

2019 Measurement and Verification Plan

Table of Contents

1. Introduction	5
2. Evaluation studies completed in 2018.....	5
3. 2019 Planned Evaluation Studies	6
3.1 Commercial and Industrial Studies.....	9
a. RI-19-CG-CustGas - Impact Evaluation of PY2017 Custom Gas Installations	9
b. RI-18-CE-CustElec - Impact Evaluation of PY2016 Custom Electric Installations (Continued from 2018)	9
c. RI-19-CE-CustElec - Impact Evaluation of PY2017 Custom Electric Installations	10
d. RI-19-CE-UpstrLight - Impact Evaluation of PY20xx Upstream Lighting Program [Year(s) TBD].....	10
e. RI-19-CE-SBNonLight - Impact Evaluation of PY2017 Small Business Electric Installations	10
f. RI-19-CX-Presc - Prescriptive Gas & Electric Measures.....	11
3.2 Residential Studies.....	11
a. RI-19-RX-IESF - Process Evaluation of the Income Eligible Single Family Program.....	11
b. RI-19-RE-UpstrLight - Residential Lighting Market Assessment	12
c. RI-19-RE- AppRecycle - Residential Appliance Recycling Savings Update.....	12
3.3 Cross-Sector/Other Studies.....	13
a. RI-19-XX-DataCollect – Primary Data Collection for Potential Study	13
b. RI-19-XE-HPmarket - Heat Pump Market Assessment	13
c. RI-19-XX-Jobs - Job Impacts Analysis Study.....	13
d. RI-18-XX-Piggybacking - Piggybacking Diagnostic Study (Continued from 2018) 13	
e. RI-19-CG-GasDR - Gas Demand Response Pilot Evaluation Study.....	14
f. RI-19-XX-M&VLegislation - Legislated M&V Study	14
4. Evaluation Study Findings.....	15
5. Historical Evaluation Studies	61
2018.....	62

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

2017.....	65
2016.....	67
2015.....	68
2014.....	69
2013.....	70
2012.....	71
2011.....	72
2010.....	73
2007.....	73

1. Introduction

Evaluation, Measurement and Verification (EM&V) has been an integral part of the National Grid's energy efficiency program planning process. The Company's EM&V Plan continues to focus on evaluating Rhode Island sites and markets while leveraging as many resources as possible from evaluation studies in other National Grid territories in order to maximize value for ratepayers ~~and keep costs low while minimizing costs~~. These studies are commissioned by the Company, conducted by independent evaluators, and overseen by the Company along with the Rhode Island Energy Efficiency & Resource Management Council and the Office of Energy Resources.

2. Evaluation studies completed in 2018

The Company, with oversight from the Rhode Island Energy Efficiency & Resource Management Council evaluation consultants and the ~~Office of Energy Resources~~ evaluation staff, completed 134 evaluation studies in 2018 (see below). The research studies include impact evaluations, process evaluations and market studies in the residential and commercial and industrial (C&I) sectors.

Commercial & Industrial

- ~~1. Impact Evaluation of Custom Gas Installations (ongoing)~~
- ~~2.1. Impact Evaluation of 2013-2015 Custom CDA (draft)~~
- ~~3.2. Impact Evaluation of PY2015 RI C&I Upstream Lighting Initiative (draft)~~
- ~~4.3. Impact Evaluation of PY2016 RI C&I Small Business Initiative: Phase I (draft)~~

Residential

1. Statewide Behavioral Evaluation: Savings Persistence Literature Review
2. 2017 Seasonal Savings Evaluation
3. Wifi Thermostat Demand Response
4. On-Site Saturation Lighting Market Assessment (draft)
5. EnergyWise HEAT Loan Assessment (draft)
6. Residential Appliance Saturation Survey (draft)
7. Impact Evaluation of Income Eligible Services Single Family Program (draft)

Cross-Cutting

1. Jobs Study 2017
2. Avoided Energy Supply Components in New England 2018

3. System ~~R~~Reliability Procurement Study

Section 4 provides detailed description, findings and recommendations of each of the studies above along with selected research studies completed in other regions and/or other National Grid jurisdictions. The results of these evaluations have been judged by the Company and the oversight team to be applicable to ~~its~~ Rhode Island's energy efficiency programs. The Company is adopting the results of these studies in 2019 program planning due to similarity, either in the measures offered, or ~~in terms of~~ program structure or ~~program~~ delivery.

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 2018 Energy Efficiency Plan have been ~~deleted~~ removed from this list.

3. 2019 Planned Evaluation Studies

This section describes planned studies that focus on areas of interest to the Rhode Island programs and build on the deep history of evaluation studies ~~performed~~ commissioned by the Company over many 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.

Table 1 lists evaluation studies that the Company plans to conduct in 2019 to inform the next planning cycle. Study labeling codes have been added to the study names to facilitate distinct identification. 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-RE-IESF refers to evaluation study of the income eligible single family program in 2018 for electric and gas. The study codes take the general form shown ~~below~~ in Table 2.

Table 1. Study Labeling Code Format

{State}	-	{Evaluation Year of Evaluation}	-	{Sector}	-	{Fuel}	-	{Keyword}
RI		18		R= residential		E= electric		
<u>MA</u>		19		C= commercial		G= gas		
		÷		X= cross-sector		X= electric & gas		

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 RE LIIESF~~ refers to evaluation study of the low income eligible program single family program in ~~2019 2018~~ for gas and electric.

Table 21. Planned Evaluation Studies in 2019

Sector	Study Code	Type	Affected Programs	Study Name	State Lead
C&I	RI-19-CG-CustGas	Impact (Rolling)	Custom	PY2017 Impact Evaluation of Custom Gas Installations	MA
C&I	RI-18-CE-CustElec	Impact (Rolling)	Custom	PY2016 Impact Evaluation of Custom Electric Installations (continued from 2018)	MA
C&I	RI-19-CE-CustElec	Impact (Rolling)	Custom	PY2017 Impact Evaluation of Custom Electric Installations	MA
C&I	RI-19-CE-UpstrLight	Impact (Rolling)	Upstream Lighting	PY20xx Impact Evaluation of Upstream Lighting Program [Year(s) TBD]	MA
C&I	RI-19-CE-SBNonLight	Impact	<u>Small Business</u>	PY2016 SBS Non-lighting Impact Evaluation	MA
C&I	RI-19-CX-Presc	Impact	Prescriptive Gas & Electric	Prescriptive Gas & Electric Measures (specific measures TBD)	MA
C&I	RI-19-CX-DataCollect	Market	Multiple	Site Primary Data Collection (for Potential Study)	RI
Res	RI-19-RX-LIIESF	Process	<u>Income Eligible Low Income Single Family</u>	Process Evaluation of Income Eligible Single Family Program	RI
Res	RI-19-RX-MF	Impact	EW-MF, Low income MF	Impact Evaluation of EnergyWise and Income-Eligible Multifamily Program	RI
Res	RI-19-RE-UpstrLight	Market	Residential Lighting	Residential Lighting Market: Sales Data <u>Analysis Assessment</u>	MA
Res	RI-19-RE-AppRecycle	Market	Residential Products	Residential Products: Appliance Recycling Savings Update (including RI in MA effort)	MA
Res	RI-19-RE-HEM	Market/Impact	EnergyWise	Residential Home Energy Monitoring System <u>Evaluation</u>	RI
<u>Cross</u>	<u>RI-19-XX-DataCollect</u>	<u>Market</u>	<u>Multiple</u>	<u>Primary Data Collection for Potential Study</u>	<u>RI</u>

Cross	RI-19-XE-HPmarket	Market	Multiple	Heat Pump Market Assessment	RI
Cross	RI-19-XX-Jobs	External	Multiple	Jobs study	RI
Cross	RI-18-XX-Piggybacking	Process	Multiple	Rhode Island Piggybacking Diagnostic Study (continued from 2018)	RI
Pilot	RI-19- XXCG- Pilots GasDR	Impact	Pilot	Pilot Gas Demand Response Pilot Evaluation Study	RI
Others	RI-19-XX-M&VLegislation	External	Multiple	Legislated M&V Legislation Review Study	RI

Table 2. Study Labeling Code Format

[State]	=	[Year Study Conducted]	=	[Sector]	=	[Fuel]	=	[Keyword]
<u>RI</u>		<u>18</u>		<u>R = residential</u>		<u>E = electric</u>		
		<u>19</u>		<u>C = commercial</u>		<u>G = gas</u>		
		<u>:</u>		<u>X = cross sector</u>		<u>X = electric & gas</u>		

The proposed budget for evaluation study expenditures in 2019 is approximately \$~~21.19~~ 21.19 million (~~\$1.64-57~~ million for electric and ~~\$0.43-38~~ million for gas) excluding internal staffing costs. The proposed budget for EM&V comprises approximately 1.8% of the total portfolio budget in 2019. Final reports along with graphical executive summaries will be made publicly available upon completion of the evaluation studies.

3.1 Commercial and Industrial Studies

a. RI-19-CG-CustGas - Impact Evaluation of PY2017 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 2017. This will be the second year of ~~several~~ ‘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 will evaluate roughly 1/3 of the number of sites, which will keep the realization rates updated yearly.

b. RI-18-CE-CustElec - Impact Evaluation of PY2016 Custom Electric Installations (Continued from 2018)

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 2016. This is the first year of ~~several~~ ‘rolling’ evaluations in coordination with evaluation efforts in Massachusetts, where the first

year ~~will be~~ a ‘full’ study (as has historically been done every 3 years), while subsequent years will evaluate roughly 1/3 of the number of sites, which will keep the realization rates updated yearly.

c. RI-19-CE-CustElec - Impact Evaluation of PY2017 Custom Electric Installations

The objective of this impact evaluation is to provide verification of electric energy savings estimates for a sample of 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 2017. This will be the second year of ~~several~~ ‘rolling’ evaluations in coordination with evaluation efforts in Massachusetts, where the first year (see RI-18-CE-CustElec above) was a ‘full’ study (as has historically been done every 3 years), while subsequent years will evaluate roughly 1/3 of the number of sites, which will keep the realization rates updated yearly.

d. RI-19-CE-UpstrLight - Impact Evaluation of PY20xx Upstream Lighting Program [Year(s) TBD]

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. The years on which this study will be based are still to be determined, as the details of the ‘rolling’ evaluation scheme ~~is~~ are still being finalized. This will be the beginning of rolling evaluations in coordination with evaluation efforts in Massachusetts, where ~~the first year was~~ a ‘full’ study was performed in 2018 (as has historically been done every 3 years), ~~while and~~ subsequent years will evaluate roughly 1/3 of the number of sites, which will keep the realization rates updated yearly.

e. RI-19-CE-SBNonLight - Impact Evaluation of PY2017 Small Business Electric Installations

The objective of this impact evaluation is to provide verification of electric energy savings estimates for a sample of small business non-lighting electric projects through

site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for small business, non-lighting electric energy efficiency offerings installed in 2017.

f. RI-19-CX-Presc - Prescriptive Gas & Electric Measures

The objective of this impact evaluation is to provide verification or re-estimation of electric energy and demand and/or natural gas savings estimates for a subset of ~~p~~Prescriptive projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine new deemed savings values and/or savings parameters for selected Prescriptive energy efficiency offerings installed in 2017. The specific measures to include in this study are still to be determined.

