# Demand Side Management Study

## Rochester Public Utilities

**Demand Side Management**
**Project No. 112056**

**5/28/2019**

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prepared for

**Rochester Public Utilities**
**Demand Side Management**
**Rochester, Minnesota**

**Project No. 112056**

**5/28/2019**

prepared by

**Burns & McDonnell Engineering Company, Inc.**
**Kansas City, Missouri**

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## EXECUTIVE SUMMARY

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# LIST OF ABBREVIATIONS

| **Abbreviation** | **Term/Phrase/Name** |
|---|---|
| AC | Air Conditioning |
| AHRI | Air-Conditioning, Heating, and Refrigeration Institute |
| Burns & McDonnell | Burns & McDonnell Engineering, Inc. |
| DLC | Direct Load Control |
| DR | Demand Response |
| DSM | Demand Side Management |
| EE | Energy Efficiency |
| EV | Electric Vehicle |
| HVAC | Heating, Ventilation, and Air Conditioning |
| kW | Kilowatts |
| LED | Light-Emitting Diode |
| LGS | Large General Service |
| MER | Minimum Efficiency Requirements |
| MGS | Medium General Service |
| NEC | Neighborhood Energy Challenge |
| NPV | Net Present Value |
| O&M | Operation and Maintenance |
| PEV | Plug-in Electric Vehicles |
| RAP | Realistic Achievable Potential |
| RPU | Rochester Public Utilities |
| SGS | Small General Service |

| **Abbreviation** | **Term/Phrase/Name** |
|---|---|
| SMMPA | Southern Minnesota Municipal Power Agency |
| TOU | Time-of-Use |
| TRC | Total Resource Cost |

# 0.0 INTRODUCTION

Burns & McDonnell Engineering, Inc. (Burns & McDonnell) was retained by Rochester Public Utilities (RPU) to conduct a review of RPU's demand-side management (DSM) programs. This review includes both existing programs that RPU is currently offering to customers, and new programs that could add additional value to the utility. The areas of focus for this review include firm dispatchable load management, price responsive programs, and conservative education and outreach.

## 0.1 Existing Demand Side Management Programs

RPU has been engaged in DSM programs for nearly two decades and has experienced considerable peak demand reduction as a result of these efforts. DSM programs include both energy efficiency (EE) and demand response (DR) programs. EE refers to a reduction in the amount of energy required to deliver products and services to customers, and DR refers to a reduction in the demand curve that improves the reliability of the electric system. The goal of EE is to ultimately conserve energy, whereas DR is aimed at shifting load to off-peak time-periods, which can translate into cheaper electricity. The existing programs are described herein, with a more in-depth look and evaluation of the DR programs that RPU has implemented. These existing DR programs are available to both residential and commercial customers and are intended to reduce existing peak demand and avoid incremental peak demand going forward.

## 0.2 New Demand Response Programs

Burns & McDonnell focused on technologies that are expected to have the greatest potential to reduce the peak load on RPU's system. Burns & McDonnell utilized data generated by RPU to evaluate the selected firm dispatchable (DR) programs and their potential benefits on the system. Part of the analysis completed includes the evaluation of existing DR programs and how they could be improved to yield a higher level of peak demand reduction. With the potential of improving programs that are already in place, the utility would avoid some of the one-time costs associated with starting a new initiative while gaining additional benefits. Technologies for new programs were also considered and evaluated to include smart thermostats, electric vehicle (EV) load control devices, and battery storage.

In addition to programs associated with firm dispatchable load management, price responsive programs expected to have the greatest potential of reducing peak load were evaluated. Burns & McDonnell focused primarily on customer rebates, time-of-use (TOU) rates for the residential customers and residential EV customers, TOU rates for small commercial & large commercial classes, and rates associated with voluntary load curtailment for large commercial. Detailed rate design was not completed for the associated rate structures; however, general assumptions were used regarding these programs and their potential impact on RPU’s system load.

## 0.3 Conservative Education and Outreach

Burns & McDonnell also considered the marketing options and strategies RPU should consider in order to facilitate education and customer involvement for DSM and DR programs. Education and outreach programs can be an effective tool in increasing customer participation in utility DSM programs. The education and outreach programs Burns & McDonnell considered include bill inserts, general advertising, public town hall meetings, and energy dashboards. Burns & McDonnell would typically recommend consideration for peak reduction and conservation programs such as commercial and industrial lighting retrofits and Energy Star appliance upgrades through an Energy Audit Program, however, RPU is already engaged in many of these EE programs for its customers.

# 1.0 EXISTING ENERGY EFFICIENCY PROGRAMS

RPU currently offers a variety of programs to its customers to reduce system peak load and overall energy usage in Rochester. As part of RPU's EE programs, customers can receive energy audits and qualify for rebates when they buy new appliances that meet the Minimum Efficiency Requirements (MER). The utility also offers load management devices for air conditioning (AC) units and hot water heaters, as well as price responsive programs which contribute to RPU's efforts in DSM.

## 1.1 RPU Existing EE Programs

RPU has several EE programs that qualifying customers can apply for and receive rebates from. Conserve & Save® is one of the programs where RPU residential and commercial customers can upgrade appliances and equipment at their home or business and receive rebate incentives from the utility. Residential customers can also receive energy audits and can pay a monthly fee to be a part of a Service Assured Underground Utility Repair Coverage Program.

### 1.1.1 Residential Programs

The Conserve & Save® program for residential customers applies to households who purchase new appliances that are not reconditioned, refurbished, or second-hand equipment and which meet the MER determined by Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and ENERGY STAR® standards. Appliances that residential customers can replace in their homes and receive rebates for are listed in the Conserve & Save® 2019 Electric Efficiency Rebate Application. These appliances include a clothes dryer, clothes washer, dehumidifier, dishwasher, freezer, refrigerator, and room air conditioners. Every product must be either ENERGY STAR® or ENERGY STAR Most Efficient®, as specified in the application. Additional rebates are given for proper recycling of old appliances if a receipt is provided to the utility.

In addition to new home appliances that customers can receive rebates for, they can also get money back for installing new heating, ventilation, and air conditioning (HVAC) systems. Rebates are offered for central air conditioners & ductless mini-split systems, furnace fan motors and new furnace installation, furnace fan motor replacements, and air or ground source heat pumps. Detailed requirements for HVAC equipment are included in the application mentioned above. Table 1-1 presents the detailed rebates available for residential customers for new appliances and equipment purchased and installed.

Several other components of the Conserve & Save® program include rebates for customers who have their AC unit cleaned and tuned, replacement of inefficient lightbulbs with light-emitting diode (LED) lighting, the purchase of energy efficient holiday lights or decorations, and rebates for the installation of solar panels on a home or small business. This solar rebate program provides a one-time payment of $0.50 per installed watt for solar electric systems between 0.5 kilowatts (kW) and 10 kW. This is available in combination with the federal tax credit of 30 percent for solar technologies.

**Table 1-1: RPU Conserve & Save® Residential Rebate Program**

| Energy Star Appliance Rebates* | Amount |
|---|---|
| Clothes Washers | $50-$100 |
| Dehumidifiers | $15-$25 |
| Dishwashers | $25-$40 |
| Freezers | $25 |
| Refrigerators | $25 |
| Room Air Conditioners | $25 |
| **Bonus Recycling Rebates*** | **Amount** |
| Dehumidifiers | up to $15 |
| Freezers | up to $15 |
| Refrigerators | up to $15 |
| Room Air Conditioners | up to $15 |

| ENERGY STAR® LED Lighting Rebates* | Amount |
|---|---|
| LED Bulbs | 50% of bulb or package cost, not to exceed $7 per bulb |
| LED Light Fixtures | 50% of bulb or package cost, not to exceed $20 per fixture |
| Ceiling fans with LED Lighting | 50% of fixture cost, not to exceed $15 per fixture ($25 for ENERGY STAR® Most Efficient models) |

| Additional Electric Rebates* | Amount |
|---|---|
| Central Air Conditioners | Starting at $100 |
| Furnace Fan Motors | $50 |
| Air Source Heat Pumps | Starting at $100 |
| Geothermal Heat Pumps | $50 |

| Water Rebates* | Amount |
|---|---|
| Clothes Washer | $25 |
| High-Efficiency Toilets | $25 |
| Rain Barrels | $10 |
| Weather-Based Irrigation Controllers | $75 |

* For all of the above rebates, see applications for minimum efficiency requirements and complete terms and conditions.

RPU has also teamed up with Minnesota Energy Resources and the Center for Energy and Environment to offer Rochester residential homeowners the Neighborhood Energy Challenge (NEC), an energy audit program. The Neighborhood Energy Challenge includes a free energy workshop offering strategies for energy conservation; a home visit from an energy professional to run various tests, install energy-saving materials, and provide ways for reducing utility bills; and help in connecting homeowners with qualified individuals for next steps in additional energy saving opportunities. With exception to the free energy workshop, the home visit and materials are a one-time fee of $50 for those interested in participating.

### 1.1.2 Commercial Programs

RPU Commercial customers go through a similar process as residential customers for the Conserve & Save® Program with established requirements to meet, but for commercial-grade appliances and equipment. Upgraded equipment eligible for rebates are included in Table 1-2 and are intended to decrease energy usage, save customers money, and recognize businesses as environmentally conscious. Included in this program for commercial customers are rebates for having an energy audit or engineering study done. This audit or study is intended to help the customer identify potential opportunities for installing new equipment to reduce energy usage, offering guidance to a customer on what changes and/or upgrades could be most beneficial.

