in the table earlier in the report (research, customer, utility and consumer protection), these tables also include program design. We indicate in the tables the type of stakeholder that brought up each issue, but we do not attribute sentiments directly to interviewees, for confidentiality.

Table 10 summarizes themes related to the category of research.

Table 10. Summary of themes from interviewees on topic of more research needed

Interviewee type	Main point/findings on topic of more research needed
Academic	We need more research to determine why customers are saving energy on prepaid meters and distribution impacts on rich versus poor customers.
Academic	It is important to collect information on self-disconnection stats to track who is being affected and how long people are without electricity (either voluntarily or nonvoluntarily).
Prepay advocate	Interviewees agree that we need more experiments that look at the impacts of shutoffs, financial penalties, and reward/price scenarios; prepay does clearly save energy, but we need more research to determine why this is the case.
Consumer advocate	Interviewees do not believe that prepay pilot programs as research are ethical.
Consumer advocate	Evaluations for prepay programs are not strong enough to call prepay energy efficiency.
Consumer advocate	We need research to determine whether shutoffs are voluntary or not, and if they are involuntary then they should not be counted as efficiency in studies.
Consumer advocate	We need research that breaks down savings from each measure to show what causes savings.

Table 11 through Table 13 summarize themes related to the category of customers.

Table 11. Summary of themes from interviewees on topic of customer satisfaction

Interviewee type	Main point/findings on topic of customer satisfaction
Consumer advocate	Customer satisfaction work is deficient; we don't see the survey questions; most in jurisdictions without bill payment programs; wants survey that asks how often people are disconnected and what that means for them, ask people if they'd want to be disconnected, and so on.
Consumer advocate	Interviewees want to look into customer satisfaction questions to make sure these surveys were completed objectively.
Consumer advocate	Interviewees mentioned customers calling into call center about positive impacts of program
Prepay advocate	Prepay provides customers a balance instead of bills. "'No more bills!' That should be the banner of prepay programs."
Prepay advocate	Prepay programs provide 21st-century service (rather than a second-tier service that some advocates claim it is).

Interviewee type	Main point/findings on topic of customer satisfaction
Consumer advocate	As a consumer advocate it's hard to go against how customers say they are satisfied with the programs, but the interviewee wants to ensure consumer protections are in place.
Minnesota utility	The customer satisfaction element is really compelling. It provides customers with convenience and optionality.
Minnesota utility	They think that their customers would like it. Want to give their customers options.
Prepay Advocate	Frustration because some consumer advocates don't seem to believe it—customers call the utility to thank them for providing the program.

Table 12. Summary of themes from interviewees on topic of customer control

Interviewee type	Main point/findings on topic of customer control
Prepay advocate	Prepay gives customers control over their energy use; accuses consumer advocates of eliminating choice and the ability of customers to save money and lower their anxiety about bills.
Consumer advocate	Prepay programs give customers feeling of control over their energy use; the number one reason customers give for liking prepay is that they have control over their energy use.
Prepay advocate	Prepay gives them control of their bill and surprises go away.
Prepay advocate	Prepay puts customers in control and helps them understand their kWh energy use.
Prepay advocate	Anecdotes over the past few years from customers about feeling in control and loving prepay programs; customers realize it was their fault for not paying, not the utilities fault for disconnecting them; shifting perception from utility shutting off to own fault for shutoff.
Minnesota utility	The customer satisfaction element is really compelling. It provides customers with convenience and optionality.
Academic	Research has found that customers did appreciate the increased control they had from prepay, as they could organize their finances around their energy bill using prepay; interviewees also think “forgetfulness” is a fake reason that people give for shutoffs, and it is more likely do not have the money and want to avoid stigma and shame.

Table 13. Summary of themes from interviewees on topic of customer voluntary program

Interviewee type	Main point/findings on topic of customer voluntary program
Consumer advocate	Interviewees say many people are on prepay because they do not have a choice; agreeing to be on prepay to avoid being disconnected.
Prepay advocate	If customers are unhappy, they can just go back to postpay.

Interviewee type	Main point/findings on topic of customer voluntary program
Consumer advocate	Prepay programs have a natural market, with about 20%–25% of customers saying they want to be on prepay. This isn't for senior citizens.
Minnesota utility	If it's an opt-in program, levels of enrollment are a concern. The utility already has a great portable for customers, so what else does prepay offer?
Prepay advocate	Prepay is a voluntary program with self-opt-in.

Table 14 through Table 16 summarizes themes related to the category of utilities.

Table 14. Summary of themes from interviewees on topic of utility costs (lost revenues)

Interviewee type	Main point/findings on topic of utility costs (lost revenues)
Consumer advocate	Research can help utilities determine whether they can count prepay as EE because of lost revenue through decreased energy sales.
Consumer advocate	A utility can't recoup costs from this type of program, and this consumer advocate thinks it's a distraction from other programs (like home upgrades or efficiency rebates).
Consumer advocate	Revenue decoupling could include prepay programs, not just EE programs; this would allow prepay to not be EE while addressing this issue.
Prepay advocate	Some larger utilities are concerned about the revenue lost from prepay programs, if they can't count prepay as EE.

Table 15. Summary of themes from interviewees on topic of utility savings

Interviewee type	Main point/findings on topic of utility savings
Minnesota utility	The utility doesn't end up paying for bad debt that customers can't pay.
Consumer advocate	It may be important to look into differences in motivations for co-ops, munis, and IOUs to run prepay programs.
Minnesota utility	Utilities are interested in knowing cost effectiveness.

Table 16. Summary of themes from interviewees on topic of prepay as a utility efficiency program

Interviewee type	Main point/findings on topic of utility efficiency program
Consumer advocate	Generally, prepay programs are a payment program (like time of use) and should not be considered the same as a typical EE program.
Minnesota utility	It would be great if utilities could count savings from prepay.

Interviewee type	Main point/findings on topic of utility efficiency program
Minnesota utility	The holy grail is how to not cannibalize the traditional EE offering. Asset-based programs are diminishing. The baseline is becoming higher. We need to be exploring innovation programs.
Consumer advocate	While prepay does lead to energy savings, nothing has proved that customers are changing their behaviors to save energy; Interviewees are unsure whether any energy efficiency education is included with prepay programs.
Consumer advocate	Does not think prepay should be an EE program measure.
Consumer advocate	Utilities need to conduct cost-benefit analysis to determine whether the costs are low and benefits high or vice versa; prepay needs to be comprehensive, but overall we need more robust research.
Academic	While people on prepay may use less energy, programs should couple behavioral changes with physical EE changes; sometimes people are forgoing basic needs to save money and energy—need more research.

Table 17 through Table 19 summarize themes related to the category of consumer protection.

Table 17. Summary of themes from interviewees on topic of general consumer protection concerns

Interviewee type	Main point/findings on topic of consumer protection concerns
Consumer advocate	We need to “first do no harm” with prepay, make sure all consumer protections are in place.
Academic	Prepay is a good option when strong consumer protections are in place; above 12 hours regularly shut off is problematic for people (e.g., freezer defrost, pipes bursting).
Academic	Public health perspective: detrimental to not have electricity at home, behavioral challenges for children and child protection services.
Consumer advocate	Costs of communication: Who is picking up the costs of the texts for communication and other costs? Program should be less expensive for participants, not more expensive; SRP doesn't allow shutoffs at night; customers need to be able to take advantage of bill assistance programs while on prepay.
Minnesota Utility	We want to make sure that the right processes/mechanisms are in place for prepay to meet the requirements of consumer protections.
Minnesota Utility	Would like a program that is fair and equitable, and they do not want to only target low-income customers.
Consumer advocate	Consumer protections are in place with regulated utilities. Prepay programs often ignore consumer protections (i.e., disconnect rules).
Consumer advocate	In Texas, customers can split deposit payments to better afford them; utilities can find better ways to collect “uncollectables” than through prepay.

Table 18. Summary of themes from interviewees on topic of consumer protections and disconnection as a main motivator for energy savings

Interviewee type	Main point/findings on topic of disconnection as motivator
Academic	People will likely reduce energy without disconnections if they have feedback, but it would likely not be as effective as with disconnections.
Consumer advocate	Disconnection is the core issue: customers can receive feedback and other benefits on other payment methods; customers can also pay in advance now if they want to; impact of disconnection is larger than just the time customer is disconnected; also must account for other societal costs (e.g., refrigerator food loss).
Consumer advocate	This consumer advocate would not support prepay if it includes the threat of disconnections.
Minnesota utility	We would not want to run a program that has disconnect, but even without the threat of disconnect, a pay-as-you-go program would keep the customer engaged for savings.
Minnesota utility	What would be the motivation to save energy without a disconnect fee?
Consumer advocate	Advocates used to be more concerned about disconnects, but now if they have the possibility to get turned back on quickly and are given adequate warning they are not as concerned; customers need constant communication through in-home display or apps to be aware of pending disconnects
Consumer advocate	Customers say they are positively lowering their energy bills, taking control of energy use; consumer advocates are interested to see whether this is due to fear of shutoff or better education/feedback.

Table 19. Summary of themes from interviewees on topic of consumer protections and equity concerns

Interviewee type	Main point/findings on topic of consumer protections and equity concerns
Consumer advocate	When shutoff notification relies on electronic notification this can be problematic (if didn't pay utility bill may not have paid phone or Internet bill); California did not approve because of shutoff.
Academic	For MPower program in Arizona people frequently experienced shutoffs, didn't have many places to top-up their cars, many didn't have car so had to use public transit; stress associated with prepay, parental self-efficacy challenged, thermal comfort issues, and security and health issues. In Phoenix, housing policy is that high arrearages can affect housing stability; prepay allows people to not gain arrearage and have stable housing.
Academic	Race and affordable rates are issues of concern, should be correcting energy burdens, cash-based economy, top-up fees.
Consumer advocate	"It's baloney that they aren't targeting low-income."

Interviewee type	Main point/findings on topic of consumer protections and equity concerns
Consumer advocate	If customers want choice, then why are programs only targeting low-income customers and not all customer classes; prepay needs to be truly free choice for low-income (not coerced into program due to high deposits or arrearages)
Minnesota utility	Interviewee does not want to explicitly target low-income customers but thinks it could benefit the customers —their own customer research suggests that low-income customers don't like to be surprised by their bills. They don't have the flexibility if they have a bigger bill one month. Could be a benefit rather than a stick because of the transparency.

Table 20 through Table 24 summarize themes related to the category of utility program design.

Table 20. Summary of themes from interviewees on topic of program design and the importance of program structure

Interviewee type	Main point/findings on topic of program design and importance of program structure
Consumer advocate	The main issues with prepay depend on program structure; prepay programs need to include in-home display (with minimal cost to participants), ability to pay with cash, low or no fees for credit card payments, reduced expense (cash avoids fees), second-tier usage ability (turn off some parts of home when money is low), ability to build some arrearages during protected shutoff times; program design is key to success of the program from customer use and company perspectives.
Minnesota utility	For a prepay program to work well, you need a strong communications plan for customers. Need the infrastructure and process for when the prepay technology isn't working perfectly ... and it won't always work perfectly.

Table 21. Summary of themes from interviewees on topic of program design and ideas for prepay pilots/program models

Interviewee type	Main point/findings on topic of program design and ideas for prepay pilots/program models
Academic	Consider programs with no disconnections or cheaper electricity if you pay on time or threat of price penalty if you don't.
Consumer advocate	Study the prepay shutoff rate compared to non-prepay program shutoff rates; don't want people to save energy from being shut off.
Consumer advocate	Programs could offer rewards to customers who pay in advance (instead of disconnection) or offer lower rates to those on prepay.
Academic	MPOWER program has higher rates for prepay; most customers know this and still decide to be on prepay!
Consumer advocate	Rates should be lower for prepay to account for utilities receiving money before providing service.

Table 22. Summary of themes from interviewees on topic of program design and barriers to prepay

Interviewee type	Main point/findings on topic of program design and barriers to prepay
Prepay advocate	Utilities don't like fighting with interveners, utilities don't like altering billing software due to fears around security, and they need more evaluations like APS.
Prepay advocate	One roadblock is consumer advocates and regulators putting the brakes on programs; some utilities don't want to fight the battle that has been out there, some states like California had consumer advocates go to "open warfare" against prepay.
Minnesota utility	People need to overcome the stigma of prepay and the "sins of the past." Prepay has evolved from where it has started, but it's constantly anchored to the past.
Consumer advocate	Concerned about natural gas prepay programs because they are not regulated the same way as electric, may have fewer protections.

Table 23. Summary of themes from interviewees on topic of program design and natural gas considerations

Interviewee type	Main point/findings on topic of program design and natural gas considerations
Consumer advocate	AMI roll-out could be of concern in MN. Minnesota should talk with CAAs who administer LIHEAP and WAP and DHS to understand low-income customers in the state and how prepay could impact.
Minnesota utility	Not planning on rolling out AMI in the near-term. To install AMI for just prepay option does not seem feasible. Shutting off gas customers has a safety aspect concern—when the gas gets turned back on, a way must be devised to make sure pilot lights are lit again.

Table 24. Summary of themes from interviewees on topic of program design and Minnesota-specific ideas

Interviewee type	Main point/findings on topic of program design and Minnesota-specific ideas
Department of Commerce	Looking for a framework that can be applied to the 130 utilities, including how to best evaluate savings and what happens to people that can't pay or may have safety/comfort compromised.
Minnesota Utility	While this utility doesn't have AMI in place, it's planning for it in the future. They are looking for direction from the Commission.

Appendix B: Prepay Elements That May Cause Energy Reduction

Feedback

A full discussion of the effects of feedback is presented within the body of the report, in the section Prepay Elements That May Cause Energy Reduction.

Fast Shutoff

One of the most controversial differences between prepay and postpay electricity plans is the promptness of electricity service disconnection. As we discuss in the *Prepay Considerations from Opponents and Advocates* section of this report, this is often the primary reason that utility regulators choose to disallow implementation of prepay electricity programs in the United States. Unlike postpay plans, in which consumers have several weeks to pay their bills and several more weeks of accumulating debt and interest before being disconnected, consumers on prepay plans are usually disconnected within about one day of running out of electricity credit. Although regulations usually stipulate when prepay customers cannot be disconnected (e.g., overnight or on extremely cold days), outside of these times the practice is to disconnect shortly after the customer runs out of credit.

The debate regarding whether this is good or bad for consumers (and particularly low-income consumers), and whether electricity should be bought and sold like most other products instead of paid for after use, is one that needs more exploration. We defer this debate to the *Concerns of Advocates and Opponents* section of the report and focus here on whether immediate shutoff may be an element responsible for changing participant behavior and reducing electricity use in prepay programs.

Some evaluations of prepay programs in Table 3 find that customers reduce consumption even after excluding reductions from disconnections. That is, the energy saved from disconnecting customers is not included in the overall accounting of energy reductions from prepay. The practice of excluding energy saved from so-called self-disconnections is sometimes debated because voluntarily disconnecting services may be used by some customers as a measure of controlling consumption and bills (Mummery and Reilly 2010). Regardless of whether these savings are accounted for in program evaluations, the looming threat of immediate shutoff could be enough of a motivator to encourage electricity conservation behavior.

Some of the earliest studies in psychology reveal that punishment reduces the occurrence of future behavior (e.g., Skinner 1953). Importantly, punishments will only be effective if they are meaningful to the recipient and strong enough to be noticed. The removal of electricity services is what Skinner might call a negative punishment and one that, unlike other strategies used in energy efficiency behavior change programs, is particularly meaningful and potent. Thus, at least theoretically, prepay may reduce

energy because it includes an efficient punishment mechanism for not topping up one's electricity credit.

Some evidence regarding the potency of electricity shutoff to change behavior comes from research on how low-income residents manage their finances. Interviews with 194 heads of lower-income households in Boston and Champaign-Urbana revealed that debt juggling was the most frequent strategy for managing expenses, especially among those with the lowest incomes (Tach and Greene 2014). These residents generally put off paying expenses such as bills and debts until they pose an immediate threat to well-being.

The most urgent needs come first. As one interviewee explained, "Rent comes before everything and I mean as long as my kids have food and clothes on their back and stuff, you know, I don't—I try not to stress myself out thinkin' of those things [bills] because right now at this point in time like I can't just even prioritize a bill because it's like I really have no income comin' in" (Tach and Greene 2014, p. 13). Thus, interviewees would take advantage of the ability to accumulate debt rather than pay bills to pay for other urgent needs. Without this ability to defer payment, electricity shutoff would become more urgent and consumers might be more likely to raise the importance of paying for electricity bills to avoid the punishment of reduced well-being.

O'Sullivan and colleagues (2014) found that prepay program participants prioritize electricity purchases highly (just after rent/mortgage payments) and that they are relatively good at budgeting (and even planning for seasonal changes in electricity use). Prepay forces consumers to avoid accumulating debt from unpaid bills and instead purchase electricity before using it. Whether this is good or bad for short- and long-term quality of life is discussed in the *Advocates and Opponents Concerns* section of this report. Regardless, this element of prepaid electricity plans could be one of the causes of reduced electricity consumption.

Cost

Although most American prepay programs that are currently offered or planned have similar built-in costs for prepay and postpay customers (N. Treadway, Managing Partner, DEFG, pers. comm., July 12, 2018), hidden costs can still make prepay slightly more expensive in some cases. For example, Salt River Project's M-Power program—the most well-documented US prepaid electricity program, available to customers in Phoenix, Arizona—has similar electricity rates for prepay and postpay plans and requires a smaller deposit for activating prepay service than for postpay, but 40% of any prepay top-up payments must go to paying down arrears (EPRI 2010). Although this may be a benefit, given that many consumers who switch to prepay owe arrears, a large proportion of prepay customers had to pay more to get the same amount of electricity (because the first 40% went to paying down arrears). This reduction of access to electricity could have impacted their disconnection rates and electricity usage.

Similarly, some programs ask participants to pay a small fee for adding credit at a kiosk, by a third-party vendor (e.g., by credit card or check), or over the phone (Howat and McLaughlin 2012). Although these transaction fees may be identical to postpay fees, they are cumulatively higher for prepay consumers

because prepay consumers are likely to engage in a larger number of transactions (Howat and McLaughlin 2012).

In South Africa, although program fees were identical between prepay and postpay and debt repayment was not required for most customers on prepay, some customers were moved onto a higher electricity rate for about three months after installation of prepay meters, and this could account for a small percentage of the savings from the program (Jack and Smith 2016).

Low-income prepay customers have, in some studies, expressed willingness to accept the higher costs of prepay programs because they believe the benefits outweigh these costs (e.g., O’Sullivan et al. 2013), but these costs may influence behavior. Traditional economic theory explains that when costs rise, consumption decreases. We would be interested to see whether prepay programs reduce energy consumption in countries such as Bangladesh or Northern Ireland, where prepaid electricity costs are lower than postpay costs.

Usually Frequent Payment

One way to encourage behavior is to make the opportunity to act more convenient or make the converse action less convenient. For example, stair use can be encouraged by slowing elevator doors or situating the stairs within line of sight of the elevator (Van Houten, Nau, and Merrigan 1981; Bungum et al. 2007). Recycling is more likely when the recycling bin is beside the garbage bin, close to where consumption of recyclable goods occurs (e.g., Ludwig, Gray, and Rowell 1998). The effort required to pay for electricity could affect its use.

Prepay customers generally pay for electricity with smaller and more-frequent payments. In itself, this could increase the chances of missing a payment by chance. If a program also requires an inconvenient method of payment, then this effect is multiplied. For example, the Salt River Project evaluation was conducted at a time during which participants had to travel an average of two to three miles to a kiosk to purchase electricity credits (Qiu, Xing, and Wang 2016). Given that they purchased credits an average of three to four times per month, this small but significant burden may have influenced consumption (and disconnection rates, which were not accounted for) in this evaluation.

Modern American prepay programs are based on smart meters and often offer payment options that are more convenient than those for many postpay programs (e.g., the ability to top-up credit by phone app at any time for any amount). DEFG’s market research shows that convenience is among the top reasons that potential consumers are interested in adopting modern prepay plans. These newer programs and the element of convenience/inconvenience should be evaluated. Whether electricity savings remain equally high for programs with convenient payment options would be interesting to see.

Active Payment

Individuals who must actively decide how much credit to add to their electricity account may subsequently pay more attention to the electricity they are using. Most prepay customers purchase electricity credits 3 to 9.5 times as frequently (3 to 9.5 times per month, depending on the program) as postpay customers pay their bills (Qiu, Xing, and Wang 2016; Jack and Smith 2016). These participants choose when to load credit onto their accounts and how much to load. This increased attention and decision making may subsequently lead participants to pay more attention to how much electricity they are using.

Evidence of the process of active decision making to change behavior can be found in studies of 401(k) deposits (Carroll et al. 2009). New employees who are forced to choose whether to enroll in a 401(k) savings plan upon being hired are significantly more likely to enroll (28% more likely) than those who are not forced to choose one of the two options. They then make higher savings contributions and save more money. Without active decision making, many employees procrastinate and make poor financial planning decisions by default.

Active decision making as a potential influence on the behavior of prepay program participants should be studied directly within a North American context. One report on Chinese prepay programs found, surprisingly, that customers on autopay did not use significantly more electricity than those on prepay, but the authors used a bottom-up estimation of energy use as opposed to actual monthly billing data (Du, Guo, and Wei 2017). The Chinese context is also different from the modern American context for several reasons. Among other things, many residents in rural China do not have electricity, and 54% of customers still pay their bills at the counter of the electricity company. They thus engage with their bills more deeply than North American consumers who, if not using autopay, tend to pay online or over the phone. Although active payment may account for only a small proportion of the effect of prepay programs, this potential influence on behavior should be tested.

Paying in Advance

One final required aspect of prepay electricity programs is that consumers must pay for their power in advance of receiving it. This characteristic of prepay programs may increase the attention and concern that consumers pay to their usage. Consumers that delay payment for electricity are using credit to pay their bills. Classical economics research finds that consumption tends to increase as access to credit increases (Ludvigson 1999), and people are willing to pay more for goods using a credit card than using cash (Prelec and Simester 2001). Similarly, restaurant-goers leave larger tips using credit cards than using cash (Feinberg 1986). This increase in spending using credit cards is partly explained by access to credit (Ludvigson 1999) and partly by other mental processes that are not entirely clear (Prelec and Simester 2001).

Loading up prepay meters in advance of using the electricity is like the process of getting cash from the bank before spending it. Conversely, paying for electricity after using it is similar to spending credit and

then paying the balance later. The same mechanism that works to reduce spending with cash may also work to reduce spending on electricity for prepay program participants. Although this effect may be limited, it is an important potential mechanism to test because it is the most fundamental to prepaid electricity plans (and strongly differentiates them from postpay plans).

In line with the results of several studies (e.g., APS 2015, Jack and Smith 2016), this effect may be most pointed for low-income customers. At least one study suggests that people with less money continue thinking about the costs of products, even after buying them, whereas wealthy people only think of those costs at the time of purchase (Shah et al. 2018). For wealthy people, consuming a product that was paid for in the past is like consuming something “for free,” whereas for people without money, the cost of the product is considered every time it is consumed. Thus we might expect that paying in advance for electricity would reduce consumption among people without money more than among those who are wealthy.

Appendix C: State Regulatory Orders/Actions Regarding Prepay

CALIFORNIA (SDG&E 2014)

In 2014 the California Public Utilities Commission (CPUC) ruled on a March 2012 proposal for a prepay program from San Diego Gas & Electric (SDG&E) that they claimed would have several benefits, including “potential energy savings.” The prepay program was opposed by several parties, including the Office of Ratepayer Advocates (ORA), The Utility Reform Network (TURN), the National Consumer Law Center (NCLC), and so on. The CPUC ruled that it did not find the proposed program to be in the public interest, apparently on ratepayer protection grounds relating to advance notice to customers about shutoffs. The issue of energy savings did not appear to be a material factor in the decision. The commission noted that it was not foreclosing the ability of the utility to propose a prepay program in the future (although we find no evidence of any prepay program being subsequently approved).

[Decision 14-01-002, January 16, 2014]

KANSAS (Westar 2016)

In 2014 Westar implemented a two-year prepay pilot program. In November 2016 Westar applied to convert the pilot into a permanent program and remove the participation limit. Westar cited as a benefit of the program that it had collected over \$300,000 in arrears from customers in the program. (We did not see any mention of energy efficiency or energy savings as an issue in the order summary.) Commission staff and a consumer group (Citizens’ Utility Ratepayer Board; CURB) filed opposition to the proposal, claiming that the company had not provided any cost-benefit analysis and that the per-customer program costs were high (e.g., \$850 to \$1,040, depending upon what was included). The commission agreed that Westar had not presented a sufficient record to justify making the program permanent, so they denied Westar’s request and gave them six months to transition current participants off the program.

[Docket No. 14-WSEE-148-TAR, December 15, 2016]

MISSOURI (2017)

In November 2017 Ameren Missouri filed an application to have a prepay pilot program approved. The proposal was opposed by commission staff as well as by the Missouri Office of Public Counsel (OPC), who argued that the program was not cost effective and would not meet the definition of an energy efficiency program under Missouri statute. In April 2018 Ameren withdrew its proposal.

[Case No. EO-2015-055]

The OPC informed us that in the recent rulemaking for the Missouri Energy Efficiency Investment Act, the definition of *demand-side programs* was updated to specifically exclude “deprivation of service” as an eligible component (Rule 4 CSR 240.20.093(1)M). This reportedly was done specifically in response to concerns about prepay.

[G. Marke, Chief Economist, Missouri Office of the Public Counsel, pers. comm., July 20, 2017]

NORTH CAROLINA (Progress Energy Carolinas 2012)

In February 2012 Progress Energy Carolinas (PEC) filed a request for approval of a prepay pilot program as an energy efficiency program. The commission noted that the utility had conducted a prepay pilot in 2001 and that the utility itself had concluded that the program was not cost effective and closed the program in 2002. For the current application, the commission concluded: “PEC has not provided sufficient information to persuade the Commission that the prepay pilot could ultimately lead to a cost-effective energy efficiency program” and denied the application.

[Docket No. E-2, sub 1011, June 13, 2012]

North Carolina Update (2018).

In January 2018 Duke Energy Carolinas filed for approval of a “Prepaid Advantage Energy Efficiency Pilot Program.” Commission staff recommended disapproval of the request in a filing on April 16. Staff was supportive of some of the proposed technical capabilities being broadly available to customers but opposed categorizing prepay as an energy efficiency program. Among their concerns, an April 17 *Utility Dive* article reported: “Staff said if the program were approved, Duke would have recovered its costs in a rider proceeding and receive a bonus utility incentive, plus a net lost revenue incentive, from all customers” (Walton 2018). While disagreeing that such treatment was appropriate, staff did say in their filing: “The billing and data usage components of the Prepaid Pilot are basic functionalities of AMI meters and should not be the basis of an EE program. Customers should receive the full benefits of AMI meter functionality, including the prepaid billing option, as part of normal electric service provided under base rates” (p. 6). They went on to say: “Staff would encourage the Company to request approval from the Commission to offer a prepay billing option that is not presented as a DSM/EE program” (p. 7).

On April 26 the company requested to withdraw its application for the prepay pilot program, and on June 15 the commission issued an order granting the withdrawal.

[Docket No. E-7, SUB 1167]

OHIO (Duke Energy Ohio 2010)

In December 2009 Duke Energy Ohio proposed a \$2.7 million prepay program as one of 10 proposed programs for their energy efficiency portfolio. The Ohio Partners for Affordable Energy (OPAE) argued against approval, saying that the program was not energy efficiency. In December 2010 the commission denied approval for the prepay program, saying that the utility had not provided adequate information to support implementation. The commission stated the company needed to provide more detailed information, “including but not limited to, the potential for any consumer benefits and any ancillary benefits that may accrue to Duke as a result of this program.” The other nine proposed energy efficiency programs were all approved.

[Case No. 09-1999-EL-POR]

PENNSYLVANIA (PECO 2018)

In October 2016 PECO filed an application to conduct a prepay pilot program, including a waiver of several typical ratepayer protections regarding billing and shutoffs. The expressed objectives of the

company were to (1) assess customer adoption and whether it increases customer satisfaction to have an alternative available; (2) collect data of customer usage and payment patterns; (3) assess whether the plan affects reduction and avoidance of delinquencies; (4) assess whether the plan assists in energy conservation. Several ratepayer advocate groups intervened and opposed the proposal.

On March 6, 2018, the administrative law judge (ALJ) issued a proposed decision for the commission to consider. The ALJ recommended denying the proposal on a number of grounds, most relating to various ratepayer protections regarding shutoffs and so forth. The ALJ noted that “some of the problems can be resolved by not including as potential participants households under 300% of the FPL. However, this modification does not cure all of the deficiencies that I found problematic” (p. 79). Among the findings of fact was the statement that “Reduced usage from prepayment is not necessarily conservation as it could also be deprivation through forced usage reduction” (p. 21).

[Recommended Decision, P-2016-2573023, March 6, 2018]

ARIZONA (Arizona Public Service [APS] 2015)

In March 2015 APS filed for approval to continue its 2013 DSM plan through 2015 and going forward, including transitioning its pilot prepay program into a fully implemented DSM program. The pilot had been approved in July 2012, with a maximum of 2,000 customers. Staff recommended that the program remain a pilot until certain operational and scalability concerns were resolved. The Southwest Energy Efficiency Project (SWEET) intervened and said the program should only be continued if the energy efficiency education and communication aspects were improved, and that any energy savings needed to be better documented by an independent study that was fully reviewed by the commission and a stakeholder group.

In November 2015 the commission ordered that the prepay program would stay as a pilot program, that APS shall discontinue the pilot program by December 2016, and that APS “shall work with stakeholders to collaborate on ways to enhance the education and communication offerings for potential future prepaid programs in order to increase program effectiveness to ensure that customers fully understand the program and their options for how to reduce their energy bills and also to ensure the energy savings due to the education and communication offerings are documented in a reliable manner” (p. 16).

[Docket No. E-01345A-15-0095, November 25, 2015]

(The APS prepay program is currently categorized as “suspended.”)

Appendix D: Recommendations to Address Consumer Concerns

Consumer advocate groups make several suggestions to reduce the likelihood of negative quality-of-life outcomes from prepaid electricity programs (NASUCA 2011; Howat and McLaughlin 2012). Following are the suggestions of National Association of State Utility Consumer Advocates (NASUCA 2011) that were echoed the following year by the National Consumer Law Center (Howat and McLaughlin 2012).

These recommendations were made six years ago and most have been addressed in modern prepaid electricity proposals. If programs met all these requirements, they would almost certainly avoid deprivation, but they may also become less appealing to utilities in Minnesota and possibly less effective as energy efficiency programs (because they remove some of the elements that potentially cause behavior change and ensure utility revenues). We present these not as requirements, but as suggestions to consider.

- All regulatory consumer protections and programs regarding disconnection limitations or prohibitions, advanced notice of disconnection, premise visits, availability of payment plans or deferred payment agreements, availability of bill payment assistance or arrearage forgiveness, and billing disputes are maintained or enhanced
- If the billing credits of a customer receiving prepaid residential electric or natural gas service are exhausted, the customer shall be given a reasonable disconnection grace period, after which the customer shall revert to traditional, credit-based service, subject to all rules and customer protections applicable to such service
- Prepayment households include no one who is income-eligible to participate in the federal Low-Income Home Energy Assistance Program (LIHEAP) or protected under state law from disconnection for health or safety reasons
- Prepaid service is marketed only as a purely voluntary service and is not marketed to customers facing imminent disconnection for nonpayment
- Utilities offering prepaid service also offer effective bill payment assistance and arrearage management programs for all customers, including customers with arrearages who choose prepayment service
- Rates for prepaid service are lower than rates for comparable credit-based service, reflecting the lower costs associated with reduced cash working capital requirements, uncollectible amounts, and shareholder risk affecting a utility's return on equity
- Utilities demonstrate the cost effectiveness of any proposed prepaid service offerings through a cost versus benefit analysis and reveal how costs will be allocated among various classes of customers

- Prepayment customers are not subjected to any security deposits or to additional fees of any kind, including but not limited to initiation fees or extra fees assessed at any time customers purchase credits
- Utilities ensure means are readily available for prepayment customers to purchase service credits on a 24-hour-a-day, seven-day-a-week basis
- Prepayment customers can return to credit-based service at no higher cost than the cost at which new customers can obtain service
- Payments to prepaid accounts are promptly posted to a customer's account to prevent disconnection or other action adverse to the customer under circumstances in which the customer has in fact made payment
- Adequate financial mechanisms are developed and in place within the state to guarantee that funds prepaid by customers are returned to the customers who prepaid them when a company becomes insolvent, goes out of business, or is otherwise unable to provide the services for which the funds were prepaid

Some of the consumer protection policies have been successfully demonstrated by other countries (Esteves et al. 2016). In some countries, such as Bangladesh and Ireland, utilities are required by law to give prepay customers a 2% discount on their electricity rates. In Colombia, the utility may ask for part of prepay top-up credits to go toward paying outstanding arrearages, but this may only be a maximum of 10% of their top-up (some US programs are allowed to require up to 40% to be debt repayment). However those Columbian utilities can also force consumers to switch to prepay if they fail to pay their electricity bill for two cycles.

Appendix E: Detailed Assessment of Evaluations

Program: Arizona Public Service, Arizona

Reference: Demand Side Management Residential Prepaid Energy Conservation Pilot Program: End of Pilot Report; Authors or organizations: Arizona Public Service (APS); Date: February 13, 2015; Source: APS

Quality: Acceptable. The methodology and duration were reasonable, and the report was transparent. However the final analysis was conducted on a small sample, and the number of months that customers were followed was not clear. The evaluation is commended for excluding customer disconnections from savings estimates and providing a detailed analysis of customer disconnections. This is also the only evaluation we found that included a cost-benefit analysis.

Program duration at time of evaluation: Some months before prepay, ~12–16 months with prepay

Electricity savings: 7.5%

Calculation of savings controls for disconnects: Yes

Costs, compared to postpay: Higher. This is because of third-party vendor fees (at kiosk and for online credit card). No reconnection fees, access fees. kWh rates are the same.

Notes: Difference-in-difference regression analysis was conducted with 86 pairs (out of 610 with pre-post data). After controlling for disconnects, found 7.5% savings. Without controlling for disconnects, the authors found 7.6% savings. Savings was driven by low-income consumers, but this may have been partly due to lack of a sufficient number of mid- and high-income participants to find a reliable result.

Number of participants: 86 in each group (prepay and control)

Evaluation design: Pre-post and matched control (difference-in-difference analysis)

Year of publication: 2015

Program: Direct Energy, Texas

Reference: Eryilmaz, D., and S. Gafford. 2018. "Can a Daily Electricity Bill Unlock Energy Efficiency? Evidence from Texas." *The Electricity Journal* 31 (3): 7–11.
www.sciencedirect.com/science/article/pii/S1040619018300666.

Quality: Acceptable. The results are published in a peer-reviewed journal, but the method by which the control group was selected is questionable. A nonmatched control group may create a selection bias that was not adequately controlled using their statistical approach. The sample size and relative costs of prepay compared to non-prepay are not transparent. They are commended for excluding savings from customer disconnections.

Program duration at time of evaluation: Three years with prepay

Electricity savings: 9.6%

Calculation of savings controls for disconnects: Yes

Costs, compared to postpay: Similar. No deposit. No transaction fees. No late fees. No reconnection fees. No debt repayment requirement. Possibly slightly higher average kWh rates than postpay.

Notes: The program had a slightly different type of approach to prepay than other programs. Customers received daily bills reflecting their usage from two days prior, and this bill was automatically deducted from preloaded credit. Customers received the bill at 8 AM and were shut off at 10 AM if they had insufficient credit. Some customers qualified for low-income electricity subsidies. Nonsubsidized electricity customers saved more electricity than subsidized customers (0.92%–6.79% versus 9.58%–13.21%).

Number of participants: Unclear. The authors stated that they had "over 20,000 customer years" in each study group. However the exact number is not disclosed. One would estimate an average of approximately 6,700 customers each year (given the three-year duration), but the exact number included in the final analysis is not presented.

Evaluation design: Nonmatched control group. Attempted to control for selection bias statistically using the "instrumental variable approach." However the selection of the instrumental variable was not sufficient to rule out potential bias.

Year published: 2018

Program: Duke Energy Carolinas, North and South Carolina

Reference: Duke Energy Carolinas Prepaid Advantage Pilot Earnings Report; Authors or organizations: Duke Energy Carolinas; Date: August 15, 2017; Source: Docket No. 2015-136-E, South Carolina PSC North and South Carolina

Quality: Acceptable. The methodology and duration were reasonable, and the report was transparent. However the final analysis was conducted on a small sample, which could be the reason for the non-statistically significant savings. The evaluation did not exclude customer disconnections from savings estimates.

Program duration at time of evaluation: Two years with prepay

Electricity savings: Not statistically significant

Calculation of savings controls for disconnects: No

Costs, compared to postpay: Higher. This is because of third-party vendor fees (credit card charge if more than two payments/month) and because the first 25% of top-ups goes to debt repayment (leaving less money for customers to purchase electricity). Late fees may apply (not clear). No monthly access fees. kWh rates are the same.

Notes: Due to undescribed data analysis problems, only 74 homes were included in the analysis, and the observed average reduction of 8.6% was not statistically significant.

Number of participants: 74 in each group (prepay and control)

Evaluation design: Matched control group (post analysis only)

Year published: 2017

Program: Eskom, Cape Town, South Africa

Reference: Jack, B. K., and G. Smith. 2016. Charging Ahead: Prepaid Electricity Metering in South Africa (No. w22895). National Bureau of Economic Research. <http://www.nber.org/papers/w22895>.