~~g. RI 19 CX DataCollect – Site Data Collection~~

~~This task will support primary data collection efforts in the C&I sector in preparation for a potential study in Rhode Island. effort~~

3.2 Residential Studies

a. RI-19-RX-~~LI~~ESF - Process Evaluation of the Income Eligible Single Family Program

This study is a process evaluation of the ~~Residential~~ Income Eligible Services program for single family homes in Rhode Island. The objectives of this study are to assess effectiveness of program delivery procedures, determine barriers to program delivery and participation and identify practical approaches to improve the overall effectiveness of the program.

~~b. RI 19 RX MF – Multifamily Program Impact Evaluation~~

~~This study is a Rhode Island specific impact evaluation of the income eligible and market rate multifamily family programs. This study will provide estimates of electric and gas savings resulting from participation in in-home retrofit of lighting and other electric and gas product measures. This proposed study will mirror and/or leverage a similar 2018 Massachusetts study to verify that recent program changes are leading to accurate savings estimates; the study approach will take into account the fact that Massachusetts and Rhode Island made different adjustments to program delivery based on the most recent multifamily evaluation.~~

**~~e.b.~~ _____ RI-19-RE-UpstrLight - Residential Lighting ~~Sales Data~~
AnalysisMarket Assessment**

The objective of this study is to characterize the current lighting market conditions in Rhode Island. The proposed study will involve sales data analysis using analyzing LightTracker and National Electrical Manufacturers Association (NEMA) shipment data to examine market share and bulb sales in Rhode Island and compare these findings to similar efforts in Massachusetts. This effort may also include targeted market assessment activities that provide useful point of comparison with the broader range of ongoing market assessment in MA and other areas of research to gather insights on how the market is evolving in Rhode Island as EISA-2020 approaches-is being phased in 2019 in Rhode Island.

~~and will be conducted in coordination with efforts done in Massachusetts. The results of this study will be used to inform program planning for the Residential Upstream Lighting program in Rhode Island.~~

**~~e.c.~~ _____ RI-19-RE- AppRecycle - Residential Appliance Recycling
Savings Update**

This objective of this study is to examine the current characteristics of refrigerators and freezers being recycled through the Residential Products program and compare the results to the findings in the 2011 Appliance Turn-In program. This study will review historical program tracking data, and apply updated unit characteristics to the refrigerator and freezer models described in the Uniform Methods Project to update the savings for the next program planning cycle. This research effort will leverage the on-going work efforts done conducted for the residential appliance recycling programevaluation study conducted in Massachusetts.

**~~e.d.~~ _____ RI-19-RE-HEM- Residential Home Energy Monitoring
Demonstration**

This study will evaluate the home energy monitoring demonstration, particularly the Sense Home Energy Monitors, in Rhode Island to understand how customers interact with this type of connected home technology. The study will quantify kWh reduction

attributable to the device, customer satisfaction, and identify customers segments that are likely to benefit the most from the program. This effort will also examine potential barriers to participation and explore ways to optimally scale up program delivery.

3.3 Cross-Sector/Other Studies

a. RI-19-XX-DataCollect – Primary Data Collection for Potential Study

This task will support primary data collection efforts in preparation for a potential study in Rhode Island. This effort will include C&I on-site data collection and may include other areas of research. The potential study will be managed by the Office of Energy Resources.

a.b. RI-19-XE-HPmarket - Heat Pump Market Assessment

This study will evaluate the current status of the heat pump market and assess potential for future growth of heat pumps in Rhode Island for displacing electric heat and for fuel switching for space heating and resulting cooling. The study will collect data from heat pump owners, contractors, manufacturers and distributors and review existing research and evaluation in the small commercial and residential markets to understand the current status of the both supply-side and demand-side markets, trends, and perceptions.

b.c. RI-19-XX-Jobs - Job Impacts Analysis Study

The study will identify the job impacts of National Grid's energy efficiency programs and services delivered in Rhode Island electricity and natural gas customers. Similar to the jobs studies conducted in 2013 to 2017, The Rhode Island job impacts study will determine the business and jobs impact due to energy efficiency programs in 2018, similar to the prior study. The study will survey the Company, vendors, distributors, partners, and market players to quantify the number of jobs and associated business impacts due to energy efficiency programs in 2018. As part of the 2018 jobs study, an element of workforce development will be incorporated.

c.d. RI-18-XX-Piggybacking - Piggybacking Diagnostic Study **(Continued from 2018)**

This study is assessing the validity and strategic ~~desirability value~~ of Rhode Island's historic practice of using evaluation results from other states and/or leveraging evaluation studies from other states with a Rhode Island sample. This study will identify ~~best practices and~~ key parameters for consideration when ~~determining if~~ a Rhode Island-specific evaluation ~~should be~~ ~~is not~~ undertaken. It will outline best practices for utilizing data from other states, either in combination with Rhode Island data or through direct adoption. This study will also estimate the monetary benefit of using and/or leveraging study results for various monitoring and verification purposes such as program improvement or ISO-NE verification.

~~d.e.~~ RI-19-CGXX-Pilots-GasDR - Gas Demand Response Pilot Study

The goal of the Gas Demand Response Pilot is to reduce peak period gas consumption of large commercial customers during the winter season. It is planned to run in the winter of 2018-2019 and the winter of 2019-2020. The gas DR pilot will be evaluated in the spring/summer of 2019 and 2020. In 2019, RI-19-CG-GasDR will evaluate winter 2018-2019 performance for benefits to the customer and the distribution system and to determine if it has a pathway to be cost effective at scale.~~This task will evaluate the process and impacts from pilots planned in Rhode Island. The Company plans to begin evaluations as new products or pilots/demonstrations are launched and once they have generated sufficient amount data to determine impacts from these efforts. Planned pilot evaluations will be detailed further in the second draft.~~

~~e.f.~~ RI-19-XX-M&V Legislation - M&V Legislation M&V—Energy Efficiency Verification Study

The objective of this study is to verify claimed energy savings from the Company's energy efficiency programs and review the Company's evaluation process as required by the M&V legislation in Rhode Island. The study will be managed by the Office of Energy Resources.

4. Evaluation Study Findings

Study Name: Two-Tier Steam Trap Savings Study

Type of Study: Impact Evaluation

Evaluation Conducted by: Energy & Resource Solutions

Date Evaluation Completed: April 26, 2018

Evaluation Objective and High Level Findings:

This Massachusetts study was designed to generate two prescriptive steam trap repair and replacement deemed savings estimates by leveraging the existing data collected from the Phase 2 Steam Trap Evaluation and to establish qualification criteria to be used when assigning the proper savings tier for prescriptive steam trap replacements.

ERS chose pressure as the sole key variable and 15 psig as the threshold value for the deemed savings tiers. Based on the parameter assessment, ERS concluded that the orifice size, hours of operation, and thermal efficiency have a direct relationship with operating pressure while leak factor (among the other parameters not chosen for assessment) has no relationship with pressure. The following table, taken from the study, shows the inputs to the savings calculation.

Table 1. Savings Equation Input Parameter Breakdown

Parameter	Units	Original	Low Pressure	High Pressure
Pressure	psig	7.2 / 86.7	7.2	86.7
Enthalpy, sat. liquid	Btu/lb _m	196 / 295	196	295
Enthalpy, sat. steam	Btu/lb _m	1,156 / 1,186	1,156	1,186
Orifice size (diameter)	in	0.25	0.25	0.156
Hours of operation	hours/yr	2,802	2,525	6,558
Thermal efficiency	%	80	80	78
Leak factor	%	36.9	36.9	36.9
Discharge coefficient	%	70	70	70
Condensate return factor	%	36.3	36.3	36.3
Low pressure incidence rate	%	90	N/A	N/A
Rate of failure in bulk installations	%	50	50	50
Per trap annual savings	MMBtu	12.2	8.4	35.6

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

Evaluation Recommendations included in the study:

ERS recommends that the PAs adopt a two-tier approach for prescriptive steam trap savings in 2019 and beyond using the following criteria for applying deemed savings appropriately: If the system operating pressure is ≤ 15 psig, PAs should claim 8.4 MMBtu/yr for every steam trap repaired or replaced at the facility through the program. If the system operating pressure is > 15 psig, PAs should claim 35.6 MMBtu/yr for every steam trap repaired or replaced at the facility through the program.

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

National Grid adopted recommendations from the study.

Savings Impact:

Savings that are able to be claimed for repairing or replacing steam traps are based on the system operating pressure. This study lowers the deemed savings value for low-pressure steam traps and increases it for high-pressure steam traps.

Study Name: Impact Evaluation of PY 2015 Rhode Island Commercial and Industrial Upstream Lighting Initiative

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Date Evaluation Completed: September 5, 2018

Evaluation Objective and High Level Findings:

The primary goal of this impact evaluation is to quantify the electric energy savings and demand reduction attributable to the Rhode Island C&I Upstream Lighting Program.

The following table gives energy savings system factors as recommended by the evaluator.

Table 1-5: Proposed Energy Savings factors (MA+RI)

Product type	Category	ISR	kW Saved per Unit	HOU	HVAC Interactive Effect (kWh)
G24 LED	5	67%	0.0173	5,389	102%
A-line, 40/60w	4	65%	0.0312	2,905	99%
A-line, 75/100w	4	65%	0.0438	2,905	99%
Decoratives	4	65%	0.0196	2,905	99%
LED Retrofit kit, <25W	3	66%	0.0356	3,335	103%
LED Retrofit kit, >25W	3	66%	0.0525	3,335	103%
MR16	3	66%	0.0205	3,335	103%
PAR20	3	66%	0.0261	3,335	103%
PAR30	3	66%	0.0354	3,335	103%
PAR38	3	66%	0.0410	3,335	103%
Stairwell Kit, 2ft w/sensor	2	70%	0.0358	5,831	100%
Stairwell Kit, 4ft w/sensor	2	70%	0.0309	5,831	100%
TLED, 2ft	1	67%	0.0079	4,296	104%
TLED, 4ft	1	83%	0.0158	4,296	104%

The study also updated peak demand savings factors, as given in the table below, taken from the report.

Table 1-6. Proposed new peak demand savings factors (MA+RI)

Product type	Category	Summer CF	Winter CF	Summer kW HVAC Interactive Effect	Winter kW HVAC Interactive Effect
G24 LED	5	85%	82%	115%	100%
A-line, 40/60w	4	45%	43%	112%	87%
A-line, 75/100w	4	45%	43%	112%	87%
Decoratives	4	45%	43%	112%	87%
LED Retrofit kit, <25W	3	58%	59%	121%	90%
LED Retrofit kit, >25W	3	58%	59%	121%	90%
MR16	3	58%	59%	121%	90%
PAR20	3	58%	59%	121%	90%
PAR30	3	58%	59%	121%	90%
PAR38	3	58%	59%	121%	90%
Stairwell Kit, 2ft w/sensor	2	66%	68%	112%	100%
Stairwell Kit, 4ft w/sensor	2	66%	68%	112%	100%
TLED, 2ft	1	80%	59%	121%	98%
TLED, 4ft	1	80%	59%	121%	98%

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

Evaluation Recommendations included in the study:

National Grid's vendor should include a flag for customers that have key account managers National Grid can compare the purchase details with any other current or planned National Grid initiatives the customer could participate in and direct those customers to the initiative that best fits the customer's needs.

National Grid's vendor should record and track any customer follow-up activity relating to initiative products in the new inspection tracking system. This will help ensure that when National Grid is contacted by a customer directly and works with that customer to return or exchange any products received through the initiative, this activity gets tracked and saved, to be retrievable later.