**Table 1-2: RPU Conserve & Save® Commercial Rebate Program Applications**

| 2019 Conserve & Save Rebate Applications |
|---|
| Anti-Sweat Heater Controls |
| Compressed Air Leak Equipment |
| Compressed Air Leak Correction |
| Cooling Equipment |
| Custom Efficiency |
| Electric Efficiency Appliances and Equipment |
| Energy Audit |
| Food Service |
| Guest Room Energy Management |
| Heat Pumps |
| Lighting |
| Motors |
| Variable Speed Drives |
| Solar Rebates |
| Water Efficiency Appliances and Equipment |

### 1.1.3 Historical Costs and Savings of Energy Efficiency Programs

For nearly two decades RPU and its power supplier SMMPA have been involved in customer engagement through EE programs to reduce energy consumption and peak demand. The programs were discussed in brief in the previous sections and target both the residential and commercial customer classes. Table 1-3 shows the total energy and demand savings from RPU's EE programs on an annual and cumulative basis, and the capital dollars spent to implement these programs. While Burns & McDonnell did not conduct a quantitative assessment of SMMPA and RPU's EE programs within this study, we recommend that RPU continue to implement the EE programs with SMMPA in accordance with its state mandates and legal requirements.

**Table 1-3: Demand (kW) and Energy (kWh) Saved from EE Programs**

| Year | Total kW Savings | Cumulative kW Savings | Total kWh Savings | Cumulative kWh Savings | Total CIP Dollars Spent | CIP Dollars Spent ($/kW) | CIP Dollars Spent ($/kWh) |
|---|---|---|---|---|---|---|---|
| 2002 | 4,743 | 4,743 | 7,562,201 | 7,562,201 | $ 1,115,327 | $ 235.15 | $ 0.1475 |
| 2003 | 5,956 | 10,699 | 7,859,697 | 15,421,898 | $ 1,327,321 | $ 222.84 | $ 0.1689 |
| 2004 | 7,189 | 17,888 | 9,827,569 | 25,249,467 | $ 1,167,760 | $ 162.44 | $ 0.1188 |
| 2005 | 4,399 | 22,287 | 7,743,700 | 32,993,167 | $ 1,213,517 | $ 275.89 | $ 0.1567 |
| 2006 | 2,210 | 24,497 | 10,417,072 | 43,410,239 | $ 1,377,074 | $ 623.00 | $ 0.1322 |
| 2007 | 4,440 | 28,938 | 15,819,295 | 59,229,534 | $ 1,995,606 | $ 449.43 | $ 0.1262 |
| 2008 | 4,332 | 33,270 | 13,665,636 | 72,895,170 | $ 1,698,407 | $ 392.03 | $ 0.1243 |
| 2009 | 5,125 | 38,395 | 16,994,220 | 89,889,390 | $ 2,303,375 | $ 449.45 | $ 0.1355 |
| 2010 | 5,339 | 43,734 | 19,126,719 | 109,016,109 | $ 3,088,665 | $ 578.51 | $ 0.1615 |
| 2011 | 4,865 | 48,599 | 20,420,120 | 129,436,229 | $ 2,908,226 | $ 597.77 | $ 0.1424 |
| 2012 | 3,735 | 52,334 | 23,248,077 | 152,684,306 | $ 3,249,817 | $ 855.68 | $ 0.1455 |
| 2013 | 4,418 | 56,752 | 29,842,896 | 182,527,202 | $ 2,491,109 | $ 563.91 | $ 0.0900 |
| 2014 | 3,670 | 60,421 | 22,102,056 | 204,629,258 | $ 2,424,762 | $ 660.79 | $ 0.1097 |
| 2015 | 2,541 | 62,962 | 19,082,072 | 223,711,330 | $ 2,679,250 | $ 1,054.53 | $ 0.1400 |
| 2016 | 3,098 | 66,060 | 24,852,024 | 248,563,355 | $ 2,867,278 | $ 925.66 | $ 0.1154 |
| 2017 | 3,886 | 69,946 | 28,233,263 | 276,796,618 | $ 3,306,510 | $ 850.92 | $ 0.1200 |
| 2018 | 3,067 | 73,013 | 21,409,935 | 298,206,553 | $ 2,513,811 | $ 819.62 | $ 0.1174 |

** Note: Data from RPU as of December 26, 2018. Conservation Improvement Plan (CIP).*

Figure 1-1 and Figure 1-2 illustrate RPU's historical energy and demand savings, showing a relatively flat load since the early 2000's, with minimal spikes and dips throughout the period. This would indicate the EE programs implemented by RPU have been effective in reducing energy use and peak demand, despite typical customer growth. The blue line on each graph shows RPU's actual energy and peak demand since 2002, and the gray lines shows what RPU's energy and demand likely would have been without savings from EE programs. Assuming RPU and SMMPA continue to administer and fund these EE programs, as required by the State of Minnesota, Burns & McDonnell expects that RPU will continue to see participation in these programs which will offset new customer peak load growth.

**Figure 1-1: RPU Historical Energy Requirements (kWh)**

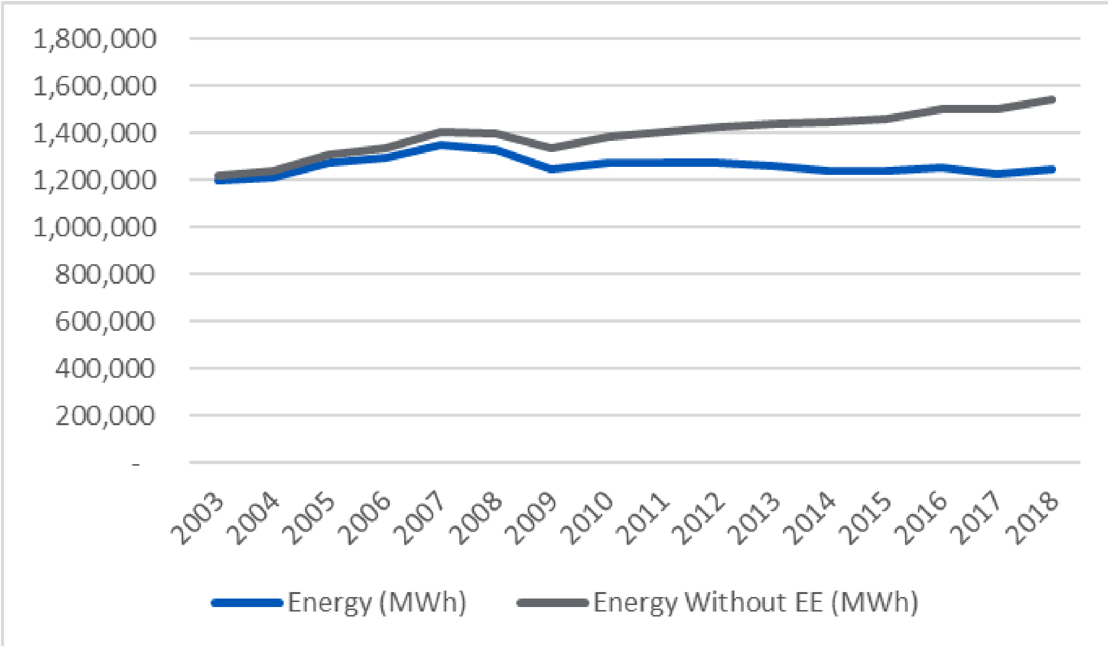
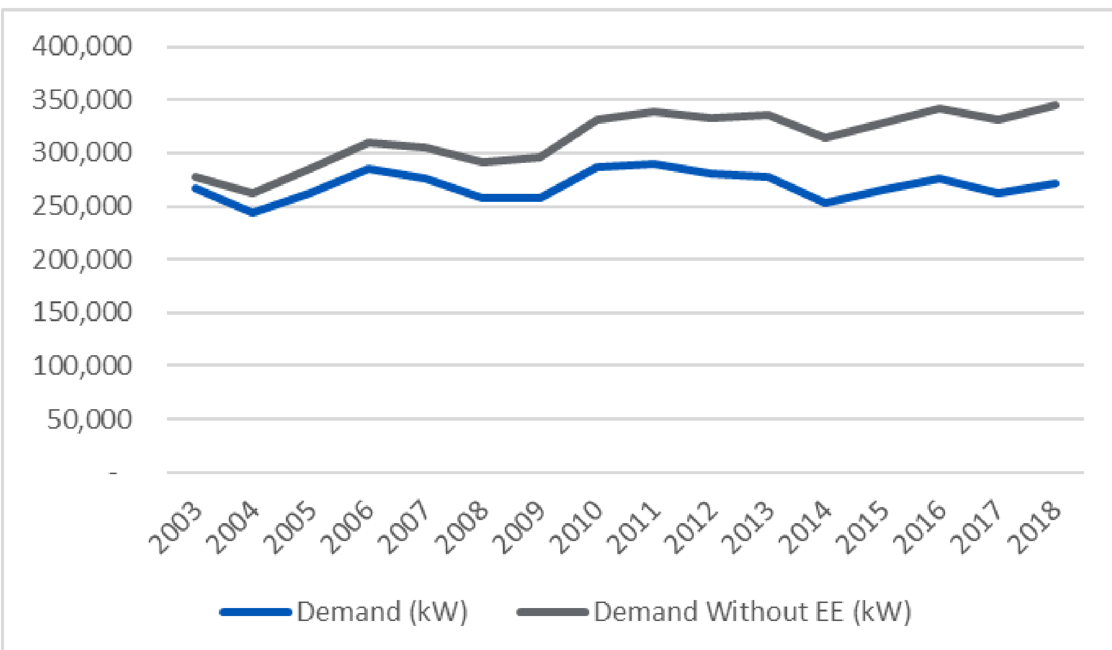



**Figure 1-2: RPU Historical Demand Requirements (kW)**



# 2.0 EVALUATION OF EXISTING DEMAND RESPONSE PROGRAMS

## 2.1 Existing Demand Response Programs

RPU currently has several DR programs in place for its Residential, Small General Service (SGS), Medium General Service (MGS), and Large General Service (LGS) classes to help with peak load reduction. These programs include direct load control (DLC) switches for AC units and hot water heaters, an interruptible rate for industrial customers (which are within the MGS and LGS classes), and TOU rates for SGS and MGS commercial customers. Table 2-1 presents these programs by class with their existing realistic achievable potential (RAP) of customer participation and the existing RAP peak demand reduction. For purposes of this report, RAP is the most reasonable result to be expected at full program adoption, which is typically based off results from comparable DSM programs at other utilities. Each of these programs were evaluated to consider customer participation, peak demand reduction, program benefits, program costs and the net impact this has on the utility. Following an evaluation of the existing programs are a series of new potential DSM programs for the utility to consider.

