The Narragansett Electric Company
d/b/a National Grid
Docket No. XXXX
Annual Plan Attachment 3

2021 Evaluation, Measurement, and Verification Plan

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1. Introduction

Evaluation, Measurement and Verification (EM&V) is an integral and required part of National Grid's energy efficiency program planning process. EM&V provides independent verification of impacts to ensure that savings and benefits claimed by the Company through its energy efficiency programs are accurate and credible. EM&V also provides insight into market characteristics and guidance on energy efficiency program design to improve the delivery of cost-effective programs.

The Company's EM&V Plan continues to focus on evaluating Rhode Island projects, markets, and energy efficiency programs while leveraging as many resources as possible from evaluation studies in other National Grid territories in order to maximize value for ratepayers while minimizing costs. These studies are commissioned by the Company. They are conducted by independent evaluation firms, whose goal is to produce an accurate, complete, and transparent review of Rhode Island's energy efficiency programs and markets. The types of evaluation may include (but not limited to) the following:

- **Impact Evaluations:** Comparisons of claimed savings against actual realized savings using methods such as literature review, billing analyses, engineering methods and onsite data logging as a means of verification.

- **Process Evaluations:** Broad examinations of existing practices, such as program delivery methods, for the purpose of gathering information to draw conclusions about effectiveness of existing processes, highlight best practices, and offer suggestions for future improvements.

- **Market Assessment Studies:** Broad studies aimed at assessing changes in market conditions, such as evolving adoption rates of current energy efficiency technologies.

- **Net-to-Gross Evaluations:** Studies aimed at quantifying the rate of free-ridership and spillover associated with energy efficiency participants and non-participants. The free-ridership rate is the percentage of savings attributable to participants who would have installed the measures in the absence of program intervention while spillover includes the effects of two components:

    1. Participants in the program who install additional energy efficient measures outside of the program as a result of participating in the program, and

    2. Non-participants who install the installation of energy efficient measures as a result of being aware of the program

The study methodologies and savings assumptions from evaluation studies are documented in the Rhode Island Technical Reference Manual (TRM). The TRM is reviewed and updated annually to reflect changes in technology, baselines and evaluation results.

The entire evaluation process is managed by the Company in consultation with the Rhode Island Energy Efficiency & Resource Management Council (EERMC) and the Office of Energy Resources (OER). The EERMC and OER follows each study closely and is involved in planning, work plan development, and review of study results.

The Company's EM&V framework provides confidence among ratepayers and stakeholders that programs are effective and EM&V activities are independent and objective.

2. Evaluation Studies Completed in 2020

The Company, with input from EERMC and OER, expects to complete 19 evaluation studies in 2020 (see below). The research studies include impact evaluations, process evaluations, and market studies in the residential and commercial and industrial (C&I), sectors as well as studies that are considered cross-cutting.

Commercial & Industrial

1. RI-19-CG-CustGas - Impact Evaluation of PY2017 Custom Gas Installations
2. RI-20-CG-CustGasPY18 - Impact Evaluation of PY2018 Custom Gas Installations
3. RI-19-CE-CustElec - Impact Evaluation of PY2018 Custom Electric Installations
4. RI-20-CX-FRSO - C&I Free-Ridership and Spillover Study (draft)
5. RI-20-CX-SEM - Strategic Energy Management Demonstration Evaluation (Year 1, draft)

Residential

1. RI-20-RX-EWSFImpact – Impact Evaluation of 2017-2018 EnergyWise Single Family Program
2. RI-20-RX-EWSFProcess – Process Evaluation of 2019 EnergyWise Single Family Program
3. RI-20-RX-EWMFImpact – Impact Evaluation of 2017-2018 EnergyWise Multifamily Program
4. RI-20-RX-EWMFProcess – Process Evaluation of 2019 EnergyWise Multifamily Program
5. RI-20-RX-IEMFImpact – Impact Evaluation of 2017-2018 Income Eligible Multifamily Program
6. RI-20-RX-IEMFProcess – Process Evaluation of 2019 Income Eligible Multifamily Program

7. RI-20-RX-HERImpact – Impact Evaluation of the 2017-2019 Home Energy Reports Program
8. RI-20-RE-UpstrLight – Residential Lighting Market Assessment – 2019 Shelf Stocking
9. RI-20-RE-UpstrLight – Residential Lighting Market Assessment – 2019 Sales Data Analysis

Cross-Cutting

1. RI-18-XX-Piggybacking - Piggybacking Diagnostic Study
2. RI-19-XX-DataCollect - Primary Data Collection for Potential Study
3. RI-19-XE-HPmarket - Heat Pump Market Assessment (draft)
4. RI-20-XX-`Codes - Rhode Island Compliance Training and Building Permit Review
5. RI-20-XX-Jobs - Rhode Island 2019 Energy Efficiency Workforce Analysis

Section 4 provides detailed descriptions, findings, and recommendations of each of the studies listed above, along with selected research studies completed in other regions and/or other National Grid jurisdictions. The results of the evaluations from other regions and National Grid jurisdictions, most commonly Massachusetts, have been judged by the Company, in consultation with EERMC and OER, to be applicable to Rhode Island's energy efficiency programs. The Company is adopting the results of these studies in 2020 program planning due to similarity, either in the measures offered, or program structure or delivery.

In addition to the studies listed above, the Office of Energy Resources is completing a study to independently verify the energy savings of National Grid's energy efficiency programs and to review the evaluation, measurement, and verification (EM&V) process to ensure quality data, rigorous methods, and appropriate assumptions are being used. This study was legislated in Senate Bill 2500, enacted in June 2018.[1] The Company will carefully review all recommendations emerging from this study and implement those that are feasible when developing future evaluations.

A complete list of historical research studies is provided in Section 5 along with a brief summary of the impact of those results in planning the Company's programs. Prior year studies that have been superseded by studies completed since the filing of the 2020 Energy Efficiency Plan have

[1] http://webserver.rilin.state.ri.us/PublicLaws/law18/law18079.htm

been removed from this list. These studies are available through the request of the EERMC[2], the Rhode Island Public Utilities Commission (PUC)[3], and National Grid.

3. 2021 Planned Evaluation Studies

This section describes planned studies that focus on areas of interest to the Rhode Island energy efficiency programs and build on the deep history of evaluation studies commissioned by the Company over numerous years. In order to optimize the use of evaluation resources, where programs are considered to be similar in program delivery and population served with those offered in Massachusetts, the studies will be done in conjunction with the Company's Massachusetts retail affiliate. The Company will also stay abreast of the voluminous Massachusetts evaluation activities that may be beneficial and applicable in Rhode Island and will use the guidelines provided by the Rhode Island Piggybacking Diagnostic Study to inform this strategy.

Table 2 lists evaluation studies that the Company plans to conduct in 2021 to inform the 2022 Annual Plan and future planning cycles. Barring changes to the 2022 Annual Plan schedule, studies that will be incorporated into the Annual Plan must be completed by July 2021. Study labeling codes take the general form shown in Table 1. For example, RI-17-CG-CustGas refers to the Custom Gas Evaluation Study that started in 2017 in the commercial sector for gas, while RI-18-RX-IESF refers to evaluation study started in 2018 of the income eligible single family program for electric and gas.

Table 1. Study Labeling Code Format

[State]	–	[Year Study Conducted]	–	[Sector]	[Fuel]	–	[Keyword]
RI		19 20 21		R = residential C = commercial X = cross sector	E = electric G = gas X = electric & gas		

[2] https://rieermc.ri.gov/plans-reports/evaluation-studies/
[3] http://www.ripuc.org/

Table 2. Planned Evaluation Studies in 2021

Sector	Study Code	Type	Affected Programs	Study Name	State Lead
C&I	RI-20-CG-CustGasPY19	Impact	Custom	PY2019 Impact Evaluation of Custom Gas Installations (continued from 2020)	RI
C&I	RI-21-CG-CustGasPY20	Impact	Custom	PY2020 Impact Evaluation of Custom Gas Installations	RI
C&I	RI-20-CE-CustElecPY18	Impact	Custom	PY2018 Impact Evaluation of Custom Electric Installations (continued from 2020)	RI
C&I	RI-20-CE-CustElecPY19	Impact	Custom	PY2019 Impact Evaluation of Custom Electric Installations (continued from 2020)	RI
C&I	RI-21-CE-CustElecPY20	Impact	Custom	PY2020 Impact Evaluation of Custom Electric Installations	RI
C&I	RI-21-CX-ISPBaseline	Market	C&I	C&I ISP and Baseline	RI
C&I	RI-20-CE-UpstrLight	Impact	Upstream	Upstream Lighting Impact Analysis (continued from 2020)	MA (with RI sites)
Residential	RI-21-RX-Participation	Market	Multiple	EE Participation and Census Study	RI
Residential	RI-21-RX-NPStudy	Market	Multiple	EE Non-Participant Market Barriers Study	RI
Residential	RI-21-RX-CSNC	Impact/ Market	Codes, RNC	Residential New Construction Baseline and Code Compliance Study	RI

Residential	RE-21-RE-AppRecycling	Impact	Products	Appliance Recycling Impact Factor Update	R
Residential	RI-21-RE-EVDR	Impact	DR	EV Demand Response Program	RI
Residential	TBD	TBD	TBD	Follow-up research on potential study issues	RI
Residential	RI-21-RG-GasHPDemo	Impact	Multiple	Gas Heat Pump Demonstration Evaluation	RI
Residential	RI-21-RE-SolarDRDemo	Impact	Multiple	Solar Inverter Direct Load Control Demonstration Evaluation	RI
Cross-cutting	RI-20-XG-GasPeak	Impact	Res	Gas Peak Demand Study (continued from 2020)	RI
Cross-cutting	RI-21-XX-Jobs	Policy	Multiple	Workforce Associated with Rhode Island Energy Efficiency Programs Analysis Study	RI
Cross-cutting	RI-20-CX-SEM	Process	LCI Retrofit	Strategic Energy Management Demonstration Evaluation (continued from 2020)	RI
Cross-cutting	RI-20-XX-AESCost	Benefits	Multiple	Avoided Cost Study, Gas & Electric (continued from 2020)	RI

The evaluation pathway for pilots, demonstrations, and assessments is based on each effort's scale, budget, scope, and the availability of external data. The Company's EM&V team will provide guidance beginning at the Plan stage for all pilots, demonstrations, and assessments, to ensure design and data collection are suitable to allow for effective evaluation. In cases where an independent evaluation is appropriate, the EM&V team will run the evaluation. For guidelines on the stakeholder review process and which pilots, demonstrations, and assessments will receive an independent evaluation, please see Attachment 8. The evaluation will follow the same established evaluation framework used in evaluations of established programs. This includes management of the independent evaluation vendor by the Company's EM&V team in consultation with the EERMC and OER. See Attachment 8 for further details on pilots, demonstrations, and assessments.

The EM&V team will follow the Company's standard procurement policy that cuts across programs and jurisdictions in order to achieve the lowest cost procurement of required external services while enabling the Company to minimize administrative costs, deliver on program commitments and meet time-sensitive regulatory deadlines. The Company's standard procurement policy is supported and enforced by stand-alone internal procurement function. Contract characteristics below certain thresholds are eligible for sole-sourcing while contract characteristics above thresholds require competitive procurement unless it can be demonstrated to the procurement organization that securing multiple bids is not possible or practical.

The proposed budget for evaluation study expenditures in 2021 is approximately $2.7 million ($1.9 million for electric and $0.8 million for gas), excluding internal staffing costs. The proposed budget for EM&V comprises approximately 1.8% of the total portfolio budget in 2021.

Final reports along with graphical executive summaries will be made publicly available upon completion of the evaluation studies. All complete graphical executive summaries will be provided as a handout at EERMC meetings and posted on the EERMC website.[4]

3.1 Commercial and Industrial Planned Evaluation Studies in 2021

a. RI-20-CG-CustGasPY19 – Impact Evaluation of PY2019 Custom Gas Installations

The objective of this impact evaluation is to provide verification of natural gas energy savings estimates for a sample of custom gas projects through site-specific inspection, metering, and analysis. The results of this study will be used to determine the realization rates for custom gas energy efficiency offerings based on installations from 2019. This will continue 'rolling' evaluation efforts, where each year will evaluate roughly 1/3 of the number of sites needed for a full sample and results will be combined with results from the previous two years, which will keep the realization rates updated yearly. This study is scheduled to begin in late 2020 and continue into 2021.

[4] https://rieermc.ri.gov/plans-reports/evaluation-studies/

b. RI-21-CG-CustGasPY20 – Impact Evaluation of PY2020 Custom Gas Installations

The objective of this impact evaluation is to provide verification of natural gas energy savings estimates for a sample of custom gas projects through site-specific inspection, metering, and analysis. The results of this study will be used to determine the realization rates for custom gas energy efficiency offerings based on installations from 2020. This will continue 'rolling' evaluation efforts, where each year will evaluate roughly 1/3 of the number of sites needed for a full sample and results will be combined with results from the previous two years, which will keep the realization rates updated yearly. This study is scheduled to begin in late 2021 and continue into 2022.

c. RI-19-CE-CustElecPY18 – Impact Evaluation of PY2018 Custom Electric Installations (continued from 2020)

The objective of this impact evaluation is to provide verification of electric energy savings estimates for a sample of both lighting and non-lighting custom electric projects through site-specific inspection, metering, and analysis. The results of this study will be used to determine the final realization rates for custom electric energy efficiency offerings based on installations from 2018. This will be the second year of 'rolling' evaluations in coordination with evaluation efforts in Massachusetts, where the first year was a 'full' study (as has historically been done every 3 years), while subsequent years evaluate roughly 1/3 of the number of sites, which will keep the realization rates updated yearly. This study was scheduled to be completed in 2020, but site work was delayed due to COVID-19-related restrictions, extending the timeline into 2021.

d. RI-20-CE-CustElecPY19 – Impact Evaluation of PY2019 Custom Electric Installations (continued from 2020)

The objective of this impact evaluation is to provide verification of electric energy savings estimates for a sample of both lighting and non-lighting custom electric projects through site-specific inspection, metering, and analysis. The results of this study will be used to determine the realization rates for custom electric energy efficiency offerings based on installations from 2019. This will continue 'rolling' evaluation efforts, where each year will evaluate roughly 1/3 of the number of sites needed for a full sample and results will be combined with results from the previous two years, which will keep the realization rates updated yearly. This study was scheduled to begin in summer 2020, but site work was delayed due to COVID-19-related restrictions, extending the timeline into 2021.

e. RI-21-CE-CustElecPY20 – Impact Evaluation of PY2020 Custom Electric Installations

The objective of this impact evaluation is to provide verification of electric energy savings estimates for a sample of both lighting and non-lighting custom electric projects through site-specific inspection, metering, and analysis. The results of this study will be used to determine the realization rates for custom electric energy efficiency offerings based on installations from 2020. This will continue 'rolling' evaluation efforts, where each year will evaluate roughly 1/3 of the number of sites needed for a full sample and results will be combined with results from the previous two years, which will keep the realization rates updated yearly. This study is scheduled to begin in summer 2021.

f. RI-21-CX-ISPBaseline – Commercial and Industrial ISP and Baseline

This study will encompass multiple quick-hit analyses to resolve issues related to industry standard practice (ISP) and measure baselines. Traditionally, much of this work is adopted from Massachusetts, and adjustments must be made to account for Rhode Island building codes and markets. Examples include lighting ISP and cannabis growing facility ISP.

g. RI-20-CE-UpstrLight – Upstream Lighting Impact Analysis (continued from 2020)

The objective of this impact evaluation is to provide verification of electric energy savings estimates for a sample of upstream lighting projects through site-specific inspection, metering, and analysis. The results of this study will be used to determine the impact savings factors that will apply to upstream lighting offerings. This study will leverage a parallel Massachusetts study, and the final sample will include projects at National Grid customer sites in both Rhode Island and Massachusetts. This study began in 2020 and is rolling into 2021.

3.2 Residential Planned Evaluation Studies in 2021

a. RI-21-RX-Participation – Energy Efficiency Participation and Census Study

The first objective of this study is to assess customer participation in Rhode Island residential energy efficiency programs from 2016 to 2020. The study will describe historical participation, characterize customers that participate in energy efficiency programs and identify customer segments that are potentially underrepresented to inform the RI-21-RX-NPStudy Non-Participant Study. The participation study will rely on secondary data such as the Company's

customer/billing data, program tracking data and third party data and may include assessment by geography, income, home ownership, and others.

A second component of this research will involve a census study and the development of a database which will identify properties, including low-rise and high-rise multifamily buildings, in Rhode Island. The database will be leveraged by internal teams within the Company to identify opportunities for Rhode Island's programs by understanding the population of customers/properties in the state.

b. RI-21-RX-NPStudy – Non Participant Market Barrier Study

The study will provide in-depth research on non-participants to characterize customers that have not participated in the programs, assess barriers to participation and identify engagement opportunities. The study will use multi-mode surveys (web, phone, mail) and in-depth interviews designed to understand non-participants' attitudes, needs and perceptions. This study will build on the Residential Non-Participant Market Characterization and Barriers Study[5] recently conducted in Massachusetts.

c. RI-21-RX-CSNC - Residential New Construction Baseline and Code Compliance Study

The objective of this research is to conduct a baseline study of Rhode Island homes built after the 2018 IECC code cycle and to develop a new User Defined Reference Home (UDRH). The study will assess gross savings for REM/Rate-modeled program homes against the new UDRH and will evaluate compliance rates used to estimate attribution for Codes programs.

d. RE-21-RE-AppRecycling – Appliance Recycling Impact Factor Update

The objective of this research is to update savings assumptions for the Appliance Recycling program by drawing on the characteristics of recycled units as reported in the 2019/2020 Rhode Island program tracking data. The study will identify the current characteristics of refrigerators and freezers being recycled through the program and calculate per-unit gross energy savings (measured as unit energy consumption or UEC), adjusted gross savings, and net savings. The study may also update savings assumptions for dehumidifier recycling.

[5] http://ma-eeac.org/wordpress/wp-content/uploads/MA19R04-A-NP-Nonpart-MarketBarriersStudy_Final.pdf

e. RI-21-RE-EVDR– EV Demand Response Program Evaluation

The objective of this study is to evaluate a newly introduced electric vehicle charging program. If approved through this Plan, the summer of 2021 would be the first year of introduction. The goal of the study would be to review all portions of the program in order to find improvements as early as possible. The impact portion would focus on verifying the demand savings occurring due to specific events called by the program. The process portion will survey program participants, along with the current vendor, National Grid implementer, and the specific participating car manufacturers to gather feedback on ways to improve program delivery.

f. RI-21-RX-Others– Follow-up Research on Potential Study Issues

This is a placeholder for follow-up research on additional study issues that may arise in the residential sector if needed by the programs.

g. RI-21-RG-GasHPDemo – Gas Heat Pump Demonstration Evaluation

This study will assess the savings potential for a possible new measure offering, gas heat pumps. The savings will be used to determine if the measure is cost effective. Furthermore, the study will review and determine if this technology is market ready and should be considered as a measure to be included as a full program offering. Some key questions will be how efficient these units work at different temperatures, do they perform close to their rated efficient and can they be the sole heating source of a home.

h. RI-21-RE-SolarDRDemo – Solar Inverter Direct Load Control Demonstration Evaluation

This study will assess the solar inverter direct load control demonstration offering. The goals of this study are to determine the effectiveness of adjusting the power factor in order to minimize the losses associated with converting the solar power to power that can be used for electricity, evaluate energy savings, and determine if this technology is ready to be offered as a full demand response program offering.