Quality: Acceptable. The evaluation included all relevant information, used a large sample size, and was of sufficient study duration. The evaluation studied only customers who were enrolled in prepay involuntarily and therefore eliminated self-selection bias. It also observed 27 separate groups of prepay transitions (from prepay to postpay) to determine results. It did not include a control group, but these other elements nevertheless creatively compensated some of the bias created by using a nonexperimental method.

Program duration at time of evaluation: ~16 months with prepay (plus ~38 months before prepay)

Electricity savings: 13%

Calculation of savings controls for disconnects: No

Costs, compared to postpay: Possibly slightly higher for some. Rates and fees were the same, but customers who were on "lifeline tariff" before prepay were moved to the more expensive "domestic tariff" after switching to prepay. This lasted an average of three months (sometimes permanently). No third-party vendor fees or kiosk fees.

Notes: The program targeted regions with low property values and therefore cannot be generalized outside these areas of South Africa. Authors observed the largest reductions in energy use for high-baseline energy consumers and those with frequently delinquent payments.

Number of participants: 4,246 (no control group)

Evaluation design: Compared usage for 27 groups of customers before and after prepay (pre-post)

Year published: 2016

Program: Glacier Electric Cooperative, Montana; Pacific Northwest PenLight, Washington

Reference: Prepay Energy Conservation Impact Study; Prepared by DEFG for the Northwest Energy Efficiency Alliance, 2014.

Quality: Acceptable or limited. The methodology was reasonable although the studies lacked control groups and were somewhat short. The PenLight subgroup was small and used only a pre-post comparison. The report also lacked detail on relative costs and convenience of prepay compared to postpay plans. However evaluations are commended for excluding customer disconnections from savings estimates and for surveying customers regarding their actual behavior change. This is the only American study to do so.

Program duration at time of evaluation: Glacier ~9 months (including some months before prepay and some with prepay); PenLight ~13 months (including some months before prepay and some with prepay)

Electricity savings: 14%; 5.5%

Calculation of savings controls for disconnects: Yes, but the procedure is debated. The Glacier Electric evaluation attempted to account for disconnections in the regression analysis but may do so in a less-than-optimal way. The authors include separate variables for disconnections and prepaid metering, plus an interaction of the two. They interpret the effect of prepaid only to be independent of the effect of disconnections on consumption because the regression also includes disconnections. However prepaid metering also has a causal effect on disconnections. If the disconnection variable were categorical, then the approach could generate an interpretation that the prepaid coefficient is the effect of prepaid metering among the group of customers with zero disconnections. However the groups differ by meter type and therefore prepaid metering affects disconnections. This means that the interpretation may be suboptimal (K. Jack, Assistant Professor of Economics, Tufts University, pers. comm., August 14, 2018). The authors also disclose that allowing electricity to be disconnected was a strong potential factor for reducing electricity in the prepay group.

Costs, compared to postpay: Not available in either case

Notes: Surveys revealed that customers engaged in a number of behaviors to reduce their electricity use. The behaviors that appeared to have the most impact were upgrading or changing the thermostat and allowing the electricity to be remotely shut off. They also found that customers on prepay who used more electricity were disconnected more frequently (the opposite of what occurs for postpay customers).

Number of participants: Glacier 1,240; PenLight 154

Evaluation design: Pre-post (no control group)

Year: 2014

Program: Oklahoma Electric Cooperative, Oklahoma

Reference: The Effect of Prepayment on Energy Use; By Michael Ozog, PhD, Integral Analytics. A research Project Commissioned by DEFG Prepay Energy Working group. March 2013. defgllc.com/publication/the-effect-of-prepayment-on-energy-use/.

Quality: Acceptable. The methodology, sample size, and duration were reasonable, and the report was transparent. The evaluation is commended for excluding customer disconnections from savings estimates. The evaluation is one of few that investigated the duration of customer disconnections. However the study did not include a control group, and some cost information was difficult to find.

Program duration at time of evaluation: ~32 months before prepay, ~22 months with prepay

Electricity savings: 10.4%

Calculation of savings controls for disconnects: Yes, but the procedure is debated. See Glacier and PenLight evaluations for details.

Costs, compared to postpay: Higher. Possible monthly vendor fee. Possibly higher rates during pilot program. Some third-party vendor fees (charge for check or credit card). No late fees. Debt repayment is optional.

Notes: When consumer disconnects are not controlled for, savings is 11%. Ninety-one percent of customer disconnections lasted no more than one day. Of those, one-third (32%) lasted one hour. However 4% of disconnects lasted over three days.

Number of participants: 1,217

Evaluation design: Pre-post (no control group)

Year: 2013

Program: Salt River Project M-Power program 2008–2009, Arizona

Reference: Qiu, Y, B. Xing, and Y. D. Wang. 2016. “Prepaid Electricity Plan and Electricity Consumption Behavior.” *Contemporary Economic Policy* 35 (1): 125–142.

Quality: Acceptable. The evaluation included all relevant information, used a large sample size, and was of sufficient study duration. The evaluation was transparent and clearly explained the matching procedure for control participants. It used a pre-post evaluation in combination with a matched control group. The study clearly laid out sufficient detail to allow readers to understand the limitations of the study (that the prepay group paid higher costs and had less-convenient payment options). The study was published in a peer-reviewed journal.

Program duration at time of evaluation: One year before prepay, one year with prepay

Electricity savings: 12%

Calculation of savings controls for disconnects: No

Costs, compared to postpay: Higher. This is because the first 35% to 40% of top-up payments went to debt repayment (as determined from other sources) and because other rates and fees were higher. Thus customers would have fewer funds to purchase electricity credits. Costs include a one-time service establishment fee, a deposit for the prepay meter, reconnection fees, and higher rates than postpay.

Notes: The biggest savers were those with lowest income and most arrearages. Savings were higher in the summer. Payment required an in-person trip to a payment kiosk. Trips were made an average of three to four times per month. The increased effort required for making multiple trips per month to the kiosk could have partly explained the savings from this program.

Number of participants: 1,641 in each group (prepay and control)

Evaluation design: Pre-post and matched control (difference-in-difference analysis)

Year: 2016

Program: Kentucky Association of Electric Cooperatives, Kentucky

Reference: Martin, W. M. 2014. "Pay-as-You-Go Electricity: The Impact of Prepay Programs on Electricity Consumption" (master's thesis, University of Kentucky). william.martin24@uky.edu; uknowledge.uky.edu/do/search/?q=William%20Martin%20&start=0&context=1737482&facet=publication_year%3A2014#.

Quality: Acceptable. The evaluation included all relevant information, used a reasonable sample size, and was of sufficient study duration. The evaluation was transparent and clearly explained the details of the prepay and postpay plans, allowing readers to understand the limitations of the study (that the prepay group paid higher costs). However the author did not attempt a difference-in-difference analysis because he had access to only a nonmatched comparison group and did not include details of payment options (i.e., convenience) for both groups. The author also did not calculate savings separately for each utility and did not enumerate all the costs to customers. The study was conducted as part of a master's thesis and, as such, underwent some degree of peer review.

Program duration at time of evaluation: ~One year prepay (and up to three years before prepay)

Electricity savings: 11.1%

Calculation of savings controls for disconnects: No

Costs, compared to postpay: Higher. This is because of monthly vendor fee and transaction fees for one of the two utilities. Third-party vendor fees and debt repayment requirement were possible. kWh rates were similar to postpay and no late fees.

Notes: The savings were calculated as a pooled analysis of two electric co-ops (Bluegrass and Jackson). More savings were found during hot or cold days than mild days. Consumers saved less over time in the program.

Number of participants: 574

Evaluation design: Pre-post (no control group)

Year: 2014

Program: Salt River Project 2003–2006, Arizona

Reference: Paying Upfront: A Review of Salt River Project's M-Power Prepaid Program; Authors or organizations: EPRI; Date: October 2010; Source: EPRI

Quality: Limited. The evaluation was not conducted by a third-party evaluator, and the report lacked sufficient detail to assess its quality. The report discusses three studies: one covering 2002–03 program year, one for 2003–04, and one for 2005–06. Details are available only for the 2005–06 study, in which they found 12% savings. In the first two years, the report cites average savings of 11% and 13%, respectively (but provides no details for control group or matching criteria).

Program duration at time of evaluation: One year before prepay, one year with prepay for 2005–06 section of evaluation

Electricity savings: 12%

Calculation of savings controls for disconnects: No

Costs, compared to postpay: Higher. This is because the first 40% of top-up payments went to debt repayment (as mentioned in the report) and because other rates and fees were higher. Thus customers were left with fewer funds with which to purchase electricity. Costs include a one-time service establishment fee, a deposit for the prepay meter, reconnection fees, and higher rates than postpay.

Notes: The 12% savings comprises an 8% reduction by participants and a 4% increase by the comparison group. Payment required an in-person trip to a payment kiosk. Trips were made an average of three to four times per month. The increased effort required for making multiple trips per month to the kiosk could have partly explained the savings from this program.

Number of participants: 463 in each group (prepay and control)

Evaluation design: Pre-post and matched control (difference-in-difference analysis)

Year: 2010

Program: TVA utilities, Tennessee

Reference: Prepaid Metering Program Study in the Tennessee Valley: Measuring the Change in Energy Consumption (PowerPoint presentation); Authors or organizations: DNV GL; Date: 2016; Source: Unknown

Quality: Limited. The information for these six utility prepay programs comes from a summary provided in a PowerPoint presentation. Although the evaluation was conducted by a third-party evaluator, the report was not made public, and thus detail was insufficient to assess the quality of the evaluation. The utility names were made anonymous in the report. The evaluation periods were short, and in some cases, the programs had small sample sizes. Although matched control groups were included, the size of these groups and criteria for matching are unknown. Whether evaluators excluded savings from disconnections in their savings estimates is not indicated.

Program duration at time of evaluation: ~One year with prepay

Electricity savings: 5.6%; 6.7%; 5%; 6.9%; 11.7%; 6.8%

Calculation of savings controls for disconnects: No

Costs, compared to postpay: Unclear. The PowerPoint presentation has insufficient detail. A monthly access charge appears to be required. The utilities may have charged third-party vendor fees (e.g., at kiosk) or reconnection fees. However the kWh rates are the same.

Notes: For most programs, savings were higher in the winter and for high-baseline electricity customers. One program found savings to be slightly higher in low-baseline electricity customers. The authors note that the one program that had significantly higher savings than the others (11.7%) is an aberration and that they expected savings to decrease as the program matures.

Number of participants: 350 prepay customers; 184 prepay customers; 201 prepay customers; 183 prepay customers; 145 prepay customers; 76 prepay customers

Evaluation design: Matched control group

Year: 2016

GUEST ESSAY

The Monster in My Home Was a Meter, and It Decided Whether I Ate and Slept

Dec. 30, 2022

By Kerry Hudson

Ms. Hudson is the author, most recently, of “Lowborn,” a memoir of growing up poor in Britain.

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GLASGOW — I grew up in a string of dilapidated slum rentals, project housing and homeless hostels. I grew up with a monster in most of those homes.

Small but cruel, it could be found under the stairs, sometimes in the kitchen. You had to feed it with coins, later with cards and keys, or be punished. When there wasn't anything to feed it, everything would go dark. The TV turned off, whatever you were cooking stopped bubbling on the stove, the shower ran cold and the food in the refrigerator started to spoil. That monster could stop us from bathing, eating or sleeping. It could, and did, make us ill. And it followed us, a single-parent working-class family, up and down the country, from one damp and drafty home to the next, no matter how often we fled to what we hoped was a fresh start.

The monster was a prepayment meter. The Meter, as it was called in our house. Effectively a slot machine for pay-as-you-use energy. Some people have meters that can be topped up online, but typically you go to your local convenience store or

post office, add money to your card, take it home and insert it into the Meter. You can use energy until your credit runs out. When it does, you're given about \$12 of "emergency credit," but you'll need to repay that the next time you top up, before anything goes toward energy.

The saying goes, if you want to add tension to a story, add a ticking clock. That's my memory of the Meter. We'd get down on our knees daily — somehow they were always placed to force you prostrate before them — and stare disbelievingly as the numbers ticked down. A literal countdown on top of all of the other stresses of trying to get a too-small income to stretch through the day, week or month.

So what did we do? We used the smallest amount of energy we could. My mother performed a frustrating, occasionally heartbreaking, arithmetic: Could she cook dinner and get the clothes dry on the radiator? If she had a hot shower in the morning, would she be able to put on the heating in our room that night? Was there enough energy left to watch our favorite TV show if all the lights were off?

But nothing was ever enough to appease the Meter. We watched the numbers count down, we negotiated, and we hoped. We hoped it wouldn't run out in the middle of the night, or while we were sick, when we had homework due or had school friends visiting. Most of all, we hoped it wouldn't happen in winter, in freezing temperatures, without even a light to read by as a distraction. But, as inevitably as Monday follows Sunday, it always happened at the worst possible time.

Who'd choose this precarity? Who would want the Meter instead of a monthly bill from the energy company? More than seven million households in Britain have one. There are people who prefer the control of paying as they go, and a lot of Britons are more afraid of huge fuel bills than they used to be. But a lot of people don't get to choose. They're in debt, or have a poor credit rating or move into low-income housing and find one already installed. Sometimes a landlord insists, or they fall behind on their bills and the energy company does.

And the number of people in debt to energy companies has risen sharply this year. The invasion of Ukraine has had a vertiginous impact on the cost of energy here. The British government has offered some belated financial assistance, but most people, however they're billed, are feeling the strain. And as people have fallen behind on payments, power companies have moved aggressively to switch them to prepayment meters — more than 300,000 applications to forcibly install one have been approved by the courts this year.

The trouble with this is that a prepayment meter is a more expensive way to pay for energy — more than \$300 more this winter, according to an estimate from the charity Citizens Advice. If people are in debt because they can't afford to pay for energy, a plan that insists that they pay for energy at a higher rate while they pay off their debts seems doomed to fail.

And then there is the process of forcibly switching, which is what it sounds like. In my 20s, I lived with my college roommate in a cheap apartment in London above a bookmakers. One night we came home to a letter on our kitchen table. Our power company had been authorized to enter our home and install a prepayment meter because we were behind on our bills. In fact, we were not in debt, but we did have a shady landlord who hadn't legally registered our address, and for almost a year we'd been paying our neighbor's bills. We protested but the engineer arrived anyway and the Meter was installed on the wall by our kitchen table. Though we eventually sorted it out with the power company, the violation of someone being empowered to enter our home remained long after the Meter had gone.

In November the End Fuel Poverty Coalition, a loose grouping of anti-poverty, environmental and health campaigners, and some local councils called for a moratorium on forcibly switching people who have fallen behind on their bills this winter. The argument was that it would lead to “self-disconnecting” — that is, when you have already used your small amount of emergency credit and have no money to top up. To me, describing having no money for heat or light as “self-disconnecting” is like calling having no money for food a hunger strike.

I write this just half an hour away from one of the flats I grew up in, where black mold climbed the walls, ice crept across the inside of the windows and the Meter could never be satiated. For much of this month the weather was very cold, and everything was covered in powdered-sugar frost. This year my Christmas tree is strung with colorful lights and I've joyfully baked cookies with my toddler without negotiating with the Meter for the pleasure. I don't believe anyone would choose to do without light or heat, to "self-disconnect" if any better option was available.

The government will cut its financial help in the spring. Another generation is growing up with its own monster. Some seven million meters, many of them in the homes of the poor, the sick, the vulnerable, the old; ticking down to sudden darkness, silence and cold.

Kerry Hudson is the author, most recently, of "Lowborn," a memoir of growing up poor in Britain.

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A version of this article appears in print on , Section SR, Page 7 of the New York edition with the headline: The Meter Eats First



Energy Insecurity on the Rise: Preliminary Findings from the 2024 Residential Energy Consumption Survey

March 2026

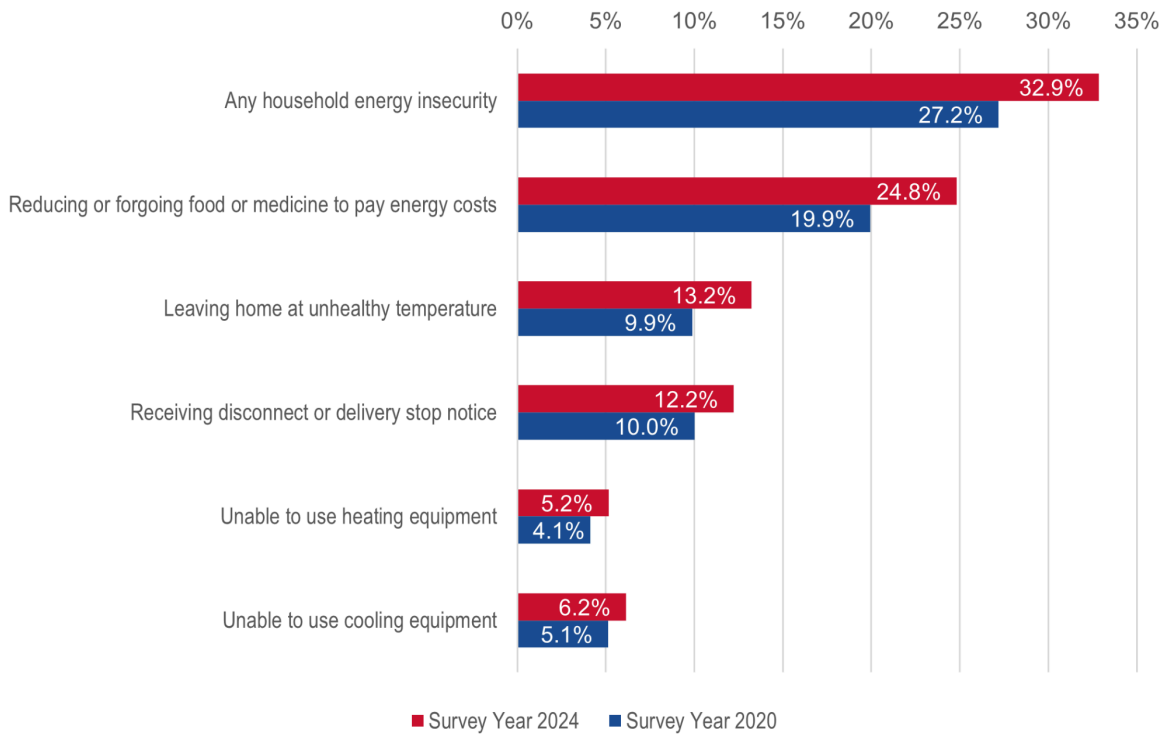
Every few years, the U.S. Department of Energy tasks its Energy Information Administration (EIA) with surveying American households about energy use and affordability. This month, EIA released new data from the most recent survey in 2024. This new data, [the first of the 2024 Residential Energy Consumption Survey \(RECS\) data](#),¹ paints an alarming picture of growing energy insecurity challenges for families.

Only preliminary data is currently available and the ability to conduct analysis that is more detailed will follow as EIA releases more of the data. The preliminary release includes compilation of responses to survey questions regarding “energy insecurity.” EIA’s energy insecurity indicators include

- Foregoing necessities to pay for home energy,
- Maintaining unhealthy indoor temperatures,
- Receipt of disconnection notices, and
- Inability to use heating or cooling equipment because of utility service disconnection, inability to afford bulk fuel delivery, or broken equipment.

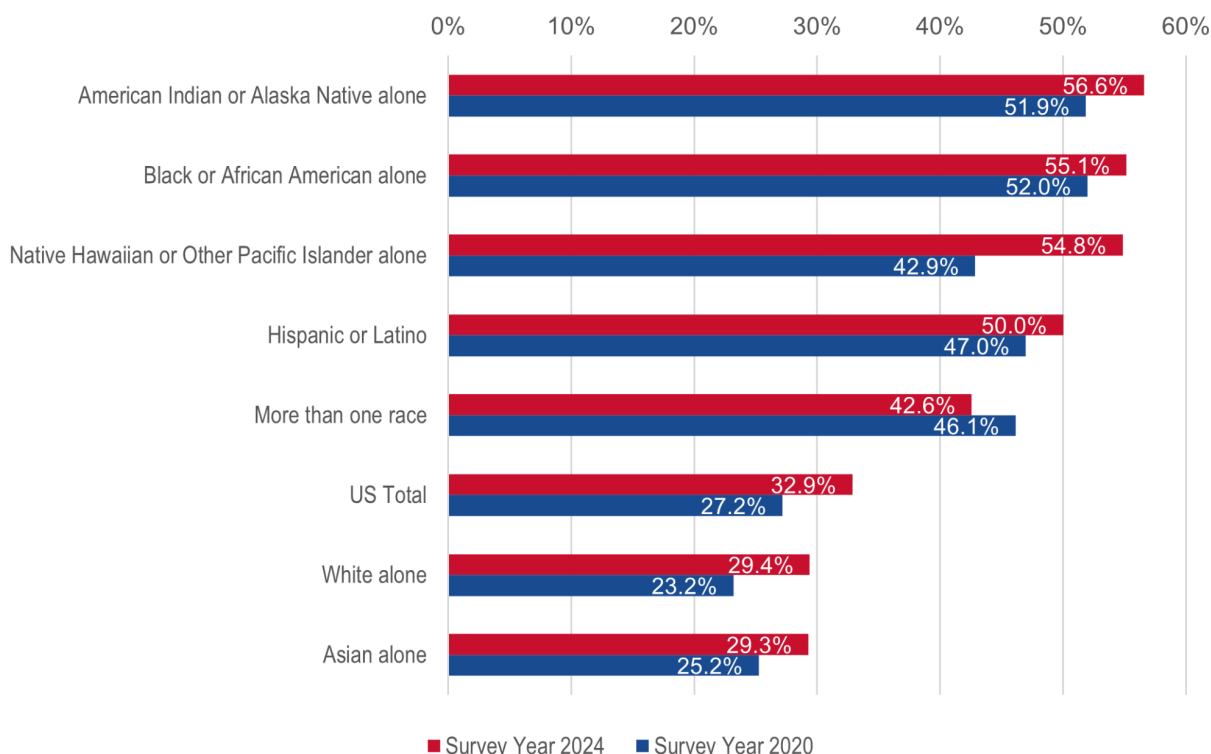
Comparison of preliminary results from the 2024 survey to results from the [2020 survey](#) clearly indicate that ***the percentage of U.S. household experiencing energy insecurity is increasing***. Results of the 2020 RECS reflected energy insecurity in about 27% of US households. The 2024 results show energy insecurity in 33% of households. This substantial increase in energy insecurity predates the recent, sharp increase in energy and utility prices that will clearly exacerbate previous levels of home energy insecurity.

Reported U.S. Energy Insecurity - 2024 and 2020 Residential Energy Consumption Survey Results



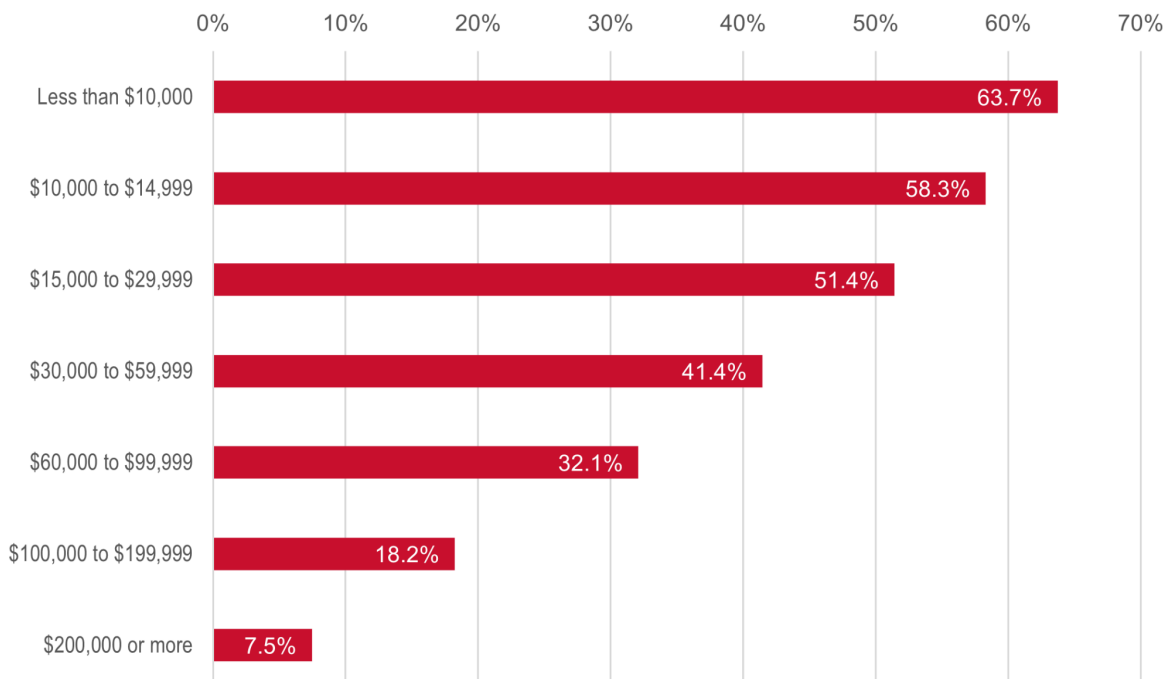
The 2024 RECS, as was the case in previous releases, demonstrate that energy insecurity is disproportionately concentrated among households of color, particularly Black and Native American households. For example, Native American households experienced at least one form of energy insecurity at a rate of 56.5% and Black households at a rate of about 55% - nearly twice the rate applicable to all U.S. households.

2024 and 2020 Energy Insecurity by Race or Hispanic/Latino Ethnicity



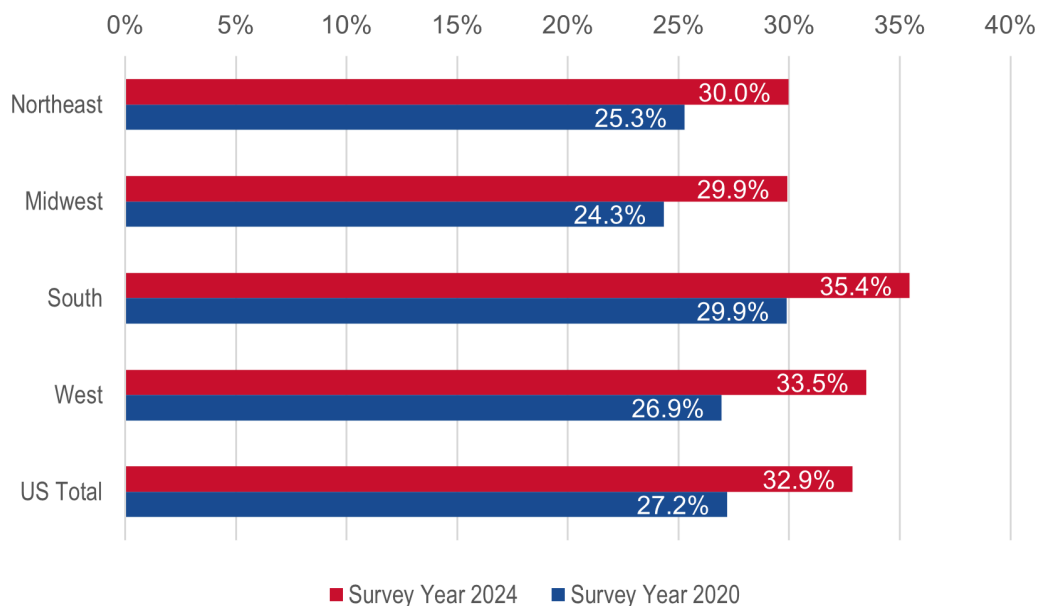
Households with very low income of less than \$10,000 in 2024 experienced energy insecurity at a rate of nearly 64%, twice the rate of households with income between \$60,000 and \$100,000.²

Percentage of U.S. Households Reporting Any Household Energy Insecurity by Annual Household Income



Energy insecurity is most severe in the South Census Region, with its concentration of African American and low-income households.

2024 and 2020 Energy Insecurity by Census Region



Similarly, results of the 2024 survey indicate that other historical disparities persist. Renter households, those with children under 18 years of age, those living in mobile homes, and in housing units with poor or no insulation experienced elevated level of energy insecurity. Energy insecurity increased between 2020 and 2024 in every region of the U.S. and for each of these household types.

Energy insecurity presents tremendous financial and personal challenges for those that grapple with it.

In the United States, those experiencing energy insecurity feel uncomfortable, exposed, marginalized, and dehumanized. The nature of energy insecurity can vary from a seasonal anxiety to an ever present symptom of individual misfortune. ...Energy insecurity sometimes becomes a source of shame that leads individuals to hide their substandard living conditions from friends and family.

Diana Hernandez, Jennifer Laird, Powerless: The People's Struggle for Energy, p. 2.

Energy insecurity stems from a number of sources, including systemic racial injustice and wealth divide, insufficient household income to pay for necessities including unaffordable utility bills, substandard housing stock, and investment in expensive, polluting energy resources. Rising utility costs exacerbate these problems.

Intentional, proactive, coordinated and targeted program and policy initiatives are required to reverse long-standing injustices and make home energy more affordable and accessible, including:

- **Effective bill assistance and arrearage management** reduce unmanageable energy burdens faced by those with insufficient income to make ends meet.
- **Deep, whole house energy efficiency retrofits and upgrades**, coupled with housing repairs needed to make such upgrades effective, lower home energy costs while improving indoor comfort, health and safety.
- **Regulatory utility consumer protections limiting service disconnections**, particularly for those households facing historically high shut-off rates and extreme temperature conditions are required.
- **Utility ratemaking mechanisms** that reward utilities for reducing disconnections in geographic areas with the highest disconnection rates can help to reverse historic inequities.
- Utility late payment fees are far in excess of the cost of carrying past due balances, penalize those who can least afford to pay them, and have not been shown to modify customer payment behavior. These **utility junk fees should be eliminated** as part of a broad effort to mitigate energy insecurity in the U.S.
- **Investment in utility-scale wind and solar generation** is cheaper on a levelized cost basis than fossil fuel and nuclear generation. Such investment is required to reduce reliance on polluting, volatily priced resources and mitigate energy insecurity challenges.

While implementation of each of these program and policy initiatives requires public discourse and debate, they are all within reach and would reflect a national commitment to energy systems are designed to stop the growth of energy insecurity reflected in recent survey data.

Contact: John Howat, jhowat@nclc.org

Endnotes

1. The 2024 RECS reflects information collected from a representative sample of U.S. households in 2024 and 2025.
2. Comparison of 2020 and 2024 RECS energy insecurity by income is not possible because EIA utilized different income tiers in the respective surveys.

**Baltimore city 2023 Self-Sufficiency Wage and Corresponding Ratio of
Self-Sufficiency Wage to Poverty Level by Selected Household
Composition**

<i>Family Composition</i>	<i>Baltimore city Self-Sufficiency Wage - 2023</i>	<i>Ratio of 2023 Self-Sufficiency Wage to Poverty</i>
1 Adult	\$33,199	228%
1 Adult, 1 Preschooler	\$64,841	329%
1 Adult, 1 Teenager	\$48,978	248%
2 Adults, 1 Infant, 1 Preschooler	\$95,095	317%
2 Adults, 2 Schoolagers	\$80,540	268%

Sources: 2023 Maryland Self-Sufficiency Standard Microdata, 2023 HHS Poverty Guidelines, NCLC computations.

**Baltimore city 2023 Self-Sufficiency Wage and
Corresponding Ratio of Self-Sufficiency Wage to Poverty
Level by Household Size**

<i>Household Size</i>	<i>Baltimore city Median Self-Sufficiency Wage - 2023</i>	<i>Ratio of 2023 Self- Sufficiency Wage to Poverty</i>
1	33,199	228%
2	58,385	296%
3	72,265	291%
4	92,731	309%
5	110,071	313%
6	133,361	331%
7	152,987	337%
8	165,875	328%

*Sources: 2023 Maryland Self-Sufficiency Standard Microdata, 2023 HHS
Poverty Guidelines, NCLC computations.*

**Ratio of Income in 2023 to Poverty:
Baltimore city**

	Population	Cumulative Population	%	Cumulative %
Total:	557,089			
Under .50	59,272	59,272	11%	11%
.50 to .99	52,605	111,877	9%	20%
1.00 to 1.24	29,804	141,681	5%	25%
1.25 to 1.49	22,562	164,243	4%	29%
1.50 to 1.84	31,565	195,808	6%	35%
1.85 to 1.99	14,677	210,485	3%	38%
2.00 and over	346,604	557,089	62%	100%

Source: American Community Survey, C17002, 2023 5-yr. estimates.

**Ratio of Income in 2023 to Poverty:
Baltimore city**

	Population	Cumulative Population	%	Cumulative %
Total:	557,089			
Under .50	59,272	59,272	11%	11%
.50 to .99	52,605	111,877	9%	20%
1.00 to 1.24	29,804	141,681	5%	25%
1.25 to 1.49	22,562	164,243	4%	29%
1.50 to 1.84	31,565	195,808	6%	35%
1.85 to 1.99	14,677	210,485	3%	38%
2.00 and over	346,604	557,089	62%	100%

Source: American Community Survey, C17002, 2023 5-yr. estimates.