Vendors should add data validation to tracking data entries so that returns (negative entries) cannot be entered without linking sales to support the return. Initiative tracking data associated with a site can include a negative sales quantity which is typically from customer lamp returns. This will allow easier verification of lamp returns made by customers and help to avoid possible keying errors. National Grid's vendor should record their follow-up on QC contractor results and how those results were reflected in their tracking system.

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

National Grid will consider recommendations from the study.

Savings Impact: This study reduced the savings estimates for upstream stairwell fixtures, along with the combined category of upstream retrofit kits, A-lines and decoratives, and G24s. It increased savings estimates for linear fixtures and lamps.

Study Name: RI C&I Impact Evaluation of 2013-2015 Custom Comprehensive Design Approach

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Date Evaluation Completed: September 2018 (draft; numeric results are final)

Evaluation Objective and High Level Findings:

The objective of this impact evaluation was to provide verification of electric energy and demand and natural gas therm savings estimates for a sample of custom CDA projects through site-specific inspection, monitoring, and analysis, and to determine prospective gross realization rates for custom CDA energy efficiency projects. These site-specific results were aggregated with results from National Grid sites included in the recently finalized MA CDA study to determine realization rates for RI.

The following table summarized the results of the study. The study found an energy realization rate of 47%.

Results	Annual Energy	On-Peak Energy	Summer On-Peak	Winter On-Peak
	MWh	%	kW	kW
Total Tracking Savings	12,900	58%	3,166	1,825
Total Evaluated Savings	6,106	51%	1,560	461
Realization Rate	47.3%	88%	49.3%	25.3%
Error Ratio	0.47	0.83	0.68	0.78
Confidence Interval	90% Confidence		80% Confidence	
Relative Precision	±18.0%	±38.9%	±23.2%	±29.1%
Error Bound	1,097	1,468	361.4	134.4

Programs to which the Results of the Study Apply: C&I Gas and Electric New Construction

Evaluation Recommendations included in the study:

This study was in draft form at the time of writing; formal recommendations have not yet been made.

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

As this study was in draft form at the time of writing, recommendations will be reviewed when the report is complete, and recommendations will be implemented by National Grid if deemed appropriate.

Savings Impact:

The adoption of these results led to a reduction in the savings that National Grid claims from CDA projects.

Study Name: Impact Evaluation of PY2016 RI C&I Small Business Initiative: Phase I

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Date Evaluation Completed: September 2018 (draft)

Evaluation Objective and High Level Findings:

The primary objective of this impact evaluation was to provide verification or re-estimation of electric energy and demand savings estimates for a sample of custom and prescriptive electric lighting Small Business (SB) projects through site-specific inspection, monitoring, and analysis. These site-specific results were aggregated with results from the 54 National Grid sites included in the recently finalized Massachusetts SB study to determine realization rates for National Grid’s SB initiative in RI. As savings from lighting measures represent a significant majority of SB savings (~96%), only lighting measures have been assessed in this evaluation.

The following table summarizes the results of the study. This study was in draft form at the time of writing. These factors were used in 2019 planning and may be adjusted slightly before study finalization. Final factors will be adopted by National Grid.

Savings Parameter	Value	Precision at 80% Confidence
Installation Rate (Quantity Adjustment - kW)	100.0%	±0.6%
Delta Watts (Technology Adjustment - kW)	98.5%	±1.2%
Connected kW Realization Rate	96.8%	±2.0%
Summer kW Realization Rate	92.2%	±6.8%
Winter kW Realization Rate	98.0%	±11.3%
kW Factors (Precision at 80% confidence)		
Summer Coincidence Factor	49.5%	±15.7%
Winter Coincidence Factor	60.4%	±9.6%
Summer kW HVAC Interactive Effect	108.0%	±1.9%
Winter kW HVAC Interactive Effect	99.8%	±0.2%
kWh Factors (Precisions at 90% confidence)		
kWh HVAC Interactive Effect	100.1%	±0.9%
Hours of Use Realization Rate	101.0%	±9.9%
% On Peak kWh	63.6%	±11.6%
Non-Electric		
Heating HVAC Interaction Effect (MMBtu/kWh)		-0.00091

Programs to which the Results of the Study Apply: C&I Electric Small Business

Evaluation Recommendations included in the study:

This study was in draft form at the time of writing; formal recommendations have not yet been made.

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

As this study was in draft form at the time of writing, recommendations will be reviewed when the report is complete, and recommendations will be implemented by National Grid if deemed appropriate.

Savings Impact:

The adoption of these results led to a slight reduction in the savings that National Grid claims from Small Business lighting projects.

Study Name: P72 Prescriptive C&I Loadshapes of Savings

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Date Evaluation Completed: March 7, 2018

Evaluation Objective and High Level Findings:

This Massachusetts study pooled known sources of 8,760 savings loadshapes in an interactive tool to estimate general prescriptive measure loadshapes over customizable time periods. The resulting loadshapes may be used in measure-level savings calculations and in the PA benefit cost model. DNV GL, ERS, DMI and Cadmus contributed a combined total of 676 different energy savings loadshapes to make up the savings tool. The loadshapes were almost entirely sourced from prescriptive impact evaluation projects vetted by the Massachusetts PAs and Energy Efficiency Advisory Council.

The study provides the following key findings:

- Coincidence energy savings associated with summer and winter peak and off-peak energy periods for the prescriptive C&I measure level categories listed below:

Electric cooling – chillers	Exterior lighting
Electric cooling – unitary equipment	Interior Lighting
Compressed air	Lighting Controls
Refrigeration	VFDs

- The associated uncertainty for each measure level coincidence energy savings estimate shown by the relative precision of coincident energy savings at 90% confidence level (%)

Programs to which the Results of the Study Apply:

The results of this study apply to the following C&I Electric programs: Large Commercial New Construction, Large Commercial Retrofit, Small Business, and Upstream Lighting

Evaluation Recommendations included in the study:

No formal recommendations were made in this evaluation.

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

No formal recommendations were made in this evaluation.

Savings Impact:

This evaluation does not impact claimed savings. The updated loadshapes will increase the BC ratio for some measures and will decrease it for others.

Study Name: P78 Upstream LED Net-to-gross Analysis

Type of Study: Net-to-Gross

Evaluation Conducted by: DNV GL

Date Evaluation Completed: August 15, 2018 (draft; results are final)

Evaluation Objective and High Level Findings:

This Massachusetts study's overall goals were to:

- Provide a retrospective 2016 NTG ratio associated with the Upstream Lighting Initiative, for both screw-based and linear LEDs.
- Estimate a prospective NTG for the 2019-2021 Three-Year Plan, through a consensus process
- Research other key market elements, such as factors influencing the purchase of LED products, awareness of the Upstream Initiative, and customer lighting purchase decision-making processes

RI does not apply retrospective realization rates. The prospective realization rates resulting from this study are shown in the table below.

Prospective NTG	2019	2020	2021
Screw-based	0.73	0.63	0.53
Linear	0.80	0.73	0.66

Other research findings included:

Participant Characterization of the Initiative's Influence: Respondents reported that the Initiative primarily influenced the timing and quantity of their LED purchases. The survey results suggest that only a small share of participants would not have installed any LEDs without support from the Initiative; 5% of 2016 upstream lighting participants would not have purchased any screw-based LEDs and 18% would not have purchased any linear LEDs without the Initiative. This suggests that the 2016 participants were aware of LED lamps and inclined to purchase them, but the Initiative encouraged them to purchase more LEDs and to accelerate those purchases.

Prior program participation also continues to have a cumulative effect on upstream lighting participation. Forty-five percent of all 2016 participants have previously participated in programs or offerings for energy-related equipment purchases. Furthermore, of those participants who purchased additional LEDs outside of a PA program, over two-thirds indicate that past program experience influenced them to purchase more LEDs.

Market Development: 2016 participants have a high saturation of LED technologies. In 2018 on-site staff observed that 71% of screw-based lamps and 58% of linear lamps at these sites were LEDs, with a portion of these lamps purchased outside the 2016 Upstream Lighting Initiative. As expected, this is significantly higher than the LED saturation of the total C&I population in 2015.¹ Planned research on the saturation of LEDs in the rest of the C&I population will allow us to determine current levels of LED market saturation that can be compared to the 2015 saturation.

¹ <http://ma-eeac.org/wordpress/wp-content/uploads/MA-CI-Market-Characterization-Study.pdf>

Lamp Replacement Decisions: The majority of 2016 participants purchased lamps through the Initiative to use in simple replacements of existing lamps (61.4% of participants) rather than renovations or new construction. Less than 3% of participants purchased lamps to install in newly constructed buildings. Ninety-four percent of participants that purchased linear LED equipment to replace existing equipment replaced equipment that was still functioning. On the other hand, only 70% of participants purchased A-lamps, downlights, and reflectors to replace functioning equipment.

Continued Importance of Market Actors: Distributors and contractors play a large role in spreading program awareness. Roughly three-quarters of the 2016 participants reported that their supplier informed them of discounted lighting and another 44% that did not report learning about the rebate from their supplier indicated they learned about the discount from a contractor or distributor. On the other hand, a smaller share of 2016 participants indicated that market actors influenced their decision to purchase LEDs outside a PA program than those in the 2015 study.

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

Evaluation Recommendations included in the study:

Ensure program records include account numbers going forward and assess effectiveness of this requirement. Many of the 2016 upstream observations did not include identification variables that would allow the team to easily link the data with existing accounts in the tracking database as we assessed out-of-program purchases. Changes to the Initiative in 2017 required buyers to give account numbers, however, the PAs and C&I data management team should assess whether those program changes are effective and that future upstream purchases can be linked to existing accounts.

The PAs should also monitor these changes with the program implementer to ensure that these added requirements do not hinder participation in the Initiative. If the PAs find this is hindering participation, they should also consider investigating whether this requirement is disproportionately impacting contractors who may not have their customers' account numbers available.

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

National Grid is considering the recommendations for adoption.

Savings Impact:

The adoption of these results led to a reduction in the savings that National Grid claims from C&I Upstream Lighting.

Study Name: P81 Process Evaluation of C&I Upstream Lighting Initiative

Type of Study: Process

Evaluation Conducted by: DNV GL

Date Evaluation Completed: August 2018 (draft; numeric results are final)

Evaluation Objective and High Level Findings:

The key objectives of this Massachusetts evaluation were:

- Gauge the success of recent process improvements to the Initiative.
- Assess the impact of the programmatic changes on data accuracy.
- Understand the current state of the C&I market for non-screw-based LED lighting.
- Measure participating customer and trade-ally satisfaction with the Initiative.

The study found the in-service rate (ISR) to be 76.15% across all categories. Due to the accelerated pace of the study, the ISR was not broken out across all categories of Upstream Lighting. In the future, this work will continue, and the ISR will continue to be refined, including differentiation of ISRs between categories.

Work on other objectives of this study is currently underway.

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

Evaluation Recommendations included in the study:

This study was in draft form at the time of writing; formal recommendations have not yet been made.

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

As this study was in draft form at the time of writing, recommendations will be reviewed when the report is complete, and recommendations will be implemented by National Grid if deemed appropriate.

Savings Impact:

The adoption of these results led to an increase in the savings that National Grid claims from upstream stairwell fixtures, along with the combined category of upstream retrofit kits, A-lines and decoratives, and G24s. It led to a decrease in the savings that National Grid claims from upstream linears, exteriors, and high/low bays.