3.3 Cross-Sector/Other Planned Evaluation Studies in 2020

a. RI-20-XG-GasPeak – Gas Passive Peak Demand Savings (continued from 2020)

The objective of this evaluation study is to determine the percentage of gas energy savings that occur during peak days and, assuming availability of necessary data, peak hours. The research area will be broken up into two studies – one for Residential and another for C&I. The C&I and Residential studies will bucket savings for the specific sector into end use categories of heating, water heating, cooking and other. The results of this study will be used to determine the passive peak gas savings that occur due to energy efficiency activities by applying the end use percentage of gas passive peak energy savings to actual end use gas savings that occur in future years. The C&I study is expected to be completed at the end of 2020 while the residential study is expected to be completed in the fall/winter of 2021.

b. RI-21-XX-Jobs – Workforce Associated with Rhode Island Energy Efficiency Programs Analysis Study

The study will identify the workforce associated with National Grid's energy efficiency programs and services delivered in Rhode Island to electricity and natural gas customers. Similar to the workforce studies conducted from 2013 to 2019, the study will survey the Company, vendors, distributors, partners, and market players to quantify the number of jobs and amount of business activities associated with energy efficiency programs in 2020. This study addresses the requirements of General Law 39-2-1.2, enacted by the Rhode Island General Assembly in 2012, and is conducted annually.

c. RI-20-CX-SEM – Strategic Energy Management Demonstration Evaluation (continued from 2020)

The objective of this evaluation is to review the methodologies and processes used to obtain and calculate the savings claimed. The results of this study will assist in monitoring and making continuous improvements to the demonstration.

d. RI-20-XX-AESCost - Avoided Cost Study, Gas & Electric **(continued from 2020)**

This study will provide updated avoided costs in support of determining least cost procurement decisions through the benefit-cost screening process. With the recent fluctuations in energy pricing, the study will re-affirm the long term energy cost estimates. The study is being conducted with regional program administrators.

4. Evaluation Study Findings

RI-20-RE-UpstrLight – Residential Lighting Market Assessment - 2019 Rhode Island Shelf Stocking Survey

Type of Study: Market Assessment Study

Evaluation Conducted by: NMR

Date Evaluation Conducted: August 7th, 2020

Evaluation Objective and High-Level Findings:
The objectives of this study were to assess the following indicators at Rhode Island retailers which participated in National Grid's residential lighting program in 2016–2019:

- Total shelf share dedicated to lighting over time by channel
- The amount of shelf share dedicated to screw-based LED, CFL, halogen, and incandescent lamps by channel
- The pricing (on a per bulb basis), number of bulb packages, and shelf locations of screw-based LED, CFL, halogen, and incandescent lamps by channel
- Differences in pricing and availability for screw-based LED ENERGY STAR® vs. Non-ENERGY STAR products by channel
- The amount of shelf share dedicated to linear lamps (LED vs. fluorescent) by channel

The key findings are summarized below:

- LED shelf share has increased steadily since 2016, whereas CFL and Halogen shelf shares have decreased slowly. Although much lower than in 2017, incandescent shelf-share is second only to LEDs.
- In the past year, Hardware and Home Improvement shelf share for LEDs increased 16% (from 44% to 60%) and 9% (from 63% to 72%), respectively.
- The amount of space dedicated to light bulbs in general continues to decrease in most channels (Table 3). This indicates that retailers are shifting shelf space to non-lighting products, perhaps due to the longevity of LEDs vs. incandescent and halogen bulbs.
- Hardware, Drug, and Grocery stores continue to devote approximately two-fifths of shelf share to inefficient bulbs: 40%, 47%, and 43%, respectively (Table 6). In contrast, Discount, Home Improvement, and Mass Merchandise stores devote 30% or less of their lighting shelf space to inefficient bulbs.
- In general, most of the incandescent and halogen bulbs represent categories currently subject to the EISA of 2007 (i.e., Phase I). In addition, while most (71%) of these halogen bulbs meet Phase I efficacy requirements, a very small portion (2%) of the incandescent bulbs do.
- No incandescent or halogen bulbs on store shelves would meet the 45 Lm/W backstop (Phase II).

- The average prices of all technologies, except LEDs, have increased since 2016. This makes LEDs an increasingly viable option. Note that LED prices in all years include the application of incentives, so removal of incentives will boost the LED shelf prices, but sales data research indicates that LED prices have trended downward regardless of incentives.
- LED prices decreased by more than half at Hardware (54%) and Discount stores (73%).
- Smart LED prices decreased for the first time in three years.
- After falling steeply for the past three years, prices of globe and reflector LEDs stabilized or increased in 2019. A-line prices also appear to have stabilized, but candelabra prices continue to fall.

Programs to which the Results of the Study Apply:
Residential Electric ENERGY STAR® Lighting – Upstream

Evaluation Recommendations included in the study:
No formal recommendations resulted from this evaluation.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
N/A

Savings Impact:
This study has no direct impact on claimable savings.

MA-19R09-E-Delta Watt Update

Type of Study: Impact Study (Delta Watts)

Evaluation Conducted by: NMR

Date Evaluation Conducted: March 26th, 2020

Evaluation Objective and High-Level Findings:
This evaluation was conducted on behalf of the Massachusetts Program Administrators (PAs) to update some of the inputs used to calculate LED delta watts in the RLPNC 17-6 Lighting Market Adoption Models (MAMs). The equivalent wattage of bulbs with similar lumen output and the sales weights based on program tracking data tie delta watts directly to program sales. The PAs and EEAC Consultants updated these equivalent wattage bins and sales weights in 2018, and this study repeats that process for data covering January through October of 2019. This study also updates delta watts for linear fixtures sold through the program over the same time period.

The key findings are summarized below:
Updating the wattage by bulb type and upstream sales share based on actual 2019 LED sales resulted in increased delta watts for GSL and decreased delta watts for reflectors and specialties (Table 1). These changes are based on differences in the lumen output of bulbs purchased through the program in 2019 versus 2018 as well as improved prediction of reflector and specialty halogen wattage equivalence. Generally, relative to 2018, through the upstream program, consumers purchased a higher proportion of high equivalent wattage LEDs in the GSL categories, moderate equivalent wattage LEDs in the reflector category, and lower equivalent wattage LEDs in the specialty category.

Table. MAM Upstream Gross Delta Watt Comparison 2017 – 2019

Bulb Type and MAM Year	Delta Watts[1]						
GSL 2017	33	34	34	34	34	34	35
GSL 2018	36	38	38	38	38	38	38
GSL 2019	38	38	40	40	40	40	40
Reflector 2017	46	46	47	47	47	47	47
Reflector 2018	45	45	46	46	46	46	46
Reflector 2019	43	43	43	43	44	44	44

Specialty 2017	37	37	38	39	39	40	40
Specialty 2018	40	41	41	42	42	42	43
Specialty 2019	34	34	35	35	36	36	36

[1] Note: All values rounded to nearest watt. Values are not rounded in the attached MAM Excel files.

Programs to which the Results of the Study Apply:
Residential Electric ENERGY STAR® Lighting – Upstream

Evaluation Recommendations included in the study:
No formal recommendations resulted from this evaluation.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
N/A

Savings Impact:
The impact of this study varied by bulb type. The delta watts increased for general service lamps but decreased for both reflectors and specialty bulbs.

MA-20R21-E Residential Lighting Hours-of-Use Quick Hits Study

Type of Study: Impact Study

Evaluation Conducted by: NMR

Date Evaluation Conducted: March 31st, 2020

Evaluation Objective and High-Level Findings:
This study re-analyzed metered HOU data collected as part of the 2014 Northeast HOU study to take into account the effects of efficient lamp saturation on HOU, as well as exploring and addressing the distribution of HOU. The revised model was applied to recent lighting inventory data (RLPNC 18-10) to produce estimated HOU values. The study also calculated the percentage of sockets whose HOU rounds to zero by room type and by efficient vs inefficient lamps to account for the distribution bump at zero. Using the state-wide collaborative process, the PAs and EEAC consultants then came to a consensus on how the HOU values would be implemented.
The key findings are summarized below:

- HOU distribution was right skewed and bounded between zero and 24 hours of use per day. While the validity of ordinary least squares (OLS) regression does not hinge on the normality of the underlying distribution, significant departures from a normal distribution can yield estimates and inferences that lack the typically assumed characteristics of OLS regression. Therefore, a transformation was performed on the 2014 HOU data to find a transformation which would allow the HOU distribution to more closely approximate normality.
- Updated model found smaller difference between efficient and inefficient HOU. The 2014 Northeast HOU study provided a point estimate for inefficient lamps (2.3) that was 23% lower than efficient lamps (3.0). Using the model created as part of this study and the 2018 saturation values, the difference was smaller with a 10% difference in HOU between inefficient (2.58) and efficient (2.86).
- Saturation and demographic factors significant in model. Room type, education, tenure, the total number of sockets, and efficient lamp saturation variables for each room type were all found to be significant in the model and were used in the final model.
- Changes in saturation by room type decreased HOU. When the revised model was applied to the most recent lighting inventory data, estimated efficient HOU decreased relative to original lighting data included in the 2014 study. This was driven by relative changes in and the inventory of efficient lamps across room types. The number of efficient lamps in rooms with lower HOU is higher in the 2018 saturation data compared to the data used for the 2014 study.
- HOU appears to increase as energy efficient saturation by room type increases. Models prepared as part of this study to explore the relationship between HOU and saturation revealed a positive and significant relationship between saturation and HOU. This relationship persisted across a variety of models and variable combinations. This finding is counterintuitive and runs counter to a previous study conducted in California, and it

highlights the complexity of the relationship between HOU and individual behavior. Possible explanations include customers with higher overall HOU tending to purchase more energy efficient lamps, and snapback behavior with customers increasing the use of lamps as saturation increases and the cost to operate lamps decreases. With no strong or compelling reasoning behind this phenomenon, care must be taken when drawing any conclusions. Additional work needs to be performed to develop a more complete understanding of the relationship.

- Inefficient lamps comprised a greater proportion of rarely used lamps (less than 0.5 daily HOU). Overall, 20% of lamps were used for less than 30 minutes a day, based on weighted metering data (pre-modeled). Efficient lamps accounted for 45% of the low-use lamps, which was lower than their portion of the entire sample of metered lamp (52%). Not surprisingly, closets had the highest proportion of low-use lamps (66%), and kitchens and the home's exterior tied for the lowest proportion of low-use lamps (10%). Inefficient lamps accounted for the majority of low-use lamps in all room types except kitchens and basements.
- Efficient lamps account for a sizeable portion of replaced lamps. Based on lamp replacement behavior observed as part of the 2018-19 Market Assessment Study, 43% of replaced medium screw-base lamps were efficient (33% CFLs and 10% LEDs) and 57% were inefficient (46%incandescent and 11%).
- Consensus process considered both inefficient and efficient HOU, adjusted for saturation rates in the 2018 to 2019 Lighting Market Assessment (RLPNC 18-10). At a meeting led by the DNV GL team, the PAs and EEAC Consultants agreed to the use of the rounded inefficient HOU (2.6) for direct install and turn-in programs and combined efficient and inefficient HOU (2.7 – unadjusted for cross-sector sales and 3.0 after adjusting for cross-sector sales) for upstream programs for the full 2019 to 2021 program cycle.

Programs to which the Results of the Study Apply:
Residential Electric ENERGY STAR® Lighting – Upstream

Evaluation Recommendations included in the study:
Recommendation: The PAs and EEAC Consultants should apply the consensus-derived HOU for the 2019 to 2021 program cycle. Rationale: The re-analysis of the original 2014 metering data considered additional factors and relied on a modelling approach more appropriate to the distribution of HOU. The PAs and EEAC Consultants carefully considered the results and reached consensus on recommended values. For the upstream program offering, general service, reflectors and specialty bulbs were calculated to be operated at 3.0 hours per day.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
Yes the results for this study were formally adopted and used to calculate the savings.

Savings Impact:

The overall impact of this study reduced the hours of operation in comparison to 2020. As a result, annual gross savings were reduced.

Rhode Island Compliance Training and Building Permit Review

Type of Study: Process

Evaluation Conducted by: NMR Group, Inc

Date Evaluation Conducted: March 2020 – August 2020

Evaluation Objective and High-Level Findings:
The objectives of this study were to (1) document trainings held by Rhode Island Code Compliance Enhancement Initiative between 2017-2019 and (2) review online residential and commercial building permits to explore extent of measure-level energy efficiency data available through online databases.

Programs to which the Results of the Study Apply:
Residential Energy Star Homes & C&I New Construction

Evaluation Recommendations included in the study:
This study recommended ways that online permit data can be improved so that it can be leveraged in future studies. These recommendations include:

- Encourage all municipalities to implement the OpenGov online building permit database system to streamline data access and provide consistency across municipalities.
- Encourage all municipalities to enable record searching on their online building permit databases.
- Encourage all building departments to require the filing of building plans, blower door results, duct blaster results, HERS certificates, and REScheck results as attachments to residential new construction building permits.
- Encourage building departments to require the filing of building plans and COMcheck results as attachments to commercial new construction building permits.
- Encourage building departments to require detailed mechanical permits including heating cooling, and water heating equipment model numbers or equipment type, capacity, fuel, and efficiency for residential and commercial new construction.
- Encourage requiring filing of duct leakage to outside results in addition to total duct leakage results for residential new construction permits.
- If possible, create a flag for new construction in the online database and allow searching for records that are new construction rather than only allowing searching by address.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:

- The Company will promote use of the OpenGov permit database and enabled record searching when engaging with municipalities that have not adopted these practices, including during Code Compliance Enhancement Initiative (CCEI) training activities.

- The Company will coordinate with State staff supporting the OpenGov database to explore opportunities to facilitate or require entry of the data fields, files, and tags identified in the Recommendations, such as funding database development work.

Savings Impact:
This study has no direct impact on claimable savings.

RI-20-RX-EWSF Impact - Impact Evaluation of EnergyWise Single Family Program

Type of Study: Impact

Evaluation Conducted by: Cadeo/Illume

Date Evaluation Conducted: September 4, 2020

Evaluation Objective and High-Level Findings:
The key objective of this evaluation was to verify gross and net energy savings for measure groups installed in 2017-2018 through the EnergyWise Single Family Program. The tables below summarize the results of this evaluation:

Table 6. EWSF - Ex Post Gross Savings by Measure and Fuel[19]

Measure Group	Measure	Electric (kWh/year)	Natural Gas (therms/year)	Oil (MMBtu/year)	Propane (MMBtu/year)
Domestic Hot Water	Aerators	28	1.4	.15	.14
	-Water Savings (gal)	269	269	269	269
	Showerhead	213	11	1.2	1.1
	-Water Savings (gal)	1,565	1,565	1,565	1,565
	Pipe Wrap/Insulation	46	3	0.3	0.3
Lighting	LED Bulbs	18**			
	LED Specialty/EISA Exempt	15**			
	LED Reflectors	19**			
	LED Fixtures	34**			
Controls	Programmable Thermostat (Heating Savings)	214.6	32	3.3	3.2
	-Fan/pump Savings (kWh)	6	19	19	19
	-Cooling Savings# (kWh)	2	8	8	8
	Wi-Fi Thermostat (Heating Savings)	214.6	32	3.3	3.2
	-Fan/pump Savings (kWh)	6	19	19	19
	-Cooling Savings# (kWh)	2	8	8	8
	Wi-Fi Thermostat (Cooling Only)	51			
Appliances & Plug Load	Refrigerator Rebate	914			
	Refrigerator Brush	10.9			
	Smart Strip	105			
	Smart Plugs°	-			
Weatherization	Air Sealing Kit	94	3.7	0.38	0.38
	Weatherization (Heating Savings)	803	96	9.8	9.6
	-Furnace Fan Savings (kWh)	10	32	32	32
	-Cooling Savings^ (kWh)	27	16	16	16
Early Retirement	Room Air Conditioner°	161			
	Dehumidifier°	159			
	Clothes Washer°,*	Varies; see engineering workbook for details			

*Includes various combination of water heating and dryer fuel types
**Net savings, not gross
°Not offered in 2017/2018; estimating savings for prospective use only.
#Only relevant for central air conditioners (CAC); per-unit savings are weighted to reflect prevalence of CACs for EWSF participants (11%)
^Relevant for all cooling types; per-unit savings are weighted to reflect prevalence of CACs, room air conditioners, and no air conditioning

Table 9. EWSF – Net-to-Gross Ratios (Measure Group)

Measure Group	Relevant Measures	Sample Size	Freeridership	Spillover	NTG
Domestic Hot Water	Showerheads, Aerators, & Pipe wrap	52	0.27	0.01	0.74
Appliances & Plug Load*	Smart Power Strips	163	0.31		0.70
Controls	Programmable & Wi-Fi Thermostats	40	0.47		0.54
Weatherization**	Air Sealing & Insulation Types	151	0.14		0.87

*Too fewer refrigerator rebates in 2017/18 to assess NTG
**No statistically significantly different results by fuel type

Table 11. EWSF – In-Service Rates (Measure Group)

Measure Group	Relevant Measures	Sample Size	Installed	Removed	In-Service Rate
Domestic Hot Water	Faucet Aerators, Showerheads, Pipe Wrap	45	242	5	98%
Appliances & Plug Load	Smart power strip*	246	415	66	84%

*Based on the total number of smart power strips left for participants to install (not the subset of units that participants went on to install). Also, as noted above, a recent study in Massachusetts determined that 8% of strips are improperly installed. As a result, National Grid should apply a 92% realization rate (in addition to this ISR - and NTG rate) when calculating the net savings for smart strips.

Programs to which the Results of the Study Apply:
Residential Electric and Gas EnergyWise – Single Family

Evaluation Recommendations included in the study:
Use gross savings, in-service rates and net-to-gross values developed as part of this study for 2021-2023 program planning.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid has adopted the gross savings, in service rates and net to gross values from this study.

Savings Impact:
The application of study results will decrease the claimable electric and gas savings from the Residential EnergyWise Single Family Program.

RI-20-RX-EWSF Process Evaluation of EnergyWise Single Family Program

Type of Study: Process

Evaluation Conducted by: Cadeo/Illume

Date Evaluation Conducted: September 4, 2020

Evaluation Objective and High-Level Findings:

This study assessed overall effectiveness of program delivery to provide actionable recommendations to prospectively increase cost-effectiveness, participation rates and customer satisfaction of the EnergyWise Single Family program. The key findings of the process evaluation are summarized below:

Participants had a positive program experience. 92% of participants reported they were satisfied with their experience in EWSF. In another indicator of satisfaction, 97% of participants said they would recommend the program to a family or friend. Also, 72% of EWSF participants shared that their experience in the program favorably changed their perception of National Grid (26% said it did not change their existing perception and only 2% said their experience had a negative impact.)

Stakeholders credit RISE for creating a high functioning program environment. Assessor and contractors consistently cited RISE's responsiveness to their feedback and effort to improve EWSF for participants and program stakeholders alike. Contractors appreciate RISE's management of the program and are satisfied with the steady way they get new weatherization jobs through RISE. Several assessors mentioned that they feel like RISE is supportive and listens to their feedback and is committed to making the program a positive experience for assessors as well as participants.

Participants increasingly know what they want. Assessors observed that an increasing number of EWSF participants sign up for the assessment knowing they want to get their home weatherized or specifically to access the HEAT loan financing for a heating system upgrade. Assessors noted that, in the past, most participants were unsure of what their home needed prior to the assessment or what the program could do for them. The results of the participant survey supported this observation; 80% of participants cited access to weatherization incentives as very important in their decision to get an assessment. This finding is consistent with a maturing program and indicate that National Grid's ongoing marketing efforts are building familiarity with the program and its offerings.

Health and safety barriers remain problematic — for participants and contractors. According to program records, assessors identified a health and safety barrier in nearly two-thirds (64%) of EWSF homes in 2019. Of these participants, only 21% went on to weatherize their home, a

lower weatherization rate than participants that did not face a health and safety barrier (43%) or for EWSF participants overall (25%). However, the program data showed that 57% of participants who weatherized their home in 2019 overcame at least one health and safety barrier, which is encouraging. Assessors expressed frustrations that they, per program guidelines, could not provide participants with more direct guidance to help them remediate identified barriers. Specifically, assessors frequently mentioned that they wished they could recommend specific remediation contractors or at least provide participants with a list of program-approved remediation contractors. Assessors felt that putting the onus on customers to identify and engage remediation contractors themselves caused a drop-off in participation.