Family Type	Adult(s)	Infant(s)	Preschooler(s)	Schoolager(s)	Teenager(s)	State	Year	All Families		Housing Costs	Child Care Costs	Transporta		Health Care Costs	Miscellaneous costs	Other		Income Tax Credit (-)	Child Care Tax Credit (-)	Monthly		Annual Self-Sufficiency Wage	Emergency Savings	Household Size	Spouse		
								Table #	County			Costs	Costs			tion Costs	Costs			Broadband & Cell Phone	Necessities					Sufficiency Wage	Sufficiency Wage
a10p000t0	1	0	0	0	0	MD	2023	24	Baltimore city	\$1,079	\$0	\$410	\$77	\$238	\$292	\$111	\$180	\$672	\$0	\$0	\$0	\$15.72	\$2,767	\$33,198.65	\$71.55	1	2
a11p000t0	1	1	0	0	0	MD	2023	24	Baltimore city	\$1,333	\$1,160	\$593	\$77	\$666	\$494	\$111	\$383	\$1,403	\$0	(\$50)	(\$167)	\$31.30	\$5,509	\$66,103.53	\$287.35	2	1
a10p001t0	1	0	0	0	1	0	2023	24	Baltimore city	\$1,333	\$630	\$713	\$77	\$675	\$454	\$111	\$343	\$1,201	\$0	(\$50)	(\$167)	\$27.64	\$4,865	\$58,385.25	\$235.94	2	2
a10p000t1	1	0	0	0	1	MD	2023	24	Baltimore city	\$1,333	\$0	\$749	\$77	\$702	\$397	\$111	\$286	\$990	\$0	\$0	(\$167)	\$23.19	\$4,082	\$48,977.99	\$163.52	2	1
a12p000t0	1	2	0	0	0	MD	2023	24	Baltimore city	\$1,333	\$2,319	\$773	\$77	\$687	\$630	\$111	\$519	\$2,044	\$0	(\$100)	(\$333)	\$42.22	\$7,430	\$89,163.38	\$535.39	3	3
a11p001t0	1	1	0	0	1	MD	2023	24	Baltimore city	\$1,333	\$1,789	\$887	\$77	\$696	\$589	\$111	\$478	\$1,737	\$0	(\$100)	(\$333)	\$37.93	\$6,675	\$80,099.29	\$474.92	3	3
a11p000t1	1	1	0	0	1	MD	2023	24	Baltimore city	\$1,333	\$1,160	\$922	\$77	\$723	\$533	\$111	\$421	\$1,451	\$0	(\$100)	(\$333)	\$32.76	\$5,765	\$69,179.55	\$336.70	3	3
a10p002t0	1	0	0	0	2	0	2023	24	Baltimore city	\$1,333	\$1,259	\$1,002	\$77	\$704	\$549	\$111	\$437	\$1,532	\$0	(\$100)	(\$333)	\$34.22	\$6,022	\$72,265.46	\$369.54	3	3
a10p001t1	1	0	0	0	1	1	2023	24	Baltimore city	\$1,333	\$630	\$1,036	\$77	\$731	\$492	\$111	\$381	\$1,247	\$0	(\$100)	(\$333)	\$29.05	\$5,112	\$61,345.72	\$284.59	3	3
a10p000t2	1	0	0	0	2	MD	2023	24	Baltimore city	\$1,333	\$0	\$1,071	\$77	\$759	\$435	\$111	\$324	\$1,105	\$0	\$0	(\$333)	\$25.26	\$4,446	\$53,348.81	\$211.96	3	3
a13p000t0	1	3	0	0	0	MD	2023	24	Baltimore city	\$1,729	\$3,479	\$933	\$77	\$708	\$804	\$111	\$693	\$3,291	\$0	(\$100)	(\$500)	\$59.21	\$10,421	\$125,056.60	\$819.58	4	4
a12p001t0	1	2	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$2,949	\$1,042	\$77	\$716	\$763	\$111	\$651	\$2,949	\$0	(\$100)	(\$500)	\$54.69	\$9,625	\$115,502.43	\$756.28	4	4
a12p000t1	1	2	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$2,319	\$1,075	\$77	\$744	\$706	\$111	\$594	\$2,511	\$0	(\$100)	(\$500)	\$48.65	\$8,562	\$102,740.07	\$652.40	4	4
a11p002t0	1	1	0	0	2	0	2023	24	Baltimore city	\$1,729	\$2,419	\$1,151	\$77	\$725	\$721	\$111	\$610	\$2,632	\$0	(\$100)	(\$500)	\$50.31	\$8,854	\$106,249.15	\$685.58	4	4
a11p001t1	1	1	0	0	1	1	2023	24	Baltimore city	\$1,729	\$1,789	\$1,184	\$77	\$752	\$664	\$111	\$553	\$2,194	\$0	(\$100)	(\$500)	\$44.26	\$7,790	\$93,480.30	\$586.26	4	4
a11p000t2	1	1	0	0	2	MD	2023	24	Baltimore city	\$1,729	\$1,160	\$1,217	\$77	\$779	\$607	\$111	\$496	\$1,753	\$0	(\$100)	(\$500)	\$38.20	\$6,723	\$80,679.02	\$501.75	4	4
a10p003t0	1	0	0	0	3	0	2023	24	Baltimore city	\$1,729	\$1,889	\$1,260	\$77	\$734	\$680	\$111	\$569	\$2,315	\$0	(\$100)	(\$500)	\$45.93	\$8,083	\$96,995.87	\$609.49	4	4
a10p002t1	1	0	0	0	2	1	2023	24	Baltimore city	\$1,729	\$1,259	\$1,293	\$77	\$761	\$623	\$111	\$512	\$1,874	\$0	(\$100)	(\$500)	\$39.87	\$7,017	\$84,201.08	\$524.98	4	4
a10p001t2	1	0	0	0	1	2	2023	24	Baltimore city	\$1,729	\$630	\$1,326	\$77	\$788	\$566	\$111	\$455	\$1,545	\$0	(\$100)	(\$500)	\$34.44	\$6,061	\$72,736.53	\$438.40	4	4
a10p000t3	1	0	0	0	3	MD	2023	24	Baltimore city	\$1,729	\$0	\$1,359	\$77	\$815	\$509	\$111	\$398	\$1,400	\$0	\$0	(\$500)	\$30.62	\$5,390	\$64,674.69	\$306.80	4	4
a14p000t0	1	4	0	0	0	MD	2023	24	Baltimore city	\$1,729	\$4,639	\$1,074	\$77	\$729	\$936	\$111	\$825	\$4,286	\$0	(\$100)	(\$667)	\$72.18	\$12,703	\$152,437.11	\$1,025.89	5	5
a13p001t0	1	3	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$4,109	\$1,178	\$77	\$737	\$894	\$111	\$783	\$3,919	\$0	(\$100)	(\$667)	\$67.48	\$11,876	\$142,511.54	\$958.31	5	5
a13p000t1	1	3	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$3,479	\$1,209	\$77	\$746	\$837	\$111	\$726	\$3,443	\$0	(\$100)	(\$667)	\$61.20	\$10,772	\$129,264.66	\$870.51	5	5
a12p002t0	1	2	0	0	2	0	2023	24	Baltimore city	\$1,729	\$3,579	\$1,281	\$77	\$764	\$852	\$111	\$741	\$3,570	\$0	(\$100)	(\$667)	\$62.88	\$11,067	\$132,808.35	\$904.40	5	5
a12p001t1	1	2	0	0	1	1	2023	24	Baltimore city	\$1,729	\$2,949	\$1,312	\$77	\$773	\$795	\$111	\$684	\$3,094	\$0	(\$100)	(\$667)	\$56.61	\$9,963	\$119,561.47	\$806.37	5	5
a12p000t2	1	2	0	0	2	MD	2023	24	Baltimore city	\$1,729	\$2,319	\$1,344	\$77	\$800	\$738	\$111	\$627	\$2,646	\$0	(\$100)	(\$667)	\$50.50	\$8,887	\$106,646.87	\$718.81	5	5
a11p003t0	1	1	0	0	3	0	2023	24	Baltimore city	\$1,729	\$3,048	\$1,385	\$77	\$754	\$810	\$111	\$699	\$3,222	\$0	(\$100)	(\$667)	\$58.29	\$10,259	\$123,105.15	\$829.79	5	5
a11p002t1	1	1	0	0	2	1	2023	24	Baltimore city	\$1,729	\$2,419	\$1,416	\$77	\$782	\$753	\$111	\$642	\$2,763	\$0	(\$100)	(\$667)	\$52.12	\$9,173	\$110,070.83	\$742.23	5	5
a11p001t2	1	1	0	0	1	2	2023	24	Baltimore city	\$1,729	\$1,789	\$1,447	\$77	\$809	\$696	\$111	\$585	\$2,325	\$0	(\$100)	(\$667)	\$46.06	\$8,106	\$97,271.48	\$633.69	5	5
a11p000t3	1	1	0	0	3	MD	2023	24	Baltimore city	\$1,729	\$1,160	\$1,479	\$77	\$836	\$639	\$111	\$528	\$1,884	\$0	(\$100)	(\$667)	\$39.98	\$7,037	\$84,439.70	\$548.93	5	5
a10p004t0	1	0	0	0	4	0	2023	24	Baltimore city	\$1,729	\$2,518	\$1,488	\$77	\$763	\$769	\$111	\$658	\$2,881	\$0	(\$100)	(\$667)	\$53.74	\$9,458	\$113,494.80	\$765.66	5	5
a10p003t1	1	0	0	0	3	1	2023	24	Baltimore city	\$1,729	\$1,889	\$1,519	\$77	\$790	\$712	\$111	\$600	\$2,442	\$0	(\$100)	(\$667)	\$47.68	\$8,391	\$100,695.45	\$665.01	5	5
a10p002t2	1	0	0	0	2	2	2023	24	Baltimore city	\$1,729	\$1,259	\$1,551	\$77	\$817	\$654	\$111	\$543	\$2,001	\$0	(\$100)	(\$667)	\$41.61	\$7,323	\$87,870.15	\$571.61	5	5
a10p001t3	1	0	0	0	1	3	2023	24	Baltimore city	\$1,729	\$630	\$1,582	\$77	\$845	\$597	\$111	\$486	\$1,627	\$0	(\$100)	(\$667)	\$35.91	\$6,320	\$75,843.75	\$486.85	5	5
a10p000t4	1	0	0	0	4	MD	2023	24	Baltimore city	\$1,729	\$0	\$1,613	\$77	\$872	\$540	\$111	\$429	\$1,480	\$0	\$0	(\$667)	\$32.08	\$5,645	\$67,744.71	\$346.56	5	5
a15p000t0	1	5	0	0	0	MD	2023	24	Baltimore city	\$1,978	\$5,799	\$1,261	\$77	\$749	\$1,098	\$111	\$986	\$5,528	\$0	(\$100)	(\$833)	\$88.39	\$15,557	\$186,679.36	\$1,402.19	6	6
a14p001t0	1	4	0	0	1	0	2023	24	Baltimore city	\$1,978	\$5,268	\$1,365	\$77	\$758	\$1,056	\$111	\$945	\$5,175	\$0	(\$100)	(\$833)	\$83.78	\$14,744	\$176,932.78	\$1,221.95	6	6
a14p000t1	1	4	0	0	1	MD	2023	24	Baltimore city	\$1,978	\$4,639	\$1,396	\$77	\$785	\$999	\$111	\$888	\$4,685	\$0	(\$100)	(\$833)	\$77.42	\$13,626	\$163,512.56	\$1,129.22	6	6
a13p002t0	1	3	0	0	2	0	2023	24	Baltimore city	\$1,978	\$4,738	\$1,468	\$77	\$767	\$1,014	\$111	\$903	\$4,814	\$0	(\$100)	(\$833)	\$79.11	\$13,923	\$167,071.80	\$1,148.48	6	6
a13p001t1	1	3	0	0	1	1	2023	24	Baltimore city	\$1,978	\$4,109	\$1,500	\$77	\$794	\$957	\$111	\$846	\$4,336	\$0	(\$100)	(\$833)	\$72.82	\$12,817	\$153,804.07	\$1,064.27	6	6
a13p000t2	1	3	0	0	2	MD	2023	24	Baltimore city	\$1,978	\$3,479	\$1,531	\$77	\$821	\$900	\$111	\$789	\$3,842	\$0	(\$100)	(\$833)	\$66.45	\$11,695	\$140,334.81	\$967.50	6	6
a12p003t0	1	2	0	0	3	0	2023	24	Baltimore city	\$1,978	\$4,208	\$1,572	\$77	\$775	\$972	\$111	\$861	\$4,463	\$0	(\$100)	(\$833)	\$74.50	\$13,112	\$157,347.75			

Exhibit JGH-4
Page 2 of 78

a10p0s3t3	1	0	0	3	3	MD	2023	24	Baltimore city	\$1,978	\$1,889	\$2,050	\$77	\$903	\$801	\$111	\$690	\$2,898	\$0	(\$100)	(\$1,000)	\$53.95	\$9,496	\$113,950.79	\$815.00	7	251%
a10p0s2t4	1	0	0	2	4	MD	2023	24	Baltimore city	\$1,978	\$1,259	\$2,079	\$77	\$930	\$744	\$111	\$632	\$2,458	\$0	(\$100)	(\$1,000)	\$47.88	\$8,426	\$101,114.46	\$727.19	7	223%
a10p0s1t5	1	0	0	1	5	MD	2023	24	Baltimore city	\$1,978	\$630	\$2,109	\$77	\$958	\$686	\$111	\$575	\$2,017	\$0	(\$100)	(\$1,000)	\$41.79	\$7,355	\$68,258.66	\$618.88	7	194%
a10p0s0t6	1	0	0	0	6	MD	2023	24	Baltimore city	\$1,978	\$0	\$2,139	\$77	\$985	\$629	\$111	\$518	\$1,774	\$0	\$0	(\$1,000)	\$37.40	\$6,582	\$78,989.62	\$533.88	7	174%
a20p0s0t0	2	0	0	0	0	MD	2023	24	Baltimore city	\$1,079	\$0	\$752	\$154	\$739	\$428	\$155	\$525	\$896	\$0	\$0	\$0	\$11.50	\$4,047	\$48,569.37	\$55.82	2	246%
a21p0s0t0	2	1	0	0	0	MD	2023	24	Baltimore city	\$1,333	\$1,160	\$925	\$154	\$760	\$589	\$155	\$433	\$1,554	\$0	(\$50)	(\$167)	\$17.77	\$6,257	\$75,078.63	\$87.16	3	302%
a20p0s1t0	2	0	0	1	0	MD	2023	24	Baltimore city	\$1,333	\$630	\$1,039	\$154	\$768	\$548	\$155	\$392	\$1,351	\$0	(\$50)	(\$167)	\$15.93	\$5,606	\$67,267.00	\$81.44	3	271%
a20p0s0t1	2	0	0	0	1	MD	2023	24	Baltimore city	\$1,333	\$0	\$1,074	\$154	\$796	\$491	\$155	\$336	\$1,134	\$0	\$0	(\$167)	\$13.68	\$4,815	\$57,775.38	\$69.83	3	232%
a21p0s0t0	2	2	0	0	0	MD	2023	24	Baltimore city	\$1,333	\$2,319	\$1,078	\$154	\$781	\$722	\$155	\$566	\$2,078	\$0	(\$100)	(\$333)	\$22.82	\$8,031	\$96,371.90	\$155.78	4	321%
a21p0s1t0	2	1	0	1	0	MD	2023	24	Baltimore city	\$1,333	\$1,789	\$1,187	\$154	\$789	\$681	\$155	\$525	\$1,872	\$0	(\$100)	(\$333)	\$20.94	\$7,371	\$88,455.80	\$129.37	4	295%
a21p0s0t1	2	1	0	0	1	MD	2023	24	Baltimore city	\$1,333	\$1,160	\$1,220	\$154	\$816	\$624	\$155	\$468	\$1,588	\$0	(\$100)	(\$333)	\$18.36	\$6,461	\$77,537.71	\$99.24	4	258%
a20p0s2t0	2	0	0	2	0	MD	2023	24	Baltimore city	\$1,333	\$1,259	\$1,296	\$154	\$798	\$639	\$155	\$484	\$1,666	\$0	(\$100)	(\$333)	\$19.07	\$6,712	\$80,539.70	\$102.97	4	268%
a20p0s1t1	2	0	0	1	1	MD	2023	24	Baltimore city	\$1,333	\$630	\$1,329	\$154	\$825	\$582	\$155	\$427	\$1,383	\$0	(\$100)	(\$333)	\$16.48	\$5,802	\$69,621.61	\$93.44	4	232%
a20p0s0t2	2	0	0	0	2	MD	2023	24	Baltimore city	\$1,333	\$0	\$1,362	\$154	\$852	\$525	\$155	\$370	\$1,232	\$0	\$0	(\$333)	\$14.56	\$5,124	\$61,493.17	\$78.18	4	205%
a23p0s0t0	2	3	0	0	0	MD	2023	24	Baltimore city	\$1,729	\$3,479	\$1,212	\$154	\$801	\$893	\$155	\$738	\$2,984	\$0	(\$100)	(\$500)	\$30.26	\$10,653	\$127,830.71	\$307.70	5	364%
a22p0s1t0	2	2	0	1	0	MD	2023	24	Baltimore city	\$1,729	\$2,949	\$1,315	\$154	\$810	\$851	\$155	\$696	\$2,663	\$0	(\$100)	(\$500)	\$28.04	\$9,871	\$118,455.32	\$276.66	5	337%
a22p0s0t1	2	2	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$2,319	\$1,346	\$154	\$837	\$794	\$155	\$639	\$2,363	\$0	(\$100)	(\$500)	\$25.41	\$8,943	\$107,316.96	\$201.92	5	305%
a21p0s2t0	2	1	0	2	0	MD	2023	24	Baltimore city	\$1,729	\$2,419	\$1,418	\$154	\$818	\$809	\$155	\$654	\$2,439	\$0	(\$100)	(\$500)	\$26.10	\$9,187	\$110,246.13	\$234.76	5	314%
a21p0s1t1	2	1	0	1	1	MD	2023	24	Baltimore city	\$1,729	\$1,789	\$1,450	\$154	\$846	\$752	\$155	\$597	\$2,155	\$0	(\$100)	(\$500)	\$23.51	\$8,275	\$99,296.40	\$175.17	5	283%
a21p0s0t2	2	1	0	0	2	MD	2023	24	Baltimore city	\$1,729	\$1,160	\$1,481	\$154	\$873	\$695	\$155	\$540	\$1,870	\$0	(\$100)	(\$500)	\$20.92	\$7,362	\$88,346.67	\$138.65	5	251%
a20p0s3t0	2	0	0	3	0	MD	2023	24	Baltimore city	\$1,729	\$1,889	\$1,522	\$154	\$827	\$767	\$155	\$612	\$2,231	\$0	(\$100)	(\$500)	\$24.20	\$8,519	\$102,225.57	\$184.94	5	291%
a20p0s2t1	2	0	0	2	1	MD	2023	24	Baltimore city	\$1,729	\$1,259	\$1,553	\$154	\$854	\$710	\$155	\$555	\$1,946	\$0	(\$100)	(\$500)	\$21.61	\$7,606	\$91,275.84	\$148.42	5	260%
a20p0s1t2	2	0	0	1	2	MD	2023	24	Baltimore city	\$1,729	\$630	\$1,585	\$154	\$881	\$653	\$155	\$498	\$1,662	\$0	(\$100)	(\$500)	\$19.02	\$6,694	\$80,326.11	\$111.89	5	229%
a20p0s0t3	2	0	0	0	3	MD	2023	24	Baltimore city	\$1,729	\$0	\$1,616	\$154	\$909	\$596	\$155	\$441	\$1,510	\$0	\$0	(\$500)	\$17.08	\$6,014	\$72,166.03	\$91.62	5	205%
a24p0s0t0	2	4	0	0	0	MD	2023	24	Baltimore city	\$1,729	\$4,639	\$1,399	\$154	\$822	\$1,030	\$155	\$874	\$3,938	\$0	(\$100)	(\$667)	\$36.77	\$12,944	\$155,332.50	\$410.78	6	386%
a23p0s1t0	2	3	0	1	0	MD	2023	24	Baltimore city	\$1,729	\$4,109	\$1,502	\$154	\$831	\$988	\$155	\$832	\$3,599	\$0	(\$100)	(\$667)	\$34.50	\$12,145	\$145,742.26	\$378.19	6	362%
a23p0s0t1	2	3	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$3,479	\$1,534	\$154	\$858	\$931	\$155	\$775	\$3,160	\$0	(\$100)	(\$667)	\$31.47	\$11,079	\$132,942.91	\$335.81	6	330%
a22p0s2t0	2	2	0	2	0	MD	2023	24	Baltimore city	\$1,729	\$3,579	\$1,606	\$154	\$839	\$946	\$155	\$791	\$3,278	\$0	(\$100)	(\$667)	\$32.28	\$11,364	\$136,366.87	\$347.15	6	339%
a22p0s1t1	2	2	0	1	1	MD	2023	24	Baltimore city	\$1,729	\$2,949	\$1,637	\$154	\$866	\$889	\$155	\$734	\$2,839	\$0	(\$100)	(\$667)	\$29.25	\$10,297	\$123,567.52	\$304.77	6	307%
a22p0s0t2	2	2	0	0	2	MD	2023	24	Baltimore city	\$1,729	\$2,319	\$1,668	\$154	\$894	\$832	\$155	\$676	\$2,477	\$0	(\$100)	(\$667)	\$26.44	\$9,308	\$111,690.40	\$262.39	6	277%
a21p0s3t0	2	1	0	3	0	MD	2023	24	Baltimore city	\$1,729	\$3,048	\$1,709	\$154	\$848	\$904	\$155	\$749	\$2,957	\$0	(\$100)	(\$667)	\$30.06	\$10,583	\$126,991.49	\$315.11	6	315%
a21p0s2t1	2	1	0	2	1	MD	2023	24	Baltimore city	\$1,729	\$2,419	\$1,741	\$154	\$875	\$847	\$155	\$692	\$2,554	\$0	(\$100)	(\$667)	\$27.14	\$9,552	\$114,619.58	\$272.73	6	285%
a21p0s1t2	2	1	0	1	2	MD	2023	24	Baltimore city	\$1,729	\$1,789	\$1,772	\$154	\$902	\$790	\$155	\$635	\$2,269	\$0	(\$100)	(\$667)	\$24.54	\$8,639	\$103,669.84	\$199.40	6	257%
a21p0s0t3	2	1	0	0	3	MD	2023	24	Baltimore city	\$1,729	\$1,160	\$1,803	\$154	\$930	\$733	\$155	\$578	\$1,985	\$0	(\$100)	(\$667)	\$21.95	\$7,727	\$92,720.11	\$162.88	6	230%
a20p0s4t0	2	0	0	4	0	MD	2023	24	Baltimore city	\$1,729	\$2,518	\$1,813	\$154	\$856	\$862	\$155	\$707	\$2,635	\$0	(\$100)	(\$667)	\$27.84	\$9,801	\$117,616.10	\$285.07	6	292%
a20p0s3t1	2	0	0	3	1	MD	2023	24	Baltimore city	\$1,729	\$1,889	\$1,844	\$154	\$884	\$805	\$155	\$650	\$2,345	\$0	(\$100)	(\$667)	\$25.24	\$8,883	\$106,599.02	\$222.18	6	265%
a20p0s2t2	2	0	0	2	2	MD	2023	24	Baltimore city	\$1,729	\$1,259	\$1,875	\$154	\$911	\$748	\$155	\$593	\$2,061	\$0	(\$100)	(\$667)	\$22.64	\$7,971	\$95,649.29	\$172.65	6	237%
a20p0s1t3	2	0	0	1	3	MD	2023	24	Baltimore city	\$1,729	\$630	\$1,907	\$154	\$938	\$691	\$155	\$536	\$1,776	\$0	(\$100)	(\$667)	\$20.05	\$6,758	\$84,699.55	\$136.12	6	210%
a20p0s0t4	2	0	0	0	4	MD	2023	24	Baltimore city	\$1,729	\$0	\$1,938	\$154	\$965	\$634	\$155	\$479	\$1,624	\$0	\$0	(\$667)	\$18.12	\$6,378	\$76,539.47	\$100.44	6	190%
a25p0s0t0	2	5	0	0	0	MD	2023	24	Baltimore city	\$1,978	\$5,799	\$1,503	\$154	\$843	\$1,183	\$155	\$1,028	\$5,019	\$0	(\$100)	(\$833)	\$44.16	\$15,545	\$186,539.93	\$532.92	7	411%
a24p0s1t0	2	4	0	1	0	MD	2023	24	Baltimore city	\$1,978	\$5,268	\$1,601	\$154	\$851	\$1,141	\$155	\$985	\$4,690	\$0	(\$100)	(\$833)	\$41.90	\$14,750	\$177,002.16	\$495.33	7	390%
a24p0s0t1	2	4	0	0	1	MD	2023	24	Baltimore city	\$1,978	\$4,639	\$1,630	\$154	\$879	\$1,083	\$155	\$928	\$4,236	\$0	(\$100)	(\$833)	\$38.83	\$13,667	\$164,000.11	\$456.27	7	361%
a23p0s2t0	2	3	0	2	0	MD	2023	24	Baltimore city	\$1,978	\$4,738	\$1,699	\$154	\$860	\$1,098	\$155	\$943	\$4,352	\$0	(\$100)	(\$833)	\$39.62	\$13,946	\$167,353.11	\$462.01	7	368%
a23p0s1t1	2	3	0	1	1	MD	2023	24	Baltimore city	\$1,978	\$4,109	\$1,728	\$154	\$887	\$1,041	\$155	\$886	\$3,911	\$0	(\$100)	(\$833)	\$36.58	\$12,875	\$154,500.50	\$419.34	7	340%
a23p0s0t2	2	3	0	0	2	MD	2023	24	Baltimore city	\$1,978	\$3,479	\$1,758	\$154	\$914	\$984	\$155	\$828	\$3,453	\$0	(\$100)	(\$833)	\$33.49	\$11,787	\$141,449.30	\$375.16	7	311%
a22p0s3t0	2	2	0	3	0	MD	2023	24	Baltimore city	\$1,978	\$4,208	\$1,797	\$154	\$869	\$1,056	\$155	\$901	\$4,025	\$0	(\$100)	(\$833)	\$37.37	\$13,153	\$157,839.35	\$430.44	7	348%
a22p0s2t1	2	2	0	2	1	MD	2023	24	Baltimore city	\$1,978	\$3,579	\$1,826	\$154	\$896	\$999	\$155	\$843	\$3,567	\$0	(\$100)	(\$833)	\$34.28	\$12,066	\$144,788.15	\$386.22	7	319%
a22p0s1t2	2	2	0	1	2	MD	2023	24	Baltimore city	\$1,978	\$2,949	\$1,856	\$154	\$923	\$941	\$155	\$786	\$3,127	\$0	(\$100)	(\$833)	\$31.24	\$10,996	\$131,951.81	\$343.72	7	291%
a22p0s0t3	2	2	0	0	3	MD	2023	24	Baltimore city	\$1,978	\$2,319	\$1,886	\$154	\$950	\$884	\$155	\$729	\$2,688	\$0	(\$100)	(\$833)	\$28.20	\$9,926	\$119,115.48	\$301.22	7	262%
a21p0s4t0	2	1	0	4	0	MD	2023	24	Baltimore city	\$1,978	\$3,678	\$1,895	\$154	\$877	\$1,014	\$155	\$858	\$3,682	\$0	(\$100)	(\$833)	\$35.07	\$12,344	\$148,126.99	\$397.62	7	326%
a21p0s3t1	2	1	0	3	1	MD	2023	24	Baltimore city	\$1,978	\$3,048	\$1,925	\$154	\$904	\$956	\$155	\$801	\$3,242	\$0	(\$100)	(\$833)	\$32.03	\$11,274	\$135,290.66	\$364.91	7	298%
a21p0s2t2	2	1	0	2	2	MD	2023	24	Baltimore city	\$1,978	\$2,419	\$1,954	\$154	\$932	\$												

Exhibit JGH-4
Page 3 of 78

a2i0p0s4t2	2	0	0	4	2	MD	2023	24	Baltimore city	\$1,978	\$2,518	\$2,328	\$154	\$969	\$950	\$155	\$795	\$3,079	\$0	(\$100)	(\$1,000)	\$30.90	\$10,877	\$130,525.24	\$360.32	8	258%
a2i0p0s3t3	2	0	0	3	3	MD	2023	24	Baltimore city	\$1,978	\$1,889	\$2,357	\$154	\$997	\$893	\$155	\$738	\$2,640	\$0	(\$100)	(\$1,000)	\$27.86	\$9,807	\$117,688.90	\$307.68	8	233%
a2i0p0s2t4	2	0	0	2	4	MD	2023	24	Baltimore city	\$1,978	\$1,259	\$2,387	\$154	\$1,024	\$886	\$155	\$680	\$2,348	\$0	(\$100)	(\$1,000)	\$25.24	\$8,886	\$106,629.65	\$265.18	8	211%
a2i0p0s1t5	2	0	0	1	5	MD	2023	24	Baltimore city	\$1,978	\$630	\$2,417	\$154	\$1,051	\$778	\$155	\$623	\$2,062	\$0	(\$100)	(\$1,000)	\$22.64	\$7,971	\$95,648.28	\$191.92	8	189%
a2i0p0s0t6	2	0	0	0	6	MD	2023	24	Baltimore city	\$1,978	\$0	\$2,447	\$154	\$1,078	\$721	\$155	\$566	\$1,910	\$0	\$0	(\$1,000)	\$20.70	\$7,288	\$87,456.56	\$155.29	8	173%
a3i0p0s0t0	3	0	0	0	0	MD	2023	24	Baltimore city	\$1,333	\$0	\$1,077	\$231	\$833	\$547	\$200	\$347	\$1,290	\$0	\$0	\$0	\$15.08	\$5,310	\$63,718.42	\$68.57	3	256%
a3i1p0s0t0	3	1	0	0	0	MD	2023	24	Baltimore city	\$1,729	\$1,160	\$1,223	\$231	\$853	\$719	\$200	\$520	\$1,989	\$0	(\$50)	(\$208)	\$21.72	\$7,646	\$91,755.87	\$128.49	4	306%
a3i0p0s1t0	3	0	0	1	0	MD	2023	24	Baltimore city	\$1,729	\$630	\$1,332	\$231	\$862	\$678	\$200	\$478	\$1,784	\$0	(\$50)	(\$208)	\$19.85	\$6,987	\$83,839.77	\$102.09	4	279%
a3i0p0s0t1	3	0	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$0	\$1,365	\$231	\$889	\$621	\$200	\$421	\$1,566	\$0	\$0	(\$208)	\$17.59	\$6,193	\$74,316.50	\$84.36	4	248%
a3i2p0s0t0	3	2	0	0	0	MD	2023	24	Baltimore city	\$1,729	\$2,319	\$1,349	\$231	\$874	\$850	\$200	\$650	\$2,500	\$0	(\$100)	(\$375)	\$26.64	\$9,378	\$112,532.21	\$236.73	5	320%
a3i1p0s1t0	3	1	0	1	0	MD	2023	24	Baltimore city	\$1,729	\$1,789	\$1,452	\$231	\$883	\$808	\$200	\$608	\$2,292	\$0	(\$100)	(\$375)	\$24.74	\$8,709	\$104,511.65	\$185.34	5	297%
a3i1p0s0t1	3	1	0	0	1	MD	2023	24	Baltimore city	\$1,729	\$1,160	\$1,484	\$231	\$910	\$751	\$200	\$551	\$2,007	\$0	(\$100)	(\$375)	\$22.15	\$7,797	\$93,561.92	\$148.81	5	266%
a3i0p0s2t0	3	0	0	2	0	MD	2023	24	Baltimore city	\$1,729	\$1,259	\$1,556	\$231	\$891	\$766	\$200	\$567	\$2,083	\$0	(\$100)	(\$375)	\$22.84	\$8,041	\$96,491.09	\$158.58	5	275%
a3i0p0s1t1	3	0	0	1	1	MD	2023	24	Baltimore city	\$1,729	\$630	\$1,587	\$231	\$918	\$709	\$200	\$510	\$1,799	\$0	(\$100)	(\$375)	\$20.25	\$7,128	\$85,541.36	\$122.06	5	243%
a3i0p0s0t2	3	0	0	0	2	MD	2023	24	Baltimore city	\$1,729	\$0	\$1,619	\$231	\$946	\$652	\$200	\$452	\$1,647	\$0	\$0	(\$375)	\$18.32	\$6,448	\$77,381.28	\$92.23	5	220%
a3i3p0s0t0	3	3	0	0	0	MD	2023	24	Baltimore city	\$1,978	\$3,479	\$1,536	\$231	\$895	\$1,012	\$200	\$812	\$3,562	\$0	(\$100)	(\$542)	\$34.24	\$12,052	\$144,623.07	\$366.10	6	359%
a3i2p0s1t0	3	2	0	1	0	MD	2023	24	Baltimore city	\$1,978	\$2,949	\$1,640	\$231	\$903	\$970	\$200	\$770	\$3,241	\$0	(\$100)	(\$542)	\$32.02	\$11,271	\$135,247.68	\$335.05	6	336%
a3i2p0s0t1	3	2	0	0	1	MD	2023	24	Baltimore city	\$1,978	\$2,319	\$1,671	\$231	\$931	\$913	\$200	\$713	\$2,803	\$0	(\$100)	(\$542)	\$28.99	\$10,204	\$122,448.34	\$292.68	6	304%
a3i1p0s2t0	3	1	0	2	0	MD	2023	24	Baltimore city	\$1,978	\$2,419	\$1,743	\$231	\$912	\$928	\$200	\$728	\$2,920	\$0	(\$100)	(\$542)	\$29.80	\$10,489	\$125,872.30	\$304.01	6	312%
a3i1p0s1t1	3	1	0	1	1	MD	2023	24	Baltimore city	\$1,978	\$1,789	\$1,775	\$231	\$939	\$871	\$200	\$671	\$2,530	\$0	(\$100)	(\$542)	\$26.91	\$9,472	\$113,662.12	\$261.64	6	282%
a3i1p0s0t2	3	1	0	0	2	MD	2023	24	Baltimore city	\$1,978	\$1,160	\$1,806	\$231	\$966	\$814	\$200	\$614	\$2,246	\$0	(\$100)	(\$542)	\$24.32	\$8,559	\$102,712.39	\$188.98	6	255%
a3i0p0s3t0	3	0	0	3	0	MD	2023	24	Baltimore city	\$1,978	\$1,889	\$1,847	\$231	\$920	\$886	\$200	\$687	\$2,606	\$0	(\$100)	(\$542)	\$27.60	\$9,716	\$116,591.29	\$277.97	6	289%
a3i0p0s2t1	3	0	0	2	1	MD	2023	24	Baltimore city	\$1,978	\$1,259	\$1,878	\$231	\$948	\$829	\$200	\$629	\$2,322	\$0	(\$100)	(\$542)	\$25.01	\$8,803	\$105,641.56	\$198.75	6	262%
a3i0p0s1t2	3	0	0	1	2	MD	2023	24	Baltimore city	\$1,978	\$630	\$1,909	\$231	\$975	\$772	\$200	\$572	\$2,038	\$0	(\$100)	(\$542)	\$22.42	\$7,891	\$94,691.83	\$162.22	6	235%
a3i0p0s0t3	3	0	0	0	3	MD	2023	24	Baltimore city	\$1,978	\$0	\$1,941	\$231	\$1,002	\$715	\$200	\$515	\$1,886	\$0	\$0	(\$542)	\$20.49	\$7,211	\$86,531.75	\$125.70	6	215%
a3i4p0s0t0	3	4	0	0	0	MD	2023	24	Baltimore city	\$1,978	\$4,639	\$1,633	\$231	\$916	\$1,139	\$200	\$940	\$4,449	\$0	(\$100)	(\$708)	\$40.27	\$14,177	\$170,119.08	\$462.75	7	375%
a3i3p0s1t0	3	3	0	1	0	MD	2023	24	Baltimore city	\$1,978	\$4,109	\$1,731	\$231	\$924	\$1,097	\$200	\$897	\$4,121	\$0	(\$100)	(\$708)	\$38.02	\$13,383	\$160,593.64	\$431.17	7	354%
a3i3p0s0t1	3	3	0	0	1	MD	2023	24	Baltimore city	\$1,978	\$3,479	\$1,761	\$231	\$951	\$1,040	\$200	\$840	\$3,663	\$0	(\$100)	(\$708)	\$34.93	\$12,295	\$147,542.44	\$386.95	7	325%
a3i2p0s2t0	3	2	0	2	0	MD	2023	24	Baltimore city	\$1,978	\$3,579	\$1,829	\$231	\$933	\$1,055	\$200	\$855	\$3,796	\$0	(\$100)	(\$708)	\$35.77	\$12,591	\$151,096.15	\$398.43	7	333%
a3i2p0s1t1	3	2	0	1	1	MD	2023	24	Baltimore city	\$1,978	\$2,949	\$1,859	\$231	\$960	\$997	\$200	\$798	\$3,338	\$0	(\$100)	(\$708)	\$32.68	\$11,504	\$138,044.95	\$365.64	7	304%
a3i2p0s0t2	3	2	0	0	2	MD	2023	24	Baltimore city	\$1,978	\$2,319	\$1,888	\$231	\$987	\$940	\$200	\$740	\$2,898	\$0	(\$100)	(\$708)	\$29.64	\$10,434	\$125,208.61	\$313.00	7	276%
a3i1p0s3t0	3	1	0	3	0	MD	2023	24	Baltimore city	\$1,978	\$3,048	\$1,927	\$231	\$941	\$1,012	\$200	\$813	\$3,452	\$0	(\$100)	(\$708)	\$33.47	\$11,782	\$141,383.79	\$366.56	7	311%
a3i1p0s2t1	3	1	0	2	1	MD	2023	24	Baltimore city	\$1,978	\$2,419	\$1,957	\$231	\$968	\$955	\$200	\$755	\$3,012	\$0	(\$100)	(\$708)	\$30.43	\$10,712	\$128,547.46	\$324.06	7	283%
a3i1p0s1t2	3	1	0	1	2	MD	2023	24	Baltimore city	\$1,978	\$1,789	\$1,986	\$231	\$996	\$898	\$200	\$698	\$2,590	\$0	(\$100)	(\$708)	\$27.44	\$9,660	\$115,919.05	\$281.56	7	255%
a3i1p0s0t3	3	1	0	0	3	MD	2023	24	Baltimore city	\$1,978	\$1,160	\$2,016	\$231	\$1,023	\$840	\$200	\$641	\$2,305	\$0	(\$100)	(\$708)	\$24.84	\$8,745	\$104,937.68	\$206.58	7	231%
a3i0p0s4t0	3	0	0	4	0	MD	2023	24	Baltimore city	\$1,978	\$2,518	\$2,025	\$231	\$950	\$970	\$200	\$770	\$3,127	\$0	(\$100)	(\$708)	\$31.22	\$10,991	\$131,886.30	\$335.11	7	290%
a3i0p0s3t1	3	0	0	3	1	MD	2023	24	Baltimore city	\$1,978	\$1,889	\$2,055	\$231	\$977	\$913	\$200	\$713	\$2,687	\$0	(\$100)	(\$708)	\$28.18	\$9,921	\$119,049.97	\$292.61	7	262%
a3i0p0s2t2	3	0	0	2	2	MD	2023	24	Baltimore city	\$1,978	\$1,259	\$2,084	\$231	\$1,004	\$855	\$200	\$656	\$2,379	\$0	(\$100)	(\$708)	\$25.52	\$8,983	\$107,794.03	\$250.11	7	237%
a3i0p0s1t3	3	0	0	1	3	MD	2023	24	Baltimore city	\$1,978	\$630	\$2,114	\$231	\$1,032	\$798	\$200	\$598	\$2,094	\$0	(\$100)	(\$708)	\$22.92	\$8,068	\$96,812.66	\$178.94	7	213%
a3i0p0s0t4	3	0	0	0	4	MD	2023	24	Baltimore city	\$1,978	\$0	\$2,144	\$231	\$1,059	\$741	\$200	\$541	\$1,941	\$0	\$0	(\$708)	\$20.98	\$7,385	\$88,620.94	\$142.31	7	195%
a3i5p0s0t0	3	5	0	0	0	MD	2023	24	Baltimore city	\$2,275	\$5,799	\$1,810	\$231	\$936	\$1,305	\$200	\$1,105	\$5,642	\$0	(\$100)	(\$875)	\$48.36	\$17,023	\$204,276.86	\$594.72	8	404%
a3i4p0s1t0	3	4	0	1	0	MD	2023	24	Baltimore city	\$2,275	\$5,268	\$1,908	\$231	\$945	\$1,262	\$200	\$1,063	\$5,300	\$0	(\$100)	(\$875)	\$46.07	\$16,215	\$194,583.31	\$556.73	8	385%
a3i4p0s0t1	3	4	0	0	1	MD	2023	24	Baltimore city	\$2,275	\$4,639	\$1,938	\$231	\$972	\$1,205	\$200	\$1,006	\$4,853	\$0	(\$100)	(\$875)	\$43.01	\$15,139	\$181,663.34	\$513.89	8	359%
a3i3p0s2t0	3	3	0	2	0	MD	2023	24	Baltimore city	\$2,275	\$4,738	\$2,006	\$231	\$953	\$1,220	\$200	\$1,020	\$4,969	\$0	(\$100)	(\$875)	\$43.80	\$15,418	\$185,016.35	\$530.68	8	366%
a3i3p0s1t1	3	3	0	1	1	MD	2023	24	Baltimore city	\$2,275	\$4,109	\$2,036	\$231	\$981	\$1,163	\$200	\$963	\$4,515	\$0	(\$100)	(\$875)	\$40.72	\$14,335	\$172,014.30	\$480.66	8	340%
a3i3p0s0t2	3	3	0	0	2	MD	2023	24	Baltimore city	\$2,275	\$3,479	\$2,066	\$231	\$1,008	\$1,106	\$200	\$906	\$4,072	\$0	(\$100)	(\$875)	\$37.68	\$13,262	\$159,142.00	\$442.93	8	315%
a3i2p0s3t0	3	2	0	3	0	MD	2023	24	Baltimore city	\$2,275	\$4,208	\$2,104	\$231	\$962	\$1,178	\$200	\$978	\$4,640	\$0	(\$100)	(\$875)	\$41.54	\$14,623	\$175,478.58	\$492.87	8	347%
a3i2p0s2t1	3	2	0	2	1	MD	2023	24	Baltimore city	\$2,275	\$3,579	\$2,134	\$231	\$989	\$1,120	\$200	\$921	\$4,187	\$0	(\$100)	(\$875)	\$38.47	\$13,540	\$162,480.85	\$454.03	8	321%
a3i2p0s1t2	3	2	0	1	2	MD	2023	24	Baltimore city	\$2,275	\$2,949	\$2,164	\$231	\$1,017	\$1,063	\$200	\$864	\$3,729	\$0	(\$100)	(\$875)	\$35.38	\$12,452	\$149,429.65	\$405.44	8	296%
a3i2p0s0t3	3	2	0	0	3	MD	2023	24	Baltimore city	\$2,275	\$2,319	\$2,194	\$231	\$1,044	\$1,006	\$200	\$806	\$3,289	\$0	(\$100)	(\$875)	\$32.34	\$11,383	\$136,593.31	\$372.02	8	270%
a3i1p0s4t0	3	1	0	4	0	MD	2023	24	Baltimore city	\$2,275	\$3,678	\$2,203	\$231	\$971	\$1,135	\$200	\$936	\$4,302	\$0	(\$100)	(\$875)	\$39.26	\$13,819	\$165,829.53	\$459.78	8	32

a3i0p0s5t1	3	0	0	5	1	MD	2023	24	Baltimore city	\$2,275	\$3,148	\$2,606	\$231	\$1,036	\$1,129	\$200	\$930	\$4,139	\$0	(\$100)	(\$1,042)	\$38.13	\$13,421	\$161,054.28	\$455.17	9	289%
a3i0p0s4t2	3	0	0	4	2	MD	2023	24	Baltimore city	\$2,275	\$2,518	\$2,635	\$231	\$1,063	\$1,072	\$200	\$872	\$3,681	\$0	(\$100)	(\$1,042)	\$35.04	\$12,334	\$148,003.07	\$412.50	9	266%
a3i0p0s3t3	3	0	0	3	3	MD	2023	24	Baltimore city	\$2,275	\$1,889	\$2,665	\$231	\$1,090	\$1,015	\$200	\$815	\$3,241	\$0	(\$100)	(\$1,042)	\$32.00	\$11,264	\$135,166.74	\$368.34	9	243%
a3i0p0s2t4	3	0	0	2	4	MD	2023	24	Baltimore city	\$2,275	\$1,259	\$2,695	\$231	\$1,117	\$957	\$200	\$758	\$2,801	\$0	(\$100)	(\$1,042)	\$28.96	\$10,194	\$122,330.40	\$325.84	9	220%
a3i0p0s1t5	3	0	0	1	5	MD	2023	24	Baltimore city	\$2,275	\$630	\$2,725	\$231	\$1,145	\$900	\$200	\$700	\$2,454	\$0	(\$100)	(\$1,042)	\$26.18	\$9,217	\$110,600.42	\$283.34	9	199%
a3i0p0s0t6	3	0	0	0	6	MD	2023	24	Baltimore city	\$2,275	\$0	\$2,754	\$231	\$1,172	\$843	\$200	\$643	\$2,301	\$0	\$0	(\$1,042)	\$24.24	\$8,534	\$102,408.69	\$219.50	9	184%
a10c10	10	10	0	#VALUE!	#VALUE!	MD	2023	24	Baltimore city	\$3,759	\$6,186	\$5,928	\$770	\$1,829	\$2,356	\$509	\$1,847	\$11,386	\$0	(\$100)	(\$2,000)	\$85.55	\$30,114	\$361,362.01	\$1,319.63	#VALUE!	#VALUE!