**Table 2-1: Existing DSM Programs**

| CUSTOMER CLASS | PROGRAM | CUSTOMER PARTICIPATION | ESTIMATED PEAK REDUCTION (KW) |
|---|---|---|---|
| Residential | Direct Load Control Air Conditioning | 15.2% | 2,277 |
| Residential | Direct Load Control Hot Water Heating | 1.2% | 448 |
| | | | |
| Small General Service | Direct Load Control Air Conditioning | 1.7% | 23 |
| Small General Service | Direct Load Control Hot Water Heating | 0.6% | 19 |
| Small General Service | Time-Of-Use (opt-in) | 0.0% | - |
| | | | |
| Medium & Large General Service | Interruptible Rate | 2.2% | 6,000 |
| Medium General Service | Time-Of-Use (opt-in) | 11.7% | 466 |
| | | | |
| Total | | | 9,233 |

## 2.2 RPU Demand Response Benefits and Costs

For these programs to provide financial value to RPU, the utility's benefits must outweigh the total costs of each program. Other external and social factors might influence RPU's decision to keep an existing program or implement a new one, but for purposes of this analysis these programs were evaluated on a total resource cost (TRC) test basis.

Benefits associated with each program come from a reduction to the utility's overall peak load, which translates into avoided capacity costs for RPU. These avoided capacity costs are assumed to be equal to \$48/kW-year as provided to Burns & McDonnell by RPU. \$48 per kW is applied to the estimated peak demand savings from peak reduction to give a total benefit on an annual basis. Additional energy savings benefits are included for EV and battery energy storage DR programs that result from customer load shifting from on-peak to off-peak hours. Subsequent to calculating annual benefits, annual costs were developed. The costs included program development costs, cost to administering the program, marketing and recruitment costs, equipment and installation cost, operation and maintenance (O&M) cost, and participant incentives.

The net benefit (cost) was calculated on an annual basis, along with the net present value (NPV) cash flow for the entire program. The NPV of the benefits and costs were used in the TRC test by dividing the NPV benefits by the NPV costs. This calculates a ratio that is below, equal to or above 1.0. If the TRC is less than 1.0, this indicates that from an economic perspective the program would not be a good investment for the utility. If the TRC is equal to 1.0, this indicates the program benefits and costs are equal; meaning the utility would be paying the same amount to implement the program as it would receive in benefits. This is also referred to as the break-even point. If the TRC is above 1.0, this indicates the program would provide more benefit to the utility than it would cost. Ideally, only programs that produce a TRC that is equal to or greater than one would be implemented. It is also important to recognized that as more refined assumptions and vendor costs became available, the results of the TRC would also change and would provide RPU with a more accurate view of each program's economics.

### 2.2.1 Existing Direct Load Control Air Conditioning and Hot Water Heating

DLC switches allow RPU and its customers to reduce peak demand and overall utility costs. Load switches use technology to support communications between the utility and homes or businesses to regulate the amount of load on RPU's system. At times of high energy use, the utility can communicate to DLC switches and turn power off to a load or appliance to reduce a customer's energy demand. A reduction in customer energy helps reduce the utility's overall demand and in turn helps reduce costs by requiring the utility to purchase less capacity. These switches can be installed on various equipment such as AC units or hot water heaters at residential homes and small businesses. The customers benefit from a 15 to 36-dollar incentive given to every participant on an annual basis by RPU. An estimate of current customer participation, program benefits and program costs are summarized in Table 2-2 and Table 2-4 for DLC switches on AC units and hot water heaters, respectively.

**Table 2-2: Existing DLC AC Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 |
| Estimated RAP - Customer Participation Rate | % | 15.18% | 1.69% |
| Total Program Participating Customers | Customers | 7,589 | 76 |
| Peak Demand Reduction per Customer | kW/Customer | 0.30 | 0.30 |
| Estimated RAP Peak Reduction | kW | 2,277 | 23 |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | $48 |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $0 | $0 |
| Program Administration Costs (Recurring) | $/kW | $5 | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $0 | $0 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | $250 |
| Annual O&M Cost | Failure Rate (%) | 2.0% | 2.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $15 | $15 |

**Table 2-3: Existing DLC Hot Water Heating Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 |
| Estimated RAP - Customer Participation Rate | % | 1.24% | 0.60% |
| Total Program Participating Customers | Customers | 620 | 27 |
| Peak Demand Reduction per Customer | kW/Customer | 0.72 | 0.72 |
| Estimated RAP Peak Reduction | kW | 446 | 19 |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | $48 |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $0 | $0 |
| Program Administration Costs (Recurring) | $/kW | $5 | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $0 | $0 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | $250 |
| Annual O&M Cost | Failure Rate (%) | 2.0% | 2.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $36 | $36 |

### 2.2.2 Existing Commercial Interruptible Service Rate Program

RPU has an interruptible service program available to commercial customers where customers who select this rate agree with RPU to reduce their load when the utility deems necessary. Customers have onsite generators that are used to reduce their load, or they shut off designated equipment during this time. Customers are given a two-hour notice and can be called on up to 35 times per year for a total interruption time of 175 hours annually. In return for this service to the utility, customers receive a lower demand charge on their interrupted load. There are currently ten (10) customers in the program, or 2.2 percent of the MGS and LGS class, all of which who joined prior to early 2011 as this rate has since been closed to anyone new. Total peak demand reduction realized by RPU on an annual basis is approximately 6.6 MW. An estimate of current customer participation, program benefits and costs are summarized in Table 2-4.

**Table 2-4: Existing Commercial Interruptible Service Rate Program Assumptions**

| PROGRAM ASSUMPTIONS: | | MGS & LGS |
|---|---|---|
| Customer Participation: | | |
| Total Program Potential Customers | Customers | 453 |
| Estimated RAP - Customer Participation Rate | % | 2.21% |
| Total Program Participating Customers | Customers | 10 |
| Peak Demand Reduction per Customer | kW/Customer | 600.00 |
| Estimated RAP Peak Reduction | kW | 6,000 |
| | | |
| Program Benefits: | | |
| Peak Demand Reduction Savings | $/kW-year | $107 |
| | | |
| Program Costs: | | |
| Program Development Costs (One-Time) | $/program | $0 |
| Program Administration Costs (Recurring) | $/kW | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 |
| Cost of Equip. & Install (One-Time) | $/new participant | $120 |
| Annual O&M Cost | Failure Rate (%) | 0.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $72,000 |

### 2.2.3 Existing Commercial Time of Use Rates

TOU rates are intended to incentivize customers to shift part of their load to off-peak time periods to reduce RPUs overall load during peak hours and provide the customer a financial benefit. The TOU rates are offered to RPU SGS and MGS customers with a peak time between the hours of 10 AM and 10 PM, Monday thru Friday. The peak hours were originally selected because they corresponded with the peak hours of RPU's wholesale supplier, Southern Minnesota Municipal Power Agency (SMMPA). 53 MGS customers are on this rate which primarily consisting of schools, convenient stores and churches; while zero SGS customers have opted for this rate. Since zero SGS customers are on this TOU rate, the results were summarized in Table 2-5 for the MGS customers.

**Table 2-5: Existing Commercial TOU Opt-In Program Assumptions**

| PROGRAM ASSUMPTIONS: | | MGS |
|---|---|---|
| Customer Participation: | | |
| Total Program Potential Customers | Customers | 453 |
| Estimated RAP - Customer Participation Rate | % | 11.70% |
| Total Program Participating Customers | Customers | 53 |
| Peak Demand Reduction per Customer | kW/Customer | 8.80 |
| Estimated RAP Peak Reduction | kW | 466 |
| | | |
| Program Benefits: | | |
| Peak Demand Reduction Savings | $/kW-year | $48 |
| | | |
| Program Costs: | | |
| Program Development Costs (One-Time) | $/program | $0 |
| Program Administration Costs (Recurring) | $/kW | $0 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 |
| Annual O&M Cost | Failure Rate (%) | 0.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $491 |

### 2.2.4 Existing Demand Response Program Summary

The tables preceding this section summarize specific assumptions regarding customer participation and program benefits and program costs. Table 2-6 shows the existing programs that RPU is currently administering and the impact they are having on the utility when evaluating the net benefit (cost) of each program. As previously discussed, each program has associated benefits and costs that were calculated on an annual proforma basis. The NPV of the annual benefits and the NPV of the annual costs were calculated to get to a total NPV for each program (or a net result). The benefit NPV was then divided by the cost NPV to calculate the TRC of each program. These results can be seen in Table 2-6. Any program that has a TRC less than 1.0 is seen as costing the utility more than it is receiving in benefits. Aside from external and social factors that might influence RPU's decision, any program with a TRC less than 1.0 should not be continued. Results would indicate that the TOU pricing program for MGS customers is the only program being administered that should be continued in its current form. As an alternative to ending several of the current programs, Burns & McDonnell evaluated the potential for making changes that would result in a net benefit for RPU. These new programs are discussed in Section 4.0 of this report.