Opportunities exist to serve delivered fuel customers more comprehensively. Assessors consistently noted the program's current inability to incentivize energy optimization measures, such as ductless mini-splits that enable participants with an inefficient oil and/or propane heating system, to switch to a high efficiency electric or gas option, prevents many participants from taking action. . According to assessors, bringing back the incentives previously offered for ductless mini-splits and/or allowing delivered fuel customers to finance heating system upgrades (to more efficient delivered fuel systems or to a high efficiency electric or gas option) would unlock much of the unrealized savings opportunities they identify in EWSF participating homes. However, the decision to incentivize energy optimization measure resides with the Public Utilities Commission, not National Grid.

The 100% landlord incentive has increased rental property participation. Program managers and assessors alike reported that the increase to a 100% renter/landlord incentive (in 2019) has enabled the program to reach previously hard-to-access rental properties. Program data support their statements: 12% of participants in 2019 lived in a rental property, a 50% increase over 2017 and 2018 (8%). Assessors also shared that the paperwork and coordination necessary to get renters and landlords on the same page can be tricky because the landlords often live elsewhere, or the renters are not overly engaged in the process.

Virtual assessments are promising but stakeholders share a healthy skepticism. Assessors shared that participants seem to enjoy and engage in virtual assessments. Assessors themselves also appreciate the streamlined and shortened assessment process, particularly the time they save for themselves (e.g., traveling to homes) and customers (e.g., scheduling 45-minute assessment during work day rather than taking time off work for a 2 ½ hour appointment). Assessors mentioned that the virtual process is much easier for straightforward home layouts (e.g., ranch style home) whereas it can be problematic for older homes of certain styles (e.g., Victorians). Assessors, program managers, and contractors expressed a healthy skepticism regarding accuracy of virtual assessments relative to in-home assessments; they are all curious to see whether the virtual assessment yields sufficiently accurate weatherization scopes of work and adequately identifies pre-weatherization barriers. Assessors noted that while the verdict will be out until contractors go back on site in greater numbers, they are optimistic that there is a place for the virtual assessments in the program long-term.

Programs to which the Results of the Study Apply:
Residential Electric and Gas EnergyWise – Single Family

Evaluation Recommendations included in the study:

Recommendation 1: Leverage word-of-mouth program awareness through realtors or home inspectors. Many assessors noted that participants who recently purchased their home frequently heard about the program through their realtor or home inspector. National Grid should cultivate relationships and provide EWSF marketing materials to local realtors and inspectors to increase new home buyer participation and encourage customers to act early in their time in the home to maximize the return on their efficiency improvements

Recommendation 2: Increase facilitation of health and safety barrier remediation. Assessors and participants described the difficulty of remediating health and safety issues and expressed a desire for more support from the program. Specifically, National Grid should work with RISE to (1) Create a list of approved electricians and/or increase RISE's ability to handle some barriers, (2) Providing informational materials explaining issues and step by step process to address issue, or (3) Raise $250 incentive for certifying knob and tube deactivation to encourage more contractors to undertake these critical inspections.

Recommendation 3: Identify the optimal long-term role for virtual assessments. Though there is some uncertainty, stakeholders assert that there is a place for virtual assessments long-term. Virtual assessments may be more successful depending on the type or layout of home and participant engagement. National Grid should identify the optimal role for virtual assessments long-term by experimenting with deploying virtual assessments participant segments including participants with straightforward home types or by participant interest or need (scheduling need, safety need etc.). Offering a mix of in-home and virtual assessments may yield similar savings with lower program delivery costs. Future evaluations could embed more research specifically related to virtual assessments and virtual program components overall. Evaluation research focused on virtual assessments could help inform program design and delivery issues, as well as how virtual processes implemented for assessments could be leveraged for other program components. This type of assessment has implications for both process and impact evaluation components, given issues related to direct versus self-install of energy efficient measures.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid will review and consider the recommendations in program planning.

Savings Impact:
This study has no direct impact on claimable savings.

RI-20-RX-EWMF Impact - Impact Evaluation of EnergyWise and Income Eligible Multifamily Program

Type of Study: Impact
Evaluation Conducted by: Cadeo/Illume
Date Evaluation Conducted: Anticipated in September 2020

Evaluation Objective and High-Level Findings:

The key objective of this evaluation was to verify gross and net energy savings for measure groups installed in 2017-2018 through the EnergyWise Multifamily and Income Eligible Multifamily Program. The tables below summarize the results of this evaluation:

Table 1. MF - Ex Post Gross Savings by Measure and Fuel[1]

Measure Group	Measure	Electric (kWh/year)	Natural Gas (therms/year)	Oil (MMBtu/year)
Domestic Hot Water	Aerators	38	2.0	0.2
	-Water Savings (gal)	359	359	359
	Showerhead	246	13	1.4
	-Water Savings (gal)	1,786	1,786	1,786
	TSV Showerhead	315	16	1.7
	-Water Savings (gal)	2,254	2,254	2,254
	Pipe Wrap/Insulation (per foot)	8.3	.5	.05
Lighting (Common Area)	LED Fixture (Interior)	206		
	LED Bulbs (Interior)	179		
	LED Reflector (Interior)	140		
	LED Fixture (Exterior)	503		
	LED Bulbs (Exterior)	162		
	LED Reflector (Exterior)	210		
Lighting (In-unit)	LED Bulbs	18		
	LED EISA EXEMPT	15		
	LED Reflectors	19		
	LED Fixtures	34		
Controls	Programmable Thermostat (Heating Savings)	249	15	1.6
	- Fan/pump Savings (kWh)	14	14	14
	-Cooling Savings# (kWh)	15	15	15
	Wi-Fi Thermostat (Heating Savings)		23	
	-Fan/pump Savings (kWh)		22	
	-Cooling Savings# (kWh)		9	
Appliances & Plug Load	Refrigerator Rebate	914		
	Smart Strip	105		
	Weatherization (Heating Savings)	CV	CV	CV
Heating System	Boiler (Residential & Commercial)		CV	

#Per-unit savings weighted to reflect prevalence of CACs for MF participants

Table 1. EWMF – Net-to-Gross Ratios (Measure Group)

Measure Group	Relevant Measures	Sample Size (EWMF)	Free-ridership	Sample Size* (Adjusted)	Freeridership* (Adjusted)	Spillover	NTG
Appliances & Plug Load	Smart Power Strips	2	0.32	163	0.31		0.70
Controls	Programmable & Wi-Fi Thermostats	19	0.48	-	-		0.53
Domestic Hot Water	Showerheads, Aerators, & Pipe wrap	25	0.08	-	-	0.01	0.93
Lighting - Common Area	LED bulbs or fixtures in common areas	1	0.40	72	0.23		0.78
Weatherization	Air Sealing & Insulation Types	28	0.33	-	-		0.68

*Because of the low n for these EWMF measure groups, the evaluation team used values from the EWSF evaluation for the Appliance and Plug Load measure group and values from the MA Res 44 evaluation for the Common Area Lighting measure group.

Table 1. MF – In-Service Rates (Measure Group)

Measure Group	Relevant Measures	Sample Size	Installed	Removed	In-Service Rate
Domestic Hot Water	Faucet Aerators, Showerheads, Pipe Wrap	27	69	7	90%
Appliances & Plug Load*	Smart power strip	246	415	66	84%
Controls	Programmable or Smart (Wi-Fi) thermostat	20	42	2	95%

*Based on the EWSF in-service rate due to insufficient EWMF responses for that measure group.

Programs to which the Results of the Study Apply:
Residential EnergyWise Electric and Gas - Multifamily
Residential Income Eligible Electric and Gas - Multifamily
C&I Retrofit Gas - Multifamily

Evaluation Recommendations included in the study:
Adopt the gross savings, in-service rates and net-to-gross (not applicable to Income Eligible Multifamily) values developed as part of this study for 2021-2023 program planning.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid has adopted the gross savings, in service rates and net to gross values from this study.

Savings Impact:
The adoption of study results led to an increase in electric savings for the Income Eligible Multifamily program and a decrease in electric savings for the EnergyWise Multifamily program. For gas, the results led to a decrease in savings for both multifamily programs.

RI-20-RX-EWMFProcess – Process Evaluation of EnergyWise and Income Eligible Multifamily Program

Type of Study: Process

Evaluation Conducted by: Cadeo/Illume

Date Evaluation Conducted: Anticipated in September 2020

Evaluation Objective and High-Level Findings:

This study assessed overall effectiveness of program delivery to provide actionable recommendations to prospectively increase cost-effectiveness, participation rates and customer satisfaction of the EnergyWise Multifamily and Income Eligible Multifamily programs. The key findings of the process evaluation are summarized below:

Overall program satisfaction among participants is high. Among residents, 86% reported that they were very, somewhat, or moderately satisfied with the program overall. Building owners and managers are also satisfied with the program overall.

Contractors, assessors, and inspectors believe the program works well, and report satisfaction with these relationships. Stakeholders did not have many suggestions for program improvement, suggesting that program processes are generally working well. Program stakeholders described the trusting relationships that they have with one another, and how this contributes to their overall satisfaction.

RISE assessors and inspectors reported that the MF paperwork is burdensome. This is, in part, because MF assessors and inspectors must still complete all program paperwork in hard copy, via paper and pen. By contrast, EWSF digitized its paperwork a year ago with the introduction of iPads, which EWSF assessors noted had substantially increased their efficiency. MF assessors noted the improvement for EWSF and speculated that a similar transition to digital paperwork would yield similar benefits for the MF program.

Some program participants reported needing more help to overcome health and safety barriers. These participants wanted additional support, including more specific guidance on how and who could help them remediate the identified health and safety barriers so they could move ahead with their efficiency upgrades. As the program continues to mature, it may become more important to help these types of participants, in order to unlock future energy savings opportunities.

Some participants expressed frustration that they did not receive certain measures that they expected, particularly related to smart thermostats and lighting. While participants receive a report that includes the measures they qualify for, the report does not explicitly detail measures

customers did not qualify for. This information tends to be communicated verbally by MF staff, which led to confusion, uncertainty, or disappointment among participants.

A subset of residents expressed concerns about their experience with their installation contractor. Almost one in five surveyed residents noted messes left behind, a lack of professionalism, and the inability of their installers to answer questions. While the current inspection process tracks and reports installation quality-related issues, further, the program also conducts customer satisfaction surveys and program staff report that RISE follows up with contractors who get poor customer reviews.

The program quickly transitioned to virtual assessments in response to the COVID-19 pandemic. Program stakeholders generally think there is a role for virtual assessments in future versions of the MF program. In fact, MF inspectors suggested that there might even be an expanded role for virtual work in certain types of inspections. However, nearly all program stakeholders also expressed some level of skepticism about virtual assessments, primarily about the program's ability to accurately assess complex buildings without a physical inspection.

National Grid program staff are interested in exploring alternative program models. The Massachusetts Program Administrators have transitioned to a residential coordinated delivery structure that integrates single-family and multifamily solutions. As described in this report, some customers fall into a "gray" area in terms of service – specifically, customers within what are technically classified as multifamily condominium properties, yet the individual condominium homes are single family-style homes. The goal of a potential new structure in Rhode Island would be to identify and develop better solutions for these customers.

Programs to which the Results of the Study Apply:
Residential EnergyWise Electric and Gas - Multifamily
Residential Income Eligible Electric and Gas - Multifamily
C&I Retrofit Gas - Multifamily

Evaluation Recommendations included in the study:
To be updated in the next draft when study is finalized

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
To be updated in the next draft when study is finalized

Savings Impact:
This study has no direct impact on claimable savings.

RI-20-RX-HERImpact – Impact Evaluation of the 2017-2019 Home Energy Reports Program

Type of Study: Impact

Evaluation Conducted by: Cadeo/Illume

Date Evaluation Conducted: August 28, 2020

Evaluation Objective and High-Level Findings:
The objective of this study was to evaluate how much electricity and natural gas the Home Energy Reports (HER) program saved in Rhode Island from 2017 to 2019. The evaluation team used monthly customer billing data to estimate electricity and natural gas savings for the program overall and for specific customer sub-groups.

From 2017 – 2019, the program achieved adjusted net energy savings of 86,092 MWh and 2,804,768 therms over the three-year period with overall realization rates of 98% for electric savings and 84% for gas savings. Among waves with electric service, the overall realization rate of evaluated net ex post savings to implementer-estimated savings is 108% for Existing Customers and 67% for New Movers. Among waves with gas service, overall realization rates are 92% for Existing Customers and 50% for New Movers (see table below).

Table 1. Summary Program Results

2017 – 2019 Net Savings	Electric Savings (MWH)		Gas Savings (Therms)	
	Existing Customers	New Movers	Existing Customers	New Movers
Evaluated Ex Post [a]	71,895	14,197	2,493,023	311,745
Implementer-Estimated Ex Post [b]	66,719	21,046	2,700,289	629,629
Realization Rate [c]	**108%**	**67%**	**92%**	**50%**

[a] Evaluated savings that have been adjusted for savings attributable to participation in other energy efficiency programs. These are energy savings attributable to HERs that would not have occurred in the absence of the program.
[b] The program implementer provides monthly savings estimates by wave in a monthly report. National Grid adds up the monthly savings estimates for an annual total.
[c] The ratio of adjusted net ex post savings to implementer-estimated ex post savings.

Savings estimates for New Mover and for some Existing Customer waves and years were not statistically significant. Among Existing Customer waves, savings from older and larger waves were more likely to be statistically significant, while newer waves or those with smaller treatment and control groups were not. As expected, due to the small wave sizes and limited baseline data for New Mover waves, the evaluation team and program implementers' savings estimates for New Mover waves were not statistically significant. However, with an RCT design,

the point estimate is still the best unbiased estimate of savings even if it is not statistically significant.

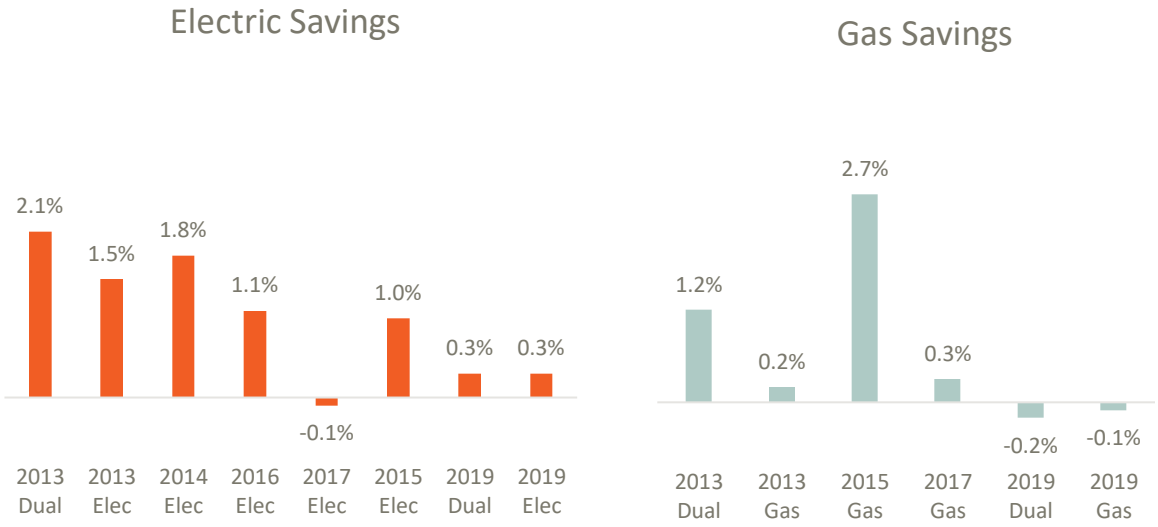
Realization rates fluctuate across waves, years, and evaluation cycles; however, implementer-reported 2017 – 2019 savings generally fall within the evaluation team's unadjusted savings confidence intervals.6 A combination of factors can cause differences in savings estimates. For example, the program implementer calculated results on a monthly basis while the evaluation team estimated annual models. Tracking program progress monthly has many benefits with the trade-off that final annual evaluated net ex post savings may differ from the summed up monthly results. Additionally, existing wave group sizes shrink through natural attrition, resulting in smaller treatment and control group sizes each program year. As the number of customers in a wave is reduced, so is the statistical power of the model, resulting in larger confidence intervals and potentially fluctuating realization rates. While fluctuating realization rates can make planning more challenging, across all waves and years, implementer-reported savings are generally within the 90% confidence interval of the evaluation unadjusted net ex post savings.

Among Existing Customer waves with electric service, those who started receiving reports earlier generally have higher and statistically significant electric savings per household compared to later waves. In 2019, the three waves that began in 2013 and 2014, along with the 2018 wave, have the highest savings (2.1%, 1.5%, and 1.8%, respectively). The 2016 and 2018 waves have moderate savings (1.1% and 1.0%, respectively) while the 2017 and 2019 waves have very low and not statistically significant savings (-0.1%, 0.3%, and 0.3%, respectively). It is too early to draw conclusions about the 2019 waves since savings for report-based feedback and education programs generally ramp up over time.

Among Existing Customer waves with natural gas service, household natural gas savings fluctuate from year to year and across waves without a clear pattern **Error! Reference source not found.**. For example, in program year 2019, the 2015 Gas and 2013 Dual Fuel waves had the highest savings (2.7% and 1.2%, respectively) while 2014, 2017, and 2019 waves had savings less than 0.5%.

[6] The program implementer does not adjust for nor remove uplift or joint savings achieved through other energy efficiency programs, so their savings estimates are most comparable to unadjusted evaluation results (before evaluation removes uplift savings).

2019 Electric and Gas Household Percent Savings by Wave



The 201703 wave produced low (<0.1%) electricity savings in all three years and low gas savings (<0.5%) in two out of three years of the program cycle; no savings estimates were statistically significant. Other National Grid waves have produced at least 1% of electricity savings by their third year of treatment and at least 0.5% of gas. Notably, this wave has the second lowest baseline electricity consumption and second lowest baseline gas consumption, indicating less opportunity for HER recipients to reduce their consumption. Additionally, the wave has a higher percentage of lower-saving personas compared to waves overall, a higher portion of savings deriving from participation in other energy efficiency programs, and a relatively lower percentage of treatment customers who receive email HERs (eHERs) (53%) compared to the population (58%).

Only 58% of customers received emailed HERS (eHERs). The percentage was even lower when focusing on gas customers: less than 50% of customers in three gas waves received eHERs. Customers who do not have an email address on file also cannot receive high bill alerts (HBAs) and other program messaging.

Treatment group customers participated in other energy efficiency programs more often than control customers. Print HERs and eHERs cross-promote other National Grid energy efficiency programs to highlight ways customers can save more energy and money. Overall, the National Grid HER program produced an incremental increase (relative to control group customers) in program participation of 3.5% (13,373 customers) for ENERGY STAR® Products and 5.2% (19,679 customers) for the Energy Wise Single Family program among electric-metered customers cumulatively over the three program years. Among gas-metered customers, the program produced 4.2% (8,482 customers) incremental participation in the Energy Wise Single Family program, and 1.8% (3,750 customers) incremental participation in the Residential Gas Heating & Water Heating program cumulatively over the three program years. These increases are

consistent with report messaging that included information on these programs multiple times over the three-year cycle along with no-cost, behavior-based, energy-saving tips. Participation in other energy efficiency programs accounted for 2.2% and 8.6% of unadjusted modeled net energy savings for electric and gas savings, respectively. To avoid double counted savings, we removed these savings from the modeled savings estimates for the HER program.

Programs to which the Results of the Study Apply:
Residential Behavioral Electric and Gas Program

Evaluation Recommendations included in the study:
Recommendation 1: For planning purposes, we recommend that National Grid use the weighted average 2017 – 2019 electric realization rates of 108% for Existing Customers and 67% for New Movers. For gas we recommend that National Grid use 92% for Existing Customers and 50% for New Movers. We recommend using separate realization rates for these two groups given their structural and performance differences.