**2023 POVERTY GUIDELINES FOR THE 48
CONTIGUOUS STATES AND THE
DISTRICT OF COLUMBIA**

Household Size	Ratio of Income to Poverty				
	50%	75%	100%	125%	150%
1	\$7,290	\$10,935	\$14,580	\$18,225	\$21,870
2	\$9,860	\$14,790	\$19,720	\$24,650	\$29,580
3	\$12,430	\$18,645	\$24,860	\$31,075	\$37,290
4	\$15,000	\$22,500	\$30,000	\$37,500	\$45,000
5	\$17,570	\$26,355	\$35,140	\$43,925	\$52,710
6	\$20,140	\$30,210	\$40,280	\$50,350	\$60,420
7	\$22,710	\$34,065	\$45,420	\$56,775	\$68,130
8	\$25,280	\$37,920	\$50,560	\$63,200	\$75,840
9	\$27,850	\$41,775	\$55,700	\$69,625	\$83,550
10	\$30,420	\$45,630	\$60,840	\$76,050	\$91,260

For families/households with more than 8 persons, add \$5,140 for each additional person.

<https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/prior-hhs-poverty-guidelines-fede>

ral-register-references

Exhibit JGH-4
Page 7 of 78

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[illegible]

[illegible]

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	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122
Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler
school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age
teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager
a11p132t1	a11p131t2	a11p130t3	a11p04t0	a11p03t1	a11p02t2	a11p01t3	a11p00t4	a10p5300	a10p43t0	a10p46t1	a10p33t0	a10p33t1	a10p33t2	a10p33t1	a10p23t0	a10p23t1	a10p23t2	a10p23t3	a10p13t0	a10p13t1	a10p13t2	a10p13t3	a10p13t4	a10p13t5	a10p13t6
\$111,115.45	\$100,932.56	\$96,736.76	\$116,305.62	\$106,117.49	\$95,994.60	\$85,719.45	\$76,249.79	\$134,025.63	\$128,853.96	\$118,317.12	\$123,682.28	\$113,246.37	\$103,063.47	\$118,510.60	\$108,248.41	\$98,065.51	\$87,856.82	\$113,433.35	\$103,250.45	\$93,061.11	\$82,845.96	\$73,783.99	\$108,433.9	\$152,286.93	\$98,252.49
\$173,598.54	\$158,000.39	\$142,242.33	\$181,064.56	\$165,339.56	\$149,568.39	\$134,018.95	\$118,469.52	\$210,537.68	\$201,179.77	\$185,387.73	\$192,772.69	\$177,128.75	\$161,407.61	\$184,486.54	\$168,761.54	\$153,184.24	\$137,467.18	\$176,227.56	\$160,510.30	\$144,753.24	\$129,202.80	\$113,736.61	\$167,060.34	\$142,921.45	\$152,286.93
\$165,250.37	\$149,156.61	\$133,298.12	\$171,956.64	\$156,055.94	\$139,975.07	\$124,116.58	\$108,524.70	\$205,826.96	\$196,032.26	\$180,062.30	\$186,769.75	\$170,725.27	\$154,829.95	\$177,546.72	\$161,506.91	\$145,426.04	\$129,567.54	\$168,209.69	\$152,325.37	\$136,244.50	\$120,386.00	\$104,920.16	\$159,000.32	\$142,921.45	\$152,286.93
\$169,317.01	\$153,716.52	\$137,931.22	\$176,995.08	\$161,250.15	\$145,464.85	\$129,894.82	\$114,386.03	\$204,915.81	\$196,411.02	\$180,729.92	\$188,304.25	\$172,546.69	\$156,932.38	\$180,224.96	\$164,475.46	\$148,680.71	\$133,110.68	\$172,041.93	\$156,429.61	\$140,644.31	\$125,074.28	\$109,727.26	\$163,970.50	\$148,177.94	\$152,286.93
\$117,853.13	\$108,257.83	\$98,720.08	\$122,659.43	\$112,872.77	\$103,335.01	\$93,790.77	\$84,227.06	\$140,005.97	\$134,929.23	\$125,057.98	\$129,834.28	\$119,963.03	\$110,296.46	\$124,739.33	\$114,911.39	\$105,373.64	\$95,835.88	\$119,644.39	\$109,988.57	\$100,450.81	\$90,900.08	\$81,329.89	\$114,603.51	\$105,065.75	\$105,065.75
\$157,474.02	\$141,591.08	\$125,924.49	\$164,870.66	\$148,976.56	\$133,309.97	\$117,643.37	\$102,452.87	\$193,408.39	\$185,060.99	\$169,213.90	\$176,743.74	\$160,902.74	\$145,019.81	\$168,314.35	\$152,621.62	\$136,738.69	\$121,072.09	\$160,007.10	\$144,124.17	\$128,457.57	\$109,250.47	\$97,763.47	\$151,725.98	\$135,843.05	\$105,065.75
\$130,719.43	\$119,266.04	\$108,090.57	\$135,604.53	\$124,151.14	\$112,812.84	\$101,741.23	\$90,656.83	\$158,400.73	\$151,832.45	\$140,170.79	\$145,055.89	\$133,602.51	\$122,149.12	\$138,487.61	\$127,034.23	\$115,599.81	\$104,528.21	\$131,919.33	\$120,465.94	\$109,250.47	\$98,178.87	\$87,081.67	\$127,825.64	\$162,182.24	\$146,257.39
\$115,033.57	\$105,484.82	\$95,936.06	\$119,702.75	\$110,033.97	\$100,485.22	\$90,923.49	\$81,342.31	\$137,443.35	\$132,268.94	\$122,386.32	\$127,094.54	\$117,211.91	\$107,627.28	\$121,920.13	\$112,176.44	\$102,627.68	\$93,072.44	\$116,745.72	\$107,176.84	\$97,628.09	\$88,059.87	\$78,779.46	\$111,726.00	\$102,177.24	\$146,257.39
\$163,805.14	\$147,832.43	\$132,080.12	\$170,351.74	\$154,564.53	\$138,598.35	\$122,846.03	\$107,069.37	\$204,252.38	\$194,633.47	\$178,777.18	\$185,323.78	\$169,392.01	\$153,608.96	\$176,009.50	\$160,127.19	\$144,161.01	\$128,408.69	\$166,664.34	\$150,993.11	\$134,926.92	\$119,174.61	\$103,533.42	\$157,411.33	\$141,445.15	\$141,445.15
\$110,240.57	\$100,172.08	\$90,090.87	\$115,376.47	\$105,307.99	\$95,239.51	\$85,139.19	\$75,837.03	\$132,793.23	\$127,691.44	\$117,277.55	\$122,589.65	\$112,307.58	\$102,239.10	\$117,487.86	\$107,375.00	\$97,306.52	\$87,212.57	\$112,510.91	\$102,442.43	\$92,367.58	\$82,267.25	\$73,373.63	\$107,578.34	\$97,509.85	\$141,445.15
\$163,331.05	\$147,328.27	\$131,547.37	\$169,951.68	\$154,137.50	\$138,139.20	\$122,358.30	\$106,899.27	\$203,574.76	\$194,093.65	\$178,210.64	\$184,831.27	\$168,868.76	\$153,059.29	\$175,602.06	\$159,651.12	\$143,652.82	\$127,871.92	\$166,260.18	\$150,462.06	\$134,463.76	\$118,682.85	\$103,347.41	\$157,053.89	\$147,656.22	\$147,656.22
\$219,485.91	\$194,483.10	\$171,888.41	\$230,433.33	\$204,236.68	\$181,407.89	\$158,863.33	\$136,294.59	\$288,052.46	\$272,724.55	\$246,342.47	\$257,396.63	\$231,038.60	\$204,791.95	\$242,068.72	\$215,789.37	\$191,308.12	\$168,727.37	\$226,786.80	\$200,873.10	\$178,246.85	\$155,716.10	\$133,147.36	\$211,537.57	\$187,656.22	\$147,656.22
\$126,412.14	\$116,691.13	\$107,280.25	\$131,434.23	\$121,713.21	\$112,132.67	\$102,740.07	\$93,340.99	\$147,326.86	\$142,627.94	\$132,906.92	\$137,929.01	\$128,208.00	\$118,486.99	\$133,230.09	\$123,509.08	\$113,867.86	\$104,475.27	\$128,531.17	\$118,810.16	\$109,327.69	\$99,935.09	\$90,529.52	\$123,832.25	\$114,180.11	\$114,180.11
\$216,297.49	\$191,772.90	\$169,218.34	\$227,359.02	\$201,392.95	\$178,792.64	\$156,287.62	\$133,746.99	\$284,409.12	\$269,302.32	\$242,953.42	\$254,072.04	\$227,764.08	\$201,740.86	\$238,841.75	\$212,611.98	\$188,607.39	\$166,066.73	\$223,673.52	\$198,108.22	\$175,641.03	\$153,149.78	\$110,609.15	\$208,521.41	\$185,100.15	\$185,100.15
\$171,655.84	\$155,873.93	\$139,910.53	\$179,323.51	\$163,398.19	\$147,429.99	\$131,688.96	\$115,954.77	\$208,409.12	\$199,218.53	\$183,352.58	\$190,924.47	\$174,979.73	\$159,183.29	\$182,647.39	\$167,722.08	\$150,961.73	\$134,998.33	\$174,274.55	\$158,481.19	\$142,517.79	\$126,776.76	\$111,208.52	\$166,015.90	\$150,259.63	\$150,259.63
\$149,444.51	\$137,960.93	\$126,477.36	\$154,872.77	\$143,166.82	\$131,683.24	\$120,199.67	\$108,967.24	\$176,466.81	\$170,046.37	\$158,528.94	\$163,741.13	\$152,251.25	\$140,545.30	\$157,457.14	\$145,751.18	\$134,267.61	\$122,784.03	\$151,179.45	\$139,473.49	\$127,989.92	\$116,506.34	\$105,398.68	\$144,679.38	\$133,195.80	\$133,195.80
\$146,876.76	\$135,380.49	\$123,884.19	\$152,082.21	\$140,370.65	\$128,874.36	\$117,378.07	\$106,226.36	\$176,460.89	\$167,926.42	\$156,405.71	\$161,395.88	\$149,684.32	\$138,188.03	\$154,889.77	\$143,178.20	\$131,681.92	\$120,185.63	\$148,168.38	\$136,472.09	\$125,175.80	\$113,762.42	\$102,651.91	\$141,692.26	\$130,165.98	\$130,165.98
\$106,256.32	\$96,734.72	\$87,187.18	\$110,858.22	\$101,336.62	\$91,802.05	\$82,254.51	\$73,849.16	\$128,092.40	\$123,000.69	\$113,247.65	\$117,908.95	\$108,327.95	\$98,806.36	\$112,929.85	\$103,408.26	\$93,880.17	\$84,332.63	\$108,010.15	\$98,488.56	\$88,947.50	\$79,575.05	\$71,407.21	\$103,090.46	\$93,562.37	\$93,562.37
\$136,596.30	\$125,384.19	\$114,237.14	\$141,580.88	\$130,336.76	\$119,156.65	\$108,214.46	\$97,371.17	\$163,082.37	\$156,851.51	\$145,444.84	\$150,628.93	\$139,271.30	\$128,094.78	\$144,201.88	\$132,989.77	\$121,777.66	\$110,106.51	\$129,749.25	\$116,300.75	\$104,757.24	\$93,876.57	\$84,325.95	\$113,746.82	\$100,534.71	\$100,534.71
\$125,142.21	\$113,693.52	\$102,546.08	\$131,021.12	\$118,478.29	\$107,252.85	\$96,105.42	\$84,925.81	\$153,169.96	\$146,292.53	\$134,758.70	\$139,628.61	\$128,094.78	\$116,560.95	\$132,964.70	\$121,430.87	\$110,106.51	\$98,959.08	\$129,749.25	\$116,300.75	\$104,757.24	\$93,876.57	\$84,325.95	\$113,746.82	\$100,534.71	\$100,534.71
\$114,164.77	\$104,623.89	\$95,083.02	\$118,865.13	\$109,232.52	\$99,661.65	\$90,137.80	\$80,576.85	\$136,297.99	\$131,193.29	\$121,318.82	\$126,808.59	\$116,214.12	\$106,671.08	\$120,983.89	\$111,279.71	\$101,738.83	\$92,191.47	\$129,749.25	\$116,300.75	\$104,757.24	\$93,876.57	\$84,325.95	\$113,746.82	\$100,534.71	\$100,534.71
\$117,581.38	\$107,660.95	\$97,787.38	\$122,903.98	\$112,809.33	\$102,935.76	\$93,055.90	\$83,150.91	\$139,573.03	\$134,687.93	\$124,480.23	\$129,802.83	\$119,595.13	\$109,608.79	\$124,917.73	\$114,757.16	\$104,883.59	\$95,010.02	\$120,932.63	\$110,031.96	\$100,158.39	\$90,272.25	\$81,325.95	\$113,746.82	\$100,534.71	\$100,534.71
\$142,323.19	\$129,076.31	\$115,840.27	\$147,422.18	\$134,175.30	\$120,928.42	\$107,967.64	\$95,168.29	\$178,867.92	\$170,569.07	\$157,286.05	\$162,385.41	\$148,915.78	\$135,668.90	\$154,237.15	\$140,767.89	\$127,521.01	\$114,337.51	\$145,866.88	\$132,620.00	\$119,373.12	\$106,464.88	\$93,659.05	\$137,718.99	\$124,472.11	\$124,472.11

123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147
Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
school-age	school-age	school-age	teenager	teenager	teenager	teenager	teenager	school-age	teenager	teenager	preschooler	preschooler	preschooler	school-age	teenager	teenager	school-age	teenager	teenager	school-age	teenager	teenager	teenager	teenager
school-age	school-age	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager
teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager
teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager
a110p0312	a110p0213	a110p0114	a110p0015	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010	a110p0010
\$88,050.25	\$78,239.89	\$69,493.71	\$63,403.99	\$170,063.79	\$167,094.10	\$161,793.53	\$151,226.73	\$164,084.41	\$158,816.82	\$146,033.69	\$153,556.99	\$142,773.86	\$132,207.06	\$161,099.95	\$155,840.12	\$145,056.98	\$139,797.15	\$129,230.35	\$145,104.12	\$139,597.58	\$129,539.32	\$123,970.52	\$113,495.97	\$158,123.25
\$136,058.87	\$120,979.43	\$105,787.45	\$93,699.11	\$275,679.57	\$269,994.42	\$260,195.04	\$241,843.00	\$246,309.28	\$254,509.89	\$236,157.85	\$244,710.51	\$246,405.67	\$208,146.35	\$258,624.13	\$248,824.75	\$230,499.12	\$239,025.36	\$220,749.25	\$202,547.00	\$229,258.69	\$194,041.93	\$178,335.33	\$182,938.98	\$158,123.25
\$127,062.96	\$111,371.54	\$96,048.81	\$83,746.99	\$265,131.61	\$260,716.05	\$249,753.61	\$231,014.69	\$256,330.49	\$245,338.05	\$226,621.79	\$234,382.41	\$215,715.63	\$197,755.19	\$251,884.93	\$240,922.49	\$222,228.90	\$229,989.51	\$211,322.74	\$193,982.10	\$200,766.97	\$184,623.00	\$247,469.37	\$247,469.37	\$247,469.37
\$132,607.91	\$117,037.88	\$101,960.54	\$89,893.49	\$270,716.60	\$265,017.82	\$255,411.67	\$237,008.46	\$259,319.04	\$249,712.89	\$231,332.03	\$240,106.74	\$221,774.80	\$203,465.29	\$253,620.26	\$244,014.11	\$225,662.27	\$234,414.54	\$216,105.03	\$198,395.10	\$224,857.30	\$190,176.88	\$174,373.64	\$247,921.47	\$247,921.47
\$95,527.99	\$85,957.80	\$77,140.68	\$71,483.95	\$175,514.12	\$177,382.56	\$167,185.53	\$157,263.39	\$169,386.18	\$164,179.15	\$154,270.16	\$158,986.67	\$148,863.51	\$138,962.72	\$166,379.81	\$161,177.71	\$151,276.92	\$145,870.27	\$135,969.49	\$210,906.97	\$193,830.26	\$178,029.80	\$150,785.22	\$120,884.43	\$163,373.43
\$120,176.45	\$104,900.86	\$89,741.17	\$78,044.34	\$257,633.27	\$251,887.51	\$242,015.49	\$223,562.10	\$246,161.74	\$236,279.73	\$217,855.57	\$226,445.13	\$208,023.93	\$191,351.58	\$240,425.88	\$230,570.25	\$212,149.05	\$202,399.12	\$186,445.64	\$210,906.97	\$193,830.26	\$178,029.80	\$150,785.22	\$120,884.43	\$163,373.43
\$102,901.14	\$91,816.73	\$80,713.13	\$73,773.11	\$201,313.27	\$197,473.86	\$190,758.90	\$179,207.18	\$193,746.45	\$187,031.48	\$175,495.90	\$180,343.28	\$168,701.96	\$157,190.80	\$220,572.07	\$202,215.88	\$233,345.13	\$243,325.35	\$224,818.69	\$233,317.77	\$214,849.68	\$153,495.51	\$169,838.06	\$158,322.00	\$146,630.16
\$130,548.89	\$114,884.37	\$99,703.52	\$87,509.21	\$270,599.34	\$264,847.94	\$254,828.16	\$236,265.74	\$259,096.54	\$249,076.75	\$230,540.77	\$239,056.97	\$220,572.07	\$202,215.88	\$253,345.13	\$243,325.35	\$224,818.69	\$233,317.77	\$214,849.68	\$197,180.20	\$223,349.17	\$204,881.28	\$188,609.64	\$172,678.95	\$247,599.73
\$92,622.00	\$83,040.82	\$74,636.08	\$68,975.23	\$172,624.50	\$169,644.78	\$164,362.14	\$154,441.57	\$166,665.06	\$161,386.43	\$151,474.87	\$156,126.88	\$145,992.94	\$136,081.38	\$163,685.34	\$158,419.24	\$148,285.79	\$153,160.19	\$143,026.24	\$133,114.68	\$147,678.26	\$127,766.69	\$117,943.56	\$160,712.59	\$247,599.73
\$125,692.84	\$109,811.12	\$94,640.09	\$82,410.07	\$262,692.38	\$258,351.51	\$247,352.60	\$228,780.12	\$254,001.55	\$243,011.74	\$224,461.32	\$232,031.57	\$213,518.32	\$195,994.78	\$249,669.79	\$238,670.88	\$220,142.53	\$227,712.77	\$209,199.53	\$192,280.22	\$216,769.77	\$198,791.32	\$182,884.06	\$166,919.41	\$245,328.92
\$87,415.90	\$77,769.89	\$69,131.77	\$63,063.50	\$168,473.64	\$165,488.99	\$160,286.39	\$149,640.60	\$162,504.33	\$157,314.53	\$146,668.74	\$152,125.61	\$141,479.82	\$131,097.12	\$159,531.60	\$154,342.67	\$143,696.89	\$146,950.66	\$138,507.96	\$128,065.26	\$143,761.74	\$133,319.04	\$122,876.34	\$112,536.90	\$166,919.41
\$125,274.69	\$109,717.60	\$94,467.33	\$82,209.62	\$262,309.02	\$257,960.13	\$247,002.29	\$228,384.91	\$253,611.24	\$242,653.40	\$224,058.22	\$231,715.99	\$213,156.30	\$195,645.74	\$249,262.35	\$238,304.58	\$202,921.60	\$237,389.30	\$208,829.61	\$191,926.51	\$227,389.30	\$198,509.13	\$182,572.46	\$166,919.41	\$245,328.92
\$165,091.49	\$142,510.55	\$120,164.19	\$101,458.07	\$356,230.30	\$352,480.69	\$346,943.50	\$310,382.12	\$348,731.08	\$333,193.89	\$306,651.86	\$317,656.71	\$291,194.85	\$264,768.88	\$344,981.47	\$329,444.28	\$302,921.60	\$313,907.10	\$287,464.58	\$261,038.62	\$272,007.57	\$258,433.53	\$242,007.57	\$245,581.61	\$219,240.57
\$104,787.51	\$95,394.92	\$86,128.67	\$79,777.94	\$182,970.40	\$180,042.04	\$175,211.84	\$165,295.36	\$177,113.68	\$172,168.29	\$162,367.00	\$167,338.09	\$157,557.62	\$147,576.78	\$174,070.13	\$169,239.93	\$159,451.14	\$164,409.73	\$154,642.05	\$144,661.22	\$159,591.42	\$149,610.59	\$139,852.13	\$130,093.67	\$171,141.77
\$162,568.73	\$140,026.93	\$117,708.67	\$99,359.12	\$352,754.62	\$349,015.56	\$333,571.34	\$307,058.80	\$345,276.50	\$329,832.29	\$303,339.04	\$314,388.07	\$287,974.51	\$261,579.99	\$341,537.45	\$326,093.23	\$299,619.28	\$310,649.28	\$284,254.75	\$257,860.23	\$295,284.75	\$268,890.23	\$242,495.70	\$216,201.78	\$337,798.39
\$134,256.23	\$118,555.20	\$103,264.71	\$91,076.39	\$274,855.11	\$269,044.47	\$259,214.77	\$240,590.15	\$263,223.82	\$253,404.12	\$234,784.23	\$243,574.42	\$223,004.99	\$206,475.99	\$257,423.18	\$247,593.48	\$229,003.41	\$237,763.78	\$219,224.18	\$201,060.26	\$227,973.95	\$209,444.94	\$192,487.58	\$176,616.47	\$251,612.53
\$121,712.23	\$110,428.70	\$99,333.08	\$91,258.38	\$223,068.34	\$218,715.69	\$211,212.91	\$198,298.17	\$214,363.05	\$208,860.27	\$194,559.66	\$199,738.09	\$188,115.47	\$176,536.79	\$210,010.41	\$202,562.99	\$190,821.15	\$195,999.58	\$184,386.28	\$172,699.50	\$189,555.39	\$177,970.38	\$166,283.60	\$154,745.17	\$205,657.77
\$118,669.69	\$107,474.63	\$96,364.13	\$88,234.13	\$220,269.81	\$215,918.31	\$208,174.33	\$195,690.23	\$211,566.81	\$203,822.83	\$191,948.40	\$196,918.95	\$185,294.67	\$173,604.22	\$207,215.31	\$199,004.04	\$189,336.12	\$188,206.56	\$193,171.12	\$181,569.15	\$169,878.69	\$186,518.12	\$174,827.58	\$163,248.72	\$205,657.77
\$84,014.83	\$75,355.20	\$67,320.21	\$61,703.73	\$163,285.35	\$160,333.23	\$155,142.03	\$145,094.71	\$157,365.43	\$152,184.22	\$142,076.91	\$146,780.63	\$136,295.40	\$127,010.76	\$154,407.62	\$149,004.04	\$139,119.10	\$143,822.83	\$133,937.89	\$124,025.95	\$138,641.62	\$128,756.68	\$118,278.81	\$151,449.82	\$205,657.77
\$109,547.18	\$98,703.89	\$87,835.33	\$79,988.56	\$206,021.51	\$201,994.17	\$195,456.57	\$184,123.93	\$198,604.64	\$191,807.57	\$180,490.51	\$185,429.54	\$174,034.03	\$162,739.63	\$194,541.20	\$184,858.18	\$178,078.87	\$176,354.78	\$161,888.55	\$159,587.27	\$147,810.68	\$164,409.73	\$152,791.44	\$141,350.50	\$180,892.20
\$97,225.18	\$86,052.01	\$75,695.83	\$68,747.13	\$196,111.90	\$192,358.27	\$185,553.47	\$173,829.93	\$188,604.64	\$181,816.17	\$170,092.07	\$174,926.15	\$163,312.77	\$151,745.31	\$184,858.18	\$178,078.87	\$176,354.78	\$161,888.55	\$159,587.27	\$147,810.68	\$164,409.73	\$152,791.44	\$141,350.50	\$180,892.20	\$205,657.77
\$91,861.37	\$82,294.55	\$73,999.10	\$68,350.28	\$171,649.41	\$168,642.18	\$163,455.87	\$153,571.11	\$165,634.95	\$160,426.87	\$150,523.02	\$155,233.35	\$145,107.14	\$135,203.29	\$162,627.73	\$157,432.78	\$147,306.56	\$152,297.27	\$142,113.05	\$132,209.21	\$146,823.38	\$136,919.54	\$127,025.70	\$117,111.86	\$205,657.77
\$95,433.20	\$85,528.20	\$76,335.61	\$70,334.47	\$174,754.12	\$171,859.89	\$166,859.91	\$156,601.06	\$168,965.65	\$163,965.68	\$153,719.07	\$158,979.80	\$148,550.74	\$138,111.18	\$166,071.42	\$161,076.64	\$150,837.08	\$156,097.81	\$145,668.74	\$135,429.19	\$151,118.99	\$140,689.92	\$130,450.36	\$127,025.70	\$205,657.77
\$111,391.61	\$98,592.26	\$85,760.48	\$76,895.19	\$215,245.76	\$213,406.53	\$203,700.56	\$190,066.07	\$211,567.30	\$202,007.88	\$188,486.34	\$193,552.13	\$180,177.70	\$166,719.03	\$209,728.07	\$200,428.15	\$186,906.62	\$191,972.41	\$178,604.90	\$165,146.24	\$183,648.45	\$170,189.79	\$156,870.15	\$143,362.61	\$205,657.77

[illegible]

	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults
school-age	teenager	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	preschooler	preschooler	preschooler	preschooler
teenager	teenager	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	preschooler	preschooler	preschooler	preschooler
teenager	teenager	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	infant	preschooler	preschooler	preschooler	preschooler
\$70,326.11	\$172,166.03	\$155,332.50	\$135,829.74	\$145,746.72	\$126.26	\$132,942.91	\$152,369.94	\$154,226.85	\$131,440.15	\$136,366.87	\$123,562.97	\$111,690.40	\$126,216.68	\$142,736.74	\$129,937.39	\$134,820.51	\$122,064.81	\$104,404.81	\$129,927.99	\$114,619.58	\$103,669.88	\$92,720.11	\$149,106.31	\$141,233.18	\$128,434.63
\$210,000.112	\$210,000.013	\$240,000.020	\$210,000.017	\$230,000.110	\$210,000.011	\$212,000.010	\$210,000.110	\$210,000.011	\$210,000.210	\$210,000.111	\$210,000.012	\$210,000.310	\$210,000.210	\$210,000.111	\$210,000.210	\$210,000.111	\$210,000.210	\$210,000.310	\$210,000.211	\$210,000.112	\$210,000.013	\$210,000.010	\$210,000.310	\$210,000.011	
\$71,032.56	\$64,855.53	\$12,835.09	\$12,968.05	\$120,970.09	\$111,702.18	\$123,101.01	\$118,103.05	\$109,247.43	\$113,686.76	\$104,968.19	\$96,249.61	\$120,223.96	\$115,511.24	\$106,792.67	\$111,222.00	\$102,513.43	\$93,794.86	\$106,952.76	\$98,234.19	\$98,515.62	\$80,797.04	\$117,366.92	\$113,056.69	\$104,337.91	
\$57,437.37	\$19,980.95	\$200,140.62	\$195,337.42	\$187,333.11	\$172,124.64	\$190,661.82	\$182,648.07	\$167,449.60	\$174,561.02	\$159,483.93	\$144,761.35	\$185,995.46	\$177,973.02	\$162,777.41	\$164,085.98	\$146,828.41	\$139,595.79	\$156,191.10	\$136,697.50	\$131,240.86	\$110,133.37	\$178,314.08	\$169,293.83	\$153,946.63	
\$595,717.12	\$85,187.42	\$19,871.58	\$189,179.84	\$180,264.59	\$167,155.71	\$176,654.73	\$161,155.71	\$167,654.73	\$167,654.73	\$154,466.34	\$159,509.10	\$154,466.34	\$172,630.13	\$157,554.93	\$164,830.69	\$146,945.95	\$133,142.92	\$155,131.47	\$125,058.99	\$141,802.79	\$126,756.48	\$172,489.64	\$157,953.73	\$152,885.31	
\$97,593.65	\$87,258.47	\$19,601.68	\$189,903.49	\$182,004.97	\$166,876.97	\$185,215.81	\$177,416.37	\$166,876.97	\$169,509.10	\$154,466.34	\$159,509.10	\$140,837.40	\$172,630.13	\$157,554.93	\$164,830.69	\$146,945.95	\$133,142.92	\$155,131.47	\$125,058.99	\$141,802.79	\$126,756.48	\$172,489.64	\$157,953.73	\$152,885.31	
\$77,146.97	\$71,437.31	\$19,601.68	\$189,903.49	\$182,004.97	\$166,876.97	\$185,215.81	\$177,416.37	\$166,876.97	\$169,509.10	\$154,466.34	\$159,509.10	\$140,837.40	\$172,630.13	\$157,554.93	\$164,830.69	\$146,945.95	\$133,142.92	\$155,131.47	\$125,058.99	\$141,802.79	\$126,756.48	\$172,489.64	\$157,953.73	\$152,885.31	
\$90,204.65	\$75,798.37	\$18,846.15	\$186,608.78	\$175,352.96	\$166,876.97	\$185,215.81	\$177,416.37	\$166,876.97	\$169,509.10	\$154,466.34	\$159,509.10	\$140,837.40	\$172,630.13	\$157,554.93	\$164,830.69	\$146,945.95	\$133,142.92	\$155,131.47	\$125,058.99	\$141,802.79	\$126,756.48	\$172,489.64	\$157,953.73	\$152,885.31	
\$82,723.65	\$75,798.37	\$18,846.15	\$186,608.78	\$175,352.96	\$166,876.97	\$185,215.81	\$177,416.37	\$166,876.97	\$169,509.10	\$154,466.34	\$159,509.10	\$140,837.40	\$172,630.13	\$157,554.93	\$164,830.69	\$146,945.95	\$133,142.92	\$155,131.47	\$125,058.99	\$141,802.79	\$126,756.48	\$172,489.64	\$157,953.73	\$152,885.31	
\$56,414.06	\$58,967.79	\$194,009.91	\$189,267.16	\$181,104.19	\$165,750.98	\$184,557.79	\$176,381.43	\$161,038.60	\$168,116.72	\$152,916.49	\$137,526.58	\$179,815.03	\$171,550.33	\$156,335.68	\$169,394.41	\$148,004.50	\$132,823.65	\$155,272.30	\$139,882.38	\$124,701.54	\$110,617.80	\$174,983.93	\$166,827.57	\$151,632.75	
\$76,347.64	\$70,628.68	\$13,711.54	\$129,854.41	\$124,854.84	\$115,512.52	\$126,997.28	\$121,997.60	\$113,128.27	\$117,020.04	\$108,851.36	\$124,140.14	\$119,140.35	\$116,400.55	\$112,664.02	\$114,575.78	\$106,406.91	\$98,238.03	\$110,298.67	\$102,129.80	\$93,960.92	\$85,792.04	\$121,288.04	\$165,408.64	\$149,609.37	
\$92,224.66	\$81,739.02	\$18,837.128	\$184,805.14	\$175,846.91	\$160,460.14	\$181,241.82	\$172,172.50	\$156,911.31	\$163,211.54	\$147,780.41	\$132,555.99	\$168,609.18	\$153,363.36	\$159,651.45	\$144,232.02	\$130,748.99	\$120,187.33	\$150,718.37	\$98,551.79	\$88,914.79	\$81,278.53	\$117,465.38	\$113,191.24	\$104,554.97	
\$71,700.65	\$65,551.95	\$12,829.925	\$126,063.99	\$121,131.42	\$111,928.80	\$123,198.43	\$118,265.85	\$109,470.86	\$113,876.20	\$105,229.93	\$96,603.66	\$120,332.87	\$121,643.80	\$107,012.18	\$111,418.25	\$102,761.25	\$94,145.49	\$130,794.02	\$152,624.56	\$137,164.20	\$128,913.93	\$108,172.92	\$175,873.38	\$166,846.85	
\$59,815.43	\$53,316.41	\$19,011.512	\$186,573.93	\$177,661.36	\$162,238.18	\$183,007.08	\$173,980.65	\$158,686.32	\$165,036.28	\$149,595.15	\$134,365.87	\$179,540.49	\$170,413.69	\$155,134.66	\$161,501.46	\$146,044.55	\$130,794.02	\$152,624.56	\$137,164.20	\$128,913.93	\$108,172.92	\$175,873.38	\$166,846.85		
\$59,815.43	\$53,316.41	\$19,011.512	\$186,573.93	\$177,661.36	\$162,238.18	\$183,007.08	\$173,980.65	\$158,686.32	\$165,036.28	\$149,595.15	\$134,365.87	\$179,540.49	\$170,413.69	\$155,134.66	\$161,501.46	\$146,044.55	\$130,794.02	\$152,624.56	\$137,164.20	\$128,913.93	\$108,172.92	\$175,873.38	\$166,846.85		
\$113,679.01	\$79,976.56	\$247,147.32	\$243,958.29	\$230,829.59	\$208,621.98	\$240,676.85	\$227,653.43	\$205,565.58	\$214,666.53	\$197,799.02	\$170,983.13	\$237,580.21	\$224,779.55	\$202,498.78	\$211,622.71	\$189,732.17	\$167,926.93	\$198,856.14	\$177,125.85	\$155,366.08	\$133,559.79	\$234,402.94	\$221,304.57	\$199,316.82	
\$84,781.95	\$79,196.48	\$14,615.84	\$138,851.69	\$134,310.89	\$124,918.08	\$136,045.88	\$131,505.70	\$126,969.51	\$147,579.92	\$109,476.52	\$133,240.54	\$214,652.56	\$192,762.16	\$202,054.44	\$180,223.18	\$158,477.48	\$189,368.45	\$167,594.38	\$145,797.37	\$124,233.71	\$224,339.08	\$211,567.61	\$189,704.51		
\$505,558.66	\$58,880.28	\$237,001.56	\$233,835.60	\$220,821.36	\$198,877.46	\$230,670.10	\$217,682.91	\$195,819.81	\$205,112.09	\$183,267.86	\$161,509.31	\$227,504.59	\$214,652.56	\$192,762.16	\$202,054.44	\$180,223.18	\$158,477.48	\$189,368.45	\$167,594.38	\$145,797.37	\$124,233.71	\$224,339.08	\$211,567.61	\$189,704.51	
\$59,240.67	\$58,880.28	\$197,521.91	\$192,735.24	\$184,736.34	\$169,351.37	\$187,948.56	\$179,790.97	\$164,585.50	\$171,881.74	\$156,656.61	\$141,212.51	\$183,181.13	\$175,203.64	\$159,854.71	\$147,297.76	\$136,202.14	\$125,106.53	\$154,132.15	\$130,136.54	\$109,252.46	\$159,725.67	\$178,741.61	\$158,689.32		
\$96,812.67	\$89,899.29	\$17,073.784	\$166,794.85	\$160,715.34	\$149,406.85	\$163,612.91	\$157,146.78	\$145,836.30	\$151,081.24	\$139,770.04	\$128,675.93	\$157,384.09	\$151,036.61	\$139,777.75	\$144,600.46	\$133,489.96	\$122,379.45	\$138,316.67	\$100,010.42	\$91,864.72	\$116,243.73	\$106,729.56	\$153,809.65		
\$94,871.80	\$87,904.38	\$16,816.264	\$164,537.94	\$158,245.20	\$146,926.64	\$160,958.54	\$154,675.94	\$148,174.91	\$151,876.20	\$137,064.40	\$125,953.90	\$157,384.09	\$151,036.61	\$139,777.75	\$144,600.46	\$133,489.96	\$122,379.45	\$138,316.67	\$100,010.42	\$91,864.72	\$116,243.73	\$106,729.56	\$153,809.65		
\$74,181.82	\$66,417.40	\$12,929.040	\$127,092.04	\$122,127.34	\$111,300.93	\$124,243.98	\$119,324.28	\$110,864.43	\$114,801.32	\$106,655.67	\$98,510.97	\$116,573.38	\$108,427.94	\$112,364.82	\$104,211.98	\$96,073.54	\$108,156.07	\$100,010.42	\$91,864.72	\$116,243.73	\$106,729.56	\$153,809.65			
\$86,348.79	\$79,489.78	\$15,450.466	\$152,952.77	\$146,741.94	\$135,898.64	\$149,276.73	\$143,245.05	\$132,421.45	\$137,231.37	\$126,388.07	\$115,771.51	\$145,788.84	\$139,764.50	\$128,682.96	\$116,733.48	\$122,900.18	\$112,776.26	\$119,927.80	\$116,915.92	\$107,604.74	\$98,292.49	\$142,300.55	\$126,278.27		
\$79,397.43	\$72,388.14	\$15,024.62	\$146,448.98	\$140,008.32	\$127,860.88	\$142,861.98	\$136,421.31	\$125,273.87	\$129,980.64	\$118,833.20	\$109,043.62	\$139,274.97	\$132,618.71	\$121,810.81	\$116,735.45	\$108,591.32	\$100,429.18	\$112,535.96	\$104,971.82	\$96,209.69	\$88,047.89	\$173,365.65	\$150,049.66		
\$75,535.98	\$71,841.66	\$15,325.0615	\$132,371.41	\$127,386.84	\$117,387.96	\$129,436.92	\$124,503.78	\$115,278.95	\$119,571.53	\$111,059.46	\$102,897.33	\$126,550.96	\$121,618.71	\$112,810.81	\$116,735.45	\$108,591.32	\$100,429.18	\$112,535.96	\$104,971.82	\$96,209.69	\$88,047.89	\$173,365.65	\$150,049.66		
\$70,326.11	\$172,166.03	\$155,332.50	\$135,829.74	\$145,746.72	\$126.26	\$132,942.91	\$152,369.94	\$154,226.85	\$131,440.15	\$136,366.87	\$123,562.97	\$111,690.40	\$126,216.68	\$142,736.74	\$129,937.39	\$134,820.51	\$122,064.81	\$104,404.81	\$129,927.99	\$114,619.58	\$103,669.88	\$92,720.11	\$149,106.31	\$141,233.18	\$128,434.63