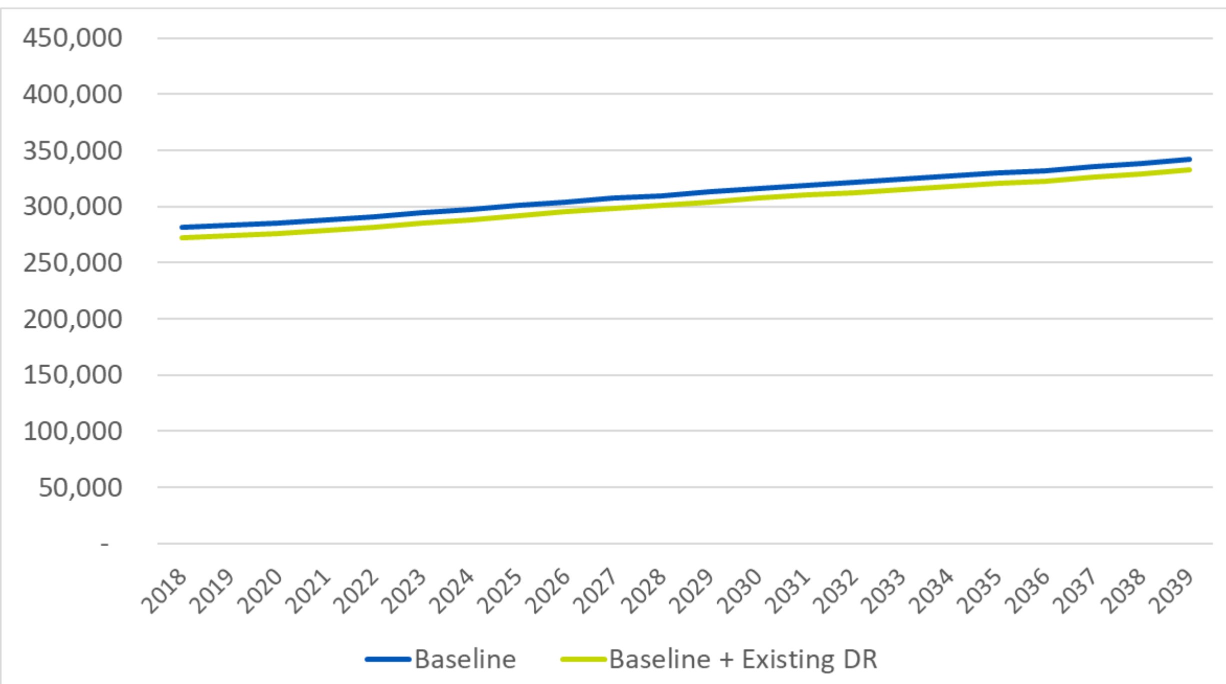
**Table 2-6: Demand Response Program Summary**

| CUSTOMER CLASS | PROGRAM | Program Benefit NPV | Program Cost NPV | Program Total NPV | Total Resource Cost (TRC) Test |
|---|---|---|---|---|---|
| Residential | Direct Load Control Air Conditioning | $ 1,369,249 | $ 1,693,581 | $ (324,332) | 0.81 |
| Residential | Direct Load Control Hot Water Heating | $ 268,473 | $ 287,018 | $ (18,545) | 0.94 |
| | | | | | |
| SGS | Direct Load Control Air Conditioning | $ 13,712 | $ 16,960 | $ (3,248) | 0.81 |
| SGS | Direct Load Control Hot Water Heating | $ 11,692 | $ 12,789 | $ (1,098) | 0.91 |
| SGS | Time-Of-Use (opt-in) | $ 5,987 | $ 170,838 | $ (164,851) | 0.04 |
| | | | | | |
| MGS & LGS | Interruptible Rate | $ 8,065,022 | $ 9,332,667 | $ (1,267,645) | 0.86 |
| MGS | Time-Of-Use (opt-in) | $ 280,502 | $ 269,868 | $ 10,634 | 1.04 |

## 2.3 Existing Demand Response Programs & Load Forecast

Under the existing DSM programs, RPU should continue seeing peak demand reductions that are consistent with historical trends. A projection of these trends is shown in Table 2-1. The blue line represents RPU's peak load forecast from SMMPA and the green line represents RPU's peak load forecast with incorporating the peak reduction of 9,233 kW produced from existing DSM programs. If the existing DSM programs are left unchanged and no additional programs are added, RPU is likely to see no further reductions from DSM.

**Figure 2-1: RPU Peak Load Forecast (kW)**



# 3.0 EVALUATION OF NEW DEMAND RESPONSE PROGRAMS

## 3.1 New Demand Response Program Evaluation

Burns & McDonnell evaluated the existing DR programs at RPU and the potential of new DR programs for the utility to consider. These evaluations included making changes to the AC and hot water DR programs, offering DLC smart thermostats and DLC EV chargers to homes and small businesses, creating a TOU pricing program for residential customers, providing battery energy storage behind the meter, and changing incentives related to the commercial interruptible rate. A summary of these programs considered in the assessment are shown in Table 3-1 by customer class. Each program was evaluated individually accounting for the costs and benefits associated with starting and administering the program. A TRC test was done to calculate the net cost of each program to determine if the program would be beneficial to the utility and to ratepayers. A more in-depth look of this analysis is discussed in the following sections.

**Table 3-1: New Demand Response Programs Evaluated**

| CUSTOMER CLASS | PROGRAM | *EST. 5-YR RAP (CUSTOMERS) | *EST. RAP PEAK REDUCTION (KW) |
|---|---|---|---|
| Residential | Direct Load Control Air Conditioning | 15.2% | 9,562 |
| Residential | Direct Load Control Hot Water Heating | 1.2% | 446 |
| Residential | DLC Smart Thermostats | 10.0% | 6,300 |
| Residential | DLC Electric Vehicle Charging | 50.0% | 2,499 |
| Residential | Time-of-Use (EV) | 50.0% | 2,499 |
| Residential | Time-of-Use (opt-in) | 28.0% | 9,800 |
| Residential | Battery Energy Storage | 1.0% | 2,500 |
| | | | |
| Small General Service | Direct Load Control Air Conditioning | 1.7% | 115 |
| Small General Service | Direct Load Control Hot Water Heating | 0.6% | 19 |
| Small General Service | DLC Smart Thermostats | 5.0% | 2,378 |
| Small General Service | Battery Energy Storage | 1.0% | 1,575 |
| | | | |
| Medium & Large General Service | Interruptible Rate | 45.0% | 8,505 |
| Medium & Large General Service | Battery Energy Storage | 1.0% | 375 |
| | | | |
| Total | | | 46,575 |

*Estimated 5-Year Realistic Achievable Potential of Customer Participation & Estimated Realistic Achievable Potential of Peak Demand Reduction (kW)

## 3.2 New AC Load Management

RPU has DLC switches on AC units for residential and small commercial customers to manage energy usage, reduce peak demand and reduce overall utility and customer costs. These load switches are supported by technology that communicate between the utility and homes or businesses to regulate the amount of load on RPU's system. The current program in place is not highly promoted and the equipment installed and software for the control is aging and becoming dated. As presented in Table 2-6, the current

DLC AC program has a TRC below 1.0. Burns & McDonnell evaluated the effects of this program under the assumption that the technology is replaced within a one-year timeframe for every customer that had an existing device installed at their home or business. It was assumed no new customers would join the program and the new technology would increase peak demand savings per customer annually, from 0.30 kW for both Residential and SGS to 1.26 kW and 1.51 kW, respectively. This translates to an increase in demand savings for the utility. Under this new version of the AC load control program, the potential increase in demand savings could lead to a greater benefit to RPU, with a TRC ratio of 1.46 which is above the break-even TRC of 1.0. Table 3-2 provides a list of assumptions used for this program, and Table 3-10 presents the NPV costs, NPV benefits, and TRC results.

**Table 3-2: New DLC AC Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 |
| Estimated RAP - Customer Participation Rate | % | 15.18% | 1.69% |
| Total Program Participating Customers | Customers | 7,589 | 76 |
| Peak Demand Reduction per Customer | kW/Customer | 1.26 | 1.51 |
| Estimated RAP Peak Reduction | kW | 9,562 | 115 |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | $48 |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | $5,000 |
| Program Administration Costs (Recurring) | $/kW | $5 | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $0 | $0 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | $250 |
| Annual O&M Cost | Failure Rate (%) | 2.0% | 2.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $15 | $15 |

## 3.3 New Hot Water Load Management

In addition to the DLC switches installed on AC units, RPU installed switches on hot water heaters for residential and small commercial customers who opted into the program. The technology enables communication between the devices and the utility to manage load on RPU’s system, when necessary. Currently, peak demand savings per customer from DLC on hot water heaters is 0.72 kW annually for both the Residential and SGS class. Similar to the DLC technology on AC units, these devices are also outdated and likely obsolete, however, the potential for updating the switches for additional peak demand reduction is different. Other utilities in the industry see peak reductions similar to 0.72 kW per year for load control of hot water heaters, and some see even less than that. Keeping the program as it stands today gives a TRC ratio of 0.94, assuming no costs are added to the existing on-going costs of the program.

Data provided does not support the solution of installing more advanced DLC technology on hot water heaters to bring greater peak demand savings to the utility. Since upgrading DLC switch technology wouldn't increase demand savings for RPU, installing new technology would simply increase cost with no increase in benefit. This would result in a TRC ratio of 0.56 which is well below the break-even point of 1.0 and below the TRC of the existing program of 0.94. This indicates that both the existing program and a new program would costs the utility more than it would receive in benefits, and from an economic position, should not be continued or pursued. Table 3-3 provides a list of assumptions used for this program, and Table 3-10 shows the NPV benefits, NPV costs, and TRC results.