Recommendation 2: For Existing Customer waves, going forward, establish treatment and control group sizes that are large enough to allow for multi-year (five or more years) customer attrition, and also consider updated forecasts or estimates of per-household HER savings.7 An assessment of prior-year confidence intervals and statistical significance or a power analysis could inform group size guidelines.

Recommendation 3: Continue to monitor realization rates and treatment and control group sizes, although there is currently no need to make changes to existing wave configurations. With respect to the implementer's evaluation, measurement, and verification (EM&V) methods, continue to monitor any changes in their approach and consider requesting an annual savings "true-up" (from an annual model) to assess whether the monthly approach may be a potential driver of differences in realization rates.

Recommendation 4: Monitor the 2017 wave for improvement over time. If savings do not improve, National Grid could consider additional efforts to understand and reach this wave such as: (1) surveys or in-depth interviews to better understand the barriers to saving energy and what interventions may be more effective, (2) marketing campaigns to increase the number of email addresses on file which will increase access to eHERs and other program enhancements, and (3) targeted messaging by persona, especially those that tend to have lower savings overall. If the program offers additional program enhancements or new ways to engage, consider setting up an experimental design within the 201703 wave to test for the incremental effects of the effort.

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[7] The size of treatment and control groups, the variability of customer consumption, and the magnitude of savings influences statistical significance. For example, waves with lower expected savings (due to, for example, lower baseline usage) or more variable customers may require larger groups for evaluation.

Recommendation 5: To increase engagement with the program, National Grid could consider efforts to collect more email addresses. These efforts could include: (1) messaging on printed reports that shares the benefits of signing up for eHERs, (2) messaging on other National Grid communications, and (3) rewards or incentives for signing up for eHERs or using the online portal.

Recommendation 6: Continue balancing messaging on low- and no-cost energy-saving tips with cross-promotion to encourage participation in other energy efficiency programs as HERs successfully channel customers to other programs. Per regulatory frameworks, the incremental savings are removed from the HER program's savings. Targeted, thoughtful use of energy efficiency program messaging can help customers save energy and boost participation in other programs while limiting the impact on HER program savings.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid has adopted the realization rates (Recommendation 1) based on this study and Recommendations 2-6 are under consideration.

Savings Impact:
The application of study results will increase the claimable electric savings and decrease claimable gas savings from the Home Energy Reports Program.

RI-19-CG-CustGas - Impact Evaluation of PY2017 Custom Gas Installations

Type of Study: Impact

Evaluation Conducted by: DNV GL

Date Evaluation Complete: May 26, 2020

Evaluation Objective and High-Level Findings:
The objective of this impact evaluation was to provide verification or re-estimation of energy (therms) savings for a sample of custom gas projects through site-specific inspections, end-use monitoring, and analysis. The site-specific results were aggregated to determine realization rates for National Grid's custom gas installations in RI.

Yearly Results and Pooled Results

Parameter	PY2016	PY2017	PYs 2016+2017
Tracking Savings	1,114,770	1,948,383	3,063,153
Sample Size	8	6	14
RR	71%	92%	85%
Relative precision @ 80% CI	±11.0%	±2.3%	±4.3%
Error Ratio	0.27	0.3	

CI = confidence interval

The program continues to generate significant natural gas savings. In RI, PY2017 participation consisted of 98 distinct accounts and adjusted gross saving of 1.95 million therms annually, with nearly 92% of the savings realized, based on the evaluation of the sample of RI PY2017 sites.

The original sample was designed to estimate the overall realization rate of the program by combining results from three program year evaluation studies (PYs 2014, 2016, and 2017) to achieve reliable relative precisions, but in this case reliable results were produced from combining results from just two programs years, 2016 and 2017.

Programs to which the Results of the Study Apply:
Gas—Large Commercial New Construction
Gas—Retrofit

Evaluation Recommendations included in the study:

Recommendations

R1: Realization Rate: DNV GL recommends National Grid to use the PY2016 and PY2017 combined RR of 85% for planning and program reporting, starting with PY2021 and continuing to subsequent years until a new impact evaluation study results are available.

R2: Research Methods for Steam Traps Estimation and Heat Load Reduction to Gas Savings Conversion: Steam traps constitute a large share of custom program savings and had a poorer realization rate in this evaluation when compared with other measures. Three out of 6 sampled sites in this study are steam trap projects and the average weighted RR for steam traps projects is 78% compared to 105% for other measures (non-steam traps). This raises the issue of whether steam trap measures should be treated as a separate segment within the custom program or even evaluated separately entirely. The latest steam trap tool that is being used for all projects was vetted and calibrated using participant billing data in 2016. The evaluation observed major discrepancies in operating condition assumptions like operating hours, steam pressures, etc. used in the tracking analysis, and potentially, the steam trap calculator could benefit from another round of calibration incorporating additional sites from recent evaluations.

Measures such as insulation and steam traps reduce the heating load served by a boiler. Converting the heat load reduction from these measures to natural gas savings requires a boiler efficiency. There have been discussions with National Grid and not full agreement on how the boiler efficiency factor should be derived. MA is currently planning a study to understand more of these issues, DNV GL recommends National Grid in RI to follow MA and conduct similar research or piggyback with the MA effort to be cost-effective.

Considerations

C1: Boiler Hours of Use Application Review: Rather than assuming a boiler and the heating distribution system operates year-round, site staff should be interviewed to determine if the specific distribution segments impacted by steam traps or pipe/fixtures insulation measures are operated only seasonally.

C2: Boiler Efficiency: The application reviewers should use site-specific information for the efficiency of the boilers impacted by steam traps or pipe/fixtures insulation measures where information is available. A convenient approach to determine the boiler system efficiency would be to request boiler combustion test receipts.

C3: Pipe and Fitting Insulation Measure Calculator: The pipe/fitting insulation measure may benefit from a deemed calculator, like the steam trap calculator. The ex-ante savings methods were not transparent, and the evaluators could not always replicate them. A deemed calculator could provide consistent and transparent estimates of savings.

C4: EMS or Control Based Projects: For EMS/Control Based projects, consider adding another level of verification such verifying the trend data showing that the control is operating as

designed or capturing screenshots of the new control software interface that shows the actual setpoints, or some other meaningful form of documentation to ensure control based claimed savings are operational. Better documentation of the pre-existing conditions with pictures or trend data would help validate savings.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
R1: *Impact Evaluation of PY2018 Custom Gas Installations* was completed subsequent to the completion of this study; those results will be applied to calculate claimable savings for 2021, so the realization rate determined by this study will not be directly applied. The results of this study were incorporated into *Impact Evaluation of PY2018 Custom Gas Installations* by way of the three-year rolling evaluation effort.

R2: The subsequent custom gas study stratified between steam trap and non-steam trap projects in order to account for the discrepancy seen in the results. The Company will follow the efforts of the MA jurisdiction to further investigate this issue.

C1: National Grid will adopt this consideration.

C2: National Grid will adopt this consideration.

C3: National Grid will review the feasibility of adopting this consideration.

C4: National Grid will review the feasibility of adopting this consideration.

Savings Impact: As discussed above, the results of a subsequent study superseded the final results of this study; the final results of this study (PY2017) feed into the cumulative estimated reported in the subsequent study (PY2018). The results from PY2017 only would increase the claimable savings for custom gas measures installed in 2021, while the cumulative results from PY2016, PY2017, and PY2018 will slightly decrease claimable savings for custom gas measures installed in 2021.

RI-20-CG-CustGasPY18 - Impact Evaluation of PY2018 Custom Gas Installations

Type of Study: Impact

Evaluation Conducted by: DNV GL

Date Evaluation Conducted: Interim results presented August 2020

Evaluation Objective and High-Level Findings:
The objective of this impact evaluation was to provide verification or re-estimation of energy (therms) savings for a sample of custom gas projects through site-specific inspections, end-use monitoring, and analysis. The site-specific results were aggregated to determine realization rates for National Grid's custom gas installations in RI.

Parameter	PY2016	PY2017	PY2018	PYs 2016+2017	Recommended Combined Results: PYs 2016+2017+2018
Tracking Savings	1,114,770	1,948,383	2,847,751	4,796,134	5,910,904
Sample Size	8	6	6	12	20
RR	71.3%	92.0%	83.3%	87.1%	84.2%
Relative precision@ 80% CI	±10.6%	±2.3%	±22.6%	±13.5%	±11.1%

Due to onsite restrictions resulting from COVID-19, measurement and verification was completed for only six of the eight sites in the original sample. For the remaining two sites, desk reviews of available documentation were performed. Results for PY2018 are based on a combination of the full measurement and verification for six sites and desk reviews for two sites. Measurement and verification will be completed for the remaining two sites in fall 2020 if feasible.

The original sample was designed to estimate the overall realization rate of the program by combining results from three program year evaluation studies (PYs 2016, 2017, and 2018) to achieve reliable relative precisions.

Programs to which the Results of the Study Apply:
Gas—Large Commercial New Construction
Gas—Retrofit

Evaluation Recommendations included in the study:
DNV GL recommends applying the combined result from PYs 2016-2018 of 84.2% RR for 2021 planning. If feasible to complete measurement and verification at the final two sites, this result should be updated and applied prospectively to 2021 program year projects.

Other recommendations will be produced when the study is finalized.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid adopted the results of this study.

Savings Impact:
The results of this study will result in a slight decrease in claimable savings from Large Commercial Custom Gas projects.

RI-19-CE-CustElec - Impact Evaluation of PY2018 Custom Electric Installations

Type of Study: Impact

Evaluation Conducted by: DNV GL

Date Evaluation Conducted: Interim results presented August 2020

Evaluation Objective and High-Level Findings:
The objective of this impact evaluation was to provide verification or re-estimation of energy (kWh) savings for a sample of custom electric projects through site-specific inspections, end-use monitoring, and analysis. The site-specific results were aggregated to determine realization rates for National Grid's custom electric installations in RI.

Lighting

Parameter	RI		MA	Combined Results	Recommended Combined Results
	PY2016	PY2018	PY 2017/18	PYs 2016+2018	RI (PY2016+ PY2018)+MA PY2017/18
Tracking Energy Savings (kWh)	19,142,741	13,294,077	40,309,720	32,436,818	72,746,538
Sample Size	3	10	10	13	23
RR	99.9%	83.5%	94.3%	93.2%	93.8%
Relative precision@ 90% CI	±5.6%	±17.2%	±19.4%	±7.8%	±11.3%

Non-Lighting

Parameter	RI		MA	Combined Results	Recommended Combined Results
	PY2016	PY2018	PY 2017/18	PYs 2016+2018	RI (PY2016+ PY2018)+MA PY2017/18
Tracking Energy Savings (kWh)	21,044,847	12,910,679	45,495,306	33,955,526	79,450,832
Sample Size	8	14	21	22	43

RR	69.3%	79.9%	70.8%	73.4%	71.9%
Relative precision@ 90% CI	±23.0%	±11.2%	±21.9%	±14.9%	±14.1%

Due to onsite restrictions resulting from COVID-19, no onsite work was completed for PY2018 sites; only desk reviews of available documentation were performed. These results were combined with full measurement and verification results from RI PY2016 and MA PY 2017-19. Measurement and verification will be completed for RI PY2018 sites in fall/winter 2020 if feasible.

The original sample was designed to estimate the overall realization rate of the program by combining results from three program year evaluation studies (RI PY2016, MA PY2017-18, and RI PY2018) to achieve reliable relative precisions.

Programs to which the Results of the Study Apply:
Electric—Large Commercial New Construction
Electric—Retrofit

Evaluation Recommendations included in the study:
DNV GL recommends applying the combined result of 93.8% RR for lighting and 71.9% RR for non-lighting for 2021.

Other recommendations will be produced when the study is finalized.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid adopted the results of this study.

Savings Impact:
The results of this study will result in a decrease in claimable lighting savings and an increase in claimable non-lighting savings from Large Commercial Custom Electric projects.

MA-19C03-E-SBIMPCT - Impact Evaluation of 2017 Small Business Electric Installations

Type of Study: Impact

Evaluation Conducted by: DNV GL and DMI

Date Evaluation Conducted: March 20, 2020

Evaluation Objective and High-Level Findings:
The purpose of this study was to provide annual energy kWh savings and realization rates, summer and winter peak kW realization rates, and lifetime kWh realization rates for HVAC and refrigeration measures installed through the small business program in the 2017 program year. Additional objectives include providing the primary drivers of the annual energy savings, establishing the proper baselines for lifetime savings (including dual baselines), and providing recommendations on how to apply study results.
The study provides the following key findings:

1. Overall, the HVAC and refrigeration measures studied are performing well and delivering meaningful savings for participants and program administrators. At the program level, the tracking estimates of annual energy impacts were observed to be reasonably accurate with realization rates of near 90% for both refrigeration and HVAC measures.
2. Among the HVAC sample, the performance of franchise sites and non-franchise sites were very different from one another. The divergent performance of these sites and the handling of franchise sites in different programs by different PAs drove the need for a combined refrigeration and non-franchise HVAC set of results and overall refrigeration and HVAC results. These results are provided below.

Impact Result Summary

Results	Energy (kWh)	Summer (kW)	Winter (kW)
Combined Refrigeration and HVAC			
Tracked savings	7,376,462	612	551
Statewide evaluated savings	6,979,214	774	779
Realization rate	94.6%	126.5%	141.5%
Relative precision	±20.6%†	33.9%*	37.0%*
Combined Refrigeration and non-franchise HVAC			
Tracked savings	5,480,531	612	551
Statewide evaluated savings	5,751,339	576	647
Realization rate	104.9%	94.1%	117.4%

Relative precision	19.1%†	28.1%*	31.7%*

† provided at the 90% confidence interval * Provided at the 80% confidence interval

1. Summer and winter peak kW savings are not being fully populated in tracking estimates of small business projects, as evidenced by instances of either blank or zero savings in these categories among the samples examined. This appears to be an issue among both HVAC and refrigeration measures, particularly among the franchise sites.
2. Lifetime savings are similarly not tracked regularly. Approximately 52% of HVAC sites in the population and 11% of refrigeration sites in the population had annual savings estimates without an accompanying lifetime estimate, though we found reasonably accurate use of lifetime values when present.
3. The 2015 NEEP Commercial Refrigeration Loadshape Report contains the conclusion that EC motors use 61% less power than shaded-pole motors, on average, compared to the MA TRM value of 65%. The MA TRM cites a 2007 study to support the 65% reduction. The NEEP study is the more recent study and is based on a larger sample size of pre/post measurements, so the 61% reduction appears to be a better value to represent average power reductions for this measure type.

Programs to which the Results of the Study Apply: Electric—Small Business Non-Lighting

Evaluation Recommendations included in the study:
Recommendation 1: Use the retrospective and prospective realization rates as provided in the table below with two important notes:

1. Application of the prospective energy savings realization rates are dependent on implementation of the recommended calculation change in the MA TRM regarding a new adjustment factor that reflects shaded pole motor power when only EC motor power is measured (recommended below).
2. Due to missing tracking summer peak kW and winter peak kW estimates in both the HVAC and refrigeration samples influencing the realization rate around these results, we do not recommend a prospective realization rate for these items. The concern is that such realization rates will not be appropriate for application when summer and winter values are fully populated.

Factor	Retrospective	Prospective
Combined refrigeration and HVAC applied when franchise served in Turnkey (Eversource, Unitil)		
Energy Realization rate (kWh)	94.6%	94.8%
Summer peak kW Realization Rate	126.5%	N/A
Winter peak kW Realization Rate	141.5%	N/A

Combined refrigeration and non-franchise HVAC applied when franchise not served in Turnkey (National Grid, Cape Light Compact)		
Energy Realization rate (kWh)	104.9%	105.2%
Summer peak kW Realization Rate	94.1%	N/A
Winter peak kW Realization Rate	117.4%	N/A

Recommendation 2: Revise the MA TRM to accommodate a demand reduction factor of 61% in its calculation when replacing shaded pole motors with ECM motors.
Recommendation 3: Work with program vendors to ensure that summer and winter peak demand estimates are fully populated in the tracking system when appropriate.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study: In RI, National Grid adopted the prospective non-franchise realization rates and will adopt recommendations 2 and 3.

Savings Impact: The application of this study results in a decrease in claimable non-lighting electric savings for this program.

MA-19C02-B-EUL - C&I Measure Life Study

Type of Study: Impact

Evaluation Conducted by: DNV GL

Date Evaluation Conducted: March 31, 2020

Evaluation Objective and High-Level Findings:
The purpose of this study was to inform Effective Useful Lives ("EULs") and Remaining Useful Lives ("RULs") for key C&I energy efficiency measures, including lighting, HVAC, custom projects, and gas heating equipment.

Programs to which the Results of the Study Apply: Gas—Large Commercial

Evaluation Recommendations included in the study:
Recommendation 1: Keep the EUL for commercial unitary HVAC equipment at 12 years. When the EUL for commercial unitary HVAC equipment was reduced from 15 to 12 years in 2018 in response to the EUL analysis conducted under Project 73 Track D, the reduction was conditional on improvements in the EUL analysis method that were to be conducted in 2019. The revised EUL analysis conducted under Project MA19C02-B-EUL did estimate EULs that were slightly higher (9-10 years) than those estimated under Project 73 Track D (6-8 years).

However, the updated estimates are still lower than the current TRM EUL of 12 years. The improved EUL estimation method still has some limitations as discussed in the detailed findings of this report. For this reason, the evaluation team is not advocating it be reduced below 12 years. However, the team believes that the 9-10-year EULs that emerged from the improved 2019 analysis also suggest that this EUL should not revert to the 15-year estimate that was used prior to 2018.

Recommendation 2: Keep the EUL for commercial furnaces at 18 years. The HVAC contractors estimated the average age of the commercial furnaces they removed which still had some useful life remaining to be 17 years. They estimated the average age of the commercial furnaces they removed which were at or near failure to be 19 years. Since the 19-year average is close to the current EUL in the TRM of 18 years, the evaluation team recommends that this EUL remain unchanged.

Recommendation 3: Reduce the EUL for commercial boilers to 20 years. As noted, the HVAC contractors estimated the average age of the commercial boilers they removed with some useful life remaining at 19 years. They estimated the average age of the commercial boilers they removed that were at or near failure to be 22 years. Both these estimates are below the current EUL in the Massachusetts TRM of 25 years.

Recommendation 4: Change the assumed ER rate for commercial boilers from 0% to 20% and for commercial furnaces from 0% to 15%. As noted, this study found an ER rate of 21% for commercial boilers and 20% for commercial furnaces. Another recent Massachusetts study which involved interviews with both HVAC contractors and end users found an ER rate of 18% for commercial boilers and 11% for commercial furnaces. Since two different evaluation studies have come out with similar results that are well above the default assumption of 0%, the team recommends that the PAs should change this ER rate to 20% for commercial boilers and 15% for commercial furnaces, which is the average of the ER rates from the two studies.

Recommendation 5: The impact evaluation team should continue reviewing site-specific EUL assumptions. The impact evaluation team should continue to provide meaningful feedback regarding EUL assumptions observed at individual sites and communicate those findings through the Monthly BAG meetings with stakeholders and in the final evaluation report.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
In RI, National Grid will adopt recommendations 1 through 3 and will follow additional work on recommendations 4 and 5. A study is in progress in MA to incorporate the results outlined in recommendation 4; RI will review this study for applicability when finalized.

Savings Impact: The application of these results will result in a reduction in claimable lifetime savings for Large Commercial Gas.

RI-20-CX-FRSO - C&I Free-Ridership and Spillover Study

Type of Study: Market

Evaluation Conducted by: Tetra Tech

Date Evaluation Conducted: September 2020 (draft)

Evaluation Objective and High-Level Findings:
The goal of this study was to identify:

- both pure and partial free-ridership, through customer survey;
- "like" participant spillover, through customer survey;
- indicators of "unlike" participant spillover, through customer survey;
- nonparticipant "like" spillover, through survey of participating design professionals and vendors.