298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322
2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	
school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	
teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	
a21p1320	a21p1311	a21p1302	a21p0330	a21p0321	a21p0312	a21p0303	a21p4300	a21p3310	a21p3301	a21p2320	a21p2311	a21p2302	a21p1330	a21p1321	a21p1312	a21p1303	a21p0340	a21p0331	a21p0322	a21p0313	a21p0304	a21p0300	a21p4310	a21p4301
\$136,447.57	\$126,235.72	\$116,185.80	\$131,364.42	\$121,152.57	\$111,833.62	\$103,090.26	\$143,737.15	\$138,654.00	\$128,442.15	\$133,570.86	\$123,359.00	\$113,722.77	\$128,487.71	\$118,275.85	\$109,370.59	\$100,627.22	\$123,404.56	\$113,761.77	\$105,018.41	\$96,275.04	\$87,531.67	\$140,860.44	\$135,777.29	\$125,565.44
\$207,835.62	\$192,537.72	\$177,391.56	\$199,616.53	\$184,440.73	\$169,210.22	\$154,123.55	\$219,382.92	\$211,240.86	\$195,942.97	\$203,130.18	\$187,832.28	\$172,601.21	\$194,911.08	\$179,754.99	\$164,524.47	\$149,255.66	\$186,804.16	\$171,573.64	\$156,477.12	\$141,212.59	\$126,149.72	\$214,646.11	\$206,535.42	\$191,237.52
\$200,735.44	\$185,144.41	\$169,612.06	\$191,572.06	\$176,134.57	\$160,614.45	\$145,043.64	\$215,187.33	\$206,139.12	\$190,937.21	\$196,975.74	\$181,515.34	\$165,982.88	\$187,927.53	\$172,394.21	\$157,000.70	\$141,429.89	\$178,916.72	\$163,384.86	\$147,814.05	\$132,458.10	\$117,109.07	\$211,542.80	\$202,494.59	\$186,896.10
\$203,912.77	\$188,589.64	\$173,330.68	\$195,860.99	\$180,679.23	\$165,424.02	\$150,332.11	\$215,082.57	\$207,142.46	\$191,819.34	\$199,090.68	\$183,895.32	\$168,640.11	\$191,150.57	\$175,988.66	\$160,745.05	\$145,453.16	\$183,229.37	\$167,974.16	\$152,871.56	\$137,579.66	\$122,495.83	\$210,372.16	\$202,432.05	\$187,111.41
\$142,372.24	\$132,805.94	\$123,239.64	\$137,363.11	\$127,796.81	\$118,230.51	\$109,890.48	\$149,498.38	\$144,489.25	\$134,922.95	\$139,480.13	\$129,913.83	\$120,347.55	\$134,471.00	\$124,904.70	\$115,600.19	\$107,416.31	\$129,461.87	\$119,895.57	\$111,314.93	\$103,131.04	\$94,947.16	\$146,606.27	\$141,597.14	\$132,030.84
\$192,225.34	\$176,969.70	\$161,632.66	\$184,074.30	\$166,729.39	\$153,534.85	\$138,153.20	\$203,930.34	\$195,651.76	\$180,381.67	\$187,486.27	\$172,141.36	\$156,932.49	\$179,354.32	\$164,009.41	\$148,625.62	\$133,453.03	\$171,114.02	\$155,909.46	\$140,527.81	\$125,355.22	\$107,038.14	\$190,911.78	\$175,661.68	
\$159,049.29	\$147,747.18	\$136,646.40	\$152,614.11	\$141,312.00	\$130,211.22	\$119,110.44	\$166,367.82	\$161,912.36	\$150,811.58	\$155,477.18	\$144,175.07	\$133,074.29	\$148,840.68	\$137,739.90	\$126,639.12	\$115,768.57	\$142,405.50	\$131,304.72	\$120,203.94	\$110,252.71	\$100,737.76	\$164,780.77	\$158,346.25	\$147,038.14
\$202,862.87	\$187,412.12	\$172,028.68	\$194,470.44	\$179,166.80	\$163,783.35	\$148,362.14	\$214,670.45	\$206,390.21	\$190,938.24	\$197,997.78	\$182,679.27	\$167,295.82	\$189,717.54	\$174,325.59	\$159,069.18	\$143,649.16	\$181,463.71	\$166,080.27	\$150,858.48	\$135,438.45	\$120,227.50	\$209,917.55	\$201,637.32	\$186,191.73
\$139,552.18	\$129,975.46	\$120,398.75	\$134,470.31	\$124,898.60	\$115,581.79	\$107,388.99	\$146,849.43	\$141,767.57	\$132,190.85	\$136,685.70	\$127,108.99	\$117,532.27	\$131,603.84	\$122,027.13	\$113,129.54	\$104,936.75	\$126,521.98	\$116,974.85	\$108,782.05	\$100,589.26	\$92,399.46	\$143,982.96	\$138,901.10	\$129,324.38
\$197,910.95	\$182,547.76	\$167,120.37	\$188,817.05	\$173,384.97	\$158,087.50	\$142,624.74	\$212,620.70	\$203,526.80	\$188,030.87	\$194,321.92	\$178,973.83	\$163,546.45	\$185,238.43	\$169,811.04	\$154,528.55	\$139,065.79	\$176,182.78	\$160,766.80	\$145,304.14	\$130,048.08	\$114,829.86	\$209,031.67	\$199,826.79	\$184,455.55
\$135,229.45	\$125,133.11	\$115,337.37	\$130,212.63	\$120,116.29	\$111,034.18	\$102,374.02	\$142,389.81	\$137,372.99	\$127,276.65	\$132,356.17	\$122,259.83	\$112,872.80	\$127,393.35	\$117,243.01	\$108,569.61	\$99,909.45	\$122,322.53	\$112,926.59	\$104,266.42	\$95,606.26	\$86,946.10	\$139,516.52	\$134,493.70	\$124,403.36
\$197,893.82	\$182,502.94	\$167,046.22	\$188,840.32	\$173,378.78	\$158,053.91	\$142,560.47	\$212,520.44	\$203,466.93	\$187,941.30	\$194,300.71	\$178,924.99	\$163,468.41	\$185,257.56	\$169,800.84	\$154,491.01	\$138,997.57	\$176,242.27	\$160,796.96	\$145,303.52	\$130,020.17	\$115,084.14	\$208,927.33	\$199,761.11	\$184,360.34
\$261,585.81	\$238,904.89	\$216,387.87	\$246,319.34	\$225,688.07	\$203,629.91	\$181,728.63	\$284,917.14	\$271,650.67	\$248,969.75	\$258,384.20	\$235,708.55	\$213,308.98	\$245,117.72	\$222,500.58	\$200,551.02	\$178,662.80	\$231,873.51	\$209,604.60	\$187,677.99	\$165,847.66	\$143,995.55	\$281,715.53	\$268,449.05	\$245,768.13
\$151,278.49	\$141,634.84	\$133,206.06	\$146,417.00	\$136,988.22	\$127,559.44	\$118,130.67	\$157,754.66	\$153,108.04	\$143,464.40	\$148,246.56	\$138,817.78	\$129,389.00	\$143,599.94	\$134,171.16	\$124,742.38	\$115,578.98	\$138,953.32	\$129,524.54	\$120,095.76	\$111,603.83	\$103,537.60	\$154,937.60	\$140,647.33	\$126,290.98
\$254,229.37	\$231,668.60	\$209,432.62	\$241,112.28	\$218,539.66	\$196,635.84	\$174,793.45	\$277,480.95	\$264,293.86	\$241,639.92	\$251,106.77	\$228,490.07	\$206,362.39	\$237,919.68	\$215,466.37	\$193,565.61	\$171,736.24	\$224,786.23	\$202,784.75	\$180,912.89	\$159,126.94	\$137,310.48	\$274,288.34	\$261,101.25	\$238,447.32
\$206,919.16	\$191,431.55	\$176,108.47	\$198,690.73	\$183,336.87	\$167,918.33	\$152,657.06	\$218,349.69	\$210,236.42	\$194,748.81	\$202,123.15	\$186,640.06	\$171,221.52	\$193,894.72	\$178,561.20	\$163,144.17	\$147,686.69	\$185,789.59	\$170,371.05	\$155,099.42	\$139,641.95	\$114,399.33	\$213,553.68	\$205,440.41	\$189,952.80
\$177,838.70	\$166,548.42	\$155,403.74	\$171,529.20	\$160,363.49	\$149,016.83	\$137,885.03	\$186,639.33	\$180,441.11	\$169,150.82	\$174,131.60	\$162,954.91	\$151,823.11	\$167,933.37	\$156,782.86	\$145,436.19	\$134,304.40	\$161,742.60	\$150,610.80	\$139,264.14	\$128,132.34	\$114,187.14	\$183,043.51	\$176,846.29	\$165,555.00
\$174,857.25	\$163,668.58	\$152,526.13	\$166,450.70	\$157,288.19	\$145,938.40	\$134,796.66	\$184,178.22	\$177,771.67	\$166,475.16	\$171,257.78	\$160,083.00	\$148,713.20	\$164,850.72	\$153,703.31	\$142,353.52	\$131,211.78	\$158,465.37	\$147,115.58	\$135,973.84	\$124,832.10	\$114,187.43	\$180,578.24	\$174,063.85	\$162,622.07
\$130,882.64	\$121,331.66	\$112,556.58	\$125,876.48	\$116,444.64	\$108,273.85	\$100,103.06	\$138,037.10	\$133,030.93	\$123,479.94	\$128,024.76	\$118,473.78	\$110,111.69	\$123,018.60	\$113,999.75	\$105,828.96	\$97,658.17	\$118,012.43	\$109,717.01	\$101,546.23	\$93,375.44	\$85,204.65	\$135,179.22	\$150,173.05	\$140,622.07
\$164,183.90	\$153,304.06	\$142,239.47	\$156,060.31	\$146,495.72	\$136,119.29	\$125,242.85	\$172,960.80	\$166,815.35	\$155,925.28	\$160,581.53	\$149,616.94	\$138,740.51	\$154,561.35	\$143,496.76	\$132,620.33	\$121,743.90	\$148,253.01	\$137,376.58	\$126,500.15	\$115,839.29	\$106,469.93	\$169,447.39	\$152,426.32	\$141,334.66
\$153,385.81	\$142,003.75	\$130,828.05	\$146,495.64	\$135,479.94	\$124,304.24	\$113,705.51	\$162,836.98	\$156,313.17	\$144,931.11	\$149,583.00	\$139,407.30	\$127,231.60	\$143,059.19	\$131,883.49	\$120,707.80	\$110,625.05	\$136,535.38	\$125,359.68	\$114,609.53	\$105,037.23	\$95,464.93	\$159,240.53	\$152,716.72	\$141,334.66
\$138,736.32	\$129,167.07	\$119,597.82	\$133,718.27	\$124,149.01	\$114,951.18	\$106,764.77	\$145,879.50	\$140,861.44	\$131,292.19	\$135,843.39	\$126,274.14	\$116,769.21	\$130,825.53	\$121,256.08	\$112,476.31	\$104,289.89	\$125,807.28	\$116,369.82	\$108,183.40	\$99,996.99	\$91,810.58	\$142,986.57	\$137,968.51	\$128,398.26
\$142,301.56	\$132,397.18	\$122,492.79	\$137,485.71	\$127,581.32	\$117,676.94	\$109,091.46	\$149,145.61	\$144,329.76	\$134,425.38	\$139,513.91	\$129,609.52	\$119,705.14	\$134,698.05	\$124,793.67	\$115,207.25	\$106,695.88	\$129,882.20	\$119,977.81	\$111,068.73	\$102,557.37	\$94,046.00	\$146,357.96	\$141,543.10	\$131,637.72
\$165,833.68	\$152,987.49	\$139,936.29	\$157,839.35	\$144,788.15	\$131,951.81	\$119,115.48	\$180,462.20	\$172,332.58	\$159,458.95	\$164,314.25	\$151,474.47	\$138,423.27	\$156,326.33	\$143,275.13	\$130,438.80	\$117,602.46	\$148,126.99	\$135,290.66	\$122,454.32	\$110,706.43	\$99,725.05	\$178,942.77	\$170,813.15	\$157,945.93

348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372
2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	
8214p0s20	8214p0s11	8214p0s02	8214p3s00	8214p2s10	8214p2s01	8214p1s20	8214p1s11	8214p1s02	8214p0s30	8214p0s21	8214p0s12	8214p0s03	8214p0s00	8214p3s10	8214p3s01	8214p2s20	8214p2s11	8214p2s02	8214p1s30	8214p1s21	8214p1s12	8214p1s03	8214p0s40	8214p0s31
\$160,947.82	\$150,735.96	\$140,315.04	\$168,257.38	\$163,154.25	\$152,942.40	\$158,071.10	\$147,650.18	\$137,438.33	\$152,987.95	\$142,567.03	\$132,355.18	\$122,143.33	\$165,368.53	\$160,277.54	\$149,856.62	\$155,194.39	\$144,773.47	\$134,561.61	\$149,902.17	\$139,690.32	\$129,478.47	\$119,266.61	\$144,819.02	\$134,607.17
\$245,322.06	\$229,567.43	\$214,004.12	\$257,290.74	\$248,861.18	\$233,091.16	\$240,431.62	\$234,698.26	\$209,298.67	\$232,023.37	\$216,377.48	\$201,187.99	\$185,897.67	\$252,400.30	\$243,970.74	\$228,221.99	\$235,547.10	\$219,829.09	\$204,593.23	\$227,154.20	\$211,672.03	\$196,374.14	\$181,211.92	\$218,761.30	\$203,561.35
\$237,270.84	\$221,236.19	\$205,654.51	\$252,298.77	\$242,889.91	\$226,830.48	\$233,496.12	\$217,496.73	\$202,009.98	\$224,128.74	\$208,448.51	\$192,846.60	\$177,403.71	\$248,508.97	\$239,100.11	\$223,057.39	\$229,723.03	\$213,852.20	\$198,250.29	\$209,355.66	\$204,803.98	\$189,202.07	\$173,663.35	\$211,242.51	\$195,640.60
\$241,938.16	\$226,171.85	\$210,699.09	\$253,550.04	\$245,295.68	\$229,514.67	\$237,041.32	\$221,296.65	\$205,988.67	\$228,822.48	\$213,260.01	\$197,936.89	\$182,746.39	\$248,653.20	\$240,398.84	\$224,639.27	\$232,165.30	\$216,489.71	\$201,278.26	\$223,947.08	\$208,549.60	\$193,226.47	\$178,055.82	\$221,820.94	\$200,609.49
\$166,127.26	\$156,549.87	\$146,768.70	\$173,283.62	\$168,253.25	\$158,666.88	\$163,224.05	\$153,657.75	\$143,876.59	\$158,214.92	\$148,433.76	\$138,867.46	\$129,301.16	\$170,379.24	\$165,348.67	\$155,774.77	\$160,331.94	\$150,765.64	\$140,984.48	\$155,322.61	\$145,541.65	\$135,975.35	\$126,409.05	\$150,313.69	\$140,332.52
\$229,542.23	\$213,865.40	\$198,452.12	\$241,561.95	\$233,088.79	\$217,291.81	\$224,636.06	\$209,125.42	\$193,712.15	\$216,260.11	\$200,959.04	\$185,554.85	\$170,209.94	\$236,675.54	\$228,182.61	\$212,551.84	\$219,729.89	\$204,385.45	\$188,972.18	\$211,520.14	\$196,106.87	\$180,834.86	\$165,489.95	\$203,353.75	\$187,290.48
\$187,231.51	\$176,084.29	\$164,832.62	\$196,605.92	\$190,116.67	\$178,959.33	\$183,644.46	\$173,392.80	\$161,254.97	\$177,182.36	\$165,930.70	\$154,819.79	\$143,517.68	\$193,003.80	\$186,519.51	\$175,372.28	\$180,057.41	\$168,805.75	\$157,682.86	\$173,490.87	\$162,348.47	\$151,247.69	\$139,945.57	\$197,954.29	\$187,955.44
\$240,225.41	\$224,333.20	\$208,794.13	\$252,500.80	\$243,892.50	\$227,984.22	\$235,291.28	\$219,413.65	\$204,041.23	\$226,720.72	\$211,100.77	\$195,648.80	\$180,340.19	\$247,559.59	\$238,951.30	\$223,064.67	\$230,371.74	\$214,628.11	\$199,176.14	\$221,801.17	\$206,347.87	\$190,895.30	\$175,607.33	\$213,407.41	\$197,955.44
\$163,205.73	\$153,629.01	\$143,837.43	\$170,532.68	\$165,429.27	\$155,884.40	\$160,339.26	\$150,762.54	\$140,970.96	\$155,257.40	\$145,465.82	\$135,889.10	\$126,312.39	\$167,654.05	\$162,554.65	\$152,977.93	\$157,472.79	\$147,681.21	\$138,104.49	\$152,390.92	\$142,599.34	\$133,022.63	\$123,445.91	\$147,094.20	\$137,517.48
\$233,977.01	\$218,067.32	\$202,682.37	\$249,139.92	\$239,686.61	\$223,751.35	\$230,262.45	\$214,478.30	\$198,982.36	\$220,850.48	\$205,384.40	\$189,888.46	\$174,451.87	\$245,409.05	\$235,959.87	\$220,036.79	\$226,547.80	\$210,889.27	\$195,393.34	\$217,180.33	\$201,795.38	\$186,305.33	\$170,877.95	\$208,086.43	\$192,590.50
\$159,367.34	\$149,074.65	\$138,978.31	\$166,540.30	\$161,510.88	\$151,414.54	\$156,494.06	\$146,201.36	\$136,105.02	\$151,477.24	\$141,184.54	\$131,088.20	\$120,991.86	\$163,655.05	\$158,637.59	\$148,344.90	\$153,620.77	\$143,328.08	\$133,231.74	\$148,407.60	\$136,311.26	\$128,214.92	\$118,118.57	\$143,390.78	\$133,294.44
\$234,328.55	\$218,280.59	\$202,867.67	\$249,306.32	\$239,893.74	\$223,926.70	\$230,509.32	\$214,687.48	\$199,161.85	\$221,138.04	\$205,633.97	\$190,108.34	\$174,641.46	\$245,570.70	\$236,161.38	\$220,207.47	\$226,790.09	\$211,094.37	\$195,568.74	\$217,453.78	\$202,040.86	\$186,520.24	\$171,063.51	\$208,400.27	\$192,871.64
\$308,669.98	\$285,989.06	\$263,308.14	\$332,090.72	\$317,765.24	\$296,053.91	\$305,468.36	\$282,787.44	\$260,106.52	\$292,201.89	\$269,520.97	\$246,840.05	\$224,215.31	\$328,874.87	\$315,549.38	\$292,852.30	\$302,266.75	\$279,585.83	\$256,904.91	\$289,000.27	\$266,310.35	\$243,638.43	\$221,027.81	\$253,733.80	\$233,052.88
\$175,713.49	\$166,133.44	\$156,693.54	\$182,217.13	\$177,550.80	\$167,970.76	\$172,773.20	\$163,305.26	\$153,876.48	\$168,106.87	\$158,688.64	\$148,015.00	\$139,586.22	\$179,388.12	\$174,610.51	\$165,141.75	\$169,944.19	\$160,488.19	\$151,059.42	\$165,277.86	\$155,841.57	\$146,197.93	\$136,769.15	\$160,623.73	\$151,194.95
\$301,535.63	\$278,881.69	\$256,227.75	\$324,774.22	\$311,530.12	\$288,876.18	\$298,343.93	\$275,689.09	\$253,035.15	\$285,155.94	\$265,502.00	\$239,848.06	\$217,320.84	\$321,567.42	\$308,337.51	\$285,683.58	\$295,150.42	\$272,496.49	\$249,842.55	\$281,963.33	\$259,309.39	\$236,656.54	\$214,250.61	\$268,776.24	\$246,122.30
\$245,036.54	\$229,085.98	\$213,351.15	\$256,932.67	\$248,486.02	\$232,520.25	\$240,049.37	\$224,120.80	\$208,555.14	\$231,636.04	\$215,814.32	\$200,441.67	\$184,965.91	\$251,935.50	\$243,498.65	\$227,555.07	\$235,070.30	\$219,155.62	\$203,759.13	\$226,670.65	\$212,421.14	\$197,130.86	\$159,966.83	\$187,401.92	\$202,905.04
\$207,187.33	\$195,845.55	\$184,632.00	\$216,025.45	\$209,800.82	\$198,459.04	\$203,576.20	\$192,234.42	\$181,036.18	\$197,236.41	\$186,016.96	\$174,726.68	\$163,547.67	\$212,414.31	\$206,189.69	\$194,847.91	\$199,849.90	\$188,623.28	\$177,440.36	\$193,625.28	\$182,421.14	\$171,130.86	\$159,966.83	\$187,401.92	\$202,905.04
\$203,618.99	\$192,271.31	\$181,063.39	\$212,871.10	\$206,437.44	\$195,089.76	\$199,892.11	\$188,656.11	\$177,463.41	\$193,458.45	\$182,245.52	\$170,949.02	\$159,776.03	\$209,955.89	\$202,822.23	\$191,474.56	\$196,276.90	\$185,052.10	\$173,755.60	\$189,843.25	\$178,645.55	\$167,349.04	\$156,191.16	\$183,427.66	\$192,131.16
\$154,681.23	\$144,915.37	\$135,364.39	\$161,835.68	\$156,829.51	\$147,053.66	\$151,835.35	\$142,057.50	\$132,506.51	\$146,602.31	\$137,051.33	\$127,500.34	\$117,949.35	\$158,977.80	\$153,937.64	\$144,205.78	\$148,750.60	\$139,199.62	\$129,648.63	\$143,744.44	\$134,193.45	\$124,642.46	\$115,388.95	\$138,728.27	\$159,187.28
\$192,469.07	\$181,528.04	\$170,508.93	\$201,384.45	\$195,112.03	\$184,160.09	\$188,941.10	\$178,014.64	\$166,995.53	\$182,790.52	\$171,771.42	\$160,860.97	\$149,796.38	\$197,459.48	\$191,584.06	\$180,646.68	\$185,422.57	\$174,403.46	\$163,482.20	\$151,853.60	\$167,699.27	\$156,505.49	\$145,123.43	\$133,947.73	\$162,175.32
\$181,508.13	\$170,250.46	\$159,046.49	\$191,085.28	\$184,519.80	\$173,190.13	\$177,968.56	\$166,938.89	\$155,490.05	\$171,301.34	\$160,101.94	\$148,719.87	\$137,544.18	\$187,459.48	\$180,908.23	\$169,578.56	\$174,250.01	\$163,029.30	\$151,853.60	\$167,699.27	\$156,505.49	\$145,123.43	\$133,947.73	\$162,175.32	\$159,187.28
\$163,463.42	\$153,894.17	\$143,110.05	\$169,632.50	\$164,593.16	\$155,031.29	\$159,570.49	\$149,786.37	\$140,217.12	\$154,552.43	\$144,768.32	\$135,199.07	\$125,629.61	\$166,727.30	\$161,695.61	\$152,126.36	\$156,677.56	\$146,893.44	\$137,324.19	\$151,659.50	\$141,875.39	\$132,306.13	\$122,736.88	\$146,428.58	\$136,857.33
\$166,481.65	\$156,514.94	\$146,427.25	\$173,303.49	\$168,467.85	\$158,543.14	\$163,632.21	\$153,777.28	\$143,639.59	\$158,815.81	\$148,788.12	\$138,939.74	\$128,919.35	\$170,504.98	\$165,668.74	\$155,755.48	\$160,844.01	\$150,939.63	\$140,851.94	\$151,628.16	\$145,940.47	\$136,036.08	\$126,131.70	\$152,736.88	\$141,424.61
\$194,674.65	\$181,754.30	\$168,752.24	\$209,368.88	\$201,316.39	\$188,255.56	\$193,148.75	\$180,234.87	\$167,232.81	\$185,107.30	\$172,105.25	\$159,232.57	\$146,181.37	\$207,842.98	\$199,675.33	\$186,733.77	\$191,622.84	\$178,715.43	\$165,713.38	\$183,587.87	\$170,585.82	\$157,719.56	\$144,668.36	\$175,569.54	\$162,571.42

373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397
2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age
teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager
8212p0212	8212p0113	8212p0004	8211p3000	8211p4510	8211p4001	8211p3210	8211p3111	8211p3002	8211p2310	8211p2211	8211p2112	8211p2103	8211p1540	8211p1311	8211p1212	8211p1113	8211p1004	8211p0510	8211p0411	8211p0312	8211p0213	8211p0114	8211p0015	8210p6500
\$124,395.32	\$114,610.06	\$105,866.69	\$162,483.97	\$157,400.83	\$146,979.90	\$152,317.68	\$141,896.75	\$147,025.46	\$136,813.60	\$126,601.75	\$116,499.20	\$114,942.31	\$131,730.46	\$121,518.60	\$112,147.02	\$103,403.66	\$136,859.16	\$126,647.31	\$116,538.21	\$107,794.84	\$99,051.47	\$90,304.11	\$159,607.26	
\$188,263.45	\$173,030.57	\$157,927.98	\$247,509.87	\$239,080.31	\$223,352.82	\$230,677.93	\$194,605.76	\$216,646.20	\$201,159.45	\$185,566.63	\$170,034.28	\$207,597.88	\$191,996.07	\$176,556.78	\$161,034.89	\$145,464.08	\$198,434.61	\$182,968.01	\$167,435.66	\$152,063.09	\$136,492.28	\$121,136.33	\$240,929.38	
\$181,185.86	\$164,653.51	\$149,077.82	\$244,719.18	\$235,317.32	\$219,284.31	\$225,949.95	\$210,207.67	\$196,456.17	\$219,071.67	\$203,839.18	\$188,516.06	\$173,257.41	\$211,110.53	\$195,787.40	\$180,605.96	\$165,350.75	\$203,170.42	\$187,847.29	\$172,591.46	\$157,469.49	\$142,177.60	\$127,093.76	\$228,859.51	
\$185,296.53	\$170,041.32	\$154,930.04	\$243,756.36	\$235,508.12	\$217,763.86	\$227,289.90	\$211,779.29	\$196,456.17	\$219,071.67	\$203,839.18	\$188,516.06	\$173,257.41	\$211,110.53	\$195,787.40	\$180,605.96	\$165,350.75	\$203,170.42	\$187,847.29	\$172,591.46	\$157,469.49	\$142,177.60	\$127,093.76	\$228,859.51	
\$130,966.22	\$121,399.92	\$112,601.89	\$167,474.86	\$162,448.95	\$152,882.65	\$157,439.83	\$147,658.66	\$138,092.36	\$152,430.70	\$142,649.54	\$133,083.24	\$123,516.94	\$147,206.71	\$137,640.41	\$128,074.11	\$118,507.61	\$110,127.71	\$142,197.58	\$132,631.28	\$123,064.98	\$114,026.33	\$105,842.44	\$97,655.56	
\$172,594.56	\$157,383.78	\$142,002.13	\$231,729.17	\$223,276.44	\$207,811.87	\$214,946.56	\$199,533.28	\$184,246.83	\$206,780.17	\$191,366.90	\$176,114.87	\$160,781.43	\$198,501.59	\$183,219.48	\$167,874.57	\$152,683.62	\$137,301.96	\$190,335.20	\$174,979.18	\$159,758.39	\$144,376.74	\$129,204.15	\$114,480.01	
\$144,611.18	\$133,510.40	\$122,409.62	\$189,401.68	\$182,932.46	\$171,680.80	\$176,470.36	\$165,218.70	\$154,110.76	\$169,903.82	\$158,776.36	\$147,474.25	\$136,373.47	\$163,441.97	\$152,341.19	\$141,039.07	\$129,938.29	\$118,837.31	\$157,006.79	\$145,704.68	\$134,603.90	\$123,503.12	\$113,080.58	\$103,565.62	
\$182,637.10	\$167,253.66	\$152,026.94	\$242,618.39	\$242,022.76	\$218,155.45	\$225,452.19	\$209,875.21	\$194,423.24	\$216,934.75	\$201,594.97	\$186,149.57	\$170,766.13	\$208,654.51	\$193,202.54	\$177,904.25	\$162,524.91	\$147,104.69	\$200,374.28	\$184,934.02	\$169,550.57	\$154,314.21	\$138,894.19	\$123,683.23	
\$127,940.77	\$118,364.05	\$109,995.81	\$164,775.42	\$159,688.18	\$149,896.60	\$154,606.31	\$144,814.73	\$144,309.59	\$135,238.02	\$149,309.59	\$139,732.87	\$130,156.16	\$120,579.44	\$144,227.73	\$134,651.01	\$125,074.29	\$115,736.37	\$139,145.86	\$129,569.15	\$119,992.43	\$111,388.88	\$103,196.08	\$95,003.29	
\$177,249.69	\$161,829.33	\$146,366.57	\$241,678.18	\$232,245.31	\$216,394.15	\$222,833.34	\$207,300.25	\$191,804.31	\$213,591.31	\$198,095.37	\$182,731.41	\$167,304.02	\$204,497.41	\$189,001.47	\$173,568.61	\$158,270.38	\$142,807.62	\$195,292.53	\$179,940.36	\$164,512.87	\$149,045.97	\$133,789.91	\$118,533.85	
\$123,198.10	\$113,677.61	\$105,017.45	\$160,781.12	\$155,764.30	\$145,471.61	\$150,747.48	\$140,484.79	\$130,388.45	\$145,534.31	\$133,437.97	\$123,341.63	\$115,516.23	\$140,517.49	\$130,421.15	\$120,324.81	\$111,213.04	\$102,552.88	\$133,500.67	\$125,404.33	\$115,570.01	\$106,909.85	\$98,249.69	\$89,589.53	
\$171,504.94	\$162,054.32	\$146,560.89	\$241,835.09	\$232,442.15	\$216,554.77	\$223,070.87	\$207,560.16	\$191,975.63	\$213,860.67	\$198,335.04	\$182,942.29	\$167,485.57	\$204,807.16	\$189,281.53	\$173,818.14	\$158,491.42	\$142,997.98	\$195,640.94	\$180,259.57	\$164,802.85	\$149,303.93	\$134,020.58	\$118,737.23	
\$230,400.74	\$208,182.02	\$186,261.43	\$325,659.01	\$312,333.52	\$289,065.68	\$299,065.13	\$276,384.21	\$253,703.29	\$285,798.66	\$263,117.74	\$240,436.82	\$217,861.08	\$272,532.19	\$249,851.27	\$227,213.25	\$205,103.12	\$183,195.59	\$259,265.71	\$236,586.18	\$214,156.71	\$192,230.00	\$170,380.46	\$148,509.21	
\$143,551.31	\$132,122.53	\$122,693.75	\$176,559.11	\$171,781.50	\$162,317.75	\$167,115.18	\$157,671.13	\$148,027.49	\$153,024.51	\$143,380.87	\$133,952.09	\$117,806.67	\$148,163.03	\$138,734.25	\$129,305.47	\$119,876.69	\$153,160.05	\$143,516.41	\$134,087.63	\$124,658.85	\$115,507.52	\$107,441.28	\$173,618.82	
\$273,527.59	\$201,568.99	\$179,702.28	\$318,360.61	\$305,144.91	\$282,490.97	\$291,957.82	\$269,303.88	\$246,649.94	\$278,770.73	\$256,116.79	\$233,478.01	\$211,180.38	\$265,583.64	\$242,929.70	\$220,349.06	\$198,383.59	\$176,645.08	\$252,396.55	\$229,774.17	\$207,607.73	\$185,710.44	\$163,905.55	\$142,087.77	
\$187,418.63	\$172,000.09	\$156,721.59	\$246,948.33	\$238,511.68	\$222,589.89	\$230,105.12	\$214,335.57	\$198,847.96	\$221,705.67	\$206,222.30	\$190,734.69	\$175,414.57	\$213,481.48	\$197,993.87	\$182,642.96	\$167,224.42	\$151,966.08	\$205,368.21	\$189,880.60	\$174,452.82	\$159,163.95	\$143,706.47	\$128,465.86	
\$164,932.63	\$153,794.78	\$142,448.12	\$206,803.17	\$202,578.55	\$191,236.77	\$196,238.77	\$185,023.55	\$173,733.26	\$190,014.14	\$178,825.32	\$167,535.03	\$156,386.20	\$183,806.10	\$172,515.81	\$161,345.94	\$149,999.28	\$138,867.48	\$177,607.88	\$166,317.59	\$155,173.89	\$143,827.23	\$132,695.43	\$121,565.63	
\$160,953.21	\$149,603.42	\$138,461.68	\$205,640.68	\$199,095.35	\$187,839.35	\$192,661.70	\$181,452.13	\$170,155.62	\$186,234.24	\$174,937.74	\$163,794.58	\$152,606.28	\$179,827.69	\$168,531.18	\$157,368.34	\$146,061.54	\$134,876.80	\$173,313.30	\$162,132.39	\$150,988.65	\$139,638.66	\$128,497.12	\$117,355.38	
\$119,666.29	\$111,106.22	\$102,935.43	\$156,119.92	\$151,113.76	\$141,347.76	\$145,886.56	\$131,335.57	\$121,784.58	\$140,886.56	\$131,335.57	\$121,784.58	\$112,944.06	\$135,880.39	\$126,329.40	\$116,832.11	\$106,661.33	\$100,490.54	\$130,874.22	\$121,323.23	\$112,930.38	\$104,378.59	\$96,207.81	\$88,037.02	
\$151,241.83	\$140,177.24	\$129,300.81	\$194,227.02	\$188,050.69	\$177,133.28	\$181,099.17	\$170,890.06	\$159,939.24	\$175,737.71	\$164,744.61	\$153,863.06	\$142,978.47	\$169,520.49	\$158,619.81	\$147,554.72	\$136,678.28	\$125,801.85	\$163,375.56	\$152,499.12	\$141,434.53	\$130,558.10	\$119,681.67	\$109,983.88	
\$138,599.62	\$127,423.92	\$116,377.61	\$183,847.91	\$177,296.67	\$165,966.99	\$170,638.44	\$159,432.85	\$148,050.79	\$164,087.20	\$152,909.05	\$141,526.98	\$130,351.29	\$157,560.93	\$146,128.87	\$135,003.18	\$123,827.48	\$113,297.15	\$151,037.13	\$139,655.06	\$128,479.37	\$117,303.67	\$107,709.33	\$98,137.03	
\$127,288.08	\$117,718.83	\$109,450.22	\$163,822.10	\$158,802.68	\$149,018.56	\$153,784.63	\$144,000.51	\$134,431.26	\$148,551.71	\$138,982.45	\$129,413.20	\$119,843.95	\$143,533.65	\$133,964.40	\$124,395.15	\$115,161.75	\$106,975.34	\$138,515.60	\$128,946.34	\$119,377.09	\$110,868.85	\$102,682.44	\$94,496.02	
\$131,220.23	\$121,315.85	\$112,218.57	\$167,705.27	\$162,872.21	\$152,967.83	\$158,056.36	\$147,968.67	\$138,064.28	\$153,240.50	\$143,152.81	\$133,248.43	\$123,344.04	\$148,241.34	\$138,336.96	\$128,432.57	\$118,528.19	\$109,822.99	\$143,425.49	\$133,521.11	\$123,616.72	\$114,195.83	\$105,684.47	\$97,173.11	
\$149,520.22	\$136,683.88	\$123,847.55	\$206,317.07	\$198,149.43	\$185,214.34	\$190,096.94	\$177,196.00	\$164,193.95	\$182,068.44	\$169,066.39	\$156,206.54	\$143,155.34	\$173,938.82	\$161,058.40	\$148,007.20	\$135,170.87	\$122,334.53	\$165,920.49	\$153,073.93	\$140,022.73	\$127,186.39	\$114,754.67	\$103,773.30	