**Table 3-3: New DLC Hot Water Heating Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 |
| Estimated RAP - Customer Participation Rate | % | 1.24% | 0.60% |
| Total Program Participating Customers | Customers | 620 | 27 |
| Peak Demand Reduction per Customer | kW/Customer | 0.72 | 0.72 |
| Estimated RAP Peak Reduction | kW | 446 | 19 |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | $48 |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | $5,000 |
| Program Administration Costs (Recurring) | $/kW | $5 | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $0 | $0 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | $250 |
| Annual O&M Cost | Failure Rate (%) | 2.0% | 2.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $36 | $36 |

## 3.4 Direct Load Control Smart Thermostats

DLC for smart thermostats work similar to the previously discussed switches for AC units and hot water heaters. Smart thermostats have additional capabilities, though, where customers can remotely control their home or business temperature over an internet connection, or they can give control to the utility for these adjustments. Often, the thermostats have an eco-friendly setting where the thermostat automatically adjusts the temperature depending on occupants that it senses at the home or business, and the utility can apply pre-set temperature settings for different times during the day. If the customer allows the utility to control their temperature during certain times of the day, the customer benefits from a lower energy bill from reduced usage, and the utility benefits from reduced peak demand.

Currently, RPU does not have a program in place for installing smart thermostats at residential homes or small commercial businesses, but as benefits have been favorable for many other utilities and customers the same potential impact could result for RPU as well. Program assumptions are summarized in Table 3-4 and were developed from proxy data and studies done at other utilities. It is recommended that RPU receive bids from various vendors to know the specific costs that would pertain to RPUs system. Under these assumptions a TRC of 1.39 was calculated and is provided in Table 3-10, along with the resulting program NPV benefits and costs.

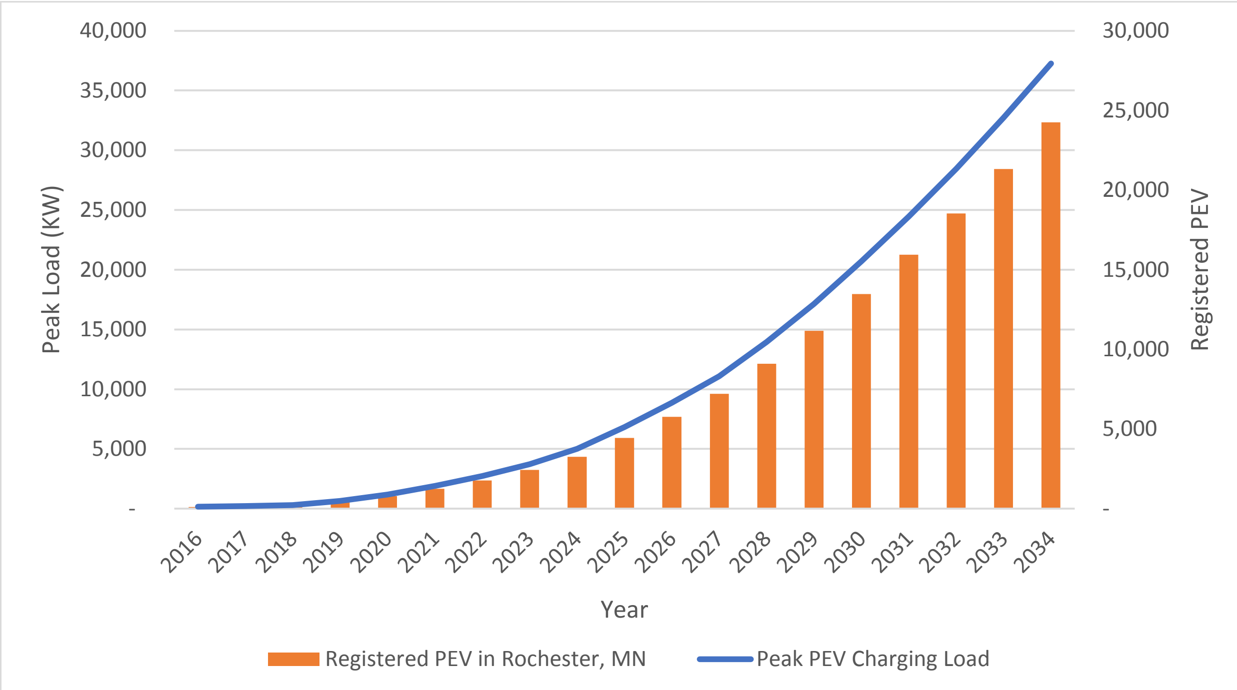
**Table 3-4: New DLC Smart Thermostat Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 |
| Estimated RAP - Customer Participation Rate | % | 10.00% | 5.00% |
| Total Program Participating Customers | Customers | 5,000 | 225 |
| Peak Demand Reduction per Customer | kW/Customer | 1.26 | 1.51 |
| Estimated RAP Peak Reduction | kW | 6,300 | 340 |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | $48 |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | $5,000 |
| Program Administration Costs (Recurring) | $/kW | $5 | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 | $45 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | $250 |
| Annual O&M Cost | Failure Rate (%) | 0.0% | 0.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $15 | $15 |

## 3.5 Direct Load Control Electric Vehicle Charging

As more consumers are purchasing EV’s, utility companies are becoming more involved in planning for the increase in electric load that this places on the system. With the expectation that these vehicles will increase significantly in the coming years, RPU directed Burns & McDonnell to generate an EV load forecast to project expected plug-in electric vehicles (PEV) and peak load demand on RPU’s system. Figure 3-1 shows this forecast and the potential of adding nearly 35,000 kW over the next fifteen (15) years. The tendency for a typical Residential customer with an EV is to plug in their vehicle in the late afternoon or early evening time-frame after getting home from work. This is happening at the same time as Residential customers are getting home, turning on lights, using various household appliances, and increasing their energy consumption in general. As the load begins to ramp up in the early evening, adding load on the system from EVs could be problematic if RPU is not proactive in finding ways to reduce or shift some of the load to different times of the day.

**Figure 3-1: Registered PEV and Peak Load (kW) Forecast**




Similar to the DLC programs available for AC units and hot water heaters, RPU could implement a program available for Residential home EV charging. These devices would be connected to the home charging station at a customer's residence and the utility would control when the EV could be charged. RPU could turn off charging capabilities during peak hours to prevent large demand spikes in the late afternoon or evening when many customers get home from work and plug in their vehicle. The control would switch "on" the device in the late evening through early morning to allow the vehicle to charge when the rest of the system's load has reduced. Customers enrolled in this program could receive an incentive of 200 to 300 dollars annually (or some dollar amount set by RPU) for giving the utility this control, and RPU would benefit from reduced load on the system. It was assumed there would be $48/kW-year in peak demand savings from avoided capacity and roughly $0.015/kW-year savings from load shifting. It is assumed that 50 percent of all EV customers would participate in this program. The remaining 50% of customers are assumed to participate in the EV TOU pricing program, which is discussed in section 4.7. Assuming that customers receive $270 in annual incentives, the program's TRC ratio is 1.20. This is above the break-even point of 1.0 that is required for the program to be economically beneficial to the utility. Table 3-5 provides the full list of assumptions used for this program, and Table 3-10 shows the NPV benefit, NPV cost, and TRC results.

**Table 3-5: New DLC EV Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 3,254 | N/A |
| Estimated RAP - Customer Participation Rate | % | 50.00% | N/A |
| Total Program Participating Customers | Customers | 1,627 | N/A |
| Peak Demand Reduction per Customer | kW/Customer | 1.54 | N/A |
| Estimated RAP Peak Reduction | kW | 2,499 | N/A |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | N/A |
| RPU Market Energy Savings from Load Shifting | $/kWh | $0.0150 | N/A |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | N/A |
| Program Administration Costs (Recurring) | $/kW | $5 | N/A |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 | N/A |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | N/A |
| Annual O&M Cost | Failure Rate (%) | 2.0% | N/A |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $270 | N/A |

## 3.6 Residential TOU Pricing Programs

Residential TOU rates are intended to efficiently incentivize customers to shift part of their load to off-peak time periods to reduce RPUs overall load during peak hours. TOU rates, if designed well, can provide a rate that reflects a utility’s costs and generates peak demand reduction. The utility currently has TOU pricing for SGS and MGS customers but does not have the metering infrastructure to implement a TOU rate for all Residential customers. If metering infrastructure were in place, RPU could create a TOU rate for the Residential class to potentially reduce customers’ costs and shift peak demand to off-peak hours. For this to be effective price differentials from the on-peak to off-peak time periods need to be considerably high to see a change in customer behavior and load shifting. A general price relation from on-peak to off-peak rates should be roughly 3:1 at a minimum; where the on-peak rate is about three times higher than the off-peak rate. The on-peak time periods should also be short enough for customers to feel as though they can realistically make behavior changes. This would indicate that a twelve (12) hour on-peak time-period will not produce results the utility desires because there are few customers who could (or would) reduce their usage for that long of a time period. However, if for example, the on-peak time periods were for two (2) hours in the morning and three (3) to four (4) hours in the late afternoon, customers have been shown to be willing to increase the temperature setting on their AC during this time and run their appliances at various other times throughout the day generating peak reductions up to 10 percent.

A robust and targeted marketing campaign directed at educating ratepayers is also imperative to see sufficient customer adoption from the TOU rates. As with any optional TOU rate design, there will be customers who become instant “winners” by switching to the rate, not changing any of their usage behaviors, and seeing a reduction in their bill from the TOU rate. As long as this rate is developed to be revenue neutral to existing rates, the loss in revenue from some customers will be made up in additional revenues from others. The exact rates for the TOU pricing structure were not analyzed, however, general assumptions were made with the above principles taken into consideration. Poorly designed TOU rates and an ineffective marketing campaign could significantly change the assumptions and results shown in Table 3-6 and Table 3-10, respectively.