Electric Results

Program	Measure Type	Surveyed	Population	Population Savings	Free-Ridership Rate	90% Margin Error (±)*	Participant "Like" Spillover Rate	90% Margin Error (±)*	Nonparticipant "Like" Spillover Rate	Net-to-Gross Rate
Bright Opportunities	Lighting - fixtures, fixture with controls, LED retrofit kits	91	2,642	16,909,798	31.2%	7.9%	0.3%	0.9%	NA	69.1%
	Lighting—screw-ins	34	711	6,389,077	76.9%	11.6%	0.2%	1.2%	NA	23.3%
	Lighting—TLEDs	28	791	4,672,299	54.9%	15.2%	0.0%	0.0%	NA	45.1%
	Total	**153**	**4,144**	**27,971,174**	**39.3%**	**6.4%**	**0.2%**	**0.6%**	**NA**	**60.9%**
Design 2000plus Program	Compressed Air	6	22	358,959	28.0%	Census	2.1%	Census	1.6%	75.7%
	Custom	9	76	11,253,874	28.0%	Census	2.1%	Census	1.6%	75.7%
	Food Service	6	60	503,856	28.0%	Census	2.1%	Census	1.6%	75.7%
	HVAC Non-unitary	1	5	328,220	28.0%	Census	2.1%	Census	1.6%	75.7%
	Lighting	4	46	3,657,323	28.0%	Census	2.1%	Census	1.6%	75.7%
	Other	0	1	820	NA	NA	NA	NA	NA	NA
	VSD	1	5	173,930	28.0%	Census	2.1%	Census	1.6%	75.7%
	Total	**27**	**215**	**16,276,982**	**28.0%**	**Census**	**2.1%**	**Census**	**1.6%**	**75.7%**
Energy Initiative	Custom	16	133	27,267,088	35.8%	Census	0.5%	Census	0.7%	65.5%
	HVAC	1	18	800,818	14.7%	Census	0.1%	Census	0.1%	85.5%
	Lighting	35	311	29,793,677	14.7%	9.3%	0.1%	0.7%	0.1%	85.5%
	VSD	5	29	2,652,783	14.7%	Census	0.1%	Census	0.1%	85.5%
	Total	**57**	**491**	**60,514,366**	**23.8%**	**8.7%**	**0.3%**	**1.1%**	**0.9%**	**77.3%**
Small Business program	Lighting	71	640	10,206,033	12.3%	6.1%	0.3%	1.1%	0.2%	88.2%
	Non-lighting	42	339	1,978,580	29.1%	10.8%	0.3%	1.3%	0.0%	71.2%
	Total	**113**	**979**	**12,184,613**	**15.1%**	**5.2%**	**0.3%**	**0.8%**	**0.2%**	**85.5%**
Total		**350**	**5,829**	**116,947,135**	**29.0%**	**3.9%**	**0.5%**	**0.6%**	**2.8%**	**74.3%**

*When a census of the population is sampled, confidence intervals cannot be estimated.
Cells highlighted in gray are using the overall program, or custom/prescriptive level, freeridership and spillover rates due to insufficient number of responses or low precision.
A value of NA means no surveys were completed for that stratum.
Program measures with no program participation are not shown.

Program	Program Type	Surveyed	Population	Population Savings	Free-ridership Rate	90% Margin Error (±)	Participant "Like" Spillover Rate	90% Margin Error (±)	Nonparticipant "Like" Spillover Rate	Net-to-Gross Rate
Bright Opportunities	Prescriptive	153	4,144	27,971,174	39.3%	6.4%	0.2%	0.6%	NA	60.9%
	Total	**153**	**4,144**	**27,971,174**	**39.3%**	**6.4%**	**0.2%**	**0.6%**	**NA**	**60.9%**
Design 2000plus	Custom	9	76	11,253,874	28.0%	Census	2.1%	Census	1.6%	75.7%
	Prescriptive	18	139	5,023,108	28.0%	Census	2.1%	Census	1.6%	75.7%
	Total	**27**	**215**	**16,276,982**	**28.0%**	**Census**	**2.1%**	**Census**	**1.6%**	**75.7%**
Energy Initiative	Custom	16	130	26,066,973	35.8%	Census	0.5%	Census	0.7%	65.5%
	Prescriptive	41	361	34,447,393	14.7%	8.6%	0.1%	0.6%	0.1%	85.5%
	Total	**57**	**491**	**60,514,366**	**23.8%**	**8.7%**	**0.3%**	**1.0%**	**0.9%**	**77.3%**
Small Business	Prescriptive	113	979	12,184,613	15.1%	5.2%	0.3%	0.8%	0.2%	85.5%
	Total	**113**	**979**	**12,184,613**	**15.1%**	**5.2%**	**0.3%**	**0.8%**	**0.2%**	**85.5%**
Total	**Custom**	**25**	**206**	**37,320,847**	**33.4%**	**14.5%**	**0.4%**	**1.9%**	**1.6%**	**68.6%**
	Prescriptive	**325**	**5,623**	**79,626,288**	**26.7%**	**3.9%**	**0.6%**	**0.7%**	**1.2%**	**75.0%**
	Total	**350**	**5,829**	**116,947,135**	**29.0%**	**3.9%**	**0.5%**	**0.6%**	**2.8%**	**74.3%**

*When a census of the population is sampled, confidence intervals cannot be estimated.

Cells highlighted in gray are using the overall program freeridership and spillover rates due to insufficient number of responses.

Gas Results

Program	Measure Type	Surveyed	Population	Population Savings	Free-Ridership Rate	90% Margin Error (±)*	Participant "Like" Spillover Rate	90% Margin Error (±)*	Nonparticipant "Like" Spillover Rate	Net-to-Gross Rate
Commercial New Construction—Custom	Controls	0	9	34,546	NA	NA	NA	NA	NA	NA
	Food service	1	3	12,017	47.7%	Census	2.2%	Census	3%	57.6%
	HVAC	2	3	21,267	47.7%	Census	2.2%	Census	3%	57.6%
	HVAC—Distribution	0	3	72,497	NA	NA	NA	NA	NA	NA
	HVAC—Plant	0	3	21,737	NA	NA	NA	NA	NA	NA
	Insulation	1	4	33,175	47.7%	Census	2.2%	Census	3%	57.6%
	Water Heating	2	10	82,333	47.7%	Census	2.2%	Census	3%	57.6%
	Other	0	1	3,640	NA	NA	NA	NA	NA	NA
	Total	**6**	**36**	**281,212**	**47.7%**	**Census**	**2.2%**	**Census**	**3%**	**57.6%**
Commercial New Construction—Prescriptive	Food service	38	172	120,223	47.7%	Census	2.2%	Census	3%	57.6%
	HVAC	5	5	7,469	47.7%	Census	2.2%	Census	3%	57.6%
	HVAC—Plant	0	27	18,045	NA	NA	NA	NA	NA	NA
	Other	1	1	3,429	47.7%	Census	2.2%	Census	3%	57.6%
	Water heating	5	116	47,213	47.7%	Census	2.2%	Census	3%	57.6%
	Total	**49**	**321**	**196,380**	**47.7%**	**Census**	**2.2%**	**Census**	**3%**	**57.6%**
Large Commercial Retrofit— Custom	Controls	2	36	227,664	6.8%	Census	0.0%	Census	16%	108.8%
	HVAC	5	40	481,331	6.8%	Census	0.0%	Census	16%	108.8%
	HVAC—Distribution	0	5	35,632	NA	NA	NA	NA	NA	NA
	HVAC—Plant	0	4	48,005	NA	NA	NA	NA	NA	NA
	Insulation	5	15	125,199	6.8%	Census	0.0%	Census	16%	108.8%
	Other	1	16	662,531	6.8%	Census	0.0%	Census	16%	108.8%
	Water heating	2	6	27,611	6.8%	Census	0.0%	Census	16%	108.8%
	Total	**15**	**122**	**1,607,973**	**6.8%**	**Census**	**0.0%**	**Census**	**16%**	**108.8%**
Large Commercial Retrofit—Prescriptive	Controls	0	10	2,122	NA	NA	NA	NA	NA	NA
	Other	0	1	6,669	NA	NA	NA	NA	NA	NA
	Water Heating	0	4	1,374	NA	NA	NA	NA	NA	NA
	Total	**0**	**15**	**10,165**	NA	NA	NA	NA	NA	NA
Small Business program—Custom	Controls	0	4	418	NA	NA	NA	NA	0%	NA
	Custom	1	14	2,091	11.4%	Census	1.7%	Census	0%	90.4%
	Insulation	0	1	105	NA	NA	NA	NA	NA	NA
	Other	1	11	1,285	11.4%	Census	1.7%	Census	0%	90.4%
	Water heating	0	10	1,516	NA	NA	NA	NA	NA	NA
	Total	**2**	**40**	**5,415**	**11.4%**	**Census**	**1.7%**	**Census**	**0%**	**90.4%**
Small Business program—Prescriptive	Controls	9	26	3,480	11.4%	Census	1.7%	Census	0%	90.4%
	Insulation	1	3	2,345	11.4%	Census	1.7%	Census	0%	90.4%
	Water heating	6	62	18,139	11.4%	Census	1.7%	Census	0%	90.4%
	Total	**16**	**91**	**23,963**	**11.4%**	**Census**	**1.7%**	**Census**	**0%**	**90.4%**
Total		**88**	**625**	**2,125,108**	**16.1%**	**Census**	**0.5%**	**Census**	**2%**	**86.6%**

*When a census of the population is sampled, confidence intervals cannot be estimated.

Cells highlighted in gray are using the overall program, or custom/prescriptive level, freeridership and spillover rates due to insufficient number of responses or low precision.

A value of NA means no surveys were completed for that stratum.

Program measures with no program participation are not shown.

Program	Program Type	Surveyed	Population	Population Savings	Free-ridership Rate	90% Margin Error (±)	Participant Spillover Rate	90% Margin Error (±)	Nonparticipant "Like" Spillover Rate	Net-to-Gross Rate
Commercial New Construction	Custom	6	36	281,212	47.7%	Census	2.2%	Census	3%	57.6%
	Prescriptive	49	321	196,380	47.7%	Census	2.2%	Census	3%	57.6%
	Total	**55**	**357**	**477,592**	**47.7%**	**Census**	**2.2%**	**Census**	**3%**	**57.6%**
Large Commercial Retrofit	Custom	15	122	1,607,973	6.8%	Census	0.0%	Census	16%	108.8%
	Prescriptive	0	15	10,165	NA	NA	NA	NA	NA	NA
	Total	**15**	**137**	**1,618,138**	**6.8%**	**Census**	**0.0%**	**Census**	**16%**	**108.8%**
Small Business	Custom	2	40	5,415	11.4%	Census	1.7%	Census	0%	90.4%
	Prescriptive	16	91	23,963	11.4%	Census	1.7%	Census	0%	90.4%
	Total	**18**	**131**	**29,378**	**11.4%**	**Census**	**1.7%**	**Census**	**0%**	**90.4%**
Total	Custom	23	198	1,894,601	11.7%	Census	0.2%	Census	8%	96.3%
	Prescriptive	65	427	230,508	54.4%	Census	3.4%	Census	1%	50.0%
	Total	**88**	**625**	**2,125,108**	**16.1%**	**Census**	**0.5%**	**Census**	**2%**	**86.6%**

*When a census of the population is sampled, confidence intervals cannot be estimated.

Cells highlighted in gray are using the overall program freeridership and spillover rates due to insufficient number of responses or low precision.

A value of NA means no surveys were completed for that stratum.

Programs to which the Results of the Study Apply:
All C&I. Results were applied with the following levels of aggregation:

Electric

- Upstream Lighting: fixtures, fixtures with controls, LED retrofit kits
- Upstream Lighting: screw-ins
- Upstream Lighting: TLEDs
- New Construction
- Retrofit Prescriptive
- Retrofit Custom
- Small Business Lighting
- Small Business Non-Lighting

Gas

- New Construction
- Retrofit
- Small Business

Evaluation Recommendations included in the study:
Recommendations to be provided in final draft.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
Recommendations will be considered by National Grid and adopted whenever feasible.

Savings Impact: The application of this study reduced claimable savings.

RI-18-XX-Piggybacking - Piggybacking Diagnostic Study

Type of Study: Process

Evaluation Conducted by: DNV GL

Date Evaluation Conducted: January 14, 2020

Evaluation Objective and High-Level Findings:
The primary objective of this study is to develop guidance on when it is appropriate to "piggyback" or combine RI evaluation efforts with MA studies or adopt MA results as a proxy for RI versus stand-alone RI studies. The report recommends which approaches National Grid should use for commercial and industrial (C&I) measure groups and residential programs.

Piggybacking Approaches: Basic Descriptions

Approach Number	Approach Name	Description
1	Direct Proxy	Use MA results directly for RI
2	Shared Algorithm	Calculate savings using data collection results from MA, applied to an independent RI sample using similar formulas
3	Pooled Sample	Collect data from MA and RI sites. Create a sample from both MA and RI so that the combined sample is large enough to meet precision requirements in RI
4	Independent Sample	Conduct data collection and analysis on an independent RI sample using the same tools as MA
5	Independent Study	Conduct a completely independent study that leverages nothing directly from MA

These approaches follow a loose hierarchy of decreasing assumptions and increasing rigor as one moves from Approach 1 to Approach 5. As such, using a higher numbered approach in lieu of a lower numbered approach is usually possible and remains technically sound. In particular, any other approach could replace Approach 1. Approach 5 could be used instead of Approach 4, which could be used instead of Approach 3.

Programs to which the Results of the Study Apply:
All programs

Evaluation Recommendations included in the study:

Recommended Approaches: C&I Measure Groups

Measure Group	Recommended Approach
Prescriptive Lighting	**Approach 4** – Independent Sample or **Approach 5** – Independent Study
Upstream Lighting	**Approach 4** – Independent Sample
Custom Electric Non-lighting	**Approach 4** – Independent Sample
Custom Electric Lighting	**Approach 4** – Independent Sample
Small Business Electric	**Approach 3** – Pooled Sample, with adjustments for participants Or **Approach 1** – Direct Proxy if limited to non-lighting
Prescriptive Non-lighting	**Approach 4** – Independent Sample or **Approach 3** – Pooled Sample if done on individual measure types
Custom Gas	**Approach 4** – Independent Sample
Prescriptive Gas	Insufficient evidence to make strong recommendation

Recommended Approaches: Residential Programs

Program	Recommended Approach
Lighting	**Approach 4** – Independent Samples **or** **Approach 2** – Shared Algorithm (with adjustments)
Behavioral Programs	**Approach 4** – Independent Samples **or** **Approach 5** – Independent Studies
EnergyWise Single Family	**Approach 4** – Independent Samples **or** **Approach 5** – Independent Studies **or** **Approach 3** – Pooled Sample (if no billing analysis & next study shows similar results for RI and MA)
Residential Cooling & Heating	Insufficient evidence to make strong recommendation
Consumer Products	Appliance Recycling: Approach 2 – Shared Algorithm **or** **Approach 3** – Pooled Sample (if field data collection used) Other Measures: **Approach 1** – Direct Proxy

Income Eligible Single Family	**Approach 4** – Independent Samples **or** **Approach 5** – Independent Studies; Approaches 1, 2, or 3 (if next study has similar results for RI and MA)
EnergyWise Multi-family	**Approach 4** – Independent Samples **or** **Approach 2** – Shared Algorithm (if not using billing analysis)
New Construction, Code Compliance, and Building Characteristics	**Approach 4** – Independent Samples **or** **Approach 5** – Independent Studies
Demand Response Programs	**Approach 4** – Independent Samples **or** **Approach 3** – Pooled Samples (if small participant population or constrained data)

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study: National Grid adopted the results of this study and will follow recommended guidelines where budget allows.

Savings Impact: This study has no direct impact on claimable savings.

RI-19-XX-DataCollect - Primary Data Collection for Potential Study

Type of Study: Market

Evaluation Conducted by: DNV GL

Date Evaluation Conducted: March 9, 2020

Evaluation Objective and High-Level Findings:
This study was designed to help RI Office of Energy Resources and National Grid better understand the state's existing C&I building and equipment stock, support the efficiency potential study and lighting baseline determination, and otherwise identify ways to expand RI statewide energy efficiency initiatives.

The study's goal was to conduct comprehensive on-site assessments of C&I facilities across the state of RI with representation among relevant business types. The study focused on understanding the highest priority electric and natural gas end uses, based on stakeholder feedback and annual energy efficiency program savings. The following end uses were included in this study: lighting, HVAC and motor/drive on the electric side and HVAC, including steam traps and boilers and hot water on the gas side.

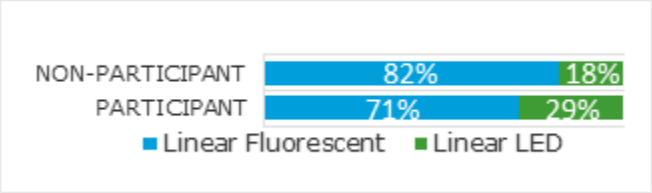
Summary of Final Population Frame

Business Size	% Consumption
Small: <500 MWh	31%
Medium: 500 - 4,500 MWh	36%
Large: >4,500 MWh	33%
TOTAL (27,508 C&I accounts)	**100% (3,503,559 kWh)**

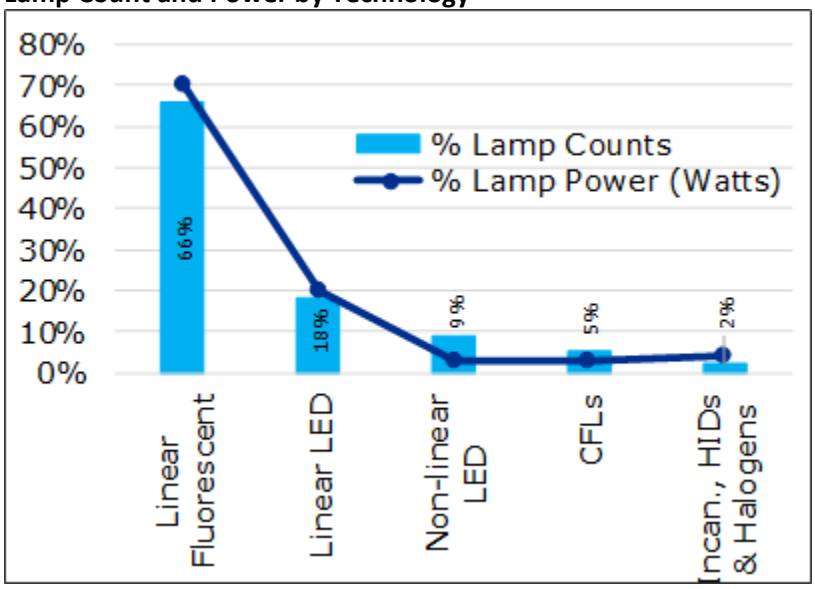
Lighting Equipment Key Findings:
7.6 million lamps operating in RI

1. 1.4M Linear LEDs
2. 4.9M Linear Fluorescents
3. 0.7M Non-linear LEDs
4. 0.4M CFLs

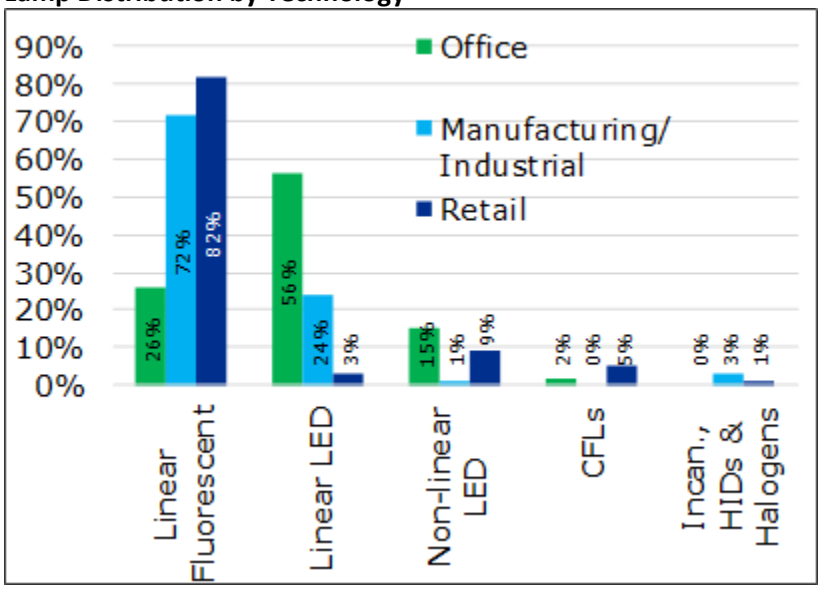
Linear Lighting Program Participation



Lamp Count and Power by Technology



Lamp Distribution by Technology



Lighting Opportunities

- 66% of lamps are fluorescent technologies, providing an opportunity to convert them to LEDs for more energy savings.
- Manufacturing/Industrial and Retail businesses have large opportunities (>70%) to install LEDs while office have about 26%.
- RI has a lot of potential for savings from installing controls for lighting equipment, such as occupancy sensors, daylighting sensors, timers, and dimming. Nearly 90% of the interior lighting is controlled manually.