Study name: National Grid Rhode Island Lighting Market Assessment

Type of Study: Market

Evaluation Conducted by: NMR Group, Inc.

Date Evaluation Completed: July 27, 2018

Evaluation Objective and High Level Findings:

The study was designed to estimate lighting saturation and other critical market indicators in Rhode Island. The study collected lighting inventories from a sample of homes in Rhode Island and compared LED saturation to findings from similar studies carried out in Massachusetts and New York.

Evidence from this study suggests that the Rhode Island programs have had a strong impact on saturation and penetration of LEDs in Rhode Island homes. LED saturation was 33% in Rhode Island compared to only 14% in New York. LED penetration was 88% in Rhode Island compared to 72% in New York.

The study assessed similarities between the residential lighting markets in Rhode Island and Massachusetts, ultimately concluding that the two markets are substantially similar; therefore, Rhode Island can likely use the results from the recently completed NTG study in Massachusetts.

Programs to which the Results of the Study Apply:

Residential Lighting

Evaluation Recommendations included in the study:

Adopt the Massachusetts NTG values for 2019 and tentatively as a placeholder for 2020, in the absence of additional research.

Program Year	Standard	Reflector	Specialty	All LEDs
2019	35%	45%	45%	39%
2020	30%	40%	40%	34%

Update the numbers for residential upstream lighting hours-of-use (HOU), and lifetime in-service rates (ISR) for LEDs. These updated values are provided for application to the upstream lighting program and should not be applied to any direct install programs.

Factor	2018 TRM Values	Updated Value
LED Daily HOU	3.0	3.1
LED Discounted Lifetime ISR		
A-line ISR ¹	93%	93%
Reflector ISR ²	94%	94%
Specialty ISR ²	Varies ³	94%
¹ Assumes a sunset year of 2022; sunset years are defined as points in time past which savings are no longer claimed, based on the assumption that consumers are unlikely to find non-LED lamps available to purchase.		
² Assumes a sunset year of 2023.		
³ The 2018 TRM provides values for two EISA exempt categories with ISR of 95% and 97% based on estimated useful lives of 15,000 or 25,000 hours. Neither category is directly comparable to the specialty ISR developed.		

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

The Company adopted recommended NTG, ISR and HOU based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a decrease in the savings that National Grid claims for lighting measures offered through Residential Lighting Program.

Study Name: 2017 Residential WiFi Thermostat DR Evaluation

Type of Study: Impact and Process

Evaluation Conducted by: Navigant Consulting, Inc.

Date Evaluation Completed: March 30, 2018

Evaluation Objective and High Level Findings:

This study assessed National Grid's WiFi thermostat DR program, ConnectedSolution, to test the effectiveness of controllable thermostats as a demand reduction (DR) technology and customer acceptance of the DR program offerings in Massachusetts and Rhode Island.

The evaluation showed promise for thermostats as a residential DR technology, though important differences exist across different thermostat models and customer acceptance has not been adequately tested due to the relatively mild temperatures on event days. The study found average demand savings of 0.44 kW per thermostat in Massachusetts and 0.52 kW per thermostat in Rhode Island

- Massachusetts: 0.48 kW per ecobee, 0.53 kW per Honeywell, and 0.41 kW per Nest30
- Rhode Island: 0.59 kW per ecobee, 0.48 kW per Honeywell, and 0.41 kW per Nest31

Programs to which the Results of the Study Apply:

Residential DR

Evaluation Recommendations included in the study:

- National Grid should claim the following average demand savings per thermostat: 0.59 kW per Ecobee, 0.48 kW per Honeywell, 0.41 kW per Nest
- Remove thermostats that persistently opt out or modify the Nest participation incentive structure to include a participation requirement
Consider implementing auto-unenroll functionality
- Proactively monitor connectivity issues; remove thermostats with persistent connectivity issues; consider implementing an auto-unenroll functionality.

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

The Company adopted recommended kW based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to claimable demand savings from Residential DR program.

Study Name: 2017 Seasonal Savings Evaluation

Type of Study: Impact

Evaluation Conducted by: Navigant Consulting, Inc.

Date Evaluation Completed: March 9, 2018

Evaluation Objective and High Level Findings:

In 2017, National Grid offered some of its customers in Massachusetts and Rhode Island a new energy savings opportunity – thermostat optimization. National Grid selected Nest to provide Seasonal Savings (SS), its thermostat optimization program during the 2017 summer season. The Seasonal Savings program made the intended setpoint adjustments, resulting in decreased runtime and, consequently, energy savings.

In Rhode Island, the Seasonal Savings program resulted in energy savings of 29.2 kWh per thermostat, with total savings of 57 MWh between July 27 and September 30, 2017. 5 Average peak demand savings were 0.068 kW per thermostat, with total peak demand savings of 134 kW.

Programs to which the Results of the Study Apply:

Residential DR

Evaluation Recommendations included in the study:

- **National Grid should claim the following average energy/demand savings per thermostat in 2017:** Average energy savings of 29.2 kWh per thermostat, and average demand savings of 0.068 kW per thermostat.
- **Continue offering a summer thermostat optimization program to achieve energy and demand savings** Consider offering a winter thermostat optimization program to address electric and gas savings.
- **The summer SS program should be evaluated an additional year to:**
 - Assess how customers respond to two summers of schedule adjustments
 - Understand whether customers leave SS during hot weather
 - Seek to ascertain a relationship between savings and weather
 - Develop an approach to incorporate SS into the Massachusetts and Rhode Island Technical Reference Manuals

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

| The Company will consider recommendations in program planning.

Savings Impact: The adoption of these results led to claimable demand savings from Residential DR program.

Study Name: Rhode Island Home Energy Reports Savings Decay: Literature Review

Type of Study: Impact

Evaluation Conducted by: Illume Advising, LLC

Date Evaluation Completed: January 19, 2018

Evaluation Objective and High Level Findings:

The study reviewed research from 11 utilities to address the research question: What happens to energy savings when Home Energy Report (HER) recipients no longer receive reports or if they receive reports at a reduced cadence? Illume analyzed study results, paying particular attention to: fuel type, length of time customers received reports, climate/location, customer baseline energy use, and customer characteristics. Incorporating these comparisons, four predictive scenarios were developed to illustrate possible impact on savings if National Grid Rhode Island altered the report cadence of its Statewide Behavioral Program customer groups.

- Finding 1: Across 15 study groups, the decay rate for first-year electricity savings ranges from 2 percent to 36 percent with a median of 20 percent. The median remained around 20 percent even when the team subset the studies based on location, report cadence, and length of treatment period.
- Finding 2. Most customer treatment groups have high baseline electric and natural gas energy use which may limit their applicability to Rhode Island. Many programs specifically select high energy users, while on average, the Rhode Island customer treatment groups have moderate baseline energy use. Research literature suggests that customers with higher baseline energy use typically save more energy as a result of receiving HERs (Alcott, 2011). In the literature review, only one program had customers with moderate baseline energy use and that program had widely varying decay rates of 6 percent and 32 percent for its two study groups.
- Finding 3: Results from multi-year studies in Illinois and Connecticut suggest that decay rates may accelerate over time.
- Finding 4. Only 4 studies have examined savings decay in natural gas usage and they report widely varying results of 0 to 150 percent decay rates. The single study of natural gas decay over time, reports modest increases in decay rates from 7 percent to 38 percent over five years.
- Finding 5. Approaches such as report timing, report cycling, electronic portals, and emailed reports may provide options for modifying the treatment approach to reduce costs, yet maintain more savings over completely stopping reports. However, these approaches have not been thoroughly tested and compared against the typical HER program.

Programs to which the Results of the Study Apply:

Residential Behavior

Evaluation Recommendations included in the study:

- Recommendation: In any predictive benefit-cost modeling, National Grid Rhode Island should take into account the potential risks and rewards of over- or under-predicting savings. For example, in this report we present scenarios showing 20 percent and 30 percent first-year decay rates. A lower decay rate assumption may over-predict actual savings while a higher decay rate assumption could cause a program to fail a benefit-cost screen and result in a missed opportunity.
- Recommendation: In any predictive benefit-cost modeling, National Grid Rhode Island may want to model savings assuming a 40 to 80 percent decay in for electricity savings in years 2 through 4 after treatment stops. However, any assumptions will also need to take into account the risks and rewards of over- or under-predicting savings.
- Recommendation: For predictive benefit-cost modeling for natural gas savings, National Grid Rhode Island should model high and low savings decay scenarios while understanding the uncertainties of these assumptions.
- Recommendation: National Grid Rhode Island's Statewide Behavioral Program may benefit (from a benefit-cost perspective) from modifying the treatment approach. We suggest piloting new approaches when the current implementer contract ends. Two approaches that may merit further scoping and testing are:
 - Report cycling: National Grid can test the effect on electricity savings from cycling reports with a one year on/one year off cadence. The pilot could split larger treatment waves (such as the March 2013 or January 2014 waves) so that a portion of each wave receives reports each year.
 - Report timing: For natural gas, National Grid can test sending fewer reports and only send them during the heating season. For example, the program might send reports only in October and January.

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

The Company will consider recommendations in program planning and reporting in 2019.

Savings Impact: N/A

Study Name: Rhode Island Income Eligible Services Single Family Program Impact Evaluation

Type of Study: Impact

Evaluation Conducted by: Cadeo

Date Evaluation Completed: August 30, 2018

Evaluation Objective and High Level Findings:

This study was designed to estimate energy savings and realization rates for each electric, natural gas, propane and heating oil measures and/or measure groups. The study analyzed 2015 and 2016 program participants and used a combination of billing analysis, engineering analysis and building simulation to estimate savings for each measure groups. The results are presented in the table below:

Table 4. IES PY 2015-2016 Ex Post Savings by Measure and Fuel

IES Measure	Electric (kWh)	Natural Gas (Therms)	Oil (MMBTU)	Other (MMBTU)
AC Replacement (Window Unit)	71	N/A	N/A	N/A
AC Timer	0	N/A	N/A	N/A
Appliance Removal (Refrigerator or Freezer)	1,036	N/A	N/A	N/A
Clothes Washer and Dryer**	Various (See Workbook for Details)			
Dehumidifiers Replacement**	1,106	N/A	N/A	N/A
Domestic Hot Water (Aerators or Showerheads)	160	8	0.9	0.8
Education Materials (TLC kits)	21	N/A	N/A	N/A
Freezer Replacement	333	N/A	N/A	N/A
Heat Pump Water Heaters	814	N/A	N/A	N/A
Heating Systems	N/A	79	7.8	7.9
Furnace Fan (due to heating system replacement), kWh	N/A	16	10	16
CFL	18*	N/A	N/A	N/A
LED Bulbs		N/A	N/A	N/A
LED EISA EXEMPT		N/A	N/A	N/A
LED Reflectors		N/A	N/A	N/A
Programmable Thermostats**	232	34	3.4	3.4
Electric savings (Fan savings and cooling savings for CAC), kWh	18.8	11.2	8.7	11.2
Refrigerator Replacement	467	N/A	N/A	N/A
Smart Strip	75	N/A	N/A	N/A
Waterbed	872	N/A	N/A	N/A
Weatherization	1,201	124	12.6	12.4
Furnace Fan Savings, kWh	N/A	63	65	63
Cooling Savings, kWh	78	30	30	30

*Note: 18 kWh represents the average per-bulb savings estimate for all lighting measures

**Added to IES after 2016 or under consideration for future inclusion; not offered as part of IES during 2015 and 2016

Key

	Billing Analysis
	Engineering Algorithm
	Building Simulation

Programs to which the Results of the Study Apply:

Residential Income Eligible Single Family Program

Evaluation Recommendations included in the study:

Use estimated kWh and therms savings for each measure groups to update current savings assumptions for measures offered through the program

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

The Company adopted recommended kWh and therms savings based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a decrease in the savings that National Grid claims for measures offered through Residential Income Eligible Services Single Family Program.