**Table 3-6: New Residential TOU Pricing Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 |
| Estimated RAP - Customer Participation Rate | % | 28.00% | 13.00% |
| Total Program Participating Customers | Customers | 14,000 | 585 |
| Peak Demand Reduction per Customer | kW/Customer | 1.00 | 0.02 |
| Estimated RAP Peak Reduction | kW | 14,000 | 12 |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | $48 |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | $0 |
| Program Administration Costs (Recurring) | $/kW | $0 | $0 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 | $45 |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | $250 |
| Annual O&M Cost | Failure Rate (%) | 0.0% | 0.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $30 | $3 |

## 3.7 EV TOU Pricing Program

Similar to the DLC EV program, the EV TOU pricing program is intended to shift customer’s EV load from on peak (4 pm – 8 pm) to off-peak (6 am – 4 pm) or super off-peak (12 am – 6 am) time periods. Instead of customer’s getting home from work in the early evening and plugging in their vehicle, the EV TOU rate would be such that customers are incentivized to charge when the rate is significantly cheaper during the late evening to early morning hours. Under the DLC EV program, customers would not physically be able to charge their vehicle when the control is switched to “off”, however with the EV

TOU program, customers could charge at any time of the day, but they would pay a premium rate for charging at peak times as set by RPU. One program gives the utility primary control in managing load, while the other gives the customer primary control. Both, however, will benefit the customer by avoiding large increases in monthly energy bills from charging their EV and will benefit RPU by avoiding increased peak demand. It is assumed that while 50 percent of customers would choose the DLC EV program, the remaining 50 percent would choose the EV TOU pricing program, resulting in 100% participation and a minimal to no effect on RPU peak load growth from future EV adoption. Under this program, it is assumed that RPU would implement an EV TOU rate using energy rates like the existing General Service TOU rates and using existing metering technology. With $48/kW-year in peak demand savings from avoided capacity, roughly $0.015/kW-year savings from load shifting, and minimal program costs; a TRC ratio of 3.02 was calculated, showing that EV TOU rates are favorable for RPU to implement. Table 3-7 provides the full list of assumptions used for this program, and Table 3-10 shows the NPV benefits, NPV costs, and TRC results.

**Table 3-7: New EV TOU Pricing Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS |
|---|---|---|---|
| Customer Participation: | | | |
| Total Program Potential Customers | Customers | 50,000 | N/A |
| Estimated RAP - Customer Participation Rate | % | 50.00% | N/A |
| Total Program Participating Customers | Customers | 25,000 | N/A |
| Peak Demand Reduction per Customer | kW/Customer | 1.54 | N/A |
| Estimated RAP Peak Reduction | kW | 38,400 | N/A |
| | | | |
| Program Benefits: | | | |
| Peak Demand Reduction Savings | $/kW-year | $48 | N/A |
| RPU Market Energy Savings from Load Shifting | $/kWh | $0.0150 | N/A |
| | | | |
| Program Costs: | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | N/A |
| Program Administration Costs (Recurring) | $/kW | $0 | N/A |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 | N/A |
| Cost of Equip. & Install (One-Time) | $/new participant | $250 | N/A |
| Annual O&M Cost | Failure Rate (%) | 0.0% | N/A |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $270 | N/A |

## 3.8 Behind the Meter Battery Energy Storage

Battery energy storage is becoming increasingly popular as the deployment of EVs and renewables are increasing in scale. Batteries can store energy during off-peak time-periods while demand on the system is low, and then use this energy to offset demand during on-peak time-periods. This can help in flattening out the utility's load curve as a portion of the peak demand could be reduced and essentially shifted to other time periods. Effectively this would reduce RPU's peak demand and increase the benefit of avoided capacity costs. The issue utilities are currently facing with this technology are the high costs they must incur to buy and install a battery. Although the idea behind battery energy storage as a method for peak demand management could be advantageous in the future, current costs are not showing a TRC net benefit. This program was evaluated for the Residential, SGS, MGS and LGS classes with the TRC ratio below 1.0 in all scenarios. The program assumptions for each class are shown in Table 3-8 with the NPV and TRC results listed in Table 3-10.

**Table 3-8: New EV TOU Pricing Program Assumptions**

| PROGRAM ASSUMPTIONS: | | RESIDENTIAL | SGS | MGS & LGS |
|---|---|---|---|---|
| Customer Participation: | | | | |
| Total Program Potential Customers | Customers | 50,000 | 4,500 | 453 |
| Estimated RAP - Customer Participation Rate | % | 1.00% | 1.00% | 1.00% |
| Total Program Participating Customers | Customers | 500 | 45 | 5 |
| Peak Demand Reduction per Customer | kW/Customer | 5.00 | 5.00 | 83.33 |
| Estimated RAP Peak Reduction | kW | 2,500 | 225 | 378 |
| | | | | |
| Program Benefits: | | | | |
| Peak Demand Reduction Savings | $/kW-year | $48.00 | $48 | $48 |
| RPU Market Energy Savings from Load Shifting | $/kWh | $0.0150 | $0.0150 | $0.0150 |
| | | | | |
| Program Costs: | | | | |
| Program Development Costs (One-Time) | $/program | $50,000 | $5,000 | $5,000 |
| Program Administration Costs (Recurring) | $/kW | $5 | $5 | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 | $45 | $45 |
| Cost of Equip. & Install (One-Time) | $/new participant | $7,500 | $7,500 | $125,000 |
| Annual O&M Cost | Failure Rate (%) | 0.0% | 0.0% | 2.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $0 | $0 | $0 |

## 3.9 New Interruptible Rate Program

RPU has an interruptible service program available to commercial customers where customers who select this rate agree with RPU to reduce their load when the utility deems necessary. Customers have onsite generators that are used to reduce their load, or they shut off designated equipment during this time. Customers are given a two-hour notice and can be called on up to 35 times per year for a total interruption time of 175 hours annually. In return for this service to the utility, customers receive a demand charge that is $10/kW-month lower on their interrupted load. As the program currently stands, the costs outweigh the benefits on a TRC test basis because the demand charge reduction given to participating customers is too high compared to RPU's benefits of $11.41/kW-month in the winter months and $4/kW-month in the summer months. Burns & McDonnell evaluated the existing program against a new potential program, where several of the current parameters are changed to make this program more equitable on a TRC test basis. On the existing program new customers have not been able to join since early 2011, as the rate has since been closed. Due to this, only 10, or 2.2 percent of the MGS and LGS customers are on this rate. On the new program, RPU would open the rate to allow any MGS and LGS customer to join and RPU would change the interruptible rate being offered to decrease the demand charge credit (from where it currently is) during summer months to $4/kW-month. A full list of assumptions for this new program are provided in Table 3-9, with NPV and TRC results listed in Table 3-10.

**Table 3-9: New Load Curtailment Rate Program Assumptions**

| PROGRAM ASSUMPTIONS: | | MGS & LGS |
|---|---|---|
| Customer Participation: | | |
| Total Program Potential Customers | Customers | 453 |
| Estimated RAP - Customer Participation Rate | % | 45.00% |
| Total Program Participating Customers | Customers | 204 |
| Peak Demand Reduction per Customer | kW/Customer | 42.00 |
| Estimated RAP Peak Reduction | kW | 8,562 |
| | | |
| Program Benefits: | | |
| Peak Demand Reduction Savings | $/kW-year | $107 |
| | | |
| Program Costs: | | |
| Program Development Costs (One-Time) | $/program | $50,000 |
| Program Administration Costs (Recurring) | $/kW | $5 |
| Annual Marketing and Recruitment Costs (One-Time) | $/new participant | $45 |
| Cost of Equip. & Install (One-Time) | $/new participant | $120 |
| Annual O&M Cost | Failure Rate (%) | 0.0% |
| Per Participant Annual Incentive Cost (Recurring) | $/participant/yr. | $4,032 |

## 3.10 Evaluation of New Demand Response Programs

The tables preceding this section went into specific details regarding customer participation and program benefits and costs. Table 3-10 below shows the new programs that Burns & McDonnell evaluated and the impact they could have on the utility. As previously discussed, each program has associated benefits and costs that were calculated on an annual pro forma cash flow basis. The NPV of the annual benefits and the NPV of the annual costs were calculated to determine a total NPV for each program (or a net result). The benefit NPV was then divided by the cost NPV to calculate the TRC of each program. These results are provided in Table 3-10. Any program that has a TRC less than 1.0 is costing more overall than it is receiving in benefits. Aside from external and social factors that might influence RPU’s decision, any program with a TRC less than 1.0 should not be continued or developed. Results show that several of the new programs evaluated by Burns & McDonnell have a TRC above 1.0, indicating that from a TRC standpoint RPU could improve some existing programs and add several new ones to receive additional peak demand reduction benefits.

**Table 3-10: Total Resource Cost Test Summary by New Program**

| CUSTOMER CLASS | PROGRAM | Program Benefit NPV | Program Cost NPV | Program Total NPV | Total Resource Cost (TRC) Test |
|---|---|---|---|---|---|
| Residential | Direct Load Control Air Conditioning | $ 5,750,848 | $ 3,926,207 | $ 1,824,641 | 1.46 |
| Residential | Direct Load Control Hot Water Heating | $ 268,473 | $ 482,256 | $ (213,783) | 0.56 |
| Residential | DLC Smart Thermostats | $ 3,223,804 | $ 2,311,884 | $ 911,919 | 1.39 |
| Residential | DLC Electric Vehicle Charging | $ 7,769,019 | $ 6,477,899 | $ 1,291,120 | 1.20 |
| Residential | Time-of-Use (EV) | $ 7,769,019 | $ 2,569,032 | $ 5,199,987 | 3.02 |
| Residential | Time-of-Use (opt-in) | $ 7,164,008 | $ 7,489,073 | $ (325,065) | 0.96 |
| Residential | Battery Energy Storage | $ 1,286,326 | $ 3,613,231 | $ (2,326,905) | 0.36 |
| | | | | | |
| SGS | Direct Load Control Air Conditioning | $ 69,019 | $ 44,590 | $ 24,429 | 1.55 |
| SGS | Direct Load Control Hot Water Heating | $ 11,692 | $ 23,690 | $ (11,998) | 0.49 |
| SGS | DLC Smart Thermostats | $ 173,855 | $ 109,062 | $ 64,793 | 1.59 |
| SGS | Battery Energy Storage | $ 150,594 | $ 325,667 | $ (175,073) | 0.46 |
| | | | | | |
| MGS & LGS | Interruptible Rate | $ 9,791,869 | $ 9,207,343 | $ 584,526 | 1.06 |
| MGS & LGS | Battery Energy Storage | $ 252,663 | $ 642,589 | $ (389,926) | 0.39 |

## 3.11 Proposed Demand Response Programs

All seven (7) of RPUs existing DSM programs were evaluated, along with thirteen (13) new potential programs. Various new programs were evaluated as a replacement for existing ones, with careful consideration given to not double-up on benefits that RPU would receive from multiple programs. This was considered throughout the analysis when making assumptions on customer participation and peak demand reduction. An example of this occurrence pertains to Residential DLC for AC units and Residential smart thermostats. A Residential customer could not have a DLC switch on an AC unit and also have a smart thermostat in order to receive peak reduction from both programs, thus assumptions were adjusted to account for this. It would also be necessary for RPU to track customers by program and limit customers to only one program of similar type. This same theory applies for DLC and smart thermostats for SGS. Even though a Residential customer could not have both a DLC switch for their EV and also be on the TOU rate, they could however, have a smart thermostat and be on a program for reducing their EV load. The complete list of programs that were evaluated for RPU are in Table 3-11.