Non-Lighting Equipment Key Findings

153k Cooling Systems:

- 61% were split or packaged air conditioners
- 28% were packaged terminal or window units
- 11% were heat pumps

79k Heating Units:

- 39% were packaged furnaces
- 14% were hot water or steam boilers
- 23% were Baseboard/Unit Space heaters
- 24% were packaged terminal or window units and heat pumps

52k Domestic Hot Water (DHW) Heaters:

- 86% are Storage water heaters.
- 13% are Instantaneous systems
- 1% use central plants/heat exchangers.
- 72% of the DHWs use non-electric fuels like natural gas, propane, etc.

Non-Lighting Opportunities

- 66% of the packaged AC and heat pumps were below federal standard efficiency.
- Nearly 21% of all heating systems are below federal efficiency standards.

Programs to which the Results of the Study Apply:
All C&I

Evaluation Recommendations included in the study:
This study did not produce any recommendations.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
N/A

Savings Impact: This study has no direct impact on claimable savings.

MA-19DR01-E 2019 Residential Wi-Fi Thermostat Direct Load Control Offering Evaluation

Type of Study: Impact/Process

Evaluation Conducted by: Guidehouse

Date Evaluation Conducted: April 1st, 2020

Evaluation Objective and High-Level Findings:
This evaluation's objectives included verifying that the 2019 residential Wi-Fi thermostat direct load control (DLC) solution successfully enables demand reductions (and if so, by how much) and assessing the customer experience and acceptance of the solution. These objectives were achievable through the investigation of several research questions relating to 1) Customer Experience, 2) DR Impacts, and 3) Program Design and Implementation. Where appropriate, these research questions were explored by PA (i.e., Eversource MA and CT, National Grid MA, and Unitil MA). The evaluation also sought to compare select metrics for this National Grid offering across 2016 to 2019.

The key findings are summarized below:

- **Overall, 96% of thermostats that enrolled since September 30, 2018 remained enrolled through the end of the evaluated 2019 DR season.** The rate of sustained enrollment for thermostats enrolled after September 30, 2018 was 94% for National Grid.
- **The annualized rate at which thermostats leave the ConnectedSolutions offering ("annualized attrition") ranges from 5 to 11% per year.** For National Grid, annual attrition ranges from 6% to 10% depending on the period of enrollment, reflecting National Grid's device management plan. However, for National Grid, implementation vendor transitions impact the ability to fully analyze the extent to which thermostats have left the programs over time.
- **Across all PAs and cohorts, more than 85% of survey respondents reported that they are likely or very likely to participate again in the future.** Respondents were generally satisfied with event characteristics in 2019, including the number, length, and timing of events.
- **Bill savings is a perceived offering benefit.** Bill savings is the most commonly cited motivation for participating, including among returning National Grid customers. Although this offering achieved energy savings in 2019, the primary goal of the offering is to achieve peak demand reductions. As a result, any given participant may or may not experience bill savings by participating in the offering. The perception that participation will lead to bill savings may be a consequence of co-marketing the offering with Wi-Fi thermostat rebates.
- **55% of respondents were satisfied with the mode of notification received.** Overall, approximately 73% of survey respondents reported receiving event notification, and 75% of these respondents received their preferred mode of notification.

- **About 20% of respondents would like more flexibility in terms of how they are notified of events.** 25% of respondents *who reported receiving event notifications* would like to receive a different mode of event notification than what they received in 2019. Of these, a majority would like notifications by email.
- **Overall 17% of respondents reported not receiving event notifications and 10% were unsure whether or not they received event notifications. A**bout 62% of National Grid new participant respondents and 70% of National Grid returning participant respondents reported receiving advance notifications. The remaining participants either reported receiving no event notification or they were unsure whether or not they received notifications National Grid elected not to send advance notification emails. For device types where email notification was an option the PAs could select, participants that received event notifications *only* through the thermostat provider's app had lower rates of event notification recall than those who also received an email. For respondents who reported not receiving any event notification, a majority would like to receive email notification, at a minimum.
- **Approximately two-thirds of participants reported noticing temperature changes during events but only 40% reported ever opting out**. Most of those who reported having opted out stated that they did so only sometimes (30-40%) or rarely (50-65%). When looking at thermostat telemetry data, the percentage of devices that opted out at least once over the course of the season, and the frequency with which they opted out, is somewhat higher than what survey respondents reported. Notably, 16% of National Grid returning participants reported not knowing if they ever opted-out of an event. Relatedly, over 40% of survey respondents indicated they did not recall pre-cooling happening prior to events. In open-ended feedback, three respondents noted that it was too easy to override events inadvertently.
- **Approximately 10% of survey respondents are interested in seeing changes to or the ability to customize offering design parameters.** Some survey respondents would like to see changes to or to be able to specify their preferences related to: pre-cooling temperature adjustment and/or duration (26), event duration and/or timing (16), event setpoint maximum (3). Three survey respondents would like to be able to opt back into the event after opting-out.

Thermostat Usage Assessment Findings

- **2019 full participation rates exceeded 50% on average and across the season with** National Grid MA at 52%. The primary reason for devices not fully participating in events was not being in cooling mode.
- **A significant number of devices were never in cooling mode for any event.** National Grid MA stem from devices that were in system off/heat mode for the entire season.
- **Connectivity was a small issue overall during events for National Grid MA.** A large portion of connectivity issues stem from devices that were disconnected for the entire season.
- **Participants exhibited no evidence of event participation fatigue (increased opt-out rates) due to back-to-back events or a higher event dispatch frequency.** Devices in the

experimental design groups participated at similar rates regardless of the number of events for which they were dispatched.

Impact Analysis Findings

- **National Grid had average treatment effects for the 2019 season of 0.59 kW per thermostat.**
- **As a percent of baseline usage, average demand savings was 59% for National Grid.** For National Grid, this reduction in cooling load is slightly higher than 2018 (likely due to the higher temperature setback during events), but consistent with the previous two implementation seasons.
- **Fully participating devices have average event savings across the 2019 season that are over 35% higher than the average across all dispatched participants.** Impacts for full participants show the technical potential of the offering. As opt-outs and other forms of non-participation are reduced, average and total event impacts should increase.
- **National Grid's average demand savings per event in 2019 was 0.59 kW, a decrease from the average savings found in 2018 (0.71 kW).** The lower savings likely stem from the later event times and the fewer number of event days exceeding 90°F in 2019 compared to 2018, which resulted in a lower baseline cooling load.

Programs to which the Results of the Study Apply: Residential ConnectedSolutions

Evaluation Recommendations included in the study:

Recommendation 1: Unenroll thermostats from the offering that frequently opt out of events, do not have connectivity, and/or are consistently in a non-cooling mode. This will lower the costs of the Direct Load Control Offering and increase average savings per thermostat. In parallel, ensure that the enrollment tracking system allows for the tracking of unenrollment reasons related to the opt outs, connectivity and AC system mode behavior.

Recommendation 2: Include the count of all residential and non-residential devices and participants enrolled as of August 31 in the Massachusetts ADR BCR model. For 2019, the count of thermostats is 11,503 for National Grid MA. The count of participants is 7,814, and 45 for National Grid MA.

Recommendation 3: Calculate ex-post savings by applying the savings adjustment factor to vendor-reported savings. Use ex-post savings for claiming savings in 2019 and in future years. For the event period, the savings adjustment factor is an equation based on average outdoor temperature: -3.06 + (0.05 x Avg Temp °F). For pre-cooling and recovery hours, the savings adjustment factors are constants, 0.72 and 0.68, respectively.

The adjustment factor can apply when the ISO-NE or PJM baseline is used, pre-cooling and event duration conditions are met, the assumed AC nameplate capacity continues to be 3.5 kW in the EnergyHub portal, and the average outdoor temperature is 75 degrees F or higher. When these conditions are not met, the savings adjustment factor does not apply.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:

Recommendation 1: Yes, **t**his recommendation has been adopted.
Recommendation 2: No this is a specific MA recommendation and would not apply to RI.
Recommendation 3: No there were two specific savings results that came out of this study. One was using a deemed savings result and the other was applying a realization rate to vendor specified savings. RI has chosen to apply the deemed savings value from this study instead of the realization rate as this recommendation suggests.

Savings Impact:
This demand savings increased when compared to 2019 estimates.

MA-19DR02-E 2019 Residential Energy Storage Demand Response Demonstration Evaluation – Summer Season

Type of Study: Impact/Process

Evaluation Conducted by: Guidehouse

Date Evaluation Conducted: 02/10/2020

Evaluation Objective and High-Level Findings:
The purpose of this study was to assess the technical feasibility, customer acceptance, and scalability of using residential energy storage systems (battery) to reduce peak demand for National Grid as part of their broader active demand response initiatives. This study confirmed this feasibility; however, it has not looked at whether that control will be cost-effective for the electric system, program administrators, and/or customers. National Grid provided a performance incentive to customers in exchange for control of their existing battery as part of a "Bring Your Own Battery". Between July and September of 2019, National Grid called 27 events for 50 participating customers and between August 1 and September 30.

The study provides the following key findings for National Grid:

- Access to backup power is a primary motivation for purchasing a battery system.
- Survey respondents reported extremely low opt-out rates, with 94% reporting they never opted out of an event.
- Ninety-seven percent of respondents would recommend the program to other National Grid customers, and 97% are likely or very likely to continue with the program should it be offered in the future.
- Events called by National Grid during the summer season saved 139 kW per event on average, including 126 kW during the 2019 ISO-NE Peak Hour.
- Battery devices that successfully participated in 2-hour events saved an average of 5.5 kW per unit.
- On average, called events had 64% of the expected maximum impact given the maximum expected discharge of the batteries operational at the time of the event. This is affected by some batteries opting out of events and also by lower relative performance by some devices, especially DC coupled batteries.
- 50 devices participated in at least one event this season.
- Consecutive event days appeared to have a negligible effect on impacts this season. Weather had a larger effect on devices not being fully charged in time for the next event. The small effects that could be seen were instead caused by weather conditions that prevented some devices from fully charging in time for the next event.
- Successfully participating devices dispatched at a constant rate for the length of the event. This includes DC coupled batteries.

- The conventions (e.g., sign, time zone) associated with the telemetry data varied across manufacturers. Navigant made informed corrections to align the telemetry data for all devices into a single convention.

Programs to which the Results of the Study Apply: Residential ConnectedSolutions

Evaluation Recommendations included in the study:
Recommendation 1: Ensure customers are aware National Grid knows backup is important to them. Two manufacturers include the existence of a battery reserve in their marketing materials, and one offers the option, but National Grid does not make this clear in the marketing materials. Create a consistent battery reserve level and publicize both the battery reserve and the restriction of events prior to storms. This will help alleviate customer concern about batteries being depleted when they are being relied upon to provide power in an emergency
Recommendation 2: National Grid to encourage EnergyHub to work with manufacturers and/or integrators to align all details of the telemetry data so the data fields are consistent.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
Recommendation 1: This recommendation is still under consideration.
Recommendation 2: Yes this recommendation has been implemented.

Savings Impact:
This study verified that the 5.5 kW was accurate and due to this did not have any impact on savings.

MA-19DR03-E Cross State C&I Active Demand Reduction Initiative Summer 2019

Type of Study: Impact/Process

Evaluation Conducted by: Energy & Resource Solutions (ERS)

Date Evaluation Conducted: April 15th, 2020

Evaluation Objective and High-Level Findings:
The primary objectives of the evaluation are to independently assess program initiative impact and identify process improvement opportunities. Impact is measured as both the average demand reduction during specified events and during the annual peak installed capacity (ICAP) hour. Load reduction is based on the comparison of measured load against four different alternative/baseline load scenarios. The evaluation also attempts to understand the overlap between the PA ADR initiatives and the ISO-NE Forward Capacity Market (FCM) and provide input on other opportunities for peak demand management.

Process Evaluation Findings:

- Settlement and payment: Payment processing remains challenging. Program marketing materials state that incentives will be paid out in October. When the evaluation team interviewed National Grid's staff in December of 2019, there were still several payments that had not yet been made. National Grid staff explained that the delay in payments was largely because National Grid's procurement protocols had been revised. This meant that National Grid staff had to have CSPs re-sign contracts, NDAs, and ISAs in order to process ADR initiative payments. Additionally, staff explained that each summer season, a small percentage (less than 5%) of customers experience metering or data issues that result in delayed settlement and payment. With the increase in program enrolment over the past three summers, it has become more time-consuming for staff to resolve these data issues.

- Recruitment: Recruitment for the 2019 summer season was more difficult for the PA than it had been over the first two years of the program. A significant percentage of the PA's largest commercial and industrial customers have already signed up for the program. The National Grid staff noted they had to increase their sales efforts in 2019 to achieve the same amount of MW reduction that had been reached in prior years when less resources were spent on recruiting. As can be expected with any growing PA offering, the PA anticipates this need for increased promotion to continue.

C&I Interruptible Findings (Impact Findings)
The evaluation team recommends using a symmetrically adjusted baseline (called Evaluated-Symmetric in the tables below) as the most appropriate estimate of event period load reduction for the 2019 summer season. The symmetrically adjusted baseline, with additional adjustment for likelihood of unreported shutdowns (called Evaluated-Forecast below), is the best estimate

of load reduction for future years. The symmetrically adjusted baseline reduces biases for sites with variable load due to weather or other production factors. The symmetrically adjusted baseline methodology is the most commonly used baseline approach and is used by ISO-NE. The Baselines section of the Impact Evaluation Methodology and Framework describes the baselines and their advantages and disadvantages in detail. The C&I Interruptible Impact Evaluation Findings and Integrated Impact and Process Evaluation Findings substantiate the 7 evaluator's baseline recommendation for the 2019 summer season.
Table 1-4 provides the summary of National Grid's load reduction estimates for Massachusetts. National Grid called a single event on July 30, the ICAP day.

National Grid Impact Summary – Massachusetts

Resul	Event Average Reduction (kW)	ICAP Hour Reduction (kW)
Enrolled Capacity	93,134	93,134
Reported-Asymmetric	71,428	N/A
Evaluated-Validation	71,611	N/A
Evaluated-Unadjusted	42,461	36,090
Evaluated-Asymmetric	69,561	63,190
Evaluated-Symmetric	58,464	52,173
Evaluated-Forecast	57,264	51,266
Evaluated-Regression	48,752	42,538

Based on the above results, the evaluators calculated the following performance ratios. They are defined as follows:

- Enrollment Ratio: This ratio is the reported asymmetric load reduction to the CSP reported enrolled capacity. This ratio provides insight into what percentage of the reported enrolled capacity was achieved, based on the program baseline and calculation methodology. This ratio is particularly meaningful for planning and sales purposes.
- Asymmetric Ratio: This ratio is the evaluated asymmetric load reduction to the reported asymmetric load reduction. This is an apples-to-apples comparison of the same baseline methodology between the PAs and evaluators; however, this metric identifies the impact that different calculation rules between the PAs and evaluators has on load reduction.
- Retrospective Realization Rate: This ratio is the evaluated symmetric load reduction to the reported asymmetric load reduction. The evaluators determined that the symmetrically adjusted baseline is the most appropriate measure of retrospective load reduction for the 2019 summer season. This ratio shows how the choice of baseline adjustment and calculation methodologies impacts the load reduction estimates. The

evaluators recommend using this realization rate to calculate the symmetric load reductions at the end of future seasons if there are no evaluations conducted.

- Prospective Realization Rate: This ratio is the evaluated symmetric load reduction with an adjustment for unreported shutdowns to the reported asymmetric load reduction. The evaluators determined that the symmetrically adjusted baseline accounting for unreported shutdowns is the most appropriate measure of prospective load reduction for future seasons. This ratio provides insight into the magnitude of reductions that could be achieved during future seasons as a function of the validated load reduction estimates. The prospective realization rate should only be used as an ex-ante estimate of future performance for planning purposes and not retrospectively.

PA and State	Enrollment Ratio (Reported Asymmetric / Enrolled Capacity)	Asymmetric Ratio (Evaluated Asymmetric / Reported Asymmetric)	Retrospective Realization Rate (Evaluated Symmetric / Reported Asymmetric)	Prospective Realization Rate (Evaluated Forecast / Reported Asymmetric)
National Grid MA	77%	97%	82%	80%

Integrated Process and Impact Evaluation Findings:

- Challenges to Reliability: The ADR initiative and prior demand demonstrations provide substantial evidence that it is reasonable to expect PA load reduction targets to be met. Despite variability in load reduction across states and events, the CSPs and PAs have successfully recruited and managed resources, identified the annual system peak hour, and met overarching PA load reduction targets. However, the variability in load reduction across the limited number of event days and hours reduces confidence in the reliability of DR resources in the future. A better understanding of the dimensions of variability inherent in any DR program mitigates these concerns and suggests opportunities for continued reliability improvements.
- Shutdown Days: Customers are failing to report shutdown days to the PAs even though the initiative rules include a shutdown day allowance. The intent of this rule was to ensure that customer performance would not be negatively impacted if they had scheduled shutdowns. The shutdown day rule could save customers from a lower than expected event performance if events were called on a shutdown day. Also, shutdown days could have an impact on customer payments if they fell within their baseline period and went unreported.
- Pre-Cooling, Gaming, and Snapback: The impact evaluation investigated whether there was evidence of pre-event load increases that could be explained either by pre-cooling, load shifting, or gaming.3 Pre-cooling and load shifting are acceptable strategies for participation in the ADR initiative; however, acceptable load shifting strategies can be

difficult to distinguish from gaming. Post-event, the impact evaluation investigated whether there was evidence of post-event load increases that could be explained by snapback. None of the load shapes point toward pre-event activity or snapback. The process evaluation investigated whether there was evidence of gaming through the customer surveys, where customers were asked if building operational adjustments were made in the hours leading up to an event. A quarter of respondents said yes but described taking action to reduce load prior to events (e.g., begin shutdown of slow-ramping equipment) to ensure that they could curtail adequately during events. These findings are described in more detail with illustrations in the body of this report (Evidence of Pre-Cooling, Gaming, and Snapback).

Summary of PA ADR Initiatives and ISO-NE Overlap Findings;

- Scenarios in which PA ADR initiative events and ISO-NE scarcity conditions overlap or are called coincidently are rare, as scarcity conditions occur because of a supply constraint (at the transmission level) while PA ADR events are called in response to mitigate load during the system peak hour.
- ISO-NE staff concerns regarding PA ADR initiative overlap are:
    - Participation in PA ADR events could result in eroding the ISO-NE baseline calculation and same-day adjustment for performance, or vice versa.
    - The ISO could over designate reserves of demand response resources (DRRs) that participate in PA ADR initiatives if their FCM bids are not revised.
- Although the ADR initiative rules specify how co-participation in the PA initiative and ISO-NE FCM should work, the PA initiative rules do not address the ISO's overlap concerns.
- Both ISO and PA staff expressed a willingness to discuss overlap concerns and solutions.