[illegible]

423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447
2 Adults school-age teenager	2 Adults teenager	All other 2 adult + 7 child families (average)	All other 2 adult + 8 child families (average)	All other 2 adult + 9 child families (average)	All other 2 adult + 10 child families (average)	3 Adults infant	3 Adults preschooler	3 Adults school-age teenager	3 Adults teenager	3 Adults infant	3 Adults preschooler	3 Adults infant	3 Adults school-age teenager	3 Adults infant	3 Adults preschooler	3 Adults school-age teenager	3 Adults school-age	3 Adults school-age teenager	3 Adults school-age teenager	3 Adults infant	3 Adults infant	3 Adults infant	3 Adults infant	3 Adults infant teenager
a210p0115	a210p0506	a2c27	a2c48	a2c59	a2c10	a310p0000	a311p0000	a310p1300	a310p0110	a310p0001	a312p0000	a311p1500	a311p0010	a311p0001	a310p2000	a310p1510	a310p1501	a310p0020	a310p0111	a310p0012	a313p0000	a312p1500	a312p0010	a312p0001
\$83,492.89	\$77,301.06	\$145,299.88	\$158,756.16	\$176,713.54	\$190,036.51	\$60,266.68	\$80,744.85	\$78,298.37	\$74,092.08	\$66,569.16	\$96,930.58	\$94,475.83	\$90,196.59	\$81,478.01	\$92,021.07	\$87,741.83	\$79,023.26	\$83,462.59	\$74,744.02	\$68,576.98	\$121,406.53	\$118,539.49	\$114,060.44	\$105,341.86
\$117,244.86	\$106,897.52	\$216,131.85	\$234,982.14	\$263,453.36	\$282,467.01	\$75,649.89	\$115,676.44	\$111,695.28	\$104,962.52	\$93,260.90	\$144,428.10	\$139,772.54	\$131,823.37	\$116,843.52	\$135,116.98	\$127,167.81	\$112,853.23	\$119,218.64	\$106,039.98	\$95,673.56	\$184,148.27	\$179,473.22	\$171,386.18	\$156,322.36
\$109,793.45	\$99,235.39	\$212,586.64	\$232,609.05	\$260,480.53	\$280,799.35	\$75,641.40	\$108,828.05	\$105,752.28	\$98,248.84	\$86,352.78	\$136,735.21	\$133,130.67	\$124,259.32	\$110,123.50	\$129,526.14	\$120,654.78	\$107,039.85	\$112,558.95	\$99,450.48	\$88,920.83	\$175,315.58	\$171,584.47	\$162,678.98	\$147,141.38
\$114,923.02	\$104,553.15	\$212,506.65	\$232,020.54	\$259,806.27	\$279,615.06	\$77,636.93	\$110,224.00	\$106,244.97	\$99,685.59	\$87,999.69	\$138,553.53	\$133,894.75	\$126,128.03	\$111,952.54	\$129,235.97	\$121,469.25	\$107,963.13	\$114,197.85	\$101,312.31	\$90,973.52	\$179,652.24	\$174,866.00	\$167,065.57	\$152,004.06
\$91,028.12	\$85,294.05	\$153,681.96	\$166,489.66	\$185,495.29	\$198,389.96	\$64,306.96	\$86,761.13	\$84,300.49	\$80,162.89	\$73,211.83	\$102,262.17	\$99,794.76	\$95,583.33	\$87,423.86	\$97,327.35	\$93,115.92	\$84,956.45	\$88,904.49	\$80,874.03	\$75,164.37	\$128,715.32	\$125,831.12	\$120,908.30	\$112,205.72
\$103,522.40	\$95,083.21	\$198,083.55	\$216,640.17	\$242,564.82	\$261,740.01	\$71,311.70	\$103,610.92	\$99,605.08	\$92,834.19	\$81,069.54	\$130,544.30	\$125,854.91	\$117,851.96	\$104,787.89	\$121,165.51	\$113,735.96	\$100,772.83	\$106,883.85	\$93,920.73	\$83,509.14	\$168,419.15	\$163,709.98	\$155,706.15	\$140,356.74
\$94,987.95	\$87,988.06	\$165,261.97	\$179,482.03	\$199,932.17	\$214,215.34	\$70,074.48	\$94,109.30	\$91,064.20	\$85,695.49	\$77,383.86	\$112,892.78	\$109,839.32	\$104,397.03	\$94,907.09	\$106,785.87	\$101,343.58	\$91,853.63	\$95,901.29	\$86,411.34	\$79,436.46	\$142,646.20	\$139,083.84	\$132,734.50	\$121,662.90
\$111,678.50	\$101,206.46	\$209,681.85	\$228,125.56	\$255,734.20	\$274,567.90	\$77,422.11	\$110,218.82	\$106,200.80	\$99,322.51	\$87,521.35	\$138,099.01	\$133,396.08	\$125,273.97	\$111,107.92	\$128,693.16	\$120,571.04	\$107,081.28	\$113,124.96	\$100,127.15	\$89,680.88	\$179,231.05	\$174,399.95	\$166,243.59	\$151,051.22
\$88,332.56	\$82,589.58	\$149,380.98	\$162,220.85	\$180,705.79	\$193,408.55	\$62,860.84	\$86,095.46	\$83,659.19	\$79,452.46	\$72,091.49	\$101,558.39	\$99,114.14	\$94,837.03	\$86,668.15	\$96,669.89	\$92,392.78	\$84,223.90	\$88,115.66	\$80,075.79	\$74,356.73	\$125,941.15	\$123,084.01	\$118,084.42	\$109,780.51
\$107,285.68	\$96,773.06	\$204,917.98	\$223,606.51	\$250,640.33	\$269,886.32	\$73,625.42	\$105,460.77	\$102,439.77	\$94,898.98	\$83,072.05	\$132,819.16	\$129,270.77	\$120,346.14	\$106,572.26	\$125,722.38	\$116,848.30	\$103,542.24	\$108,921.71	\$95,921.38	\$85,435.77	\$172,835.32	\$169,272.00	\$160,323.19	\$144,897.07
\$82,821.77	\$76,653.13	\$144,720.37	\$157,992.94	\$175,867.11	\$189,003.19	\$59,073.12	\$81,404.06	\$78,952.74	\$74,794.08	\$67,323.70	\$97,383.18	\$94,925.24	\$90,694.51	\$82,058.04	\$92,467.29	\$88,236.37	\$79,600.10	\$84,005.44	\$75,369.17	\$69,224.43	\$120,468.15	\$117,602.59	\$113,307.28	\$104,671.02
\$107,773.37	\$97,246.03	\$206,251.62	\$225,555.72	\$252,800.00	\$272,149.22	\$73,922.35	\$106,893.82	\$103,862.62	\$96,343.92	\$84,490.05	\$134,352.47	\$130,800.61	\$121,920.52	\$108,178.56	\$127,248.75	\$118,368.66	\$105,137.91	\$110,591.26	\$97,535.90	\$87,036.87	\$172,592.98	\$169,026.13	\$160,122.82	\$144,662.46
\$132,806.11	\$114,620.49	\$270,763.35	\$296,833.31	\$332,959.27	\$359,145.20	\$84,939.70	\$131,125.62	\$128,096.72	\$115,873.46	\$98,616.90	\$170,470.22	\$167,416.43	\$154,855.34	\$133,049.06	\$164,362.64	\$151,814.44	\$130,008.16	\$139,055.02	\$117,463.61	\$101,525.84	\$221,184.44	\$218,024.47	\$205,373.07	\$183,502.46
\$101,185.16	\$95,568.74	\$161,633.81	\$175,185.12	\$194,800.05	\$208,460.42	\$69,234.29	\$92,994.69	\$90,605.39	\$86,812.37	\$79,992.02	\$108,995.33	\$106,595.70	\$102,711.62	\$94,676.33	\$104,196.06	\$100,311.98	\$92,276.69	\$96,427.90	\$88,521.62	\$82,993.14	\$156,598.01	\$133,793.03	\$129,252.85	\$119,860.25
\$126,468.96	\$109,431.96	\$264,235.74	\$290,594.74	\$327,130.86	\$353,546.85	\$81,833.76	\$125,535.35	\$122,515.99	\$111,171.14	\$94,149.88	\$164,966.01	\$161,928.00	\$149,248.48	\$127,684.22	\$158,896.17	\$146,216.65	\$124,652.39	\$133,752.00	\$112,904.83	\$97,246.44	\$218,207.50	\$215,149.85	\$202,579.03	\$180,745.54
\$115,878.41	\$105,417.30	\$219,655.92	\$239,723.25	\$268,585.54	\$288,729.24	\$79,522.29	\$112,512.97	\$108,460.52	\$101,751.01	\$89,952.19	\$141,169.20	\$136,422.95	\$128,479.14	\$113,830.62	\$131,676.70	\$123,732.90	\$109,770.24	\$115,985.75	\$102,974.59	\$92,541.83	\$182,825.16	\$178,058.78	\$169,970.00	\$154,723.45
\$112,582.49	\$105,680.15	\$188,405.76	\$203,907.72	\$227,544.86	\$243,503.52	\$78,808.41	\$107,112.63	\$104,070.10	\$98,972.09	\$90,694.83	\$128,112.61	\$124,544.05	\$118,478.45	\$108,794.27	\$120,975.50	\$115,233.61	\$105,741.40	\$110,044.54	\$100,552.33	\$93,638.94	\$160,559.26	\$156,990.71	\$150,925.10	\$139,614.62
\$108,793.00	\$101,798.84	\$183,978.57	\$198,520.83	\$221,635.42	\$236,703.34	\$76,279.28	\$105,983.14	\$102,931.20	\$97,625.52	\$89,306.66	\$126,303.07	\$122,728.63	\$116,542.73	\$107,509.56	\$119,154.18	\$113,481.85	\$103,967.68	\$108,097.48	\$98,583.31	\$91,615.90	\$158,305.36	\$154,730.92	\$148,235.08	\$137,124.57
\$81,438.40	\$75,717.43	\$138,896.02	\$151,883.44	\$168,808.33	\$181,726.25	\$66,264.72	\$83,593.64	\$81,165.54	\$77,030.76	\$69,270.95	\$99,160.09	\$96,710.60	\$92,504.84	\$84,359.19	\$94,277.10	\$90,068.34	\$81,922.70	\$85,859.58	\$77,842.95	\$72,147.12	\$117,126.89	\$114,481.64	\$102,336.00	\$90,736.00
\$101,723.37	\$94,835.90	\$172,641.62	\$187,335.79	\$208,867.53	\$223,677.84	\$68,574.53	\$96,773.46	\$93,787.72	\$88,699.43	\$80,559.47	\$115,667.27	\$112,652.02	\$107,480.00	\$98,168.25	\$109,655.87	\$104,484.75	\$95,172.99	\$99,312.73	\$90,000.98	\$83,141.96	\$147,555.13	\$138,040.96	\$127,197.67	\$116,020.83
\$89,468.75	\$82,435.25	\$158,495.38	\$172,498.09	\$192,267.15	\$206,460.94	\$63,975.53	\$91,073.33	\$87,973.04	\$82,527.64	\$74,168.49	\$109,825.66	\$106,733.18	\$101,236.57	\$91,688.48	\$103,680.81	\$98,164.20	\$88,616.11	\$92,647.59	\$83,099.49	\$76,090.20	\$137,006.81	\$133,419.80	\$126,979.13	\$116,920.83
\$87,867.25	\$82,120.65	\$149,220.05	\$162,201.65	\$180,649.85	\$193,495.30	\$65,795.52	\$88,198.92	\$85,737.51	\$81,591.43	\$74,637.56	\$103,689.23	\$101,221.09	\$97,001.59	\$88,839.46	\$98,752.94	\$94,533.45	\$86,371.31	\$89,513.95	\$82,280.62	\$76,568.50	\$135,096.37	\$122,211.31	\$117,279.07	\$109,098.28
\$96,639.01	\$84,557.38	\$151,047.25	\$164,147.14	\$182,831.00	\$196,016.22	\$62,913.95	\$86,438.31	\$84,060.42	\$80,007.72	\$72,731.58	\$102,472.48	\$100,085.75	\$96,025.13	\$87,540.25	\$97,699.01	\$93,638.40	\$85,153.52	\$89,577.79	\$81,092.90	\$75,097.76	\$127,374.55	\$124,597.18	\$119,871.99	\$111,004.26
\$95,648.28	\$87,456.56	\$181,381.31	\$199,153.30	\$223,964.55	\$242,415.60	\$63,718.42	\$91,755.87	\$90,479.04	\$83,839.77	\$74,316.50	\$112,532.21	\$111,246.61	\$104,511.65	\$93,561.92	\$109,961.01	\$103,226.05	\$92,276.32	\$96,491.09	\$85,541.36	\$77,381.28	\$144,623.07	\$143,120.31	\$135,247.68	\$122,448.34

	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472
	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	
	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	
	preschooler	school-age	teenager	school-age	teenager	school-age	school-age	teenager	school-age	school-age	teenager	school-age	school-age	teenager	school-age	school-age	teenager	school-age	teenager	school-age	school-age	school-age	school-age	school-age	
a31p2500	a31p1s10	a31p1s01	a31p0s20	a31p0s11	a31p0s02	a31p0s00	a31p0s10	a31p0s01	a31p1s20	a31p1s11	a31p1s02	a31p0s30	a31p0s21	a31p0s12	a31p0s03	a31p0s00	a31p1s00	a31p0s10	a31p0s01	a31p2s00	a31p1s10	a31p1s01	a31p0s20	a31p0s11	
\$115,884.92	\$111,605.68	\$102,897.11	\$107,326.44	\$98,607.87	\$89,889.29	\$113,430.17	\$109,150.93	\$100,492.35	\$104,871.69	\$96,153.11	\$87,434.54	\$100,592.45	\$91,873.87	\$83,155.30	\$76,988.26	\$141,404.59	\$138,527.87	\$133,444.73	\$123,232.87	\$135,651.16	\$130,568.01	\$120,356.16	\$125,484.86	\$115,542.93	
\$174,693.57	\$166,711.13	\$151,666.80	\$157,748.58	\$143,515.96	\$126,485.01	\$170,018.53	\$162,042.19	\$146,809.57	\$154,093.02	\$138,860.41	\$123,829.45	\$145,942.19	\$130,911.24	\$116,061.73	\$105,695.30	\$214,509.37	\$209,803.93	\$201,693.24	\$186,400.81	\$205,098.49	\$186,879.39	\$181,715.06	\$188,768.71	\$173,534.72	
\$167,964.65	\$159,074.44	\$143,536.84	\$149,988.22	\$134,665.49	\$119,342.76	\$164,344.82	\$155,469.90	\$146,383.69	\$131,060.95	\$119,992.30	\$137,512.33	\$177,512.33	\$122,189.60	\$108,352.87	\$97,823.22	\$205,984.36	\$202,339.83	\$193,176.45	\$177,732.15	\$198,580.13	\$159,591.92	\$173,991.80	\$164,981.96	\$157,981.75	
\$170,187.60	\$162,392.83	\$147,137.23	\$154,626.11	\$139,370.51	\$124,322.96	\$166,509.20	\$157,734.05	\$142,478.45	\$149,759.28	\$134,711.73	\$119,664.18	\$141,992.55	\$126,945.01	\$112,652.14	\$102,313.35	\$210,438.42	\$205,728.01	\$197,676.22	\$182,486.82	\$201,017.59	\$192,965.81	\$177,796.25	\$185,095.96	\$169,781.75	
\$122,946.92	\$118,024.10	\$109,738.32	\$113,686.36	\$105,526.88	\$97,367.41	\$120,062.72	\$115,430.38	\$107,270.91	\$111,218.55	\$103,059.48	\$94,900.01	\$107,007.52	\$98,848.05	\$90,817.58	\$85,107.92	\$147,953.55	\$145,061.44	\$140,052.31	\$130,486.01	\$142,169.33	\$137,160.20	\$127,593.90	\$132,151.07	\$122,584.78	
\$159,019.70	\$151,016.75	\$135,667.34	\$142,804.73	\$127,664.39	\$113,189.27	\$154,330.30	\$146,118.28	\$130,977.94	\$138,115.34	\$122,974.99	\$109,174.22	\$130,112.39	\$115,285.24	\$104,026.71	\$94,536.76	\$189,944.76	\$194,204.79	\$186,045.41	\$170,700.50	\$189,464.82	\$181,325.42	\$165,980.51	\$157,872.29	\$145,510.99	
\$135,521.48	\$129,172.14	\$118,100.54	\$122,822.80	\$112,522.45	\$103,032.51	\$131,930.12	\$125,609.78	\$114,911.29	\$119,260.44	\$109,469.00	\$99,979.06	\$113,516.66	\$104,026.71	\$94,536.76	\$87,561.88	\$165,837.40	\$162,255.56	\$155,820.39	\$144,518.27	\$158,683.46	\$152,248.28	\$140,946.17	\$145,611.77	\$134,510.99	
\$169,677.19	\$161,529.14	\$146,139.23	\$153,407.03	\$138,017.12	\$122,886.27	\$164,954.44	\$156,826.22	\$141,436.30	\$148,495.03	\$133,314.19	\$118,133.34	\$140,372.92	\$125,192.08	\$111,037.80	\$100,591.53	\$209,679.93	\$204,927.04	\$196,534.60	\$181,222.26	\$200,174.14	\$191,781.71	\$176,489.40	\$183,513.17	\$168,135.73	
\$120,226.88	\$115,505.13	\$107,336.26	\$111,228.02	\$103,059.15	\$94,890.27	\$117,369.75	\$113,060.88	\$104,892.00	\$108,783.77	\$100,614.89	\$92,446.02	\$104,506.66	\$96,337.78	\$88,297.91	\$82,578.85	\$145,145.63	\$142,279.16	\$137,197.29	\$127,620.58	\$139,412.68	\$124,330.82	\$124,754.11	\$129,248.96	\$119,671.25	
\$165,708.69	\$156,774.80	\$141,343.68	\$147,643.47	\$132,419.05	\$117,194.63	\$162,151.05	\$153,226.42	\$137,795.29	\$144,095.08	\$128,870.66	\$113,851.46	\$135,170.45	\$119,946.03	\$106,230.60	\$95,744.98	\$203,271.80	\$198,571.89	\$190,478.00	\$175,146.08	\$195,982.87	\$186,892.39	\$171,465.00	\$177,836.75	\$162,413.93	
\$115,080.27	\$110,849.34	\$102,213.07	\$106,618.41	\$97,982.14	\$89,345.88	\$112,622.32	\$108,391.39	\$99,755.13	\$104,160.47	\$95,524.20	\$86,887.93	\$99,929.54	\$91,293.27	\$82,657.00	\$76,512.26	\$140,171.10	\$137,297.81	\$132,280.99	\$122,184.65	\$134,424.52	\$129,407.70	\$119,311.36	\$124,390.88	\$114,700.72	
\$165,459.28	\$156,570.96	\$141,110.60	\$147,480.78	\$132,230.51	\$117,004.67	\$161,899.19	\$153,019.10	\$137,558.74	\$143,928.93	\$128,678.65	\$113,964.02	\$135,048.84	\$119,798.57	\$106,362.01	\$95,862.99	\$203,213.23	\$199,507.40	\$190,453.90	\$174,985.55	\$195,914.29	\$186,864.33	\$171,407.61	\$177,848.04	\$162,298.97	
\$214,957.67	\$202,306.27	\$180,446.67	\$189,539.70	\$167,737.63	\$145,913.46	\$211,890.87	\$199,124.31	\$177,392.87	\$186,478.11	\$164,683.84	\$142,872.56	\$173,769.07	\$152,134.29	\$130,328.01	\$112,531.22	\$263,155.17	\$259,953.55	\$246,687.08	\$224,063.01	\$256,751.94	\$243,485.47	\$220,875.51	\$230,246.45	\$208,034.91	
\$130,988.05	\$126,447.87	\$117,068.96	\$121,907.69	\$113,184.88	\$105,149.59	\$128,183.06	\$123,642.89	\$114,669.32	\$119,102.71	\$110,785.24	\$102,749.96	\$114,936.45	\$106,901.16	\$98,994.88	\$93,409.41	\$156,498.67	\$153,681.61	\$148,820.12	\$139,391.34	\$150,864.54	\$146,003.06	\$136,574.28	\$141,356.44	\$131,927.66	
\$212,092.20	\$199,406.21	\$177,700.86	\$186,839.05	\$165,072.06	\$143,286.30	\$209,034.55	\$196,348.56	\$174,544.89	\$183,794.37	\$162,033.59	\$140,254.47	\$171,165.57	\$149,354.08	\$127,789.82	\$110,593.89	\$260,244.24	\$257,051.64	\$243,864.55	\$221,279.79	\$253,859.03	\$240,671.94	\$218,113.14	\$227,526.37	\$205,431.52	
\$173,181.12	\$165,203.63	\$149,772.33	\$157,252.63	\$141,828.53	\$126,619.29	\$168,414.75	\$160,450.18	\$145,026.09	\$152,506.38	\$137,082.28	\$121,873.05	\$144,347.71	\$129,138.47	\$114,394.67	\$103,962.12	\$213,650.64	\$208,854.63	\$200,741.36	\$185,264.13	\$204,058.62	\$195,830.19	\$180,488.46	\$167,716.92	\$172,288.32	
\$153,422.15	\$147,141.68	\$136,046.07	\$141,076.08	\$129,980.46	\$118,884.84	\$149,638.74	\$143,573.13	\$132,477.51	\$137,507.52	\$126,411.91	\$115,581.28	\$131,441.92	\$120,346.30	\$110,392.20	\$103,478.82	\$184,436.30	\$180,840.48	\$174,530.97	\$163,352.59	\$177,244.66	\$170,935.15	\$159,777.96	\$164,736.93	\$153,599.91	
\$151,156.47	\$144,660.63	\$133,550.13	\$138,372.84	\$127,262.34	\$117,295.25	\$147,373.97	\$141,086.65	\$129,975.68	\$134,798.40	\$123,677.89	\$113,234.37	\$128,510.61	\$117,400.10	\$107,058.00	\$100,882.59	\$181,732.71	\$178,132.74	\$174,618.35	\$160,442.55	\$174,424.92	\$168,018.37	\$156,857.68	\$161,619.73	\$150,471.99	
\$112,236.91	\$108,045.15	\$99,899.50	\$103,836.39	\$95,660.75	\$87,545.10	\$109,817.41	\$105,608.69	\$97,463.01	\$101,399.90	\$93,254.25	\$85,108.61	\$97,191.14	\$89,045.49	\$81,028.86	\$75,333.03	\$136,411.18	\$128,547.13	\$118,996.14	\$128,695.42	\$125,689.25	\$116,284.47	\$112,001.74	\$104,683.08	\$112,001.74	
\$140,575.75	\$134,553.07	\$123,709.78	\$128,520.39	\$117,431.85	\$108,299.49	\$137,097.86	\$131,005.18	\$120,221.89	\$131,005.18	\$119,805.12	\$109,876.09	\$126,245.78	\$119,805.12	\$109,876.09	\$97,883.76	\$131,005.18	\$120,221.89	\$131,005.18	\$119,805.12	\$109,876.09	\$97,883.76	\$131,005.18	\$120,221.89	\$131,005.18	
\$129,832.79	\$123,392.12	\$112,948.46	\$116,979.94	\$107,431.85	\$97,883.76	\$126,245.78	\$119,805.12	\$109,876.09	\$131,005.18	\$119,805.12	\$109,876.09	\$126,245.78	\$119,805.12	\$109,876.09	\$97,883.76	\$131,005.18	\$120,221.89	\$131,005.18	\$119,805.12	\$109,876.09	\$97,883.76	\$131,005.18	\$120,221.89	\$131,005.18	
\$119,326.25	\$114,792.27	\$106,630.13	\$110,572.78	\$102,410.64	\$94,248.50	\$116,543.61	\$112,324.12	\$104,161.99	\$108,104.63	\$99,942.49	\$91,780.36	\$103,885.14	\$95,723.00	\$87,669.87	\$81,977.54	\$144,325.00	\$141,432.07	\$136,414.02	\$126,844.76	\$138,539.14	\$133,521.08	\$128,951.83	\$128,951.83	\$118,933.78	
\$121,819.82	\$117,102.41	\$108,617.53	\$113,041.80	\$104,556.92	\$96,072.03	\$119,042.45	\$112,324.12	\$104,161.99	\$108,104.63	\$99,942.49	\$91,780.36	\$103,885.14	\$95,723.00	\$87,669.87	\$81,977.54	\$147,014.09	\$144,226.43	\$139,410.58	\$129,506.19	\$141,438.78	\$136,622.92	\$126,718.54	\$131,807.07	\$121,902.68	
\$141,617.55	\$133,744.93	\$120,945.58	\$125,872.30	\$113,662.12	\$102,712.39	\$140,114.79	\$132,242.17	\$119,442.82	\$124,369.54	\$112,376.52	\$101,465.79	\$116,591.29	\$105,641.56	\$94,691.83	\$86,531.75	\$170,119.08	\$168,599.65	\$160,593.64	\$147,542.44	\$167,080.22	\$159,080.62	\$146,029.42	\$151,096.15	\$138,044.95	

473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497
3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	
teenager	preschooler	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	
a312p0802	a311p3010	a311p2510	a311p2001	a311p1210	a311p1111	a311p1002	a311p0310	a311p0211	a311p0112	a311p0013	a310p4600	a310p3110	a310p3001	a310p2120	a310p2111	a310p2002	a310p1310	a310p1211	a310p1112	a310p1013	a310p0810	a310p0311	a310p0212	a310p0113
\$106,799.56	\$132,774.45	\$127,691.30	\$117,479.45	\$122,608.15	\$113,079.89	\$104,336.52	\$117,525.00	\$108,727.71	\$99,984.34	\$91,240.98	\$129,897.73	\$124,814.59	\$114,969.04	\$119,731.44	\$110,616.85	\$101,873.49	\$115,008.04	\$106,264.67	\$97,521.31	\$88,777.94	\$110,655.86	\$101,912.49	\$93,169.12	\$84,425.76
\$158,429.03	\$200,393.04	\$192,173.95	\$177,029.31	\$184,078.49	\$166,847.97	\$153,762.81	\$176,001.75	\$160,782.60	\$145,518.06	\$130,455.20	\$195,579.19	\$187,469.48	\$172,238.96	\$179,392.74	\$164,162.22	\$148,894.92	\$171,211.39	\$156,116.38	\$140,851.85	\$125,788.98	\$163,136.18	\$147,871.64	\$132,808.77	\$117,745.90
\$149,404.88	\$194,935.60	\$185,895.07	\$170,362.72	\$176,885.23	\$161,361.95	\$145,791.14	\$167,764.11	\$152,390.15	\$136,819.34	\$121,463.39	\$191,291.07	\$182,266.00	\$166,733.65	\$173,144.88	\$157,748.20	\$142,177.39	\$164,135.05	\$148,561.54	\$133,205.59	\$117,849.64	\$155,160.56	\$139,589.75	\$124,233.80	\$110,073.25
\$154,671.56	\$196,195.50	\$188,255.39	\$172,997.84	\$180,346.39	\$165,091.18	\$149,792.61	\$172,331.89	\$157,211.01	\$141,919.12	\$126,835.28	\$191,485.09	\$183,562.48	\$168,307.27	\$175,655.82	\$160,413.61	\$145,121.71	\$167,641.32	\$152,540.11	\$137,248.22	\$122,164.38	\$159,750.45	\$144,458.56	\$129,374.72	\$114,701.68
\$113,615.52	\$139,277.21	\$134,268.09	\$124,701.79	\$129,258.96	\$119,692.66	\$111,141.34	\$124,249.83	\$115,039.96	\$106,856.08	\$98,672.19	\$136,385.10	\$131,375.98	\$121,809.68	\$126,366.85	\$116,851.05	\$108,667.16	\$121,357.72	\$112,565.78	\$104,381.90	\$96,198.01	\$116,464.41	\$108,280.52	\$100,096.63	\$92,041.75
\$142,490.63	\$184,737.39	\$176,605.44	\$161,269.99	\$168,365.13	\$153,172.12	\$137,730.47	\$160,246.90	\$144,865.24	\$129,692.66	\$114,898.26	\$180,017.40	\$171,777.10	\$156,569.76	\$163,645.15	\$148,262.88	\$133,090.30	\$155,546.73	\$140,165.07	\$124,982.49	\$110,873.99	\$147,239.85	\$132,067.26	\$116,931.40	\$103,940.66
\$123,410.21	\$155,111.35	\$148,474.84	\$137,374.06	\$142,039.67	\$130,938.89	\$119,838.11	\$135,604.49	\$124,503.71	\$113,938.23	\$104,423.27	\$151,539.25	\$144,902.74	\$133,801.96	\$138,467.56	\$127,366.78	\$116,392.29	\$132,032.39	\$120,931.61	\$110,876.42	\$101,361.47	\$125,597.21	\$114,875.51	\$105,360.56	\$95,845.61
\$152,905.31	\$195,309.05	\$187,031.64	\$171,648.20	\$178,786.32	\$163,403.28	\$147,983.26	\$170,492.65	\$155,192.58	\$139,772.55	\$124,561.60	\$190,556.15	\$182,298.79	\$166,915.34	\$173,945.11	\$158,699.30	\$143,270.27	\$165,699.29	\$150,479.60	\$135,059.57	\$119,848.62	\$157,479.85	\$142,059.83	\$126,848.87	\$112,430.56
\$111,114.96	\$136,546.21	\$131,464.35	\$121,887.64	\$126,382.49	\$116,855.52	\$108,662.72	\$121,300.63	\$112,508.03	\$104,315.23	\$96,122.44	\$133,679.74	\$128,597.88	\$119,021.16	\$123,516.02	\$114,403.28	\$106,210.48	\$118,434.16	\$110,055.79	\$101,862.99	\$93,670.19	\$113,901.10	\$105,708.30	\$97,515.50	\$89,451.71
\$146,951.17	\$192,393.85	\$183,318.46	\$167,891.08	\$174,155.67	\$158,854.97	\$143,392.21	\$165,100.03	\$149,630.57	\$134,374.51	\$119,118.45	\$188,804.82	\$179,744.54	\$164,317.15	\$170,581.74	\$155,296.02	\$139,833.26	\$161,534.27	\$146,071.61	\$130,815.55	\$115,787.75	\$152,516.66	\$137,053.90	\$121,797.85	\$83,844.88
\$106,040.56	\$131,551.24	\$126,534.42	\$116,539.34	\$121,517.60	\$112,236.15	\$103,575.99	\$116,593.13	\$107,992.36	\$99,272.80	\$90,612.64	\$128,677.95	\$123,661.13	\$114,074.77	\$118,644.31	\$109,771.58	\$101,111.42	\$114,128.56	\$105,468.40	\$96,808.23	\$88,148.07	\$109,825.37	\$101,165.21	\$92,505.04	\$83,844.88
\$146,903.54	\$192,321.18	\$183,286.39	\$167,829.67	\$174,162.23	\$158,834.07	\$143,340.63	\$165,146.94	\$149,646.58	\$134,363.23	\$119,079.88	\$188,728.08	\$179,708.45	\$164,251.72	\$170,584.29	\$155,271.17	\$139,777.73	\$161,577.12	\$146,083.68	\$130,800.33	\$115,752.01	\$152,599.72	\$137,106.28	\$121,822.93	\$108,066.70
\$186,114.95	\$253,550.32	\$240,283.85	\$217,713.98	\$227,060.95	\$204,956.02	\$183,049.11	\$214,009.60	\$192,082.89	\$170,233.98	\$148,363.34	\$250,348.71	\$237,082.24	\$214,635.08	\$223,873.45	\$201,877.12	\$179,983.28	\$210,930.71	\$189,004.00	\$167,168.14	\$145,310.45	\$198,057.58	\$176,294.61	\$154,503.44	\$132,660.24
\$122,498.88	\$147,832.61	\$143,185.99	\$133,757.21	\$138,539.37	\$129,110.59	\$119,681.81	\$133,892.75	\$124,463.97	\$115,340.80	\$107,274.56	\$245,015.55	\$140,368.93	\$130,940.15	\$135,722.31	\$126,293.53	\$116,905.97	\$131,075.69	\$112,164.61	\$112,930.83	\$104,864.59	\$126,429.07	\$117,021.92	\$108,955.69	\$101,018.45
\$183,548.44	\$250,666.43	\$237,479.34	\$215,042.91	\$224,347.84	\$202,361.29	\$180,491.23	\$211,465.27	\$189,564.50	\$167,752.11	\$145,917.68	\$247,473.83	\$234,298.26	\$211,972.68	\$221,169.31	\$199,175.90	\$177,434.02	\$208,395.04	\$186,499.39	\$164,694.90	\$142,873.38	\$195,598.25	\$173,760.27	\$152,115.34	\$130,298.87
\$157,018.55	\$199,147.45	\$191,034.18	\$175,712.79	\$182,941.18	\$167,522.64	\$152,263.04	\$174,751.04	\$159,460.91	\$144,003.43	\$128,760.82	\$194,351.44	\$186,244.37	\$170,825.83	\$178,165.51	\$162,750.15	\$147,292.68	\$169,975.37	\$154,705.41	\$139,247.93	\$124,005.32	\$151,903.28	\$146,445.80	\$131,203.19	\$116,132.46
\$142,253.24	\$173,537.56	\$167,339.33	\$156,191.32	\$161,151.07	\$149,804.41	\$138,672.61	\$154,979.02	\$143,682.36	\$132,500.56	\$121,368.76	\$169,941.74	\$163,743.51	\$152,610.69	\$157,570.43	\$146,223.77	\$135,091.97	\$151,398.38	\$140,051.72	\$128,919.92	\$117,788.12	\$145,011.47	\$133,879.67	\$122,747.87	\$112,415.77
\$139,128.20	\$170,824.95	\$164,418.39	\$153,272.80	\$158,034.86	\$146,685.06	\$135,543.32	\$151,655.17	\$140,305.38	\$129,163.63	\$118,021.90	\$167,224.97	\$160,829.66	\$149,479.87	\$154,449.88	\$143,100.19	\$131,958.45	\$147,862.24	\$136,720.50	\$125,578.76	\$114,826.82	\$141,482.56	\$130,340.82	\$119,199.08	\$109,363.76
\$103,809.95	\$127,837.54	\$122,831.37	\$113,839.58	\$117,825.21	\$109,586.85	\$101,386.06	\$113,444.90	\$105,274.11	\$97,103.33	\$88,932.54	\$124,979.66	\$119,873.49	\$111,394.69	\$115,282.74	\$107,111.96	\$98,941.17	\$111,000.01	\$102,829.22	\$94,658.44	\$86,487.65	\$106,717.28	\$98,546.49	\$90,375.70	\$82,333.92
\$129,492.85	\$160,175.28	\$154,055.10	\$142,990.51	\$147,746.76	\$136,627.32	\$125,693.89	\$141,676.57	\$130,750.14	\$119,873.71	\$110,148.79	\$156,676.32	\$150,556.14	\$139,130.57	\$152,954.87	\$139,130.57	\$122,494.93	\$138,127.62	\$127,221.08	\$116,484.25	\$107,144.04	\$132,027.43	\$121,131.00	\$111,228.50	\$101,888.29
\$117,448.60	\$149,250.82	\$142,727.02	\$131,551.32	\$136,203.21	\$125,027.51	\$114,325.01	\$129,679.40	\$118,503.70	\$108,727.19	\$99,164.89	\$145,654.38	\$139,130.57	\$127,954.87	\$132,606.76	\$121,431.07	\$111,244.56	\$126,082.95	\$115,229.03	\$105,656.73	\$96,084.43	\$115,559.15	\$109,641.20	\$100,068.91	\$90,496.61
\$110,489.60	\$133,646.21	\$130,628.15	\$121,068.90	\$123,601.10	\$116,201.13	\$108,074.72	\$120,592.04	\$111,908.23	\$103,721.81	\$95,555.40	\$132,753.28	\$127,735.22	\$118,165.97	\$122,717.17	\$113,726.25	\$105,539.64	\$117,699.11	\$109,433.55	\$101,246.94	\$93,060.53	\$113,326.86	\$105,140.45	\$96,934.03	\$88,896.63
\$112,722.87	\$138,651.12	\$133,835.27	\$123,930.88	\$129,019.41	\$119,115.03	\$110,377.29	\$124,203.56	\$114,700.14	\$106,188.77	\$97,677.41	\$135,863.47	\$131,047.61	\$121,143.23	\$126,231.76	\$116,443.07	\$107,931.71	\$121,415.90	\$112,304.56	\$103,793.19	\$95,281.83	\$116,677.40	\$108,166.04	\$99,634.67	\$91,143.31
\$125,208.61	\$165,560.78	\$157,567.61	\$144,516.41	\$149,368.27	\$136,531.93	\$123,695.59	\$141,383.79	\$128,547.46	\$115,919.05	\$104,937.68	\$164,041.35	\$156,054.59	\$143,003.39	\$147,855.25	\$135,018.92	\$122,182.58	\$139,870.78	\$127,034.44	\$114,624.68	\$103,643.31	\$131,886.30	\$119,049.97	\$107,794.03	\$96,812.66