**Table 3-11: Existing & New Demand Response Program Results**

| CUSTOMER CLASS | PROGRAM | Program Benefit NPV | Program Cost NPV | Program Total NPV | Total Resource Cost (TRC) Test |
|---|---|---|---|---|---|
| **EXISTING PROGRAMS:** | | | | | |
| Residential | Direct Load Control Air Conditioning | $ 1,369,249 | $ 1,693,581 | $ (324,332) | 0.81 |
| Residential | Direct Load Control Hot Water Heating | $ 268,473 | $ 287,018 | $ (18,545) | 0.94 |
| | | | | | |
| SGS | Direct Load Control Air Conditioning | $ 13,712 | $ 16,960 | $ (3,248) | 0.81 |
| SGS | Direct Load Control Hot Water Heating | $ 11,692 | $ 12,789 | $ (1,098) | 0.91 |
| SGS | Time-Of-Use (opt-in) | $ 5,987 | $ 170,838 | $ (164,851) | 0.04 |
| | | | | | |
| MGS & LGS | Interruptible Rate | $ 8,065,022 | $ 9,332,667 | $ (1,267,645) | 0.86 |
| MGS | Time-Of-Use (opt-in) | $ 280,502 | $ 269,868 | $ 10,634 | 1.04 |
| | | | | | |
| **NEW PROGRAMS:** | | | | | |
| Residential | Direct Load Control Air Conditioning | $ 5,750,848 | $ 3,926,207 | $ 1,824,641 | 1.46 |
| Residential | Direct Load Control Hot Water Heating | $ 268,473 | $ 482,256 | $ (213,783) | 0.56 |
| Residential | DLC Smart Thermostats | $ 3,223,804 | $ 2,311,884 | $ 911,919 | 1.39 |
| | | | | | |
| Residential | DLC Electric Vehicle Charging | $ 7,769,019 | $ 6,477,899 | $ 1,291,120 | 1.20 |
| Residential | Time-of-Use (EV) | $ 7,769,019 | $ 2,569,032 | $ 5,199,987 | 3.02 |
| Residential | Time-of-Use (opt-in) | $ 7,164,008 | $ 7,489,073 | $ (325,065) | 0.96 |
| Residential | Battery Energy Storage | $ 1,286,326 | $ 3,613,231 | $ (2,326,905) | 0.36 |
| | | | | | |
| SGS | Direct Load Control Air Conditioning | $ 69,019 | $ 44,590 | $ 24,429 | 1.55 |
| SGS | Direct Load Control Hot Water Heating | $ 11,692 | $ 23,690 | $ (11,998) | 0.49 |
| SGS | DLC Smart Thermostats | $ 173,855 | $ 109,062 | $ 64,793 | 1.59 |
| SGS | Battery Energy Storage | $ 150,594 | $ 325,667 | $ (175,073) | 0.46 |
| | | | | | |
| MGS & LGS | Interruptible Rate | $ 9,791,869 | $ 9,207,343 | $ 584,526 | 1.06 |
| MGS & LGS | Battery Energy Storage | $ 252,663 | $ 642,589 | $ (389,926) | 0.39 |

The list provided in Table 3-11 includes each of the programs evaluated by Burns & McDonnell. As shown in the far-right column, the TRC results are highlighted in either red or green colors and indicate whether RPU should continue an existing program or implement a new one. Any program highlighted in red has a TRC result less than 1.0 and would ultimately cost more than the benefits received. Table 3-12 shows a condensed list of only the programs that resulted in a TRC equal to or above 1.0, and thus are recommended that the utility pursue. The programs included in the proposed list were determined based off the economic analysis described in this report and does not account for any external or social value that RPU might also receive. Table 3-12 also shows the estimated customer participation and estimated peak demand reduction in kW. For the MGS TOU pricing program, it is assumed it will continue in its current form with no incremental benefit or costs incurred. For the new programs, however, these participation rates and peak reduction estimates are assumed to reach full potential after five (5) years of implementation. During these first 5 years RPU will need time to develop each program and market it to customers, before the full potential of the program will be realized. The numbers in Table 3-12 are representative of the 5-year RAP, or full penetration of the program.

**Table 3-12: Proposed Demand Response Programs**

| CUSTOMER CLASS | PROGRAM | Customer Participation | Estimated Peak Reduction (kW) | Total Resource Cost (TRC) Test |
|---|---|---|---|---|
| **EXISTING PROGRAMS:** | | | | |
| MGS | Time-Of-Use (opt-in) | 12% | 466 | 1.04 |
| | | | | |
| **NEW PROGRAMS:** | | | | |
| Residential | Direct Load Control Air Conditioning | 15% | 9,562 | 1.46 |
| Residential | DLC Smart Thermostats | 10% | 6,300 | 1.39 |
| Residential | DLC Electric Vehicle Charging | 50% | 2,499 | 1.20 |
| Residential | Time-of-Use (EV) | 50% | 2,499 | 3.02 |
| | | | | |
| SGS | Direct Load Control Air Conditioning | 2% | 115 | 1.55 |
| SGS | DLC Smart Thermostats | 5% | 2,378 | 1.59 |
| | | | | |
| MGS & LGS | Interruptible Rate | 45% | 8,505 | 1.06 |

## 3.12 Peak Demand Reduction

RPU has been engaged in EE and DR programs for nearly two decades and has seen considerable reductions in peak demand on their system because of it. Figure 3-2 and Figure 3-3 show forecasts of expected RPU peak load under several different scenarios. Figure 3-2 shows a forecast of RPU's peak load without the consideration of EV load growth added to the system. The blue line represents RPU's peak load forecast from SMMPA and the green line represents RPU's peak load forecast with incorporating the peak reduction of 9,233 kW produced from existing DR programs. The orange line was added to show the additional peak reduction that RPU could see through implementation of the proposed DR programs from Table 3-12.

Figure 3-3 takes the load forecast a step further and layers in the expected growth from EVs that is forecasted. The blue line represents RPU's peak load forecast from SMMPA with the addition of RPU's peak load forecast for EVs developed by Burns & McDonnell. The green line represents RPU's peak load forecast including EV growth with the peak reduction of 9,233 kW produced from existing DR programs. The gray line shows the peak reduction that RPU could see through implementation of the proposed DR programs in Table 3-12. If growth in EVs develops as the forecast indicates, RPU, should be able to offset most, if not all, of this demand by shifting it to other time periods through DR programs.