Programs to which the Results of the Study Apply: C&I ConnectedSolutions

Evaluation Recommendations included in the study:
Recommendation 1: Continue to seek solutions to accelerate the incentive payment process. National Grid is starting to allow CSPs to access their online day-after data and daily performance summaries. This access should help CSPs more quickly identify faulty meters or reconcile data discrepancies, which affect the payment turnaround time.

Recommendation 2: Remind and educate the CSPs of the shutdown allowance and reporting rule. The PAs could ask for pre-planned shutdown information during the application/enrollment process.

Recommendation 3: Adapt the shutdown rule to account for unexpected facility shutdown events. To exclude a facility shutdown day from a customer's baseline calculation, that customer or their CSP must notify their PA at least seven days in advance of the shutdown. It is difficult to do this when a facility shutdown event is unexpected. Consider allowing customers or CSPs to report the shutdown to the PA 24 hours before an event is called.

Recommendation 4 : Formally standardize all rules related to data quality, baseline calculation methods, and aggregation.

Recommendation 5: Establish data quality rules with clear outcomes for poor quality and/or insufficient data. The evaluation team developed several rules as part of this study, which are described in the Data Sufficiency section of this report; these rules may be a useful starting point to develop consistent rules. The data issues encountered in this study were not anticipated. Establishing firmer expectations or providing incentives are two possible means of motivating and ensuring clean and complete data in future initiative cycles.

Recommendation 6 : Use the retrospective realization rate to determine past season performance.

Recommendation 7: Use the prospective realization rate to estimate future load reduction.

Recommendation 8: In the short-term, representatives from ISO-NE, the PAs, and, if feasible, the CSPs should come together at a Demand Resources Working Group (DRWG) meeting and brainstorm mutually beneficial design solutions that would minimize the impact of one entity on the other.

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
Recommendation 1 – Yes National Grid continues to explore ways to make the incentive payment process faster.

Recommendation 2 – This recommendation is still under consideration.

Recommendation 3 – This recommendation is still under consideration.

Recommendation 4 – This recommendation is still under consideration.

Recommendation 5 – This recommendation is still under consideration.

Recommendation 6 – No National Grid is not applying the 82% retrospective realization rate in RI. The reason for this is RI applies results prospectively and due to this the prospective realization rate highlighted in Recommendation 7 is being applied to the RI 2021 plan.

Recommendation 7 – Yes National Grid is applying the 80% prospective RR result to the 2021 annual plan and any future plans until a new EM&V study is completed.

Recommendation 8 – This recommendation is still under consideration.

Study Name: Rhode Island 2019 Energy Efficiency Workforce Analysis Final Report

Type of Study: Economic Impact
Evaluation Conducted by: Guidehouse
Date Evaluation Conducted: 2020

Evaluation Objective and High Level Findings:
National Grid engaged Guidehouse to estimate the workforce associated with implementation of National Grid Rhode Island's electric and gas energy efficiency programs delivered in 2019. This study addresses the requirements of General Law 39-2-1.2, enacted by the Rhode Island General Assembly in 2012. In 2019, National Grid spent a combined $134,751,5788 on the Rhode Island programs that saved 190,159 annual megawatt hours (MWh) of electricity9 and 451,466 million British thermal units (MMBtu) of natural gas.10

The focus of the study was to quantify the workforce that was involved in delivering National Grid's Rhode Island programs in 2019. The workforce analysis reported the number of jobs associated with the programs and compares them to past years. Guidehouse calculated 877.6 full-time equivalent (FTE) workers associated with National Grid spending in 2019 for Rhode Island programs.11 Since an FTE employee often represents the combined labors of more than one person over the course of a year, the number of individual workers is far greater than the number of FTEs. At a high level, spending for energy efficiency programs in Rhode Island increased from 2018 to 2019, leading to increased activity and therefore an increase in effort by the associated workforce. An overview of the findings of this report are shown in Table 1.

[8] The Narragansett Electric Company d/b/a National Grid, 2019 Energy Efficiency Year End Report.
[9] Note that although the savings are not quantified here, the electric portfolio also includes delivery of energy efficiency services to customers that heat with delivered fuels.
[10] The Narragansett Electric Company d/b/a National Grid, 2019 Energy Efficiency Year End Report.
[11] As indicated in Appendix C, most vendors are either headquartered or have a physical presence in Rhode Island. The number of FTEs reported do not include customer employees who assist in various ways with project implementation in their facilities.

Table 1 Summary of FTEs (2015-2019)

	2019	2018	2017	2016	2015
Electric Programs					
Residential Non-Income Eligible	189.1	170.9	98.1	104.0	125.4
Residential Income Eligible	65.1	45.8	46.0	42.3	37.0
Commercial and Industrial	265.0	250.0	263.5	241.1	210.0
Gas Programs					
Residential Non-Income Eligible	218.1	191.6	174.9	159.3	172.1
Residential Income Eligible	56.2	39.4	36.5	41.4	43.8
Commercial and Industrial	28.7	31.9	34.4	36.1	32.0
Other					
CAP Agencies12		35.0	35.0	38.0	34.0
National Grid13	43.3	39.5	38.2	39.9	41.6
Marketing14	12.1				
Total	877.6	804.1	726.5	702.2	695.8

Source: Guidehouse analysis and 2018 study

Key Findings:

- 877.6 full-time equivalent workers were associated with 2018 Rhode Island programs.
- Aggregate number of FTEs increased for the fifth consecutive year.
- One "full-time equivalent" worker often represents the combined labors of multiple persons.
- 1,151 individual companies and agencies were associated with delivering the programs.
- 71% of these entities are either headquartered or have a physical presence in Rhode Island.

Programs to which the Results of the Study Apply: This is an overall indicator of economic impact and is not applied to a specific program.

Evaluation Recommendations included in the study:
N/A

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:

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[12] Note that for the 2019 analysis, CAP Agency staff were included within the Residential Income Eligible program under both Electric and Gas.
[13] In years prior to 2019 a 2,016-hour work year was assumed when calculating FTEs. National Grid changed this assumption in recent years to a 1,768-hour work year. This new assumption was implemented beginning in 2019 and resulted in a slight increase in FTEs. Under the new assumption, the 2018 National Grid FTE count would have been 45.
[14] Beginning in 2019, marketing was contracted to a new vendor, resulting in an increase in jobs, these are therefore shown separately.

N/A

Savings Impact:
N/A

MA19R17-B-TRM Comprehensive TRM Review (Draft)

Type of Study: Impact
Evaluation Conducted by: Guidehouse
Date Evaluation Conducted: July 2020 (Draft findings)

Evaluation Objective and High Level Findings:
This study reviewed the quality of assumptions and values in the Massachusetts Technical Reference Manual (TRM) to ensure that relevant data from the RES 1 Baseline Study and other recent studies are incorporated into the TRM. The study prioritized TRM parameters that were based on older data sources, data sources outside MA or New England, or those that contribute significantly in EE programs. Table 1 summarizes the measures and recommended TRM updates that RI adopted based on the draft results of this study.

Table 1: Summary of Recommended TRM Parameter Value Updates (Leveraged in RI)

Measure Name	Parameter Name	Parameter Unit	Existing Value	Proposed Value
Clothes Dryer (RES-A-CD)	EUL, Electric	Years	12	16
	EUL, Gas	Years	12	17
Dehumidifier (RES-PL-DH)	Capacity	Pints/Day	35	*Remove*
	Efficiency	Liters/kWh	Retirement: 1.0 Baseline: 1.5 Measure: 2.0	Retirement: 1.6 Baseline: 2.8 Measure: 3.3
	Hours of Operation	Hours/Year	Undocumented	*Remove*
	Dehumidification Load	Liters/Year	n/a	1,520
	Energy Savings	kWh/Year	New: 167.6 Retirement: 152.7	New: 82.3 Retirement: 407.1
	Demand Savings	kW	New: 0.04 Retirement: 0.04	New: 0.02 Retirement: 0.10
	EUL	Years	12	17
Low-Flow Showerhead (RES-WH-S)	EUL	Years	7	15
Low-Flow Showerhead with	Electric (Single Family)	kWh	372	247
	Electric (Single Family)	kW	0.08	0.06

Measure Name	Parameter Name	Parameter Unit	Existing Value	Proposed Value
Thermostatic Valve (RES-WH-STV)	Gas (Single Family)	MMBtu	1.84	1.22
	Oil (Single Family)	MMBtu	2.09	1.32
	Other (Single Family)	MMBtu	1.84	1.22
	Electric (Multi-family)	kWh	335	183
	Electric (Multi-family)	kW	0.09	0.04
	Gas (Multi-family)	MMBtu	1.66	1.41
	Oil (Multi-family)	MMBtu	1.88	1.44
	Other (Multi-family)	MMBtu	1.66	1.41
Pool Pump (RES-MAD-PP)	Operating Days per Year	Days/Year	91	122
	Pool Size	Gallons	20,000 to 23,000	22,000
	Flow Rates	gpm	Baseline: 64 2S: 66 high, 33 low VS: 50 high	Baseline: 71 2S: 71 high, 36 low VS: 57 high, 23 low
	Daily Operating Hours	Hours/day	Baseline: 8.5 2S: 2 high, 12.5 low VS: 2 high, 18 low	Baseline: 7.7 2S: 2 high, 13 low VS: 2 high, 22 low
	Energy Factor	EF	Baseline: 2.1 2S: 2.0 high, 5.2 low VS: 4.0 high, 8.8 low	Baseline: 2.0 2S: 2.0 high, 5.3 low VS: 2.9 high, 10.5 low
	Energy Savings	kWh/year	2S: 842, VS: 1,062	2S: 835, VS: 1,360
	Demand Savings	kW	2S: 0.87, VS: 1.12	2S: 0.87, VS: 1.43
	EUL	Years	10	6
Programmable Thermostat (RES-HVAC-PT)	EUL	Years	15	19

Measure Name	Parameter Name	Parameter Unit	Existing Value	Proposed Value
Room Air Cleaner (RES-PL-RAC)	Energy Savings	kWh	391	Varies
Room Air Conditioner (RES-PL-ROOMAC)	EUL	Years	8	12
ECM Circulator Pump (RES-HVAC-ECMCP)	CFWP	-	0.16	0.53
Heat Recovery Ventilator (RES-HVAC-HRV)	HRV Gas Savings	MMBtu	7.7	8.6
	HRV Electricity Savings	kWh	-133	-171
	HRV Demand Savings	kW	-0.10	-0.02
	ERV Gas Savings	MMBtu	-	8.8
	ERV Electricity Savings	kWh	-	-127
	ERV Demand Savings	kW	-	-0.014

Source: MA Comprehensive TRM Review (July 29, 2020 Draft Results)

Programs to which the Results of the Study Apply:
Residential Energy Star Products Electric
Residential EnergyStar HVAC
Residential EnergyWise Electric and Gas – Single Family and Multifamily programs
Residential Income-Eligible Electric and Gas – Single Family and Multifamily programs
Residential New Construction Electric
C&I Multifamily Gas

Evaluation Recommendations included in the study:
The evaluation team recommends the PAs adopt updated TRM values

Explain Whether or Not National Grid Decided to Adopt Recommendations from the Study:
National Grid adopted the results of this study.

Savings Impact:
The savings impact depends on the measure. See Table 1 for more details.

5. Historical Evaluation Studies

Sector	Program	Study type	2013	2014	2015	2016	2017	2018	2019	2020	2021 Plan
Residential	EnergyWise SF	Impact									
	EnergyWise SF	Process						HEAT Loan			
	Income Eligible SF	Impact									
	Income Eligible SF	Process									
	EnergyWise MF	Impact									
	EnergyWise MF	Process									
	Income Eligible MF	Impact									
	Income Eligible MF	Process									
	Home Energy Reports	Impact									
	Home Energy Reports	Process									
	EnergyStar Lighting	Impact/Market									
	EnergyStar Products	Impact									
	HVAC	Impact									Demo
	HVAC	Process/Market									
	Connected Solutions	Impact									
Cross-cutting	Potential study	Market									
	Job Impact	Jobs									
	Avoided Cost	Benefits									
	REMI	Benefits									
	Participation	Market									
	Non-Participant	Market									
	RASS	Market									
	Gas Peak Demand	Impact									
	Piggybacking Study	Process									
	Heat Pumps Study	Market									
	ES Homes/Codes & Standards	Impact/Market									
	Legislated M&V Study	Market									
C&I Electric	Custom	Impact									
	HVAC	Impact									
	Industrial Process	Impact									
	CAIR	Impact									
	Refrigeration, Motors, Other	Impact									
	Custom Lighting	Impact									
	Street Lighting	Impact									
	CDA	Impact									
	CHP	Impact									
	Prescriptive Lighting	Impact									
	Upstream Lighting	Impact									
	Upstream Lighting	Process									
	Prescriptive HVAC	Impact				chillers					
	Prescriptive VSD	Impact									
	Prescriptive CAIR	Impact									
	Connected Solutions	Impact									
	All	NTG									
C&I Gas	Custom	Impact									
	Prescriptive	Impact			steam traps		steam traps	steam traps			
	All	NTG									
Small Business	Lighting	Impact			prescriptive						
	Non-Lighting Electric	Impact									
	All	NTG									

These studies are available through the EERMC[15], the PUC[16], and National Grid.

[15] https://rieermc.ri.gov/plans-reports/evaluation-studies/
[16] http://www.ripuc.org/

2020	
Study	**Impact Descriptions**
Cadeo, Impact and Process Evaluation of EnergyWise Single Family Program, September 2020.	This study updated gross savings, in-service rates and net-to-gross ratios for the EnergyWise Single Family program.
Cadeo, Impact and Process Evaluation of EnergyWise Multi Family Program, September 2020.	This study updated gross savings, realization rates, in-service rates and net-to-gross ratios for the EnergyWise Multi Family program.
Cadeo, Impact and Process Evaluation of Income Eligible Multi Family Program, September 2020.	This study updated gross savings, realization rates and in-service rates for the Income-Eligible Multi Family program.
Cadeo, Impact Evaluation of Home Energy Reports Program 2017-2019, September 2020.	This study updated realization rates for the Home Energy Reports program.
Guidehouse, Comprehensive TRM Review Interim findings in July 2020 (Leveraged study from MA)	This study reviewed and updated savings assumptions and effective useful lives of several residential measures in MA. Rhode Island adopted the results to update savings assumptions and measure lives of several measures in the residential programs.
NMR, Lighting Hours of Use Study, March 2020. (Leveraged study from MA)	This study reviewed and updated the HOU used to calculate the lighting savings measures in MA. Rhode Island adopted the results to update savings assumptions for the lighting measures in RI.
NMR, LED Delta Watts Update, March 2020. (Leveraged study from MA)	This MA study updated delta watts for lighting measures. Rhode Island adopted the results to update gross savings calculation for its Residential Lighting measures.
Guidehouse, Residential Wi-Fi Thermostat DR Evaluation, April 2020. (Leveraged study from MA)	This study reviewed and updated the savings being used In MA for the Wi-FI DLC program offering. Rhode Island adopted the results to update savings for Wi-Fi DLC offering in RI.

Guidehouse, 2019/2020 Residential Energy Storage Demonstration, Februray 2020. (Leveraged study from MA)	This study reviewed and verified the savings being used In MA were accurate for the Residential demand response battery storage offering. Rhode Island adopted the results for residential battery storage demand response offering in RI.
ERS, Evaluation of 2019-2020 Cross-State DR Program, Februrary 2020. (Leveraged study from MA)	This study reviewed and updated the summer demand realization rate being used In MA for the C&I targeted dispatch program offering. Rhode Island adopted the results for the C&I targeted dispatch demand response offering in RI.
DNV GL, Impact Evaluation of PY2017 Custom Gas Installations. May 2020.	The study updated realization rates for custom gas projects, as part of a rolling effort that incorporated results from PY2016 and PY2017.
DNV GL, Impact Evaluation of PY2018 Custom Gas Installations. September 2020.	The study updated realization rates for custom gas projects, as part of a rolling effort that incorporated results from PY2016, PY2017, and PY2018.
DNV GL, Impact Evaluation of PY2018 Custom Electric Installations. Interim Findings August 2020.	The study updated realization rates for custom electric projects, as part of a rolling effort that incorporated results from RI PY2016, MA PY2017-18, and RI PY2018.
DNV GL, Impact Evaluation of 2017 Small Business Electric Installations. March 2020.	The study updated electric non-lighting impact factors for the Small Business initiative. RI leveraged the MA study of this initiative.
DNV GL, C&I Measure Life Study. March 2020.	This study informed Effective Useful Lives and Remaining Useful Lives for key C&I energy efficiency measures, updating the commercial boiler EUL. RI leveraged the MA study of this initiative.
Tetra Tech, C&I Free-Ridership and Spillover Study. Anticipated September 2020.	This study updated free-ridership and spillover rates for the C&I program
2019	
Study	**Impact Descriptions**

NMR, Residential Appliance Recycling Impact Factor Update. April 2019	This study updated gross savings, realization rate and net savings estimates for refrigerator and freezer recycling offered through ENERGY STAR Products program.
NMR, Delta Watts Update. April 2019. (Leveraged study from MA)	This MA study updated delta watts for general service lamps, specialty and reflectors. Rhode Island adopted the results to update gross savings calculation for its Residential Upstream Lighting program.
NMR, RLPNC 17-9 2019-21 Planning Assumptions: Lighting Hours-of-Use and In-Service Rate. July 2018. (Leveraged study from MA)	This study recommended planning values for hours of use and in-service rates for general service lamps, specialty and reflectors. Rhode Island adopted the results to update impacts for its Residential Upstream Lighting program.
NMR, RLPNC 17-3 Advanced Power Strip Metering Study (Revised). March 2019. (Leveraged study from MA)	This study yielded recommended gross electric savings and realization rates from advanced power strips offered through the Home Energy Services and upstream programs. Rhode Island adopted the result from this study to inform savings for Tier 1 and Tier 2 advanced power strips offered through its Retail Products program.
Navigant, Wifi Thermostat Impact Evaluation Secondary Research Study. September 2018. (Leveraged study from MA)	This study recommended annual savings values of 31 therms for combustion heating, 97 kWh for electric resistance heating, and 64 kWh for central air conditioning for Wifi thermostats. Rhode Island adopted these results to update savings assumptions for Wifi thermostats in HVAC and residential retrofit programs.
DNV GL, Impact Evaluation of PY2016 Custom Gas Installations. December 2019.	The study updated realization rates for custom gas projects, as part of a study leveraging the MA study of the same program element.
DNV GL, Impact Evaluation of PY2016 Custom Electric Installations. January 2020.	The study updated realization rates for custom electric projects, as part of a study leveraging the MA study of the same program element.
2018	
Study	**Impact Descriptions**

Energy & Resource Solutions, Two-Tier Steam Trap Savings Study. April 2018.	This MA study recommends a two-tier approach for prescriptive steam traps. It calculates deemed savings to be 8.4 MMBtu/yr for system operating pressure ≤15 psig, and 35.6 MMBtu/yr for system operating pressure is >15 psig.
DNV GL, Impact Evaluation of PY 2015 Rhode Island Commercial and Industrial Upstream Lighting Initiative. September 2018.	The study updated impact factors for the Upstream Lighting initiative. The RI study leveraged the MA study of the same initiative.
DNV GL, Rhode Island Commercial & Industrial Impact Evaluation of 2013-2015 Custom Comprehensive Design Approach. October 2018.	The study updated the realization rate for the CDA initiative. The RI study leveraged the MA study of the same initiative.
DNV GL, Impact Evaluation of PY2016 RI C&I Small Business Initiative: Phase I. June 2019.	The study updated impact factors for the Small Business initiative. The RI study leveraged the MA study of the same initiative.
DNV GL, Prescriptive C&I Loadshapes of Savings. March 2018.	This MA study pooled known sources of 8,760 savings loadshapes in an interactive tool to estimate general prescriptive measure loadshapes over customizable time periods.
DNV GL, P78 Upstream LED Net-to-gross Analysis. August 2018.	This MA study updated net-to-gross values for the C&I Upstream Lighting initiative for 2019, 2020, and 2021.
DNV GL, P86 Lighting Hours of Use Study. April 2019.	This MA study used lighting hours of use data from several previous studies to determine hours of use by building type for the C&I Upstream Lighting program.
DNV GL, P81 Process Evaluation of C&I Upstream Lighting Initiative. September 2018.	The MA study updated in-service rates for the C&I Upstream Lighting initiative.
Illume Advising LLC, Rhode Island Statewide Behavioral Evaluation: Savings Persistence Literature Review. January 2018.	This study reviewed the existing research on the persistence of savings generated by HERs with particular attention to the applicability of each study to Rhode Island. The study explored potential impacts on the HER program when reducing the cadence of reports.