	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521
	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
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	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
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	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschooler	preschooler	Infant	
	teenager	Infant	Infant	Infant	Infant																			

598	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622
3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	3 Adults	
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	preschooler	
school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	school-age	
teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	teenager	
311P23112	311P23013	311P3400	311P3311	311P3212	311P3113	311P3004	311P0310	311P0411	311P0312	311P0213	311P0314	311P0315	311P0600	311P0510	311P0501	311P0420	311P0411	311P0402	311P0330	311P0321	311P0312	311P0303	311P0240	311P0231	
\$138,713.59	\$128,501.73	\$154,263.21	\$143,842.29	\$133,630.44	\$123,418.59	\$113,773.78	\$148,970.99	\$138,759.14	\$128,547.29	\$118,335.44	\$109,421.60	\$100,678.23	\$171,753.75	\$166,649.17	\$156,424.09	\$161,552.80	\$151,340.95	\$140,920.02	\$156,469.65	\$146,048.73	\$155,836.87	\$125,625.02	\$151,386.50	\$140,965.58	
\$209,063.05	\$193,765.16	\$231,779.55	\$216,141.86	\$200,952.37	\$185,663.03	\$170,432.51	\$223,386.66	\$208,031.17	\$192,573.28	\$177,586.29	\$162,360.54	\$147,096.01	\$260,584.98	\$252,155.42	\$236,371.07	\$243,725.86	\$227,978.17	\$212,468.30	\$235,303.28	\$219,585.77	\$204,357.61	\$189,059.71	\$204,215.08	\$207,895.54	
\$201,421.08	\$185,827.14	\$223,519.07	\$207,859.61	\$192,257.70	\$176,817.30	\$161,294.30	\$214,298.14	\$198,696.23	\$183,228.53	\$167,696.18	\$152,322.51	\$136,751.70	\$257,305.66	\$247,896.60	\$231,815.09	\$238,487.73	\$222,447.72	\$206,824.76	\$229,113.36	\$213,263.29	\$197,661.38	\$182,198.07	\$204,215.08	\$207,895.54	
\$205,334.62	\$190,011.49	\$228,145.51	\$212,605.96	\$197,282.83	\$182,095.09	\$166,839.88	\$219,927.29	\$204,665.85	\$189,342.72	\$174,080.59	\$158,952.37	\$143,660.48	\$256,227.62	\$247,973.26	\$232,180.52	\$239,718.90	\$223,962.30	\$208,564.31	\$231,488.33	\$215,835.65	\$200,624.20	\$185,311.18	\$207,895.54	\$207,895.54	
\$146,626.39	\$137,060.09	\$160,964.72	\$151,398.42	\$141,617.26	\$132,080.96	\$122,484.66	\$155,955.60	\$146,174.43	\$136,608.13	\$127,041.83	\$117,475.53	\$109,244.61	\$178,282.35	\$173,140.70	\$163,533.83	\$168,110.35	\$158,524.56	\$148,743.40	\$163,081.74	\$153,515.44	\$143,734.27	\$134,167.97	\$158,072.61	\$148,291.45	
\$190,960.84	\$175,710.53	\$213,508.80	\$198,095.53	\$182,815.14	\$167,470.23	\$152,280.97	\$205,342.42	\$189,929.14	\$174,574.83	\$159,355.75	\$143,974.09	\$128,801.51	\$242,263.80	\$233,787.56	\$217,966.92	\$225,334.84	\$209,800.53	\$194,387.26	\$216,935.22	\$201,634.14	\$186,227.10	\$170,882.19	\$208,768.83	\$193,335.56	
\$161,531.67	\$150,430.89	\$177,460.22	\$166,208.56	\$155,096.50	\$143,794.38	\$132,693.60	\$170,893.69	\$159,762.10	\$148,459.99	\$137,359.21	\$126,258.43	\$115,442.27	\$199,772.09	\$193,879.54	\$182,112.25	\$186,797.37	\$175,650.15	\$164,398.49	\$180,335.27	\$169,083.61	\$157,959.57	\$146,657.45	\$173,768.74	\$162,625.17	
\$202,588.68	\$187,139.08	\$225,217.23	\$209,688.22	\$194,196.25	\$178,893.76	\$163,510.32	\$216,707.75	\$201,367.98	\$185,923.53	\$170,540.09	\$155,299.57	\$139,879.54	\$254,607.79	\$246,049.49	\$230,131.76	\$237,441.19	\$221,561.19	\$206,116.02	\$228,868.25	\$213,175.56	\$197,723.59	\$182,406.23	\$220,297.69	\$204,895.32	
\$148,235.16	\$133,698.44	\$157,521.59	\$147,730.01	\$138,153.29	\$128,576.58	\$118,999.86	\$152,439.73	\$142,648.15	\$133,071.43	\$123,494.72	\$114,385.05	\$106,192.26	\$175,142.54	\$169,927.85	\$160,323.99	\$164,824.43	\$155,242.13	\$145,450.55	\$159,736.98	\$149,945.40	\$140,368.68	\$130,791.97	\$154,655.12	\$144,863.54	
\$198,394.73	\$183,029.51	\$220,242.29	\$204,796.77	\$189,300.83	\$173,866.71	\$158,567.23	\$211,087.83	\$195,591.89	\$180,238.46	\$164,811.07	\$149,342.82	\$134,086.76	\$254,251.50	\$244,798.19	\$228,840.59	\$235,351.69	\$219,428.61	\$204,010.58	\$225,939.71	\$210,301.64	\$194,805.71	\$179,455.58	\$216,599.70	\$201,207.75	
\$137,343.22	\$127,246.88	\$152,275.44	\$142,482.74	\$132,326.40	\$122,230.06	\$112,847.27	\$147,502.27	\$137,405.92	\$127,309.58	\$117,213.24	\$108,544.08	\$99,883.92	\$169,936.11	\$164,898.41	\$154,796.27	\$159,875.79	\$149,583.10	\$139,486.75	\$154,858.97	\$144,566.28	\$134,469.93	\$124,373.59	\$149,646.80	\$139,549.46	
\$198,526.22	\$183,132.67	\$220,490.10	\$204,998.35	\$189,472.72	\$174,008.51	\$158,681.00	\$211,357.76	\$195,832.13	\$180,449.94	\$164,993.22	\$149,493.51	\$134,210.16	\$254,324.45	\$244,909.87	\$228,920.82	\$235,503.44	\$219,549.53	\$204,099.34	\$226,132.16	\$210,458.74	\$194,933.11	\$179,554.73	\$216,818.15	\$201,405.24	
\$259,713.66	\$237,032.47	\$291,809.03	\$269,128.11	\$246,447.19	\$223,824.18	\$201,829.52	\$278,542.56	\$255,861.64	\$233,197.12	\$210,883.12	\$188,956.40	\$167,120.74	\$341,805.75	\$328,480.26	\$305,725.91	\$315,154.77	\$292,459.44	\$269,778.52	\$301,873.89	\$279,192.97	\$256,512.05	\$233,844.66	\$288,607.41	\$265,926.49	
\$158,677.66	\$149,034.02	\$172,928.42	\$163,459.82	\$154,031.04	\$144,387.40	\$134,958.62	\$168,262.09	\$158,813.20	\$149,169.56	\$139,740.78	\$130,312.00	\$120,883.22	\$188,881.00	\$174,629.62	\$179,543.34	\$174,765.73	\$169,963.29	\$160,507.22	\$174,765.73	\$165,296.97	\$155,860.60	\$146,216.96	\$170,099.41	\$160,642.76	
\$257,669.06	\$235,023.43	\$289,789.84	\$267,135.90	\$244,481.97	\$221,894.48	\$199,876.36	\$276,602.75	\$253,948.81	\$231,319.59	\$209,095.50	\$187,196.88	\$165,392.39	\$339,467.69	\$326,221.94	\$303,504.57	\$312,976.19	\$290,317.48	\$267,663.54	\$299,784.33	\$277,130.39	\$254,476.45	\$231,844.90	\$286,597.24	\$263,943.30	
\$207,722.04	\$192,244.43	\$230,783.90	\$214,991.22	\$199,503.61	\$184,146.30	\$168,727.76	\$222,384.45	\$206,877.95	\$191,390.34	\$176,067.43	\$160,660.94	\$145,203.46	\$239,516.24	\$231,079.59	\$235,102.39	\$242,642.94	\$226,702.94	\$211,049.30	\$234,218.17	\$218,308.48	\$202,936.03	\$187,449.49	\$225,818.72	\$210,195.21	
\$184,522.29	\$173,232.00	\$200,852.53	\$189,510.75	\$178,324.06	\$167,033.78	\$155,887.05	\$194,512.74	\$183,304.84	\$172,014.56	\$160,846.80	\$149,500.14	\$138,368.34	\$222,270.04	\$215,915.26	\$204,688.65	\$209,690.64	\$198,348.86	\$187,124.69	\$203,466.02	\$192,124.74	\$180,926.47	\$169,636.18	\$197,126.23	\$185,907.25	
\$180,189.13	\$168,892.63	\$196,195.71	\$184,971.25	\$173,674.74	\$162,490.33	\$151,348.59	\$189,762.05	\$178,564.70	\$167,268.19	\$156,110.64	\$144,760.85	\$133,619.11	\$218,427.80	\$211,993.15	\$200,757.21	\$205,559.49	\$194,211.81	\$182,299.51	\$199,014.16	\$187,778.16	\$176,589.16	\$165,292.65	\$181,371.27	\$168,580.50	
\$138,622.90	\$124,071.92	\$147,718.71	\$138,167.72	\$128,616.74	\$111,065.75	\$100,618.12	\$142,712.54	\$133,161.55	\$123,610.57	\$114,506.17	\$106,335.99	\$98,164.60	\$165,107.15	\$160,091.40	\$150,543.21	\$155,088.09	\$145,322.18	\$133,771.19	\$150,081.86	\$140,316.01	\$130,765.02	\$121,214.04	\$144,860.83	\$135,309.84	
\$168,687.48	\$153,993.88	\$184,687.48	\$173,668.37	\$162,670.13	\$151,873.70	\$140,809.11	\$178,542.03	\$167,522.92	\$156,629.95	\$145,565.36	\$134,688.93	\$123,812.49	\$205,349.89	\$196,774.89	\$188,693.19	\$193,488.88	\$182,543.64	\$171,524.34	\$187,319.53	\$176,398.19	\$165,379.08	\$154,494.92	\$170,154.97	\$155,823.77	
\$154,768.33	\$143,386.27	\$170,625.75	\$159,420.22	\$148,038.16	\$136,862.46	\$125,666.76	\$168,074.51	\$157,892.41	\$141,514.35	\$130,338.65	\$119,162.95	\$109,301.85	\$193,349.89	\$186,774.89	\$175,552.20	\$180,223.65	\$168,893.98	\$157,695.69	\$173,565.43	\$162,347.58	\$151,171.88	\$139,789.82	\$158,174.08	\$155,823.77	
\$142,404.53	\$132,835.27	\$156,739.84	\$146,955.72	\$137,386.47	\$127,817.22	\$118,247.97	\$151,721.78	\$141,937.67	\$132,368.42	\$122,799.16	\$113,796.40	\$105,609.99	\$173,963.31	\$168,923.98	\$159,331.62	\$163,884.64	\$154,313.77	\$144,529.65	\$156,864.96	\$149,080.85	\$139,511.59	\$129,942.34	\$153,946.91	\$144,062.79	
\$146,528.32	\$136,623.93	\$161,704.54	\$145,800.15	\$141,712.46	\$131,808.08	\$121,903.69	\$156,888.68	\$146,800.99	\$136,896.61	\$126,992.22	\$117,096.58	\$108,585.22	\$178,335.93	\$173,404.97	\$163,460.06	\$168,569.33	\$158,644.20	\$148,556.51	\$163,733.69	\$153,828.35	\$143,740.66	\$133,836.28	\$148,823.19	\$148,823.19	
\$173,727.57	\$160,848.04	\$191,618.68	\$178,711.29	\$165,709.23	\$152,863.57	\$139,812.37	\$183,583.73	\$170,581.67	\$157,715.43	\$144,664.23	\$131,827.89	\$118,991.56	\$222,557.84	\$214,365.39	\$201,419.72	\$206,312.91	\$193,252.07	\$180,337.75	\$198,145.26	\$185,210.19	\$172,208.14	\$159,335.03	\$190,092.78	\$177,191.86	

	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672
	All other 4 adult + 5 child families (average)	All other 4 adult + 6 child families (average)	All other 4 adult + 7 child families (average)	All other 4 adult + 8 child families (average)	All other 4 adult + 9 child families (average)	All other 4 adult + 10 child families (average)	5 Adults 5 adult + 1 child families (average)	5 adult + 2 child families (average)	5 adult + 3 child families (average)	5 adult + 4 child families (average)	5 adult + 5 child families (average)	5 adult + 6 child families (average)	5 adult + 7 child families (average)	5 adult + 8 child families (average)	5 adult + 9 child families (average)	5 adult + 10 child families (average)	6 Adults 6 adult + 1 child families (average)	6 adult + 2 child families (average)	6 adult + 3 child families (average)	6 adult + 4 child families (average)	6 adult + 5 child families (average)	All other 6 adult + 6 child families (average)	All other 6 adult + 7 child families (average)		
84C5	\$133,706.45	\$146,963.67	\$164,972.93	\$178,394.39	\$196,299.68	\$209,781.36	\$78,156.93	\$91,372.60	\$99,780.76	\$115,015.95	\$127,914.74	\$145,708.74	\$159,175.03	\$177,134.17	\$190,458.92	\$208,515.81	\$222,005.75	\$85,617.88	\$96,366.86	\$106,172.71	\$122,123.03	\$135,380.24	\$153,383.31	\$166,653.77	\$184,631.15
84C6	\$195,790.81	\$214,193.62	\$242,425.28	\$261,438.93	\$289,918.52	\$308,992.17	\$105,202.25	\$125,336.90	\$139,968.92	\$167,360.53	\$185,682.97	\$213,185.17	\$231,932.93	\$260,390.83	\$279,404.48	\$307,884.08	\$326,963.53	\$113,150.47	\$131,526.67	\$148,078.84	\$175,608.99	\$193,852.57	\$221,464.62	\$240,410.84	\$268,890.44
84C7	\$190,325.37	\$209,980.52	\$237,451.71	\$257,770.54	\$285,661.02	\$305,979.84	\$98,555.19	\$117,220.87	\$132,925.94	\$159,735.70	\$179,288.14	\$206,188.90	\$225,985.64	\$253,827.79	\$274,146.61	\$302,037.10	\$322,402.43	\$106,754.33	\$123,576.84	\$141,321.36	\$168,150.76	\$187,719.25	\$214,655.84	\$234,751.24	\$262,632.20
84C8	\$192,311.66	\$211,477.98	\$238,928.10	\$258,736.89	\$286,544.08	\$306,352.87	\$100,566.03	\$121,377.60	\$136,479.68	\$163,211.87	\$182,292.88	\$209,130.22	\$228,525.84	\$256,296.20	\$276,105.00	\$303,912.18	\$323,773.19	\$109,258.55	\$128,131.69	\$145,417.06	\$172,185.68	\$191,283.00	\$218,143.21	\$237,853.73	\$265,665.91
84C9	\$142,924.29	\$155,934.23	\$174,796.49	\$187,757.35	\$206,847.33	\$219,797.29	\$84,786.12	\$99,596.20	\$107,648.27	\$124,857.81	\$137,652.88	\$156,682.30	\$169,502.73	\$188,511.80	\$201,531.02	\$220,578.35	\$233,937.58	\$92,198.05	\$104,533.46	\$114,084.71	\$132,381.48	\$145,176.55	\$164,208.57	\$177,169.59	\$196,099.55
84C10	\$177,748.22	\$196,150.51	\$221,448.02	\$240,555.19	\$266,632.76	\$285,807.96	\$93,098.37	\$110,487.33	\$124,105.60	\$148,978.71	\$167,494.09	\$192,601.10	\$211,157.73	\$236,865.31	\$256,040.35	\$282,117.92	\$301,293.11	\$101,111.82	\$115,835.73	\$132,291.97	\$157,374.15	\$175,823.33	\$200,968.99	\$219,447.20	\$245,444.94
84C11	\$152,338.89	\$166,407.82	\$186,911.21	\$201,191.07	\$221,787.93	\$236,455.92	\$88,954.69	\$110,960.80	\$112,143.35	\$131,622.87	\$145,679.69	\$166,206.26	\$180,426.32	\$200,988.66	\$215,163.60	\$236,246.46	\$250,975.64	\$96,440.79	\$107,969.78	\$118,907.86	\$139,221.82	\$153,479.97	\$188,058.56	\$208,651.46	\$229,546.55
84C12	\$189,049.36	\$207,277.50	\$234,411.84	\$253,234.59	\$280,881.85	\$299,715.55	\$99,264.09	\$119,571.52	\$134,111.34	\$160,690.71	\$178,826.78	\$205,495.03	\$223,791.94	\$251,381.50	\$270,215.20	\$297,862.46	\$316,717.37	\$106,919.16	\$125,549.91	\$141,901.17	\$168,501.54	\$186,649.46	\$213,350.83	\$231,923.20	\$259,546.55
84C13	\$138,811.25	\$151,651.12	\$169,979.96	\$182,769.79	\$201,321.32	\$214,053.86	\$83,980.46	\$96,744.25	\$104,702.52	\$120,901.38	\$133,526.39	\$152,042.73	\$164,672.69	\$183,163.06	\$195,876.28	\$214,448.81	\$227,489.34	\$91,283.00	\$101,576.19	\$110,981.95	\$128,241.53	\$140,866.53	\$159,382.87	\$172,043.96	\$190,546.40
84C14	\$184,066.66	\$202,676.56	\$229,098.59	\$248,310.33	\$275,402.52	\$294,688.51	\$94,975.48	\$114,728.27	\$129,173.24	\$155,223.75	\$173,625.32	\$199,725.62	\$218,360.88	\$245,368.52	\$264,614.52	\$291,706.71	\$310,952.70	\$102,859.65	\$120,487.60	\$137,241.50	\$163,292.01	\$181,834.67	\$207,983.03	\$226,776.78	\$253,826.52
84C15	\$133,280.74	\$146,336.95	\$164,277.94	\$177,310.50	\$195,337.49	\$206,628.72	\$78,695.19	\$91,263.87	\$99,063.26	\$114,863.84	\$127,560.92	\$145,282.33	\$158,594.69	\$176,431.41	\$189,569.84	\$207,545.11	\$220,809.57	\$85,963.95	\$96,106.60	\$105,973.22	\$121,841.10	\$134,917.31	\$152,835.08	\$165,921.33	\$183,818.43
84C16	\$184,256.60	\$203,213.01	\$229,852.71	\$249,640.87	\$276,935.14	\$296,754.35	\$96,636.65	\$114,600.34	\$129,190.87	\$155,195.08	\$173,823.14	\$199,846.10	\$218,751.60	\$245,674.19	\$265,445.96	\$292,740.23	\$312,562.37	\$104,791.52	\$120,525.38	\$137,534.35	\$163,498.56	\$182,310.70	\$208,373.02	\$227,461.15	\$254,422.11
84C17	\$237,211.65	\$263,321.61	\$299,354.30	\$325,484.43	\$361,677.41	\$387,863.35	\$111,172.02	\$139,390.99	\$160,673.95	\$195,310.10	\$220,568.13	\$256,528.49	\$282,598.46	\$318,661.09	\$344,847.03	\$381,040.01	\$409,769.67	\$120,259.39	\$146,112.03	\$169,581.08	\$204,382.37	\$229,841.17	\$265,842.61	\$291,912.57	\$328,016.64
84C18	\$152,714.13	\$166,116.32	\$185,852.25	\$199,349.59	\$219,198.49	\$233,180.07	\$92,583.09	\$107,202.63	\$115,461.80	\$134,648.27	\$148,039.42	\$167,814.28	\$181,373.49	\$201,169.94	\$214,675.15	\$234,945.41	\$248,980.25	\$101,266.14	\$112,981.27	\$124,037.80	\$143,579.57	\$157,185.58	\$176,894.74	\$190,393.93	\$210,177.32
84C19	\$298,770.82	\$266,069.81	\$302,538.48	\$328,912.83	\$365,543.72	\$391,969.62	\$114,146.40	\$145,311.27	\$166,740.32	\$201,948.77	\$227,549.76	\$263,977.02	\$290,276.02	\$326,810.72	\$353,226.71	\$389,857.60	\$420,319.00	\$128,254.02	\$156,664.23	\$180,292.86	\$215,447.28	\$241,544.89	\$278,013.55	\$304,312.55	\$340,990.70
84C20	\$197,752.08	\$217,238.82	\$245,971.13	\$266,114.83	\$294,977.12	\$315,135.15	\$102,176.63	\$124,199.81	\$139,727.83	\$167,481.06	\$186,881.77	\$214,749.43	\$234,673.78	\$263,526.21	\$283,669.91	\$312,535.02	\$332,768.32	\$110,403.40	\$130,576.31	\$148,153.84	\$176,054.09	\$195,376.07	\$223,416.43	\$243,500.42	\$272,362.71
84C21	\$175,698.03	\$191,033.71	\$214,476.14	\$230,265.52	\$254,493.19	\$270,493.28	\$103,285.89	\$119,158.35	\$130,608.21	\$153,953.32	\$169,234.38	\$192,594.76	\$208,096.72	\$231,881.63	\$247,859.49	\$272,116.55	\$288,116.64	\$111,968.94	\$125,913.11	\$139,539.51	\$162,884.63	\$178,314.84	\$201,717.30	\$227,104.10	\$241,225.80
84C22	\$170,997.87	\$185,542.39	\$208,540.05	\$223,260.85	\$247,021.13	\$262,136.31	\$101,194.11	\$116,313.34	\$127,120.39	\$149,823.43	\$164,071.43	\$187,397.94	\$202,046.26	\$225,168.74	\$240,251.33	\$264,052.38	\$279,786.76	\$109,036.53	\$122,290.51	\$135,116.96	\$158,028.05	\$172,501.68	\$195,440.79	\$210,110.48	\$233,515.42
84C23	\$128,346.48	\$141,099.04	\$158,236.38	\$171,020.70	\$188,128.03	\$201,104.38	\$81,774.89	\$89,301.14	\$96,962.27	\$111,306.27	\$123,071.71	\$139,397.94	\$152,961.61	\$169,911.16	\$182,829.08	\$199,874.96	\$212,851.30	\$89,317.51	\$94,348.80	\$103,522.52	\$117,796.94	\$130,549.50	\$147,471.97	\$177,531.94	\$192,745.58
84C24	\$163,237.18	\$174,029.15	\$193,185.90	\$210,944.30	\$232,823.12	\$248,400.62	\$95,664.98	\$108,402.61	\$117,958.54	\$139,194.22	\$153,918.76	\$175,300.33	\$189,905.83	\$211,419.09	\$226,337.61	\$248,533.80	\$263,738.81	\$100,699.81	\$113,825.04	\$126,266.49	\$147,502.17	\$166,151.52	\$183,642.58	\$198,282.67	\$219,842.10
84C25	\$145,237.76	\$159,409.15	\$179,141.80	\$193,188.63	\$213,025.26	\$227,410.98	\$85,646.40	\$97,771.64	\$106,902.91	\$124,747.10	\$138,721.13	\$158,479.10	\$172,481.74	\$192,250.73	\$206,444.52	\$226,440.28	\$241,053.74	\$92,985.84	\$102,667.59	\$113,274.87	\$132,186.50	\$146,151.52	\$165,928.67	\$180,059.41	\$199,751.96
84C26	\$138,672.76	\$151,654.36	\$169,946.55	\$182,878.70	\$201,393.88	\$214,269.36	\$86,189.80	\$96,467.18	\$104,503.62	\$120,632.38	\$133,399.11	\$151,878.95	\$164,650.54	\$183,104.25	\$195,960.15	\$214,495.86	\$227,686.02	\$93,574.11	\$101,386.89	\$110,913.89	\$128,125.46	\$140,892.20	\$159,372.03	\$172,175.40	\$190,641.58
84C27	\$140,016.61	\$153,061.88	\$171,430.00	\$184,676.37	\$203,428.13	\$216,633.44	\$84,414.87	\$97,603.98	\$105,746.49	\$122,157.33	\$133,019.29	\$153,479.80	\$166,353.44	\$184,801.05	\$197,757.18	\$216,417.19	\$230,003.81	\$92,150.26	\$102,769.50	\$112,505.00	\$130,021.98	\$142,883.94	\$161,344.45	\$174,250.41	\$192,716.64
84C28	\$167,565.41	\$185,400.11	\$210,013.68	\$228,142.83	\$253,589.10	\$272,097.44	\$89,979.41	\$106,595.96	\$118,560.23	\$142,861.44	\$160,724.87	\$185,228.65	\$203,132.19	\$227,964.56	\$246,433.33	\$271,918.38	\$290,426.72	\$100,290.64	\$113,913.93	\$129,385.44	\$153,901.51	\$171,584.22	\$196,135.54	\$214,049.60	\$239,277.55

[illegible]

9 Adults	698		699		700		701		702		703		704		705		706		707		708		709		710		711		712		713		714		715		716		717		718		719	
	All other 9 adult + 1 child families (average)	All other 2 child families (average)	All other 9 adult + 3 child families (average)	All other 9 adult + 4 child families (average)	All other 9 adult + 5 child families (average)	All other 9 adult + 6 child families (average)	All other 9 adult + 7 child families (average)	All other 9 adult + 8 child families (average)	All other 9 adult + 9 child families (average)	All other 10 adult families (average)	All other 10 adult + 1 child families (average)	All other 10 adult + 2 child families (average)	All other 10 adult + 3 child families (average)	All other 10 adult + 4 child families (average)	All other 10 adult + 5 child families (average)	All other 10 adult + 6 child families (average)	All other 10 adult + 7 child families (average)	All other 10 adult + 8 child families (average)	All other 10 adult + 9 child families (average)	All other 10 adult + 10 child families (average)																								
89C0	\$114,960.08	\$124,674.96	\$135,854.21	\$153,802.18	\$167,074.40	\$185,051.78	\$198,410.05	\$216,466.95	\$230,235.68	\$248,862.00	\$262,761.18	\$123,007.09	\$132,250.00	\$143,429.25	\$151,267.68	\$174,571.38	\$192,569.29	\$206,050.97	\$224,190.12	\$238,033.35	\$256,689.01	\$270,588.19																						
	\$154,129.88	\$174,178.98	\$190,905.89	\$218,416.57	\$237,348.31	\$265,827.91	\$284,841.56	\$304,188.77	\$324,424.46	\$341,029.01	\$360,126.08	\$163,096.73	\$182,427.44	\$199,083.98	\$216,878.05	\$245,847.92	\$274,327.51	\$293,341.16	\$321,864.29	\$340,961.36	\$369,565.91	\$388,662.98																						
	\$143,904.25	\$163,480.24	\$181,348.56	\$208,258.10	\$228,127.83	\$255,979.47	\$276,298.29	\$294,188.77	\$324,563.68	\$352,578.23	\$372,987.44	\$153,359.14	\$171,861.26	\$189,788.45	\$206,893.43	\$246,783.88	\$285,102.70	\$312,998.05	\$333,407.26	\$361,421.81	\$381,831.02																							
	\$151,123.56	\$170,452.32	\$187,906.57	\$214,766.78	\$234,359.83	\$262,155.85	\$281,964.64	\$309,771.83	\$329,658.72	\$357,588.73	\$377,485.01	\$160,914.18	\$179,535.19	\$196,919.56	\$223,966.46	\$243,718.37	\$271,525.56	\$291,334.35	\$319,173.53	\$339,069.81	\$366,999.82																							
	\$125,493.86	\$137,012.26	\$148,176.90	\$167,222.03	\$180,182.65	\$199,125.45	\$212,144.68	\$231,566.39	\$244,961.16	\$264,692.28	\$278,110.68	\$133,862.12	\$144,535.93	\$155,915.43	\$174,777.61	\$187,738.39	\$206,828.37	\$219,777.67	\$239,432.96	\$252,851.35	\$272,582.47																							
	\$135,714.04	\$153,550.30	\$170,255.65	\$195,374.35	\$213,930.97	\$239,788.28	\$258,923.47	\$285,001.04	\$304,176.24	\$330,334.96	\$349,594.94	\$144,740.18	\$161,741.88	\$178,584.88	\$203,742.24	\$222,317.69	\$248,331.06	\$267,506.26	\$293,583.83	\$312,762.82	\$338,955.69																							
	\$128,615.79	\$141,750.88	\$154,420.32	\$174,781.29	\$189,006.82	\$209,599.72	\$223,959.87	\$245,193.10	\$259,925.13	\$281,214.87	\$295,946.90	\$137,048.07	\$149,349.82	\$162,019.27	\$182,516.47	\$196,669.63	\$217,262.53	\$231,889.20	\$253,157.06	\$267,889.09	\$289,178.83																							
	\$146,608.00	\$165,964.39	\$182,480.30	\$209,164.02	\$227,589.58	\$255,195.85	\$274,029.55	\$301,676.81	\$320,548.58	\$348,318.09	\$367,235.06	\$155,446.67	\$173,787.07	\$190,314.00	\$217,019.82	\$235,720.83	\$263,362.90	\$282,196.60	\$309,843.86	\$328,751.74	\$356,521.25																							
	\$121,875.00	\$132,390.70	\$143,313.42	\$161,829.76	\$174,501.23	\$193,014.13	\$205,861.84	\$224,526.23	\$237,711.47	\$256,904.52	\$270,144.56	\$130,122.12	\$139,793.23	\$150,868.43	\$169,193.95	\$181,983.78	\$200,531.96	\$213,264.51	\$232,190.01	\$245,409.20	\$264,602.24																							
	\$141,003.28	\$159,868.39	\$176,784.64	\$202,911.66	\$221,530.02	\$248,554.72	\$267,800.71	\$294,892.90	\$314,148.77	\$341,360.46	\$360,691.34	\$149,969.35	\$167,967.93	\$184,886.84	\$211,048.09	\$229,951.04	\$257,012.72	\$276,258.71	\$303,350.90	\$322,644.08	\$349,855.76																							
	\$113,925.43	\$123,976.39	\$135,479.27	\$153,387.03	\$166,485.62	\$184,382.73	\$197,354.40	\$215,529.67	\$229,070.41	\$247,604.62	\$261,305.67	\$121,576.25	\$131,352.79	\$142,835.66	\$160,793.43	\$173,872.64	\$197,786.76	\$205,077.99	\$223,103.20	\$236,744.99	\$255,312.53																							
	\$141,315.33	\$160,024.79	\$177,199.75	\$203,240.41	\$222,148.38	\$249,085.93	\$268,613.44	\$295,616.00	\$315,157.86	\$342,279.94	\$361,893.89	\$150,709.51	\$168,401.48	\$185,578.44	\$211,654.62	\$230,857.93	\$257,833.86	\$277,361.37	\$304,363.93	\$323,944.51	\$351,065.59																							
	\$164,939.80	\$192,247.86	\$215,763.83	\$251,607.75	\$277,677.71	\$313,718.46	\$339,904.40	\$376,097.38	\$404,006.68	\$446,206.80	\$476,738.95	\$174,707.09	\$201,320.12	\$224,942.13	\$260,921.86	\$286,991.83	\$323,074.01	\$349,259.95	\$385,452.93	\$414,915.02	\$447,115.13																							
	\$139,126.63	\$151,587.12	\$163,347.83	\$183,083.11	\$196,568.66	\$216,392.05	\$230,301.04	\$250,765.59	\$264,809.09	\$285,302.86	\$299,346.36	\$148,902.53	\$160,518.50	\$172,316.36	\$192,070.83	\$205,691.20	\$225,644.56	\$239,638.22	\$260,131.98	\$274,175.49	\$294,669.25																							
	\$189,257.09	\$216,810.65	\$241,226.16	\$277,694.83	\$303,993.83	\$340,589.55	\$367,005.54	\$405,584.39	\$436,384.78	\$479,095.49	\$509,895.87	\$203,722.54	\$230,727.47	\$255,262.70	\$291,731.36	\$318,057.63	\$354,688.53	\$381,104.52	\$402,023.45	\$452,823.83	\$495,534.54																							
	\$152,470.98	\$172,748.11	\$190,510.67	\$218,381.81	\$238,441.09	\$267,303.38	\$287,447.08	\$316,328.98	\$336,562.29	\$365,552.97	\$385,786.27	\$161,759.38	\$181,321.14	\$199,008.45	\$227,176.94	\$247,277.58	\$276,139.67	\$296,283.57	\$325,204.78	\$345,438.09	\$374,428.77																							
	\$152,834.59	\$168,703.33	\$182,486.08	\$205,906.31	\$221,393.39	\$245,581.77	\$261,581.86	\$285,838.91	\$301,839.00	\$326,159.21	\$342,230.47	\$162,632.16	\$177,783.79	\$191,471.25	\$214,913.68	\$230,718.49	\$254,948.16	\$270,948.26	\$295,205.31	\$311,205.40	\$335,567.27																							
	\$147,348.61	\$163,033.21	\$176,008.89	\$198,854.54	\$213,524.22	\$237,049.39	\$251,183.57	\$275,894.82	\$291,119.00	\$314,933.59	\$330,134.62	\$156,392.16	\$171,053.46	\$184,039.13	\$207,090.44	\$221,698.37	\$245,432.77	\$260,566.95	\$284,368.20	\$299,502.38	\$324,354.00																							
	\$113,270.13	\$121,842.29	\$132,565.63	\$149,089.32	\$161,657.96	\$179,634.77	\$191,457.34	\$208,639.13	\$227,501.87	\$237,694.87	\$259,996.55	\$275,131.56	\$297,373.24	\$312,609.85	\$329,127.27	\$346,559.95	\$362,974.15	\$379,124.64	\$394,574.15	\$409,972.59	\$424,974.56																							
	\$137,429.63	\$151,788.79	\$164,782.39	\$186,203.52	\$200,955.72	\$222,501.87	\$237,694.87	\$259,996.55	\$275,131.56	\$297,373.24	\$312,609.85	\$329,127.27	\$346,559.95	\$362,974.15	\$379,124.64	\$394,574.15	\$409,972.59	\$424,974.56	\$432,340.43	\$449,607.07	\$463,833.08																							
	\$121,426.30	\$133,774.43	\$146,135.24	\$165,912.32	\$180,033.06	\$199,726.54	\$213,930.33	\$234,187.83	\$248,815.30	\$269,320.45	\$283,659.83	\$129,713.22	\$141,213.83	\$153,781.01	\$173,383.00	\$187,513.74	\$207,349.58	\$221,536.85	\$241,974.56	\$256,613.93	\$271,758.66																							
	\$121,231.11	\$132,199.93	\$143,336.22	\$161,816.06	\$174,629.79	\$193,106.43	\$206,097.07	\$224,731.64	\$238,066.42	\$257,221.18	\$270,609.85	\$129,568.79	\$139,693.01	\$151,004.17	\$169,333.78	\$182,265.93	\$200,778.50	\$213,653.97	\$232,555.11	\$246,924.53	\$265,079.29																							
	\$123,585.75	\$134,840.33	\$146,169.20	\$164,634.35	\$177,644.48	\$196,031.00	\$209,098.10	\$227,835.87	\$241,265.17	\$260,403.77	\$273,871.91	\$132,268.73	\$142,704.98	\$154,217.16	\$172,531.31	\$185,541.44	\$204,059.55	\$217,027.64	\$236,036.04	\$249,500.48	\$268,639.08																							
	\$142,389.57	\$159,363.04	\$175,542.84	\$199,999.27	\$217,913.33	\$243,295.29	\$261,803.62	\$287,288.68	\$305,797.01	\$331,368.29	\$349,958.95	\$154,274.24	\$170,229.33	\$186,413.96	\$211,031.84	\$229,196.91	\$254,647.85	\$273,156.18	\$298,641.24	\$317,172.92	\$342,771.35																							