Study Name: Rhode Island Residential Appliance Saturation Survey

Type of Study: Market

Evaluation Conducted by: NMR

Date Evaluation Completed: September 12, 2018 (draft)

Evaluation Objective and High Level Findings:

The Residential Appliance Saturation Survey (RASS) study included 900 web surveys and 75 follow-up on-site verification visits with National Grid Rhode Island customers. The study also used on-site verification visit data to conduct a mini-split heat pump (MSHP) technical feasibility analysis and collected lighting data for an upstream program net-to-gross analysis. This effort developed an inventory of residential end-uses, including appliances, consumer electronics, heating and cooling equipment, thermostats, water heating, and building characteristics.

Heating and Cooling

- Fuel. The slight majority (51%) of customers' primary heating fuel was natural gas. While single-family customers were next most likely to primarily use fuel oil for heating (36%), multifamily customers were next most likely to primarily use electric heat (33%).
- Boilers. Boilers were the most common heating system and were 14 years old, on average across all fuel types. Natural gas boilers were most common, with penetration reaching 37%. Oil boilers had the next highest penetration (28%), yet they were much more common in single-family (32%) than in multifamily (1%) homes.
 - The average rated (not tested) annual fuel utilization efficiency (AFUE) among the boilers observed on site was 83 for natural gas boilers (n = 33) and 84 for oil boilers (n = 16).² These values are in line with federal standards (80-84) but notably lower than the minimum AFUE requirement for National Grid natural gas boiler rebates (90).
- Furnaces. Furnaces were the next most common heating system. Natural gas furnaces were most common (23%) followed by fuel oil (6%) and propane (2%). Furnaces were 14 years old, on average across all fuel types.
 - The average rated AFUE among the furnaces observed on site was 85 for natural gas furnaces (n = 11), 81 for oil furnaces (n = 3), and 86 for propane furnaces (n = 4). These AFUEs are above the federal standard (80), but well below the minimum program requirement for natural gas furnaces (95).

² Note that rated AFUE can and often does differ from tested efficiencies.

- Electric heat sources. The most commonly reported electric heating equipment was space heaters (13%) followed by baseboard heaters (11%), central air source heat pumps (3%), and MSHPs (2%).
- Cooling. One-fifth of customers have no cooling systems. Room air conditioners were the most commonly reported cooling systems (59%), followed by central air (27%) and MSHP or air source heat pumps (5%). Room air conditioners were newer than central air conditioners (eight versus 13 years old, on average). In accordance with age, the average central air conditioner seasonal energy-efficiency ratio (SEER) was below the federal standard as well (11 versus 13), but the average room air conditioner energy-efficiency ratio (EER) was in line with federal standards (10 versus 9-11).

Thermostats

- Programmable. While programmable thermostats are in more than two-fifths (44%) of homes, two-fifths of those who have them say they do not use the programmable features.
- Wireless. Only one in ten homes (9%) have adopted smart wireless (Wi-Fi) thermostats.
- Settings. Depending on the time of day, customers set their thermostats to between 66°F and 68°F in the winter, on average. Those who have cooling systems, set their thermostats on average to 70°F during the cooling season. Comparing their minimum setpoints to their maximum setpoints, customers change their thermostat set points by 3°F on average over the course of typical winter day and 1°F on average on a typical summer day.

Water Heating

- Fuel. Natural gas was the most commonly used water heating fuel source (50%) followed by electricity (26%), fuel oil (20%), and propane (4%).
- System. Water heaters were most often natural gas standard tank units (40%), followed by standard electric storage tank units (23%).
- Age. While the average age of water heaters was only nine years, nearly one in five (17%) were 18 years old or older and one-half were manufactured before 2011.
- Efficiency. Aside from inefficient tankless coil systems, the average Energy Factor (EF) among fossil-fuel based units ranged from 0.61 to 0.91. The average EF among the 12 electric units observed on site was 1.07 – the one heat pump water heater observed on site had an EF of 2.40.

- Heat pump water heaters. Only 1% of homes had heat pump water heaters (HPWHs), but one-third of homes had water heaters installed in locations that could readily accommodate a HPWH (meaning that the spaces were sufficiently large, warm, and had a drain to handle condensate). The lack of a drain is the most common reason why a space was not currently suitable for a HPWH – ignoring the drain issue, 53% of spaces would have been suitable for a HPWH installation.

Appliances

- Refrigerators. The average home had 1.19 refrigerators, with 16% of homes having more than one. Fourteen percent of refrigerators were new (manufactured after 2012) and ENERGY STAR® labeled. The average refrigerator was 11 years old.
- Dishwashers. Two-thirds (67%) of homes had dishwashers. Sixteen percent were new and ENERGY STAR labeled. The average dishwasher was 11 years old.
- Clothes washers and dryers. Nearly four-fifths of homes had in-unit clothes washers (78%) and dryers (78%). Fifteen percent of clothes washers were new and ENERGY STAR, but only 4% of clothes dryers were. The average clothes washer was ten years old and the average clothes dryer was 11 years old. Dryers were most often electric – 64% of customers had electric clothes dryers. Based on self-reported data, the average home runs 4.6 loads of laundry per week.
- Dehumidifiers. More than one-quarter (28%) of customers had dehumidifiers, and one-quarter of dehumidifiers were new and ENERGY STAR labeled. Where age was discernable, dehumidifiers were seven years old, on average (n=24).
- Freezers. Standalone freezers were uncommon (9% penetration); three of nine observed on site were new and ENERGY STAR.

Consumer Electronics

- Electronics. With high penetration levels, the average home had 2.13 cell phones, 2.29 televisions, and 1.31 laptop computers. Laptop computer (81%) penetration was particularly high compared to desktop computer (44%) penetration.
- Advanced power strips. More than one-quarter (27%) of customers had advanced power strips (APS). That penetration level was higher than initially expected since APS are generally considered an emerging technology, not often available outside of energy-efficiency programs. The high APS penetration is likely attributable to National Grid's aggressive programs, which have distributed or rebated over 80,000 APS in Rhode Island since January 2016.

Miscellaneous End-Uses

- Photovoltaic (PV) solar panels have not penetrated the market: only 1% of homes have them installed. Their average installed capacity was 6.11 kW. One in ten of homes with PV solar panels had energy-storage batteries. Most miscellaneous end-uses, such as pools (8%), air purifiers (6%), and electric cars (1%), also had limited penetration.

Building Characteristics

- Type, Age, Size. Compared to the population, the web-survey sample oversampled homes in buildings with two to four units (33%) and under-sampled single-family detached homes (44%). On-site visits more closely resembled the population, with single-family detached homes comprising more than one-half (53%) of the sample and homes in buildings with two to four units comprising roughly one-quarter (23%) of the sample. The population (85%) has a slightly older building stock than the web (62%) and on-site (69%) samples, with more homes built before 1990.
- Insulation. While the average R-value for on-site homes' exterior above grade walls is about 9, when we group all walls to unconditioned space, including walls to garages, unconditioned basements, and so forth, their average R-value drops to about 7. These buffer spaces are often inconsistently insulated, resulting in lower overall R-values.
- Windows. Most window glazing was double paned (89%) and most had vinyl frames (64%) – 44% of total glazing area across all homes was composed of vinyl-framed double-paned windows. About one-fifth (19%) had a low-emissivity coating and less than 4% were filled with insulating gas.
- Air infiltration. The majority of homes (86%) received the two lowest air infiltration rankings – loose or semi-loose, based on Manual J's qualitative assessment criteria.
- Duct sealing. More than one-half of ducts are either entirely unsealed (23%) or sealed to below-average standards (29%), again using Manual J qualitative assessment criteria.

Programs to which the Results of the Study Apply:

Residential EnergyWise SF/MF, Residential Income Eligible Services SF/MF Programs
Residential Lighting and Products

Evaluation Recommendations included in the study: N/A

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

The Company will use the results in program planning and reporting in 2019 and future years.

Savings Impact: N/A

Study Name: Rhode Island HEAT Loan Assessment

Type of Study: Market

Evaluation Conducted by: Research into Action

Date Evaluation Completed: July 26, 2018 (draft)

Evaluation Objective and High Level Findings:

This study was designed to understand the extent to which HEAT Loans enable EnergyWise and HVAC projects and to identify opportunities for changes to the HEAT Loan offering that will enable higher uptake of measures offered through the programs. To address the objectives, RIA team conducted participant surveys, contractor and lender interviews and program tracking data analysis.

The key findings are summarized below:

- The current HEAT Loan model with 0% interest for customers over seven years is well-liked by customers, contractors, and lenders. Contractors were not interested in offering their own financing and lenders were not interested in a loan loss reserve model. Half of HEAT Loan recipients would not have used the loan if it included interest.
- The HEAT Loan is generating energy savings for National Grid that would not have otherwise occurred.
- There is an opportunity to improve customer education on the HEAT Loan process. Some customers are reportedly unclear about the HEAT Loan process, including the home energy assessment requirement, rebates, and how the contractor is paid.
- The home energy assessment requirement limits HEAT Loan participation for customers with emergency HVAC replacements, particularly in the wintertime. As reported by HVAC contractors, some customers who may benefit from the HEAT Loan do not want to lengthen their HVAC upgrade projects to meet the home energy assessment requirement for loan eligibility.
- There is widespread interest in the HEAT Loan, and customers want to be able to finance other upgrades with it. More than half of HVAC program participants reported interest in using the HEAT Loan to finance for future upgrades and surveyed participants wanted to be able to use the HEAT Loan to finance efficient air conditioning, window replacements, and solar installations.

Programs to which the Results of the Study Apply:

Residential EnergyWise Single Family Program

Evaluation Recommendations included in the study:

- Maintain the 0% interest to the customer with the interest rate buy down for the lenders.
- Maintain the HEAT Loan offering for EnergyWise customers.
- National Grid should provide HVAC contractors and assessors with a pamphlet to give customers that explain the HEAT Loan process, including the need to contact National Grid to schedule the assessment, authorization and application requirements, how rebates tie in, and how the contractor is paid.
- National Grid should create a policy for emergency replacement situations that defines a winter-months protocol for RISE Engineering to respond to customer requests for assessment scheduling within four business hours; and RISE should inform the customer of their eligibility to apply for a HEAT Loan with a lender at the time of assessment scheduling.
- Conduct research to determine which additional measures would offer cost-effective energy savings if financed through the HEAT Loan.

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

The Company will continue to offer the HEAT Loan program in 2019 and will consider study recommendations in program planning.

Savings Impact: N/A

Study Name: RLPNC 18-5 Home Energy Assessment LED Net-to-Gross and EUL Consensus

Type of Study: Impact

Evaluation Conducted by: NMR Group, Inc.