Synapse Energy Economics, Avoided Energy Supply Components in New England 2018 Report. March 2018.	This study developed new estimates of avoided costs associated with energy efficiency measures for program administrators throughout New England States. Rhode Island used the avoided costs of energy, capacity, natural gas, fuel oil, environmental costs and demand reduction induced price effects resulting from this study for 2019 program planning.
Navigant, 2017 Seasonal Savings Evaluation. March 2018.	This study evaluated the Nest thermostat optimization program offered in Massachusetts and Rhode Island. The study found that the program achieved energy and demand savings of 57 MWh and 134 kW, respectively, in Rhode Island
Navigant, 2017 Residential Wifi Thermostat Demand Response. April 2018.	This study evaluated the controllable thermostats as a demand response technology offered through Massachusetts and Rhode Island ConnectedSolutions programs. The study found average demand savings of 0.44 kW per thermostat in Massachusetts and 0.52 kW per thermostat in Rhode Island.
NMR, Rhode Island Lighting Market Assessment. July 2017	This Residential study estimated lighting saturation and other critical market indicators in Rhode Island and included a detailed comparison to Massachusetts. The study concluded that the two markets are substantially similar, therefore Rhode Island can use the results from the recently completed net-to-gross consensus study in MA to inform program planning for the Residential Upstream Lighting program.
Research Into Action, Rhode Island HEAT Loan Assessment. December 2018	This study assessed the extent to which HEAT Loan encourages uptake of weatherization and HVAC projects through the EnergyWise program. Findings from this study will be used to inform program planning and support future potential studies in Rhode Island.

NMR, Rhode Island Residential Appliance Saturation Survey. October 2018	This study developed an inventory of residential end-uses, including appliances, consumer electronics, heating and cooling equipment, thermostats, water heating, and building characteristics. Findings from this study will be used to inform program planning and support future potential studies in Rhode Island.
Cadeo, Rhode Island Impact Evaluation of Income Eligible Services Single Family Program, August 2018	This study deemed savings values and realization rates for electric and gas participants using billing and engineering analysis. The Company adopted the deemed savings values in the 2019 program plan.
NMR, RLPNC 17-11 LED Net-to-Gross Consensus Panel Report. June 2018. (Leveraged study from MA)	This study yielded recommended prospective net-to-gross ratios for 2019 to 2021 for the Residential Upstream Lighting program in MA. Rhode Island adopted the NTG established for 2019 and 2020 due to similarity in lighting market condition.
NMR, RLPNC 18-5 Home Energy Assessment LED Net-to-Gross and EUL Consensus. July 2018 (leveraged study from MA)	The study yielded recommended net-to-gross and estimated useful life for direct installed LED bulbs offered through the Home Energy Services Initiative in Massachusetts. Rhode Island adopted the results from this study to inform 2019 and 2020 planning for the Residential EnergyWise program.
NMR, RLPNC 18-4 Products Net-to-Gross Consensus Study, August 2018. (Leveraged study from MA)	This study yielded prospective net-to-gross for Residential Retail products for 2019 to 2021 in Massachusetts. Rhode Island adopted the results from this study to inform 2019 and 2020 planning for the Residential Products program.
Navigant, MA Residential Electric Loadshape and Baseline Study (Heating and Cooling Season report). July 2018. (Leveraged study from MA)	This study collected saturation, penetration and usage behavior data for all major electric and gas appliances in Massachusetts. Rhode Island adopted the end use load shapes determined by this study.

NMR, RLPNC 17-4/17-5 Products Impact Evaluation of In-service and Short-term Retention Rates Study. March 2018. (Leveraged study from MA)	This study yielded estimates of in-service rates (ISRs) and short-term retention rates for products currently offered through the Residential Consumer Products Core Initiative or the Mass Save® Home Energy Assessment (HEA) Programs. Rhode Island adopted the result from this study to inform savings for measures offered through Residential Products program.
NMR/Tetra Tech, TXC34 Massachusetts Residential HVAC Net-to-Gross and Market Effects Study. July 2018. (Leveraged study from MA)	This study yielded recommended net-to-gross ratios for selected heating, cooling, and water heating measures that will receive Mass Save® Standard rebates in 2019-2021. Rhode Island adopted the result from this study to inform savings for measures offered through Residential HVAC/HEHE programs.
Tetra Tech, Market-Rate Multifamily NEI – Phase I Final Memo. March 2018.	This MA study reviewed non-energy impacts associated with market-rate multifamily properties, including whether or not any additional NEIs should be applied, whether NEI values differ based on type and ownership of building, and whether there is double counting of NEIs.
Tetra Tech, Non-Energy Impact Framework Study Report. January 2018.	This MA study reviewed the current status of NEIs and had the following recommendations: do not count existing property value NEIs, review the BCR-model-related differences highlighted in the study and determine whether there is a reason for each, and, in cases where an NEI for one initiative or measure is applied to a different initiative or measure, provide clear public documentation of how the decision was made.

DNV GL, NMR Group, Tetra Tech, Massachusetts Commercial and Industrial Upstream HVAC/Heat Pump and Hot Water NTG and Market Effects Indicator Study. September 2018.	This MA study updated NTG for the following upstream equipment: • Ductless mini-split heat pumps • Electric water-source heat pumps • Air-cooled unitary/split central air conditioning (>5 tons) • Gas-fired storage water heaters between 76,000 and 300,000 BTU/hour • Gas-fired tankless water heaters between 180,000 and 199,900 BTU/hour
DNV GL, Evaluation of 2017 Demand Response Demonstration: C&I ConnectedSolutions. February 2018.	This MA study reviewed the baseline application and impacts calculated by the AutoGrid system, examine the effectiveness of the Connected Solution baseline, and assess ex-post impacts. It was also designed to understand customer acceptance and experience with the intervention, readiness of systems for larger deployment, and PA and vendor success in delivery.
2017	
Study	**Impact Descriptions**
Navigant, Rhode Island Energy Efficiency Program Customer Participation Study – Phase 1, October 2017	The study characterized participants and non-participants in several energy efficiency programs and identified customers that can be potentially targeted to increase participation.
NMR, 2017 Rhode Island Single-Family Code Compliance/Baseline Study, July 2017	This study yielded the final agreed upon baseline values to update the User Defined Reference Home (UDRH) in Rhode Island
ICF, 2017 Rhode Island Residential Code Savings Analysis	This study found that the average Rhode Island home could attain annual electric savings of 3,690 kWh and gas savings of 10 MMBtu if it fully complied with the state's building energy code.

NBI, 2017 Rhode Island Commercial Code Savings Analysis	This study found that the average Rhode Island commercial building could attain annual electric savings of 0.73 kWh/sf and gas savings of 0.90 MMBtu/sf if it fully complied with the state's building energy code.
NMR, 2017 Rhode Island Code Compliance Enhancement Initiative Attribution and Savings Study	The study found residential and commercial attribution factors of 23% and 46, respectively, which were used along with study results on average savings as well as construction activity projections to calculate the CCEI's projected savings from 2018-2020.
Peregrine Energy Group, Analysis of Job Creation from 2016 Expenditures for Energy Efficiency in Rhode Island by National Grid, April 2017	A study of the job impacts of National Grid's energy efficiency programs delivered to Rhode Island electricity and natural gas customers in 2016. The study estimated that 702 FTE workers, across 923 companies and agencies were employed in 2016 as a result of investments energy efficiency programs in Rhode Island.
New Buildings Institute, Energy Impacts of Commercial Building Code Compliance in Rhode Island, July 2017	This study quantified the energy impacts of energy code compliance patterns from field data collection and analysis of building characteristics.
The Cadmus Group, Inc., Ductless Mini-Split Heat Pump Impact Evaluation, 2016	This study estimated savings from various types of heat pumps.
DNV-GL, Impact Evaluation of 2014 Custom HVAC Installations, September 2017	The study updated realization rates for custom electric HVAC projects, as part of a study leveraging the MA study of the same program element.
DNV-GL, 2014 RI Custom Process Impact Evaluation, December 2017	The study updated realization rates for custom process projects, as part of a study leveraging the MA study of the same program element.
TetraTech, C&I Programs Freeridership & Spillover Study, September 2017	This study updated free-ridership and spillover values for the C&I electric and gas programs.
DNV-GL, MA C&I Steam Trap Evaluation Phase 2, Feb, 2017	This study updated steam trap savings estimates.
DNV-GL, Gas Boiler Market Characterization Study Phase II: Final Report, March 2017	This study updated C&I condensing boiler savings estimates.

DNV-GL, MA45 Prescriptive Programmable Thermostats, March 2017	This study updated programmable thermostat deemed gas savings for C&I programs.
2016	
Study	**Impact Descriptions**
DNV-GL, Impact Evaluation of 2014 Custom Gas Installations in Rhode Island Final Report, July 2016	This study yielded an energy realization rate for Custom Gas projects.
DNV-GL, Impact Evaluation of 2014 RI Prescriptive Compressed Air Installations Final Report, July 2016	This study yielded an energy realization rate for prescriptive compressed air compressors, dryers, and EE accessories.
DNV-GL, Impact Evaluation of 2012 National Grid-Rhode Island Prescriptive Chiller Program Final Report, July 2016	This study yielded an energy realization rate for prescriptive chillers.
DNV-GL, Multifamily Impact Evaluation, National Grid Rhode Island, January 2016	This study estimated realization rates for electric and gas savings for 2013 participants using a billing analysis. The results include a low level of precision and thus the realization rates are not applicable. The Company has been improving tracking, savings estimations and verification processes in line with the study's recommendations.
Research Into Action, National Grid Rhode Island EnergyWise Single Family Process Evaluation, August 2016	This study surveyed customers, vendors, contractors, and lending agencies to order to assess customer experience, HEAT Loan lender perspectives on the program, performance of the lead vendor and sub-contractors and lessons learned from programs elsewhere in the country.
DNV-GL, Impact Evaluation of 2014 EnergyWise Single Family Program, National Grid Rhode Island, August 2016	This study estimated deemed savings values and realization rates for electric and gas 2014 participants using billing and engineering analysis. The Company adopted the deemed savings values in the 2017 program plan.

Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study. Prepared by the NMR Group and Three3, Inc. for the Massachusetts Program Administrators. August 5, 2016.	This study developed Non Energy Impacts for low income programs, based on USODE's Weatherization Assistance Program tailored to MA context. Dollar benefits rose substantially over prior values primarily based on avoidance of deaths due to thermal stress.
Cadmus Group; Large Commercial and Industrial On-Bill Repayment Program Evaluation, September, 2016	National Grid commissioned this study to evaluate the financing component of the large commercial and industrial (LCI) energy efficiency program. Cadmus evaluated the program design, performance, and sustainability; the overall market for the program; and the program's penetration of that market to date.
Ductless Mini-Split Heat Pump (DMSHP) Final Heating Season Results; Ductless Mini-Split Heat Pump (DMSHP) Cooling Season Results, COOL SMART Impact Evaluation Team, 2015 / 2016	Heating and cooling memos that describe the number of full load hours found with field installed systems in MA and RI; these hours were used with historic data on incentivized systems to come up with average savings per unit.
DNV GL, Stage 2 Results—Commercial and Industrial New Construction Non-Energy Impacts Study—Final Report, prepared for the Massachusetts Program Administrators, March 2016	The purpose of this study was to quantify the dollar value of participant NEIs for C&I NC projects completed in 2013, and to estimate gross NEIs per unit of energy savings resulting from NC electric and gas measures separately.
2015	
Study	**Impact Descriptions**
Cadmus, Inc., High Efficiency Heating Equipment Impact Evaluation: Final Report, March 2015	The study determined revised deemed savings values for each furnace and boiler measure, including condensing boilers and early replacement of heating equipment. The study also reflected the increasing baseline for standard efficiency heating equipment.

DNV-GL, Retrofit Lighting Controls Measure Summary of Findings: Final Report (MA), October 2014	The study examined trends in lighting control savings and noted a decrease in savings over previous program years. It recommended updated coincidence factors as well as potential program and technology areas that may yield higher savings. Finally, the study recommended a change in the savings calculation algorithm for lighting controls.
Tabors Caramanis Rudkevich, Avoided Energy Supply Costs in New England: 2015 Report, April 2015	This study developed new estimates of avoided costs for application in 2016 through 2018 energy efficiency programs throughout the six New England states. Avoided costs were developed for natural gas, electric energy, electric capacity, demand reduction induced price effects (DRIPE), other fuels (oil, propane and wood), and carbon.
DNV-GL, Massachusetts 2013 Prescriptive Gas Impact Evaluation; Steam Trap Evaluation Phase 1, March 2015	The study concluded that there should continue to be both prescriptive and custom pathways for steam trap retrofit incentives, and further recommended that a group convene to review and revise the deemed savings estimate for steam traps. The study also recommended the use of a six year lifetime for steam traps.
Cadmus, Inc., LED Incremental Cost Study – Modeling LightTracker LED and Halogen Pricing Data, June 2015	This memo summarizes selected findings from the LightTracker LED, CFL, and halogen pricing data modeling effort and the resulting state-level price forecast through 2020 for LED, CFL, and halogen bulbs. These results are based on light bulb price data from 25 states that lacked LED programs from 2009 to 2014.
Cadmus, Inc., Cool Smart Incremental Cost Study: Final Report, July 2015	This incremental cost study estimates how manufacturing production costs (MPCs) and purchase prices of residential air conditioning (AC) and heat pump (HP) equipment change as equipment efficiency increases. The results support Cool Smart program enhancements and cost-effectiveness analysis, as well as potential upstream residential upstream heating, ventilation and air conditioning (HVAC) incentive programs.

Cadmus, Inc., Lighting Interactive Effects Study Preliminary Results – Draft, April 2015	This memo details the preliminary findings of the Lighting Interactive Effects study evaluated for the Massachusetts (MA) Program Administrators to better understand and report the true impact of energy efficient lighting retrofits. It recommended factors for electric and gas energy to be applied to residential program savings.
2014	
Study	**Impact Descriptions**
DNV GL, 2014 , Impact Evaluation of National Grid Rhode Island C&I Prescriptive Gas Pre-Rinse Spray Valve Measure	The evaluation examined the gas and water savings associated with the installation of reduced-flow pre-rinse spray valves. The results are based on site measurements from MA and RI facilities. The final gross gas and water savings are 11.4 MMBtu and 6,410 gallons per spray valve respectively.
NMR Group, Inc., Northeast Residential Lighting Hours-of-Use Study	This multi-State study provided updated hours-of-use assumptions for residential lighting programs in various room types.
The Cadmus Group, Impact Evaluation: Rhode Island Income Eligible Services, Volume II The Cadmus Group, National Grid Income Eligible Services Process Evaluation	This RI-specific impact evaluation focused on the electric and gas savings resulting from the participation of these dwellings in in-home retrofit of electrical components and weatherization of electric, gas, and fossil fuel heated homes. It used billing analysis, engineering reviews, and interviews for the process components.
National Grid, Macroeconomic Impacts of Rhode Island Energy Efficiency Investments REMI Analysis of National Grid's Energy Efficiency Programs	This study quantifies the macroeconomic impacts of National Grid's 2014 EE Program Plan for Rhode Island and provides updated economic impact multipliers to quantify the benefits of future EE programs in the Rhode Island economy. This updates the multipliers from an economic impact study conducted by Environment Northeast (ENE) in 2009.
2013	
Study	**Impact Descriptions**

KEMA, Inc., Impact Evaluation of 2011 Rhode Island Prescriptive Lighting Installations KEMA, Inc., Impact Evaluation of 2011 Rhode Island Custom Lighting Installations	The Custom and Prescriptive Lighting studies involved the impact evaluation of components of the Large Commercial and Industrial electric efficiency programs. The studies included on-site engineering and end-use metering of a statistically drawn random sample of participants. The custom portion of the study was coupled with the results of the 2013 Massachusetts Custom Lighting study.
KEMA, Inc., Impact Evaluation of 2011 Prescriptive Gas Measures	On-site monitoring and verification of installation provided updated impacts for four major prescriptive gas measures. Programs and measures are similar between National Grid affiliates in MA and RI, and results are applied to RI. The overall realization rate for the four measures was approximately 102% and the relative precision was about ±15%.
KEMA, Inc., and DMI, Inc., Impact Evaluation of 2011-2012 Prescriptive VSDs	This evaluation provided a new estimate of the impacts of prescriptive variable speed drives, based on pre-post metering of measures installed in 2011 and 2012. Programs and measures are similar between National Grid affiliates in MA and RI, and results are applied to RI. Key findings include an annual kWh realization rate was 94% with a relative precision of +/- 23%, and identification of factors that influenced the realization rate.
The Cadmus Group, Inc., 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing	The results of this study yielded updated net-to-gross factors and estimates of the timing of equipment replacement for residential heating and cooling measures. Programs and measures are similar between National Grid affiliates in MA and RI, and results are applied to RI.
KEMA, Inc., Impact Evaluation of 2010 Prescriptive Lighting Installations	The RI Prescriptive lighting study listed above did not examine case lighting separately from other lighting systems. To complement the RI-specific results, this MA study provided impact updates on case lighting.

2012	
Study	**Impact Descriptions**
TetraTech, Final Report – Commercial and Industrial Non-Energy Impacts Study, (prepared for Massachusetts Program Administrators), June 29, 2012	This report provides a comprehensive set of statistically reliable Non-energy impact (NEI) estimates across the range of C&I prescriptive and custom retrofit programs offered by the MA electric and gas Program Administrators (Pas). The analytical methods used allow this report's findings to be applicable to RI.
2011	
Study	**Impact Descriptions**
KEMA, Inc., C&I Lighting Loadshape Project, Prepared for the Regional Evaluation, Measurement, and Verification Forum, June 2011.	A compilation of lighting loadshape data from the Northeast. The study provided updated coincidence factors for the Energy Initiative and Small Business Lighting programs. The Small Business program summer coincidence factor went from 0.80 to 0.79, while the Energy Initiative summer coincidence went from 0.88 to 0.89
KEMA, Inc., C&I Unitary HVAC Loadshape Project Final Report, Prepared for the Regional Evaluation, Measurement, and Verification Forum, June 2011.	From end use metering, the study produced updated diversity and equivalent full load hours for unitary HVAC measures
2010	
Study	**Impact Descriptions**
ADM Associates, Inc., Residential Central AC Regional Evaluation, Final Report, October 2009	kWh and kW savings figures for the installation of efficient residential CAC systems

2007	
Study	**Impact Descriptions**
RLW Analytics, Small Business Services Custom Measure Impact Evaluation, March 23, 2007	Verification of energy savings from custom lighting projects in the Small Business Services program.
RLW Analytics, Impact Evaluation Analysis of the 2005 Custom SBS Program, May 29, 2007	Realization rates for the Small Business Services program