**Figure 3-2: RPU Peak Load Forecasts (kW)**

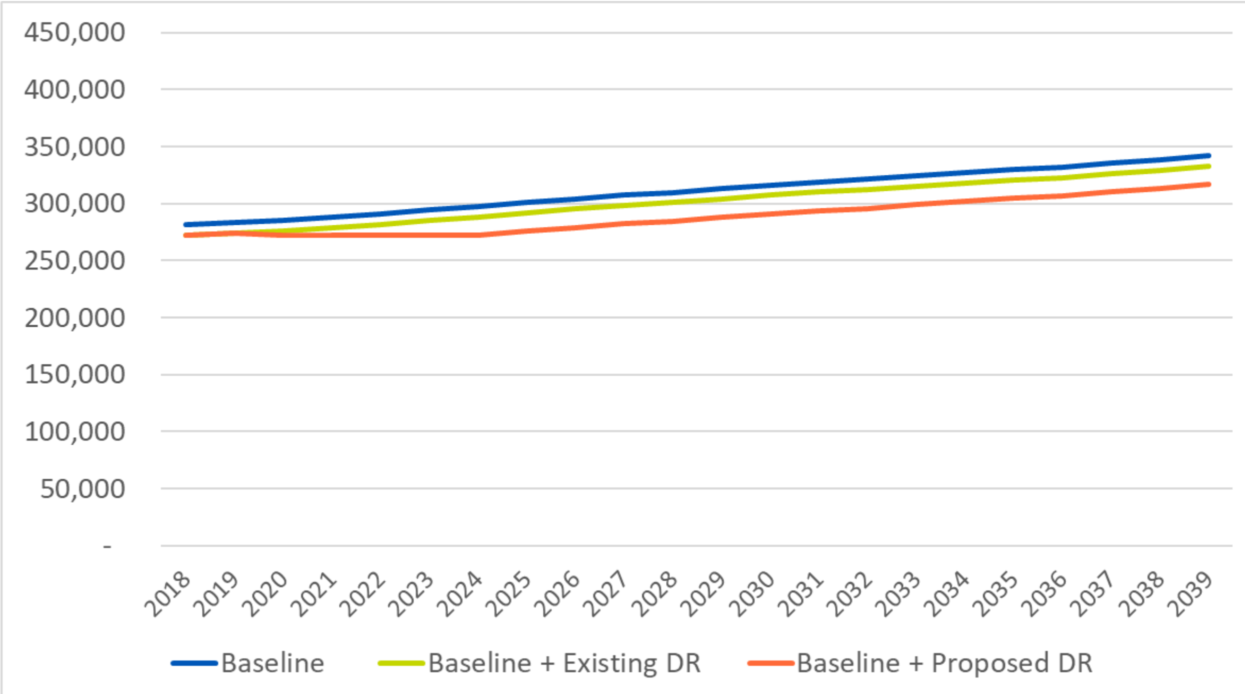
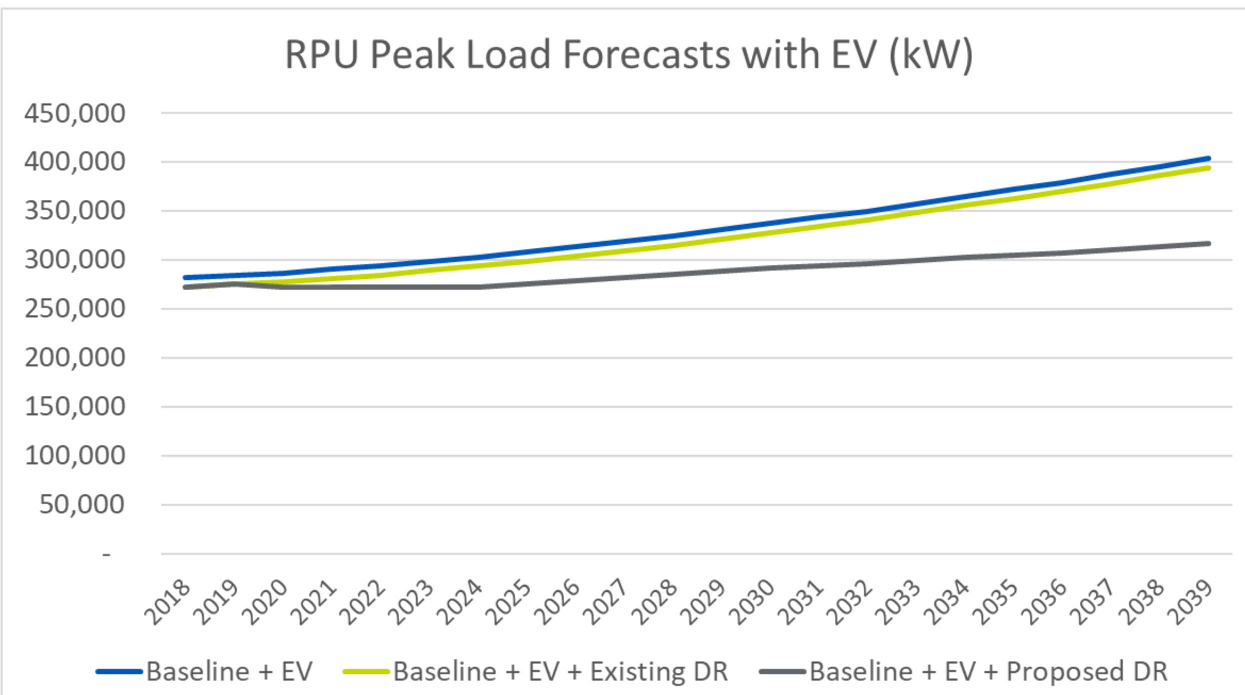



**Figure 3-3: RPU Peak Load Forecasts with EV (kW)**



# 4.0 DEMAND SIDE MANAGEMENT EDUCATION AND OUTREACH

## 4.1 Existing Demand Side Management Education and Outreach

RPU has provided a variety of education and outreach opportunities to customers to inform them of the DSM programs available. Customer interest is driven by program incentives and through rebates given for the purchase of energy efficient appliances and demand response services. These education and outreach activities are intended to give customers information on ways to reduce their energy usage and to communicate the benefit they receive in return. Several of the more involved outreach initiatives include hosting a booth at the annual Rochester Area Builders Home Show, sponsoring an Arbor Day celebration, holding annual meetings with vendors and trade allies, meeting with key account commercial customers, hosting customer education classes for specific DSM programs, and a variety of other events. Over the years, RPU has also been engaged in promoting DSM on their website, on social media platforms, through sending out email newsletters and mailers, and advertising on the radio, television, and billboard signs. The efforts put forth by RPU to promote and educate customers about DSM programs are extensive and the effects are evident in the level of avoided peak demand and reduction in energy usage per customer that has been achieved for nearly two decades.

## 4.2 Proposed Demand Response Education and Outreach

As mentioned above, RPU has been engaged in customer education and outreach to promote their DSM programs already in place. In recent years, they have shifted from sending bill inserts and promoting on billboards, to utilizing their social media sites, sending emails, posting on their website, and using other means of communication that are in line with today's technologies. Promoting through online channels can also be a more cost-effective alternative to printing paper and paying for billboard space. As with any new DSM program, it is important to get customer buy-in prior to implementing something that will require considerable amounts of capital dollars being spent. Part of the initial process of setting up a program requires RPU to get as many vendor bids as possible to select the least-cost option for the utility and customers. This will provide actual costs for RPU to evaluate before going through with a specific program.

When considering new programs to implement, it could be beneficial to begin with a pilot program before rolling something out at full-scale. This would give the utility an opportunity to measure the expected customer adoption and estimated peak demand reduction without spending the capital required for a full program implementation. During this time, education of customers and promotion of the program could continue, along with channels provided for customer feedback and suggestions for improvements. It is recommended that RPU continue meeting with key commercial accounts on an individual basis to discuss program options and to be informed of concerns they might have. As for Residential customers, it is important for RPU to continue with the education programs that have proven to be effective, and to continue staying up-to-date with current trends of how people most commonly communicate. RPU has been proactive in this effort as they have moved further from bill inserts and mailers to social media and other online means of communication. The following sections provide some considerations for education and outreach initiatives for each of the proposed programs in Table 3-12.

### 4.2.1 Time of Use Pricing Program

Marketing a TOU (opt-in) pricing program takes considerable effort to promote and educate customers on the specifics of what it is and how it could benefit ratepaying customers. Although RPU does have experience with TOU from developing a rate for commercial customers, marketing a TOU rate to the Residential customer class is often times more challenging due to the larger number of customers to reach and customers reluctance to change. To effectively market the program and reach full adoption levels, RPU may consider providing links on their website to inform customers on the basics of TOU, show sample bills with the kWh breakdown of a customer going from a standard Residential rate to a TOU rate, provide an online calculator for customers to estimate their bill under a TOU rate, offer workshops on how customers could benefit from switching to this rate, and provide a channel for receiving questions and feedback on the program from customers and stakeholders.

### 4.2.2 Direct Load Control Air Conditioning

Nearly 7,600 RPU Residential customers and 76 commercial customers currently have a DLC switch on their AC unit. This technology is aging and becoming dated, resulting in less than optimal peak demand reduction. With the installation of new technology, RPU could expect to see a significant increase in peak demand savings, where the overall benefits outweigh the costs associated with installing new devices. RPU would need to educate current customers who have a DLC switch and inform them that a new device is going to be installed on their AC unit at no charge to them. It will be important for RPU to communicate to customers that this initial cost will save the utility money over time, which is why the new device is no additional cost to the customer. People can be speculative of "free" upgrades, so the benefit to the utility (and ultimately, ratepayers) needs to be communicated so it is not assumed costs will be hidden in future rate increases nor will the customer experience inconveniences.

### 4.2.3 Direct Load Control Smart Thermostats

RPU does not currently have a smart thermostat program in place, thus the efforts to educate and promote this program to customers could be more significant. Similar to initiatives RPU has completed in the past program marketing will need to educate customers on what smart thermostats are, why they are important to RPU, and how they can be beneficial for the customer. These efforts could include creating informational pages on their website, promoting through social media, hosting educational workshops or events, and advertising on the television and radio.

### 4.2.4 Direct Load Control Electric Vehicle Charging

In respect to EVs, RPU will want to proactively engage customers who purchase these vehicles and offer them the option of a DLC switch for their EV charging station or the option of being on an EV TOU rate. These options should be clearly communicated to customers who currently have an EV, and also to customers in general so they know options are available if they choose to purchase one. Increases in electricity bills could be a deterrent to residents wanting to purchase an EV, however, educating them on shifting that load to off-peak time-periods could prove to be beneficial for the consumer. Many utilities often provide a section on their website covering the programs they offer specifically for EVs.

### 4.2.5 Electric Vehicle Time of Use Pricing Program

Promoting a Residential EV TOU pricing program for customers with EVs would require much of the same type of efforts as discussed in the Time of Use Pricing Program and Direct Load Control Electric Vehicle Charging sections. This program should specifically be targeted at customers who own EVs, as well as other consumers considering this as a potential purchase in the future. RPU’s goal should be 100 percent adoption of EV customers in either the DLC program or the TOU program to result in minimal to no increase in the peak demand load. Many utilities often provide a section on their website covering the programs they offer specifically for EVs.

### 4.2.6 Interruptible Rate

The interruptible rate for load curtailment has been closed to new customers since early 2011. Under the proposed interruptible rate, the rate would be reopened for new customers to join, however, the discounted rate that customer would receive on the demand charge would be reduced. Currently, the incentive given to customers is costing RPU more than it is receiving in avoided peak capacity savings, meaning the demand rate charged to interruptible customers is too low. This sort of change would need to be communicated with individual commercial customers who are a part of the existing program to explain why the rate would be changing and what the expectations are going forward. Additional communications would be necessary with other commercial customers who could qualify for the rate to gauge interest level and the potential for expected peak demand capabilities on an individual basis.

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