Date Evaluation Completed: July 23, 2018

Evaluation Objective and High Level Findings:

This study was designed to provide a means through which the Massachusetts PAs and EEAC consultants could come to consensus on what prospective NTGR values should be used for LEDs installed as part of the Home Energy Services (HES) initiative.

The final NTGR and Effective Useful Life (EUL) values adopted by the PAs and EEAC are included in Table 1. Since it is uncertain if the upstream LED program will exist for all years 2019 – 2021, the PAs and EEAC consultants agreed to varying NTGR values based on when the upstream program ends.

Table 1: Prospective HEA LED NTGR and Effective Useful Lives

Program Year	Effective Useful Life	Upstream Program Ends			
		Dec. 31, 2021 (Base)	Dec. 31, 2018	Dec. 31, 2019	Dec. 31, 2020
2019	3	88%	88%		
2020	2	80%	83%	82%	
2021	2	66%	74%	72%	69%

Programs to which the Results of the Study Apply:

Residential EnergyWise Single Family Program

Evaluation Recommendations included in the study:

National Grid should use this data to come to a consensus on NTG values for LED lighting through the Home Energy Services Program.

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

The Company adopted recommended NTG and EUL based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to an increase in the savings that National Grid claims for lighting measures offered through Residential EnergyWise Single Family Program.

Study name: RLPNC 17-3 Advanced Power Strip Metering Study

Type of Study: Impact

Evaluation Conducted by: NMR Group, Inc.

Date Evaluation Completed: August 2, 2018

Evaluation Objective and High Level Findings:

The study was designed to measure baseline usages and the energy reduction potential (ERP), kWh and kW savings of Tier 1 and Tier 2 advanced power strips (APS). The study relied on in-home metering of end-use energy consumption. In total, the study metered 133 sites, including 65 control sites and 68 treatment sites.

The study found baseline usage values that are lower than those published in the previous Technical Resource Manual (TRM), possibly due to decreased usage times. Tier 2 Infrared Strips generated the highest ERP and kWh and peak demand savings. Tier 2 Infrared/Occupancy Sensing strips were the next highest performers. Tier 1 APS also demonstrated substantial savings across these metrics. Results are presented in the table below:

Table 1. kWh and kW Savings from Advanced Power Strips

APS	Gross kWh Savings	Gross kW Savings
Tier 1 - HES	114	9
Tier 1 – Online/Upstream	111	6
Tier 2 IR	225	31
Tier 2 IR - OS	132	12

As part of the metering study, NMR looked at the setups for 26 pre-existing (customer installed) APS units and recommend reducing savings by 8% to account for installations that produce zero or reduced savings. The study recommended applying a 92% realization rate on gross savings for Massachusetts.

Programs to which the Results of the Study Apply:

Residential Products

Evaluation Recommendations included in the study:

The study reported the following considerations:

- The PAs should adopt baseline usage estimates for HECs, PCs, and combined end-uses as part of updates to the TRM for the 2019–2021 program cycle. The estimates should be independent of APS technology or brand.
- The PAs should adopt performance bands for Tier 2 APS products as part of the next program cycle (2019–2021). Performance bands should be based on technology differences between Tier 2 APS products.
- The PAs should explore benchmarks outside ERP, including persistence and satisfaction, when considering performance bands.

- The PAs should consider using future program tracking efforts or surveys to update the percentage of HEC versus PC end-uses.
- The PAs should continue to monitor and consider the decreases in television viewing time when planning for future program activities and evaluations.

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

The Company adopted recommended gross kWh savings and realization rates for APS Tier 1 and Tier 2 based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a decrease in the savings that National Grid claims for advanced power strips through Residential Products Program.

Study Name: RLPNC 18-1 Appliance Recycling Report

Type of Study: Impact

Evaluation Conducted by: NMR

Date Evaluation Completed: September 12, 2018 (draft)

Evaluation Objective and High Level Findings:

This study was designed to estimate unit energy consumption (UEC), adjusted gross energy savings, and net energy savings (and a net-to-gross ratio) based on the characteristics and alternative outcomes for refrigerators and freezers currently recycled through the Residential Products program.

Based on the characteristics of units recycled in 2017, the UMP regression algorithm suggests that the current UEC (equivalent to gross energy savings) is 1,019 kWh for refrigerators and 718 kWh for freezers. On average, survey respondents reported that they had their refrigerators plugged in 88% of the year prior to recycling and their freezer for 68% of the year. Application of these part-use factors yielded an adjusted gross energy savings of 897 kWh for refrigerators and 488 kWh for freezers. The study also yielded a net-to-gross ratio of 44% for refrigerators and 56% for freezers, or net savings of 398 kWh and 275 kWh, respectively.

Programs to which the Results of the Study Apply:

Residential Products

Evaluation Recommendations included in the study:

Use estimated kWh savings and NTG for to update savings values used for refrigerator/freezer recycling through the Residential Products Program.

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

The Company adopted recommended kWh savings and NTG based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a decrease in the savings that National Grid claims for appliance recycling offered through Residential Products Program.

Study Name: RLPNC 17-4 and 17-5: Products Impact Evaluation of In-service and Short-Term Retention Rates Study

Type of Study: Impact

Evaluation Conducted by: NMR

Date Evaluation Completed: March 23, 2018

Evaluation Objective and High Level Findings:

This study was designed to establish current 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) Program. Process research questions focused on product installation experiences, satisfaction with product performance, and likelihood of recommending the product. The evaluated in-service rates and short-term retention rates are provided below:

Table 1: Evaluated ISR and Short-term Retention Rates

Product Name	MA Primary Research			Literature Range	
	Sample Size	ISR	Short-term Retention		
Low to Moderate Price Measures					
Leave behind APS Tier 1	252	81%	94%	76%	42% - 86%
Online APS Tier 1	359	89%	97%	86%	80%
Online APS Tier 2	340	81%	93%	75%	80% - 87%
Dehumidifiers	137	99%	97%	96%	94%
Room Air Cleaners	126	100%	97%	97%	100%
Temperature Sensitive Showerheads, Adapters	178	86%	91%	78%	N/A
High Price Measures					
Dryers	128	98%	99%	97%	N/A

*Note that two dryers had never been installed and one was removed. While we do not have further details on the two never installed, the respondent who removed one plans to reinstall it in the future.

Overall, 82% of respondents who purchased products through the program voice satisfaction with product performance and similar percentages say they would recommend the products. Also, Respondents who removed APS (both tiers and program delivery modes) and showerheads from service voice skepticism about whether they will reinstall the products.

Programs to which the Results of the Study Apply:

Residential Products

Evaluation Recommendations included in the study:

The PAs should use the combined Massachusetts ISR/short-term retention rates listed in Table 1 for the 2017 Annual Report, the 2018 Annual Report, updates to the TRM, and program planning for 2019 to 2021 for all evaluated products

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

The Company adopted recommended ISR/short-term retention rates based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a decrease in the savings that National Grid claims for products offered through Residential Products Program.

Study Name: Massachusetts Residential HVAC Net-to-Gross and Market Effects Study (TXC34)

Type of Study: Impact/Market

Evaluation Conducted by: NMR/Tetra tech

Date Evaluation Completed: July 27, 2018

Evaluation Objective and High Level Findings:

The primary purpose of this study was to estimate and recommend net-to-gross ratios (NTGRs) for selected heating, cooling, and water heating measures that will receive Mass Save® Standard rebates in 2019-2021. Another purpose was to measure market effects indicators for evidence of progress toward market transformation that may be attributed to the program, and to set baselines for comparison with future measurements.

This study's recommended NTGRs differ from current TRM values, which are mostly based on a 2012 study. The recommended 2019-2021 NTGRs for ductless mini-split heat pumps (DMSHPs) and boilers increased from the 2016-2018 NTGRs. The recommended NTGRs for heat pump water heaters (HPWHs), central air conditioning (CAC), central heat pumps (CHP), and furnaces decreased. The results are presented below:

Consensus Group Recommended 2019-2021 Net-to-Gross Ratios

Measure	Previous	Recommended
Ductless MSHP	0.62	0.77
Heat pump water heater	1.00	0.83
Central air conditioner	0.86	0.67
Central heat pump	0.86	0.60
Furnace	0.81	0.76
Hot water boiler	0.77	0.79
Condensing combination boiler	0.74	0.79

Programs to which the Results of the Study Apply:

Residential HVAC/HEHE programs

Evaluation Recommendations included in the study:

Use NTGRs recommended by consensus group for equipment incentivized by standard rebates.

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

The Company adopted recommended NTGs based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a slight increase in the overall savings that National Grid claims for measures offered through Residential HVAC Program.

Study Name: RLPNC 18-4 Products Net-to-Gross Consensus Report

Type of Study: Impact

Evaluation Conducted by: NMR

Date Evaluation Completed: August 9, 2018

Evaluation Objective and High Level Findings:

The PAs and EEAC engaged NMR Group, Inc., to lead a consensus process that would yield recommended prospective NTGRs for 2019 to 2021 for the Residential Retail Products Program. The consensus approach rests on the assumption that asking a panel of experts, who represent various stakeholder groups, to review and asses NTGRs will diminish the bias inherent in relying on a single estimate of NTGR or the interpretation of one stakeholder group. As part of the consensus process the PAs, EEAC consultants, and evaluators reviewed and discussed retrospective and prospective NTGR estimates and market information drawn from literature reviews, ENERGY STAR market penetration rates, and historical as well as planned specification changes. ~~decreased.~~

The NTG results of the consensus process are presented below:

Table 1: Recommended Prospective NTGRs

	2019	2020	2021
Recommended Product NTGRs for Program Planning			
Freezers	60%	58%	56%
Room Air Cleaners	71%	68%	65%
Clothes Dryers	57%	54%	51%
Dehumidifiers	61%	58%	55%
Room Air Conditioners	63%	63%	63%
Pool Pumps	95%	93%	91%
Tier 1 Advanced Power Strips	100%	100%	100%
Tier 2 Advanced Power Strips	100%	100%	100%
Temperature Sensing Showerheads	97%	97%	97%
Refrigerators*	N/A	N/A	N/A
Clothes Washers*	N/A	N/A	N/A
Dishwashers*	N/A	N/A	N/A

* As refrigerators, clothes washers, and dishwashers are not included in 2019-2021 Plan the consensus panel deferred conversation on these products.

Programs to which the Results of the Study Apply:

Residential Products

Evaluation Recommendations included in the study:

Use NTGRs recommended by consensus group for energy star products offering through the Residential products program.

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

The Company adopted recommended NTGs based on this study in program planning and reporting in 2019.

Savings Impact: The adoption of these results led to a decrease in the overall savings that National Grid claims for measures offered through Residential Products Program.

Study Name: Res 1 Baseline Loadshape Study (Cooling season report)

Type of Study: Impact

Evaluation Conducted by: Navigant

Date Evaluation Completed: February 7, 2018

Evaluation Objective and High Level Findings:

The study documented the load shapes, summer peak demand levels and summer energy consumption for all major end uses, metered at approximately 350 homes representative of the Massachusetts statewide population during the summer of 2017. The results are designed to assist the PAs and EEAC in designing and evaluating program offerings targeted to reduce residential peak demands now and in the future.