Exhibit JGH-4
Page 36 of 78

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Exhibit JGH-4
Page 38 of 78

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at10p35x1	at10p35x2	at10p35x3	at10p35x4	at10p35x5	at10p35x6	at10p35x7	at10p35x8	at10p35x9	at10p35x10	at10p35x11	at10p35x12	at10p35x13	at10p35x14	at10p35x15	at10p35x16	at10p35x17	at10p35x18	at10p35x19	at10p35x20	at10p35x21	at10p35x22	at10p35x23	at10p35x24	at10p35x25	at10p35x26	at10p35x27	at10p35x28	at10p35x29	at10p35x30	at10p35x31	at10p35x32	at10p35x33	at10p35x34	at10p35x35	at10p35x36	at10p35x37	at10p35x38	at10p35x39	at10p35x40	at10p35x41	at10p35x42	at10p35x43	at10p35x44	at10p35x45	at10p35x46	at10p35x47	at10p35x48	at10p35x49	at10p35x50	at10p35x51	at10p35x52	at10p35x53	at10p35x54	at10p35x55	at10p35x56	at10p35x57	at10p35x58	at10p35x59	at10p35x60	at10p35x61	at10p35x62	at10p35x63	at10p35x64	at10p35x65	at10p35x66	at10p35x67	at10p35x68	at10p35x69	at10p35x70	at10p35x71	at10p35x72	at10p35x73	at10p35x74	at10p35x75	at10p35x76	at10p35x77	at10p35x78	at10p35x79	at10p35x80	at10p35x81	at10p35x82	at10p35x83	at10p35x84	at10p35x85	at10p35x86	at10p35x87	at10p35x88	at10p35x89	at10p35x90	at10p35x91	at10p35x92	at10p35x93	at10p35x94	at10p35x95	at10p35x96	at10p35x97	at10p35x98	at10p35x99	at10p35x100	at10p35x101	at10p35x102	at10p35x103	at10p35x104	at10p35x105	at10p35x106	at10p35x107	at10p35x108	at10p35x109	at10p35x110	at10p35x111	at10p35x112	at10p35x113	at10p35x114	at10p35x115	at10p35x116	at10p35x117	at10p35x118	at10p35x119	at10p35x120	at10p35x121	at10p35x122	at10p35x123	at10p35x124	at10p35x125	at10p35x126	at10p35x127	at10p35x128	at10p35x129	at10p35x130	at10p35x131	at10p35x132	at10p35x133	at10p35x134	at10p35x135	at10p35x136	at10p35x137	at10p35x138	at10p35x139	at10p35x140	at10p35x141	at10p35x142	at10p35x143	at10p35x144	at10p35x145	at10p35x146	at10p35x147	at10p35x148	at10p35x149	at10p35x150	at10p35x151	at10p35x152	at10p35x153	at10p35x154	at10p35x155	at10p35x156	at10p35x157	at10p35x158	at10p35x159	at10p35x160	at10p35x161	at10p35x162	at10p35x163	at10p35x164	at10p35x165	at10p35x166	at10p35x167	at10p35x168	at10p35x169	at10p35x170	at10p35x171	at10p35x172	at10p35x173	at10p35x174	at10p35x175	at10p35x176	at10p35x177	at10p35x178	at10p35x179	at10p35x180	at10p35x181	at10p35x182	at10p35x183	at10p35x184	at10p35x185	at10p35x186	at10p35x187	at10p35x188	at10p35x189	at10p35x190	at10p35x191	at10p35x192	at10p35x193	at10p35x194	at10p35x195	at10p35x196	at10p35x197	at10p35x198	at10p35x199	at10p35x200	at10p35x201	at10p35x202	at10p35x203	at10p35x204	at10p35x205	at10p35x206	at10p35x207	at10p35x208	at10p35x209	at10p35x210	at10p35x211	at10p35x212	at10p35x213	at10p35x214	at10p35x215	at10p35x216	at10p35x217	at10p35x218	at10p35x219	at10p35x220	at10p35x221	at10p35x222	at10p35x223	at10p35x224	at10p35x225	at10p35x226	at10p35x227	at10p35x228	at10p35x229	at10p35x230	at10p35x231	at10p35x232	at10p35x233	at10p35x234	at10p35x235	at10p35x236	at10p35x237	at10p35x238	at10p35x239	at10p35x240	at10p35x241	at10p35x242	at10p35x243	at10p35x244	at10p35x245	at10p35x246	at10p35x247	at10p35x248	at10p35x249	at10p35x250	at10p35x251	at10p35x252	at10p35x253	at10p35x254	at10p35x255	at10p35x256	at10p35x257	at10p35x258	at10p35x259	at10p35x260	at10p35x261	at10p35x262	at10p35x263	at10p35x264	at10p35x265	at10p35x266	at10p35x267	at10p35x268	at10p35x269	at10p35x270	at10p35x271	at10p35x272	at10p35x273	at10p35x274	at10p35x275	at10p35x276	at10p35x277	at10p35x278	at10p35x279	at10p35x280
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221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257
2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults
Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	
preschool	school-age	teenager	preschool	preschool	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	
a21p1s0t0	a21p0s1t0	a21p0s0t1	a20p2s0t0	a20p1s1t0	a20p1s0t1	a20p0s2t0	a20p0s1t1	a20p0s0t2	a20p0s0t0	a20p1s0t0	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	
\$19.90	\$18.90	\$16.84	\$19.32	\$18.32	\$16.26	\$17.33	\$15.27	\$13.49	\$25.73	\$25.15	\$24.13	\$22.07	\$24.56	\$23.55	\$22.49	\$22.54	\$20.47	\$18.41	\$23.98	\$22.97	\$20.91	\$21.96	\$19.89	\$17.83	\$20.94	\$18.88	\$16.82	\$15.36	\$30.50	\$29.82	\$28.64	\$26.44	\$29.14	\$27.96	\$25.66	
\$28.48	\$26.78	\$23.74	\$27.43	\$25.84	\$22.79	\$24.24	\$21.20	\$18.75	\$39.77	\$38.66	\$36.78	\$33.17	\$37.56	\$35.68	\$32.07	\$33.75	\$30.19	\$26.79	\$34.46	\$34.53	\$30.97	\$31.64	\$29.09	\$25.84	\$30.76	\$27.28	\$24.23	\$17.78	\$47.38	\$46.24	\$44.35	\$40.74	\$44.35	\$39.64	\$41.33	
\$27.46	\$25.69	\$22.59	\$26.73	\$24.96	\$21.86	\$23.18	\$20.08	\$17.60	\$37.97	\$37.12	\$34.97	\$31.34	\$36.26	\$34.11	\$30.48	\$32.01	\$28.38	\$25.19	\$35.36	\$33.26	\$29.63	\$31.16	\$27.56	\$24.46	\$29.06	\$25.76	\$22.66	\$20.17	\$45.65	\$44.79	\$42.68	\$39.01	\$43.93	\$38.15	\$39.68	
\$27.71	\$26.16	\$23.12	\$26.77	\$25.22	\$22.18	\$23.67	\$20.62	\$18.18	\$36.33	\$37.22	\$35.34	\$31.77	\$36.12	\$34.23	\$30.67	\$32.39	\$28.83	\$25.62	\$34.97	\$33.13	\$29.57	\$31.29	\$27.73	\$24.68	\$29.45	\$26.16	\$23.10	\$20.06	\$46.07	\$44.96	\$43.11	\$39.51	\$43.85	\$42.00	\$40.13	
\$20.53	\$19.55	\$17.63	\$19.95	\$17.05	\$17.05	\$17.99	\$16.10	\$14.75	\$26.84	\$26.26	\$23.26	\$23.33	\$24.68	\$23.46	\$22.74	\$23.68	\$21.75	\$19.81	\$25.09	\$24.09	\$22.16	\$23.09	\$21.16	\$20.93	\$24.42	\$20.17	\$18.26	\$16.91	\$31.62	\$30.93	\$29.77	\$27.54	\$30.25	\$29.08	\$26.96	
\$26.22	\$24.62	\$21.55	\$25.27	\$23.06	\$22.06	\$23.06	\$19.00	\$16.54	\$36.52	\$35.36	\$32.46	\$29.88	\$34.25	\$32.35	\$28.77	\$30.46	\$27.00	\$23.93	\$33.14	\$31.24	\$27.67	\$29.35	\$26.05	\$27.49	\$24.42	\$21.36	\$18.89	\$14.14	\$43.03	\$41.10	\$37.51	\$41.91	\$39.99	\$36.40	\$38.09	
\$27.66	\$22.03	\$19.79	\$22.58	\$21.31	\$19.07	\$20.04	\$17.80	\$16.15	\$36.15	\$29.66	\$28.16	\$25.85	\$28.82	\$27.38	\$25.13	\$26.09	\$23.84	\$21.60	\$24.98	\$23.95	\$24.41	\$25.37	\$23.12	\$20.87	\$24.08	\$21.83	\$19.58	\$17.93	\$36.37	\$35.48	\$33.88	\$31.36	\$34.64	\$33.14	\$30.52	
\$26.91	\$26.03	\$22.96	\$26.71	\$25.08	\$22.01	\$23.45	\$20.38	\$17.92	\$38.35	\$37.23	\$35.26	\$31.67	\$28.12	\$25.53	\$22.58	\$23.52	\$21.57	\$19.64	\$24.95	\$23.94	\$22.44	\$23.11	\$22.55	\$20.47	\$23.19	\$20.98	\$18.07	\$16.72	\$31.42	\$30.74	\$29.56	\$27.26	\$30.07	\$28.88	\$27.70	
\$20.20	\$19.20	\$17.28	\$19.62	\$18.63	\$16.70	\$17.63	\$15.73	\$14.39	\$26.69	\$26.11	\$25.09	\$23.16	\$20.58	\$18.42	\$16.25	\$17.19	\$15.02	\$13.36	\$24.46	\$23.34	\$22.74	\$22.00	\$20.99	\$19.66	\$21.91	\$19.88	\$18.07	\$16.72	\$31.42	\$30.74	\$29.56	\$27.26	\$30.07	\$28.88	\$27.70	
\$19.55	\$18.57	\$16.53	\$18.97	\$17.99	\$15.95	\$17.00	\$14.96	\$12.88	\$25.81	\$25.23	\$24.23	\$22.19	\$24.65	\$23.65	\$21.60	\$22.65	\$20.60	\$18.56	\$24.07	\$23.07	\$21.02	\$22.07	\$20.02	\$17.98	\$21.06	\$19.02	\$16.97	\$15.52	\$30.52	\$29.84	\$28.68	\$26.50	\$29.17	\$28.00	\$25.92	
\$27.03	\$25.25	\$22.17	\$26.31	\$24.53	\$21.45	\$22.75	\$17.19	\$17.19	\$37.38	\$36.54	\$34.39	\$30.78	\$35.70	\$33.55	\$29.94	\$31.45	\$27.83	\$24.73	\$34.81	\$32.71	\$29.10	\$30.60	\$27.10	\$24.01	\$28.50	\$25.30	\$22.21	\$19.72	\$45.02	\$44.17	\$42.06	\$38.41	\$43.33	\$37.57		
\$34.66	\$31.72	\$26.78	\$33.95	\$31.00	\$26.16	\$28.06	\$19.89	\$46.23	\$46.23	\$47.50	\$44.48	\$39.32	\$46.75	\$43.76	\$38.60	\$40.75	\$35.63	\$34.06	\$46.02	\$43.03	\$39.88	\$40.02	\$34.86	\$29.74	\$37.05	\$31.89	\$26.91	\$23.15	\$38.51	\$37.76	\$34.65	\$49.59	\$57.00	\$53.90		
\$21.72	\$20.82	\$18.93	\$21.16	\$20.26	\$18.36	\$19.36	\$17.50	\$16.18	\$28.41	\$27.74	\$26.82	\$24.92	\$27.17	\$26.25	\$24.35	\$25.33	\$23.43	\$21.53	\$25.60	\$25.68	\$23.78	\$24.77	\$22.86	\$20.96	\$23.85	\$21.94	\$20.07	\$18.75	\$33.54	\$32.87	\$31.80	\$29.57	\$32.21	\$31.13		
\$32.75	\$29.82	\$25.16	\$32.03	\$29.11	\$24.55	\$26.41	\$22.05	\$18.35	\$45.85	\$45.13	\$42.16	\$37.01	\$44.40	\$41.41	\$36.45	\$38.45	\$35.30	\$28.19	\$43.68	\$40.69	\$35.58	\$37.73	\$32.86	\$27.51	\$34.73	\$29.63	\$24.99	\$21.28	\$56.11	\$55.36	\$52.28	\$47.08	\$54.61	\$51.53		
\$28.27	\$26.61	\$23.53	\$27.24	\$23.52	\$21.28	\$22.32	\$20.99	\$18.52	\$39.04	\$37.92	\$36.04	\$32.39	\$34.80	\$31.86	\$28.45	\$32.98	\$29.38	\$23.06	\$33.67	\$33.74	\$30.14	\$31.86	\$28.26	\$25.10	\$29.98	\$26.57	\$23.49	\$21.02	\$46.76	\$45.63	\$43.73	\$40.09	\$44.50	\$42.61		
\$25.45	\$24.24	\$22.00	\$24.73	\$23.52	\$21.28	\$22.32	\$20.99	\$18.52	\$34.20	\$33.36	\$31.92	\$29.29	\$32.51	\$31.08	\$28.45	\$32.98	\$29.38	\$23.06	\$33.67	\$33.74	\$30.14	\$31.86	\$28.26	\$25.10	\$29.98	\$26.57	\$23.49	\$21.02	\$46.76	\$45.63	\$43.73	\$40.09	\$44.50	\$42.61		
\$24.81	\$23.55	\$21.31	\$24.09	\$22.83	\$20.58	\$21.57	\$19.33	\$17.69	\$33.84	\$32.99	\$31.51	\$28.88	\$32.15	\$30.66	\$28.03	\$29.17	\$26.71	\$23.46	\$33.30	\$32.81	\$27.26	\$28.32	\$25.99	\$23.73	\$26.97	\$24.71	\$22.46	\$20.81	\$39.80	\$38.95	\$37.46	\$34.78	\$38.11	\$36.62		
\$20.06	\$19.08	\$17.16	\$19.49	\$18.51	\$16.58	\$17.53	\$15.64	\$14.29	\$26.09	\$25.51	\$24.52	\$22.59	\$24.94	\$23.94	\$22.01	\$22.95	\$21.02	\$19.09	\$24.36	\$23.36	\$21.44	\$22.37	\$20.44	\$18.51	\$21.67	\$19.44	\$17.55	\$16.20	\$30.76	\$30.09	\$28.82	\$26.82	\$29.41	\$28.25		
\$21.88	\$20.59	\$18.34	\$21.16	\$19.87	\$17.61	\$18.58	\$16.33	\$14.67	\$29.70	\$28.85	\$27.38	\$25.12	\$28.00	\$26.66	\$24.08	\$25.35	\$22.09	\$18.03	\$27.24	\$25.93	\$23.67	\$24.62	\$22.36	\$20.10	\$23.32	\$21.06	\$18.80	\$17.24	\$35.57	\$34.67	\$33.15	\$30.51	\$33.62	\$29.60		
\$20.89	\$19.90	\$17.98	\$20.30	\$19.32	\$17.40	\$18.34	\$16.43	\$15.10	\$27.18	\$26.60	\$25.60	\$23.67	\$26.01	\$25.01	\$23.40	\$24.01	\$22.08	\$18.56	\$25.43	\$24.43	\$22.27	\$23.32	\$21.31	\$19.30	\$22.36	\$20.35	\$18.34	\$16.90	\$31.85	\$31.20	\$30.08	\$27.74	\$30.54	\$29.42		
\$20.42	\$19.48	\$17.47	\$19.86	\$18.91	\$16.91	\$17.97	\$15.97	\$14.54	\$26.93	\$26.37	\$25.41	\$23.40	\$25.80	\$24.84	\$22.83	\$23.88	\$21.87	\$19.86	\$25.24	\$24.28	\$22.27	\$23.32	\$21.31	\$19.30	\$22.36	\$20.35	\$18.34	\$16.90	\$31.85	\$31.20	\$30.08	\$27.74	\$30.54	\$29.42		
\$22.51	\$20.94	\$18.36	\$22.21	\$20.64	\$18.05	\$19.07	\$16.48	\$14.56	\$30.26	\$29.91	\$28.04	\$25.41	\$27.69	\$25.55	\$23.10	\$24.58	\$23.51	\$20.92	\$29.20	\$27.39	\$24.80	\$25.80	\$23.20	\$20.61	\$24.20	\$21.61	\$19.02	\$17.08	\$36.77	\$36.42	\$34.50	\$31.47	\$36.06	\$34.15		

221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257
2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults	2 Adults
Infant	Infant	Infant	preschool	preschool	preschool	school-age	school-age	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschool	preschool	preschool	school-age	school-age	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
preschool	school-age	teenager	preschool	school-age	teenager	school-age	teenager	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	preschool	preschool	preschool	school-age	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age	teenager	school-age
a21p1s0t0	a21p0s1t0	a21p0s0t1	a20p2s0t0	a20p1s1t0	a20p1s0t1	a20p0s2t0	a20p0s1t1	a20p0s0t2	a20p0s0t0	a20p1s0t0	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	a20p1s0t1	a20p2s0t0	
\$19.90	\$18.90	\$16.84	\$19.32	\$18.32	\$16.26	\$17.33	\$15.27	\$13.49	\$25.73	\$25.15	\$24.13	\$22.07	\$24.56	\$23.55	\$22.49	\$22.54	\$20.47	\$18.41	\$23.98	\$22.97	\$20.91	\$21.96	\$19.89	\$17.83	\$20.94	\$18.88	\$16.82	\$15.36	\$30.50	\$29.82	\$28.64	\$26.44	\$29.14	\$27.96	\$25.66	\$27.71
\$28.48	\$26.78	\$23.74	\$27.43	\$25.84	\$22.79	\$24.24	\$21.20	\$18.75	\$39.77	\$38.66	\$36.78	\$33.17	\$37.56	\$35.68	\$32.07	\$33.75	\$30.19	\$26.79	\$34.46	\$34.53	\$30.97	\$31.64	\$29.09	\$25.84	\$30.76	\$27.28	\$24.23	\$17.78	\$47.38	\$46.24	\$44.35	\$40.74	\$44.35	\$39.64	\$41.33	
\$27.46	\$25.69	\$22.59	\$26.73	\$24.96	\$21.86	\$23.18	\$20.08	\$17.60	\$37.97	\$37.12	\$34.97	\$31.34	\$36.26	\$34.11	\$30.48	\$32.01	\$28.38	\$25.19	\$35.36	\$33.26	\$29.63	\$31.16	\$27.56	\$24.46	\$29.06	\$25.76	\$22.66	\$20.17	\$45.65	\$44.79	\$42.68	\$39.01	\$43.93	\$38.15	\$39.68	

[illegible]

20200101	20200201	20200301	20200401	20200501	20200601	20200701	20200801	20200901	20201001	20201101	20201201	20210101	20210201	20210301	20210401	20210501	20210601	20210701	20210801	20210901	20211001	20211101	20211201	20220101	20220201	20220301	20220401	20220501	20220601	20220701	20220801	20220901	20221001	20221101	20221201	20230101	20230201	20230301	20230401	20230501	20230601	20230701	20230801	20230901	20231001	20231101	20231201	20240101	20240201	20240301	20240401	20240501	20240601	20240701	20240801	20240901	20241001	20241101	20241201	20250101	20250201	20250301	20250401	20250501	20250601	20250701	20250801	20250901	20251001	20251101	20251201	20260101	20260201	20260301	20260401	20260501	20260601	20260701	20260801	20260901	20261001	20261101	20261201	20270101	20270201	20270301	20270401	20270501	20270601	20270701	20270801	20270901	20271001	20271101	20271201	20280101	20280201	20280301	20280401	20280501	20280601	20280701	20280801	20280901	20281001	20281101	20281201	20290101	20290201	20290301	20290401	20290501	20290601	20290701	20290801	20290901	20291001	20291101	20291201	20300101	20300201	20300301	20300401	20300501	20300601	20300701	20300801	20300901	20301001	20301101	20301201	20310101	20310201	20310301	20310401	20310501	20310601	20310701	20310801	20310901	20311001	20311101	20311201	20320101	20320201	20320301	20320401	20320501	20320601	20320701	20320801	20320901	20321001	20321101	20321201	20330101	20330201	20330301	20330401	20330501	20330601	20330701	20330801	20330901	20331001	20331101	20331201	20340101	20340201	20340301	20340401	20340501	20340601	20340701	20340801	20340901	20341001	20341101	20341201	20350101	20350201	20350301	20350401	20350501	20350601	20350701	20350801	20350901	20351001	20351101	20351201	20360101	20360201	20360301	20360401	20360501	20360601	20360701	20360801	20360901	20361001	20361101	20361201	20370101	20370201	20370301	20370401	20370501	20370601	20370701	20370801	20370901	20371001	20371101	20371201	20380101	20380201	20380301	20380401	20380501	20380601	20380701	20380801	20380901	20381001	20381101	20381201	20390101	20390201	20390301	20390401	20390501	20390601	20390701	20390801	20390901	20391001	20391101	20391201	20400101	20400201	20400301	20400401	20400501	20400601	20400701	20400801	20400901	20401001	20401101	20401201	20410101	20410201	20410301	20410401	20410501	20410601	20410701	20410801	20410901	20411001	20411101	20411201	20420101	20420201	20420301	20420401	20420501	20420601	20420701	20420801	20420901	20421001	20421101	20421201	20430101	20430201	20430301	20430401	20430501	20430601	20430701	20430801	20430901	20431001	20431101	20431201	20440101	20440201	20440301	20440401	20440501	20440601	20440701	20440801	20440901	20441001	20441101	20441201	20450101	20450201	20450301	20450401	20450501	20450601	20450701	20450801	20450901	20451001	20451101	20451201	20460101	20460201	20460301	20460401	20460501	20460601	20460701	20460801	20460901	20461001	20461101	20461201	20470101	20470201	20470301	20470401	20470501	20470601	20470701	20470801	20470901	20471001	20471101	20471201	20480101	20480201	20480301	20480401	20480501	20480601	20480701	20480801	20480901	20481001	20481101	20481201	20490101	20490201	20490301	20490401	20490501	20490601	20490701	20490801	20490901	20491001	20491101	20491201	20500101	20500201	20500301	20500401	20500501	20500601	20500701	20500801	20500901	20501001	20501101	20501201	20510101	20510201	20510301	20510401	20510501	20510601	20510701	20510801	20510901	20511001	20511101	20511201	20520101	20520201	20520301	20520401	20520501	20520601	20520701	20520801	20520901	20521001	20521101	20521201	20530101	20530201	20530301	20530401	20530501	20530601	20530701	20530801	20530901	20531001	20531101	20531201	20540101	20540201	20540301	20540401	20540501	20540601	20540701	20540801	20540901	20541001	20541101	20541201	20550101	20550201	20550301	20550401	20550501	20550601	20550701	20550801	20550901	20551001	20551101	20551201	20560101	20560201	20560301	20560401	20560501	20560601	20560701	20560801	20560901	20561001	20561101	20561201	20570101	20570201	20570301	20570401	20570501	20570601	20570701	20570801	20570901	20571001	20571101	20571201	20580101	20580201	20580301	20580401	20580501	20580601	20580701	20580801	20580901	20581001	20581101	20581201	20590101	20590201	20590301	20590401	20590501	20590601	20590701	20590801	20590901	20591001	20591101	20591201	20600101	20600201	20600301	20600401	20600501	20600601	20600701	20600801	20600901	20601001	20601101	20601201	20610101	20610201	20610301	20610401	20610501	20610601	20610701	20610801	20610901	20611001	20611101	20611201	20620101	20620201	20620301	20620401	20620501	20620601	20620701	20620801	20620901	20621001	20621101	20621201	20630101	20630201	20630301	20630401	20630501	20630601	20630701	20630801	20630901	20631001	20631101	20631201	20640101	20640201	20640301	20640401	20640501	20640601	20640701	20640801	20640901	20641001	20641101	20641201	20650101	20650201	20650301	20650401	20650501	20650601	20650701	20650801	20650901	20651001	20651101	20651201	20660101	20660201	20660301	20660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516.24	528.74	528.06	527.00	524.94	527.43	526.42	524.36	525.41	523.34	521.28	526.85	523.78	524.83	522.76	520.70	523.81	521.75	519.69	518.23	533.48	532.80	531.59	529.17	532.11	530.91	528.49	529.71	527.35	525.28	531.43	530.23	527.81	529.03	526.77	524.70	528.12	526.00	527.30	525.18	526.52	524.45	525.78	523.71	525.05	522.98	524.91	522.84	524.77	522.70	524.63	522.56	524.49	522.42	524.35	522.28	524.21	522.14	524.07	521.99	523.92	521.85	523.78	521.71	523.64	521.57	523.50	521.43	523.36	521.29	523.22	521.15	523.08	520.99	522.92	522.85	522.78	522.71	522.64	522.57	522.50	522.43	522.36	522.29	522.22	522.15	522.08	522.01	521.94	521.87	521.80	521.73	521.66	521.59	521.52	521.45	521.38	521.31	521.24	521.17	521.10	521.03	520.96	520.89	520.82	520.75	520.68	520.61	520.54	520.47	520.40	520.33	520.26	520.19	520.12	520.05	519.98	519.91	519.84	519.77	519.70	519.63	519.56	519.49	519.42	519.35	519.28	519.21	519.14	519.07	519.00	518.93	518.86	518.79	518.72	518.65	518.58	518.51	518.44	518.37	518.30	518.23	518.16	518.09	518.02	517.95	517.88	517.81	517.74	517.67	517.60	517.53	517.46	517.39	517.32	517.25	517.18	517.11	517.04	516.97	516.90	516.83	516.76	516.69	516.62	516.55	516.48	516.41	516.34	516.27	516.20	516.13	516.06	515.99	515.92	515.85	515.78	515.71	515.64	515.57	515.50	515.43	515.36	515.29	515.22	515.15	515.08	515.01	514.94	514.87	514.80	514.73	514.66	514.59	514.52	514.45	514.38	514.31	514.24	514.17	514.10	514.03	513.96	513.89	513.82	513.75	513.68	513.61	513.54	513.47	513.40	513.33	513.26	513.19	513.12	513.05	512.98	512.91	512.84	512.77	512.70	512.63	512.56	512.49	512.42	512.35	512.28	512.21	512.14	512.07	512.00	511.93	511.86	511.79	511.72	511.65	511.58	511.51	511.44	511.37	511.30	511.23	511.16	511.09	511.02	510.95	510.88	510.81	510.74	510.67	510.60	510.53	510.46	510.39	510.32	510.25	510.18	510.11	510.04	509.97	509.90	509.83	509.76	509.69	509.62	509.55	509.48	509.41	509.34	509.27	509.20	509.13	509.06	508.99	508.92	508.85	508.78	508.71	508.64	508.57	508.50	508.43	508.36	508.29	508.22	508.15	508.08	508.01

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480	3 Adults	school-age
481	infant	school-age
482	3 Adults	school-age
483	infant	school-age
484	3 Adults	preschool
485	3 Adults	preschool
486	3 Adults	preschool
487	3 Adults	preschool
488	3 Adults	preschool
489	3 Adults	preschool
490	3 Adults	preschool
491	3 Adults	preschool
492	3 Adults	preschool
493	3 Adults	school-age
494	3 Adults	school-age
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496	3 Adults	school-age
497	3 Adults	school-age
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513	3 Adults	school-age
514	3 Adults	school-age
515	3 Adults	school-age
516	3 Adults	school-age

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1471	1472	1473	1474	1475	1476	1477	1478	1479	1480	1481	1482	1483	1484	1485	1486	1487	1488	1489	1490	1491	1492	1493	1494	1495	1496	1497	1498	1499	1500	1501	1502	1503	1504	1505	1506	1507	1508	1509	1510	1511	1512	1513	1514	1515	1516	1517	1518	1519	1520	1521	1522	1523	1524	1525	1526	1527	1528	1529	1530	1531	1532	1533	1534	1535	1536	1537	1538	1539	1540	1541	1542	1543	1544	1545	1546	1547	1548	1549	1550	1551	1552	1553	1554	1555	1556	1557	1558	1559	1560	1561	1562	1563	1564	1565	1566	1567	1568	1569	1570	1571	1572	1573	1574	1575	1576	1577	1578	1579	1580	1581	1582	1583	1584	1585	1586	1587	1588	1589	1590	1591	1592	1593	1594	1595	1596	1597	1598	1599	1600	1601	1602	1603	1604	1605	1606	1607	1608	1609	1610	1611	1612	1613	1614	1615	1616	1617	1618	1619	1620	1621	1622	1623	1624	1625	1626	1627	1628	1629	1630	1631	1632	1633	1634	1635	1636	1637	1638	1639	1640	1641	1642	1643	1644	1645	1646	1647	1648	1649	1650	1651	1652	1653	1654	1655	1656	1657	1658	1659	1660	1661	1662	1663	1664	1665	1666	1667	1668	1669	1670	1671	1672	1673	1674	1675	1676	1677	1678	1679	1680	1681	1682	1683	1684	1685	1686	1687	1688	1689	1690	1691	1692	1693	1694	1695	1696	1697	1698	1699	1700	1701	1702	1703	1704	1705	1706	1707	1708	1709	1710	1711	1712	1713	1714	1715	1716	1717	1718	1719	1720	1721	1722	1723	1724	1725	1726	1727	1728	1729	1730	1731	1732	1733	1734	1735	1736	1737	1738	1739	1740	1741	1742	1743	1744	1745	1746	1747	1748	1749	1750	1751	1752	1753	1754	1755	1756	1757	1758	1759	1760	1761	1762	1763	1764	1765	1766	1767	1768	1769	1770	1771	1772	1773	1774	1775	1776	1777	1778	1779	1780	1781	1782	1783	1784	1785	1786	1787	1788	1789	1790	1791	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804	1805	1806	1807	1808	1809	1810	1811	1812	1813	1814	1815	1816	1817	1818	1819	1820	1821	1822	1823	1824	1825	1826	1827	1828	1829	1830	1831	1832	1833	1834	1835	1836	1837	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
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702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719
All other 9 adult + 4 child (average)	All other 9 adult + 5 child (average)	All other 9 adult + 6 child (average)	All other 9 adult + 7 child (average)	All other 9 adult + 8 child (average)	All other 9 adult + 9 child (average)	All other 10 adult 10 child families (average)	All other 10 adult 10 child families (average)	All other 10 adult + 1 child families (average)	All other 10 adult + 2 child families (average)	All other 10 adult + 3 child families (average)	All other 10 adult + 4 child families (average)	All other 10 adult + 5 child families (average)	All other 10 adult + 6 child families (average)	All other 10 adult + 7 child families (average)	All other 10 adult + 8 child families (average)	All other 10 adult + 9 child families (average)	All other 10 adult + 10 child families (average)
\$39.55	\$43.81	\$46.97	\$51.25	\$54.51	\$58.92	\$62.21	\$29.12	\$31.31	\$33.96	\$38.18	\$41.33	\$45.59	\$48.78	\$53.08	\$56.35	\$60.77	\$64.06
\$56.19	\$62.93	\$67.43	\$74.18	\$78.70	\$85.47	\$89.99	\$38.61	\$43.19	\$47.13	\$55.71	\$58.20	\$64.95	\$69.45	\$76.20	\$80.72	\$87.49	\$92.01
\$54.01	\$60.60	\$65.41	\$72.01	\$76.84	\$83.47	\$88.30	\$36.31	\$40.69	\$44.93	\$51.31	\$56.08	\$62.69	\$67.50	\$74.10	\$78.93	\$85.56	\$90.40
\$53.48	\$62.06	\$66.75	\$73.34	\$78.04	\$84.66	\$89.37	\$38.10	\$42.50	\$46.62	\$53.02	\$57.70	\$64.28	\$68.97	\$75.56	\$80.27	\$86.88	\$91.59
\$42.66	\$47.14	\$50.22	\$54.82	\$57.99	\$62.66	\$65.84	\$31.69	\$34.22	\$36.91	\$41.38	\$44.45	\$48.97	\$52.03	\$56.68	\$59.86	\$64.53	\$67.71
\$50.65	\$56.76	\$61.30	\$67.47	\$72.01	\$78.20	\$82.76	\$34.27	\$38.29	\$42.28	\$48.23	\$52.63	\$58.79	\$63.33	\$69.50	\$74.04	\$80.25	\$84.80
\$44.75	\$49.62	\$53.02	\$58.05	\$61.54	\$66.58	\$70.06	\$32.45	\$35.36	\$38.36	\$43.21	\$46.56	\$51.44	\$54.90	\$59.93	\$63.42	\$68.46	\$71.95
\$53.88	\$60.42	\$64.87	\$71.42	\$75.89	\$82.46	\$86.94	\$36.80	\$41.14	\$45.06	\$51.38	\$55.81	\$62.35	\$66.81	\$73.35	\$77.83	\$84.40	\$88.88
\$41.31	\$45.69	\$48.74	\$53.15	\$56.28	\$60.82	\$63.95	\$30.81	\$33.10	\$35.72	\$40.06	\$43.08	\$47.47	\$50.49	\$54.97	\$58.10	\$62.64	\$65.78
\$52.45	\$58.84	\$63.40	\$69.81	\$74.37	\$80.81	\$85.39	\$35.50	\$39.77	\$43.77	\$49.96	\$54.44	\$60.85	\$65.40	\$71.82	\$76.38	\$82.83	\$87.40
\$39.41	\$43.65	\$46.77	\$51.03	\$54.23	\$58.62	\$61.86	\$28.78	\$31.09	\$33.82	\$38.06	\$41.16	\$45.40	\$48.55	\$52.82	\$56.05	\$60.44	\$63.69
\$52.59	\$58.97	\$63.59	\$69.98	\$74.61	\$81.03	\$85.68	\$35.68	\$39.87	\$43.93	\$50.11	\$54.65	\$61.04	\$65.66	\$72.06	\$76.69	\$83.11	\$87.76
\$65.74	\$74.27	\$80.47	\$89.04	\$95.65	\$105.64	\$112.86	\$41.36	\$47.66	\$53.25	\$61.77	\$67.94	\$76.49	\$82.68	\$91.25	\$96.23	\$106.22	\$115.45
\$46.54	\$51.23	\$54.52	\$59.37	\$62.69	\$67.54	\$70.87	\$35.25	\$38.00	\$40.79	\$45.47	\$48.70	\$53.42	\$56.73	\$61.58	\$64.91	\$69.76	\$73.09
\$71.97	\$80.63	\$86.89	\$96.02	\$103.31	\$113.42	\$120.71	\$48.23	\$54.62	\$60.43	\$69.07	\$75.30	\$83.97	\$90.22	\$99.91	\$107.20	\$117.31	\$124.61
\$56.45	\$63.28	\$68.05	\$74.89	\$79.68	\$86.54	\$91.33	\$38.30	\$42.93	\$47.11	\$53.78	\$58.54	\$65.37	\$70.14	\$76.99	\$81.78	\$88.64	\$93.54
\$52.41	\$58.14	\$61.93	\$67.67	\$71.46	\$77.22	\$81.02	\$38.50	\$42.09	\$45.33	\$50.88	\$54.62	\$60.36	\$64.14	\$69.89	\$73.68	\$79.44	\$83.25
\$50.55	\$56.12	\$59.70	\$65.34	\$68.92	\$74.56	\$78.16	\$37.02	\$40.50	\$43.57	\$49.01	\$52.49	\$58.10	\$61.69	\$67.32	\$70.90	\$76.55	\$80.15
\$52.41	\$58.14	\$61.93	\$67.67	\$71.46	\$77.22	\$81.02	\$38.50	\$42.09	\$45.33	\$50.88	\$54.62	\$60.36	\$64.14	\$69.89	\$73.68	\$79.44	\$83.25
\$41.34	\$45.72	\$50.65	\$55.44	\$58.91	\$63.76	\$67.23	\$30.71	\$33.43	\$36.41	\$41.05	\$44.39	\$49.09	\$52.45	\$57.29	\$60.75	\$65.61	\$69.07
\$42.06	\$46.41	\$49.50	\$53.94	\$57.12	\$61.65	\$64.84	\$31.31	\$33.78	\$36.51	\$40.85	\$43.93	\$48.31	\$51.38	\$55.88	\$59.07	\$63.60	\$66.79
\$51.59	\$57.60	\$61.98	\$68.01	\$72.40	\$78.45	\$82.85	\$36.52	\$40.30	\$44.13	\$49.96	\$54.26	\$60.29	\$64.67	\$70.70	\$75.09	\$81.15	\$85.55

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[illegible]

*The Self-Sufficiency Standard for **#state #year***

Source: Center for Women's Welfare, University of Washington.

For more information see <http://www.selfsufficiencystandard.org/#state> or contact cwwss@uw.edu

ABOUT THIS WORKBOOK

This Excel file contains the Self-Sufficiency Standards for all counties and all family types in the state.

Note that there are several sheets of data.

The "By County" tab is an easy way to look at results at a County level for a variety of family types.

The "By Family" tab is set up for data analysis and loading into databases. Use the Filter function to select data by family type or just specific counties.

The Family Type column uses the the following naming convention:

a#i#p#s#t# where a=adult, i=infant, p=preschooler, s=school-age, t=teenager

For example, if you want to see results for a household with 2 adults, 1 preschooler, 1 school-age child in Example County:

1. Select the "Filter" function
2. Click on the Family Type column header
3. In the search box enter "a2i0p1s1t0"
4. Click the County column header
5. In the search box enter "Example"

The results will then be filtered for Example County for 2 adults, 1 preschooler, 1 school-age child.

The "SSS" tab provides only annual Self-Sufficiency Standards.

The "SSW" tab provides only hourly Self-Sufficiency Standard wages (assumes full time, year round work)