The study highlights are presented below:

- Central air conditioners (AC) and room AC are the largest contributors to residential peak demand. Cooling collectively makes up about half of total residential ISO-NE and residential peak demand, with household ISO-NE peak demands of 1.7 kW and 0.6 kW from central AC/heat pump (HP) and room AC, respectively. The saturation of central cooling increased from 29% in 2008 to 45% of households in 2017, negating all cooling equipment efficiency gains over the same time period.
- Across the rest of the metered end uses, individual homes have a variety of significant end use loads during peak times. Dehumidifiers, clothes dryers, pool pumps, and hot water heaters all have significant load during peak times.
- Heat pump water heaters appear to use about half as much electricity as domestic water heaters, which corroborates much of the expected savings, at least during the summer.

Programs to which the Results of the Study Apply:

Residential Lighting and Products, Residential EnergyWise SF/MF, Residential HVAC/HEHE, Residential New Construction, Income Eligible Services SF/MF programs

Evaluation Recommendations included in the study:

No formal recommendations were made in this evaluation.

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

No formal recommendations were made in this evaluation.

Savings Impact:

This evaluation does not impact claimed savings. The updated loadshapes will increase the BC ratio for some measures and will decrease it for others.

Study Name: Res 1 Baseline Loadshape Study (Heating season report)

Type of Study: Impact

Evaluation Conducted by: Navigant

Date Evaluation Completed: March 15, 2018

Evaluation Objective and High Level Findings:

The study documented load shapes, winter peak demand levels and winter energy consumption for all major end uses, metered at approximately 350 homes representative of the Massachusetts statewide population during the winter of 2017/2018. The results are designed to assist the PAs and EEAC in crafting and evaluating program offerings targeted to reduce residential peak demands now and in the future.

The study highlights are presented below:

1. Based on initial analysis of lighting data, lighting is likely the end use with the largest contribution to total winter consumption and winter peak. Further improvements in the installed lighting efficiency and controls, either induced by programs or the overall market, will cause significant reductions in peak loads.
2. Electric resistance heat has a surprisingly flat hourly load shape on peak days, more similar to a refrigerator than an air conditioner on a peak day.
3. Electric resistance heating consumption is highly variable. The top 25% of households with electric resistance heat presently consume approximately ten times as much as the median.
4. Electric water heaters offer a significant opportunity for winter peak demand savings, the largest non-HVAC opportunity.

Programs to which the Results of the Study Apply:

Residential Lighting and Products, Residential EnergyWise SF/MF, Residential HVAC/HEHE, Residential New Construction, Income Eligible Services SF/MF programs

Evaluation Recommendations included in the study:

No formal recommendations were made in this evaluation.

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

No formal recommendations were made in this evaluation.

Savings Impact:

This evaluation does not impact claimed savings. The updated loadshapes will increase the BC ratio for some measures and will decrease it for others.

Study Name: Market-Rate Multifamily NEI – Phase I Final Memo (MF NEI Matrix and Program Data Analysis)

Type of Study: Benefits

Evaluation Conducted by: Tetra Tech

Date Evaluation Completed: March 30, 2018

Evaluation Objective and High Level Findings:

This Massachusetts study seeks to better understand the NEIs associated with retrofits to market-rate multifamily (MF) properties (defined as properties with five or more dwelling units) that accrue to the owners and managers of the 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.

Findings

All residential MF-specified measures and associated NEIs in the BCR tables were included in the TRM

NMR confirmed that the residential NEI values in the TRM and BCR models are consistent with the values reported in the original source document

For the most part, the residential MF Retrofit initiative NEI values are quite similar to the HES initiative NEI values. The LIMF Retrofit initiative generally has higher values for the same NEIs and measures, and for some measures – such as air sealing, low-flow showerheads, thermostats, and refrigerators – the LIMF Retrofit initiative has additional NEIs that accrue to the owners and managers of the LIMF facilities.

At the time of the initial review, the program tracking data did not consistently track whether measures, such as lighting, thermostats, hot water heaters and air conditioners, were installed in common areas or housing units. The PAs now track lighting by location.

For C&I MF retrofits, the PAs did not consistently use the same NEI values for the same measures in their 2016-18 plan BC models. For example, for lighting, Eversource used the residential value and National Grid used both the residential value and the C&I existing buildings value, while for HVAC measures, Eversource appeared to use the NEI value for “HVAC – custom” rather than “HVAC-prescriptive” (as reported in the 2012 C&I

Retrofit NEI study)

The BCR models do not appear to capture the diversity of electric and gas HVAC measures installed in C&I MF retrofit projects and are therefore not attributing all of the NEIs to the C&I MF initiative. The NEIs are attributed to the initiative to which the savings are claimed (the C&I MF Retrofit and C&I RF initiatives, respectively).

As noted in the NEI Framework Study Report, due to the double counting associated with property values or rental income and the individual non-property value NEIs that are the source of changes in property value or rental income, we recommend that the Pas not count their existing property value NEIs (including “housing unit value” for owners) for those measures with

both property and non-property NEIs. But for those measures that only have property value NEIs, such as appliances and low-flow showerheads, we recommend using, in the BCR calculations, the property value NEIs as proxies for the individual NEIs that have not yet been counted.

From the 2015 program year tracking data for the Residential MF Retrofit initiative and C&I MF Retrofits, lighting accounts for the largest share of electric savings (75%), followed by HVAC measures, while envelope, hot water, and HVAC measures account for the bulk of natural gas savings (40%, 27%, and 18%, respectively).

A majority of the HVAC electric and therm savings are attributed to major equipment types that are amenable to a life-cycle cost analysis, such as air conditioning, ASHP, and boilers. In contrast, the vast majority of hot water measure savings are attributable to measures such as faucet aerators and low-flow showerheads that are not appropriate for a life-cycle analysis.

Programs to which the Results of the Study Apply: Residential Multifamily Retrofit, Low-Income Multifamily Retrofit, C&I Multi-family

Evaluation Recommendations included in the study:

For measures that exist in the LIMF initiative and market-rate MF initiative (hot water measures, lighting, thermostats, air sealing, refrigerators), the team recommends that the PAs apply the associated LIMF owner NEIs to market rate MF projects (Rental Units Marketability, Reduced Tenant Complaints, Property Durability, Equipment Maintenance and Reliability [thermostats only]). For those MF NEIs that have occupant and owner values (increased home/property durability), the team recommends applying the owner NEI only. Appendix B and the accompanying spreadsheet details the measure-level NEI recommendations.

For common area lighting installed through the residential MF Retrofit initiative, the team recommends applying the C&I lighting O&M NEI value. The team notes that C&I Retrofit NEIs are currently applied to eligible C&I measures installed through the C&I MF Retrofit initiative

Ensure that the C&I MF NEIs for common area measures (i.e., not in-unit measures) are being applied consistently across the PAs' BCRs and reflect the diversity of the C&I NEIs provided by the source document

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

National Grid is considering the recommendations from this study.

Savings Impact:

This study does not impact claimed savings.

Study Name: Non-Energy Impact Framework Study Report

Type of Study: Benefits

Evaluation Conducted by: Tetra Tech

Date Evaluation Completed: January 23, 2018

Evaluation Objective and High Level Findings:

The objective of this Massachusetts study was to: develop a clear, consistent strategy and plan for conducting future NEI research, ensure coordination to avoid the inadvertent double counting of NEIs across residential and C&I initiatives, identify NEIs that are not currently being claimed by the PAs but could potentially be claimed and prioritize these for research, and outline detailed approaches and steps the PAs can take to update current NEI values, reconcile conflicts in the NEI values used for different purposes, and/or estimate values for potential new NEIs.

Programs to which the Results of the Study Apply: All

Evaluation Recommendations included in the study:

The PAs should not count their existing property value NEIs for those measures. Rather, in the BCR calculations, the PAs should count the NEI values associated with the individual amenities such as improved comfort, health, home durability, reduced O&M costs, reduced tenant complaints, etc. For those measures that only have property value NEIs, such as appliances and low-flow showerheads, we recommend using in the BCR calculations the property value NEIs as proxies for the individual NEIs that have not yet been counted.

The PAs should review the BCR-model-related differences highlighted in this report and determine whether there is a reason for each. If so, the PAs should cite their reason for using those values. If not, the PAs should update their claimed NEI values to match the relevant Massachusetts NEI studies.

In cases where the PAs decide to apply an NEI for one initiative or measure to a different initiative or measure, the PAs should provide clear public documentation of how the decision was made, such as via citation of the source of each NEI in the technical reference manual (TRM).

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

National Grid is considering the recommendations from this study.

Savings Impact:

This study does not impact claimed savings.

Study Name: Massachusetts Commercial and Industrial Upstream HVAC/Heat Pump and Hot Water NTG and Market Effects Indicator Study

Type of Study: NTG and Market Effects

Evaluation Conducted by: DNV GL, NMR Group, Tetra Tech

Date Evaluation Completed: September 5, 2018

Evaluation Objective and High Level Findings:

The primary purpose of this study was to measure the retrospective (2016) and estimate the prospective (2019-2021) net-to-gross ratio (NTGR) and market effects indicators for selected equipment types supported by the Upstream HVAC/Heat Pump (HP) Initiative and the Upstream Water Heater Initiative. The equipment, which PA staff selected in collaboration with the evaluation team, comprises five types of HVAC/HP and gas-fired water heating 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

Surveyors asked distributors to estimate the expected share of 2018 total sales from high-efficiency equipment with and without the initiative. This information allowed the team to understand the influence distributors expect the Initiatives to have on future high-efficiency sales while not requiring them to estimate sales two to four years in the future. Using these estimates, the study calculated a 2018 Distributor-Reported NTGR which was used to inform the development of the 2019-2021 NTG.

	n	Avg. Percentage With Initiative	Avg. Percentage Without Initiative	Prospective 2018 NTG
Air-cooled unitary and split CAC and HP system (>5 tons)	7	52.0%	30.6%	41.1%
Ductless Mini-split Heat Pump	7	80.8%	34.8%	56.9%
Electric Water-source Heat Pump	6	80.5%	64.4%	19.9%
Gas-fired Storage Water Heaters	14	63.7%	57.2%	10.3%
Gas-fired Tankless Water Heaters	13	95.8%	78.1%	18.5%

This research suggests that while the Initiative did modify distributor behavior by motivating them to stock and upsell high-efficiency equipment more than they had before, these changes may not have had much impact on the surveyed buyers’ decision-making. Many of the surveyed buyers indicated they were interested in high-efficiency equipment prior to the transaction and the Initiative had minimal impact on their decision to purchase an initiative-eligible unit.

Representatives from the PAs, EEAC, and Evaluators met on July 16 and July 23 to determine the prospective NTGR to use for each evaluated equipment type in the 2019-2021 Three-Year Plan. In developing these ratios, the group took into consideration the distributor self-reported retrospective and prospective NTG, the causal pathway results, and known program changes.

Equipment Type	2019	2020	2021
HVAC			
Air-cooled unitary and split CAC and HP system (>5 tons)	55%	54%	53%
Ductless mini-split heat pump (based on removing lower efficiency tier from Initiative)	51%	49%	47%
Electric water-source heat pump	50%	49%	48%
Water heating			
Gas-fired storage water heaters and indirect water heaters	31%	30%	29%
Volume water heaters (based on removing lower efficiency tier and offering multiple tiers)	60%	59%	58%
Gas-fired tankless water heaters	60%	59%	58%

Programs to which the Results of the Study Apply: C&I Electric and Gas New Construction

Evaluation Recommendations included in the study:

Adopt the 2019-2021 prospective NTGRs developed as part of this study, contingent on actual changes made to the initiative. The low retrospective NTGRs and findings from this study suggest that initiative changes should be considered prior to adopting NTGRs for 2019-2021.

Review efficiency requirements and incentive levels and assess whether the efficiency requirements are stringent enough, and the incentive levels high enough, to produce the expected outcomes.

Revise marketing materials to increase contractor and end-user awareness of the initiative.

Work with distributors to reduce the administrative burden of participating in the Initiative. The 2017 Process Evaluation found that many distributors experienced an increase in administrative burden and cash flow concerns as a result of participating in the Initiative. These distributors keep a portion of the incentive to cover such costs. Program staff should work with the implementer and partner distributors to develop tools or processes to reduce these concerns.

Provide training and outreach to contractors to increase their understanding of Initiative reporting requirements and the importance of complying with them. To improve contractor compliance with Initiative reporting requirements, consider offering a portion of the incentive to contractors.

Require distributors to include end user contact information in each application. The evaluation team encountered difficulties in reaching 2016 Initiative participants due to tracking data quality. While the HVAC tracking data included customer contact information, many fields were blank or, when populated, did not provide surveyors enough information to reach the actual decision maker.

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

National Grid is considering recommendations from the study.

Savings Impact:

The results of this study reduced the savings claimed by National Grid for these equipment categories.

Study Name: Evaluation of 2017 Demand Response Demonstration: C&I ConnectedSolutions

Type of Study: Impact and Process

Evaluation Conducted by: DNV GL

Date Evaluation Completed: February 23, 2018

Evaluation Objective and High Level Findings:

The purpose of this Massachusetts study was to provide verification of the proper 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.

The study provides the following key findings:

- The demonstration has a good general design with areas that performed very well. Participants received customized services that fit their unique opportunities. Planned curtailment included a diverse set of end uses and systems.
- With a few minor exceptions, participant respondents indicated that they curtailed load when asked to do so. There were only a few incidents of employee complaints or disruption of business operations.
- Collaboration and communication between National Grid and the CSPs was very good. CSPs appreciated that National Grid staff were open to "on-the-fly tweaks" of demonstration design and delivery.
- Participants were very satisfied with the Connected Solutions demonstration, though these results are based upon surveys performed prior to participant receipt of incentives.
- The committed enrolled capacity of the demonstration was 20.6 MW. The reduction calculated by the hybrid baseline used by National Grid and verified in this study produced curtailment estimates of 14.5 and 15.9 MW for the two events. A regression analysis performed on participants provided impact estimates of 12.3 and 12.8 MW for each event.
- The nature of the hybrid baseline offers a generous, low risk baseline for customers that carries an aggregate impact that is higher than reductions based on an adjusted or unadjusted 10 of 10 baseline individually, as well as the regression load reduction estimate.
- The combination of achieving less than committed curtailment despite a baseline that has increased potential for upward bias has implications for the demonstration as it evolves. In the absence of penalties for non-performance, incentive changes may be necessary to better align committed and achieved reductions. Left unchanged, this combination can be expected to put pressure on cost-effectiveness.
- There were delays in providing CSPs and participants with event performance data, which also delayed participant payment.

- The demonstration missed the system's peak, which occurred in June when the demonstration was still in its early stages. This prevented some participants from receiving the benefit of an ICAP reduction.
- Demonstration information could better describe several program elements including when events might be called, the possibility of events being cancelled, how customers would be paid and for how much, and participation benefits.

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

Evaluation Recommendations included in the study:

- Given the divergence between delivered load reduction and committed capacity at the customer level, National Grid should develop a way to manage this shortfall: either recognize this underperformance as a planning assumption that reflects the difference between the reduction committed vs. achieved, or consider an adjustment to the incentive structure to bring performance and committed capacity into closer alignment.
- Examine the root cause(s) that prevented prediction of the system peak. Understanding this cause will enable corrections to be made before the 2018 summer season.
- Improve to data availability for AutoGrid to calculate and provide event performance values to customers and vendors to confirm their performance level and as a touchpoint to foster further demonstration engagement.
- Revise supporting information to better describe how customers will be paid, the incentive level they can expect, the possibility of events being cancelled or not allowing cancellations, and potential ancillary benefits such as ICAP tag reduction.
- Revise the process for uploading data needed as part of the enrollment process to make it more flexible and easier for CSP data submissions.
- Work with CSPs to develop a more effective system to support demonstration management needs in terms of tracking marketing leads and the sales pipeline.
- National Grid or the vendors should inquire with participants about the sufficiency of their final 2017 incentive payments. Alternatively, DNV GL can ask about them as part of the 2018 season evaluation, though incentive receipt would have occurred roughly 11 months prior, if gathered this way.

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

National Grid is considering recommendations from the study.

Savings Impact:

Although there were many important findings in this study, the principal conclusion that Connected Solutions customers, in aggregate, did not deliver the committed load reduction in the 2017 season needs to be recognized both from a program management, system operations perspective and from a cost-effectiveness perspective.

Study name: Analysis of Job Creation from 2017 Expenditures for Energy Efficiency in Rhode Island by National Grid

Type of Study: Economic Impact

Evaluation Conducted by: Peregrine Energy Group

Date Evaluation Conducted: 2018

Evaluation Objective and High Level Findings:

In order to quantify the number of direct workers involved, National Grid commissioned Peregrine Energy Group, Inc. (Peregrine) to conduct a study of the job impacts of National Grid's energy efficiency programs delivered to Rhode Island electricity and natural gas customers in 2017.

Peregrine determined that 726 full-time equivalent (FTE) employees had work in 2017 as a result of investments by National Grid in energy efficiency programs provided to its Rhode Island electricity and natural gas customers. Most of the jobs created as a result of energy efficiency investments were local because they were tied to installation of equipment and other materials. The study identified 917 companies and agencies involved in National Grid's 2017 energy efficiency programs, 79% of which were located in Rhode Island.

The study is designed to be conducted annually.

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

Evaluation Recommendations included in the study: The evaluation study does not include recommendations.

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

Savings Impact: N/A

Study name: National Grid Rhode Island System Reliability Procurement Pilot: 2012-2017 Summary Report

Type of Study: Impact and Process

Evaluation Conducted by: Opinion Dynamics Corporation

Date Evaluation Conducted: 2018

Evaluation Objective and High Level Findings:

A final evaluation of the System Reliability Procurement Pilot, DemandLink load curtailment pilot, in Tiverton and Little Compton was completed in July 2018 by Opinion Dynamics Corporation (ODC). The final evaluation examined the effectiveness of each of the strategies employed by the Company to deliver 1 MW of load relief by 2017 (the last year of the Pilot) to defer the new substation feeder for 4 years, from 2014 to 2018. These strategies included (1) implementation of the DemandLink Programmable Controllable Thermostat Program, (2) enhancement of existing statewide energy efficiency offerings, and (3) introduction of new SRP-specific energy efficiency offerings.

The final impact evaluation found that the Tiverton Pilot fell short of its 1 MW load reduction goal. However, the Tiverton Pilot's initial progress postponed the investment of the wires alternative that would have occurred in 2014, if not earlier. The investment in the substation upgrade was further deferred due to slower than expected load growth and cooler summer temperatures in 2017.

Programs to which the Results of the Study Apply: Demand Response (DR) offerings, future non-wires alternative project.

Evaluation Recommendations included in the study:

- Future DR programs should not rely on equipment that requires customer action or reinstallation each year. The window AC plug devices used in the Tiverton Pilot were discontinued in 2016 due to significant connectivity issues and misuse by customers.
- Future DR programs should deploy a more aggressive offset strategy for events or consider cycling of the unit instead; maintain the event length at 3 hours to avoid negative savings in the last hour of the event; consider precooling before event; conduct additional testing of central AC thermostats to confirm connectivity before events begin.
- Targeted energy efficiency continue to be utilized in future initiatives. However, the Company should diversify away from lighting measures and consider new outreach channels to reach small commercial customers.

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

The Company plans to apply recommendations to future initiatives. Although the Tiverton Pilot did not meet its reduction goal, the Company gained valuable insight into customer behavior, marketing effectiveness, and DR strategies that will help improve future offerings.

Savings Impact: N/A

Study name: Avoided Energy Supply Components in New England: 2018 Report

Type of Study: Avoided Costs

Evaluation Conducted by: Synapse Energy Economics

Date Evaluation Conducted: 2018

Evaluation Objective and High Level Findings:

The Avoided Energy Supply Components in New England: 2018 Report (2018 AESC Study) was sponsored by all the electric and gas efficiency program administrators in New England and was designed to be used for cost effectiveness screening in 2019 through 2021. The avoided costs reflect current and expected market conditions and are highly influenced by the cost of fossil fuels and expectations about ISO-NE's forward capacity market.

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

Evaluation Recommendations and Program Administrator Response

Company should use the avoided costs for cost effectiveness screening in 2019 through 2021. The Company applied the results of this study to its cost effectiveness screening of 2019 measures, programs, and portfolio.

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

The Company adopted the recommendations.

Savings Impact: N/A

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. September 2018 (draft; numeric results are final).	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. September 2018 (draft).	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.	The MA study updated net-to-gross values for the Upstream Lighting initiative for 2019, 2020, and 2021.
DNV GL, P81 Process Evaluation of C&I Upstream Lighting Initiative. August 2018 (draft; numeric results are final).	The MA study updated in-service rates for the 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

<p>Navigant, 2017 Residential Wifi Thermostat Demand Response. April 2018.</p>	<p>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.</p>
<p>NMR, Rhode Island Lighting Market Assessment. July 2017 (draft)</p>	<p>This 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.</p>
<p>Research Into Action, Rhode Island HEATLoan Assessment. August 2018 (draft)</p>	<p>This study assessed the extent to which HEATLoan 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.</p>
<p>NMR, Rhode Island Residential Appliance Saturation Survey. August 2017 (in-progress)</p>	<p>To be updated 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.</p>
<p>Cadeo, Rhode Island Impact Evaluation of Income Eligible Services Single Family Program, August 2018 (in-progress)</p>	<p>To be 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. updated</p>
<p>NMR, RLPNC 17-11 LED Net-to-Gross Consensus Panel Report. June 2018. (Leveraged study from MA)</p>	<p>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 (35% for standard and 45% for reflector/specialty) due to similarity in lighting market condition.</p>
<p>NMR, RLPNC 18-5 Home Energy Assessment LED Net-to-Gross and EUL Consensus. July 2018 (leveraged study from MA)</p>	<p>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 planning for the Residential EnergyWise program.</p>

<p>NMR, RLPNC 18-4 Products Net-to-Gross Consensus Study, July-August 2018. (Leveraged study from MA)</p>	<p>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 planning for the Residential Products program.</p>
<p>NMR, RLPNC 18-1 Appliance Recycling Results. July 2018. (Leveraged study from MA)</p>	<p>This study provided updated inputs for UEC and savings calculation for refrigerator and freezer recycling in Massachusetts. Rhode Island adopted the results from this study to inform 2019 planning for the Residential Products program.</p>
<p>NMR, RLPNC 17-3 Advanced Power Strip Metering Study. August 2018. (Leveraged study from MA)</p>	<p>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 Residential Lighting program.</p>
<p>Navigant, MA Residential Electric Loadshape and Baseline Study (Heating and Cooling Season report). July 2018. (Leveraged study from MA)</p>	<p>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.</p>
<p>NMR, RLPNC 17-4/17-5 Products Impact Evaluation of In-service and Short-term Retention Rates Study. March 2018. (Leveraged study from MA)</p>	<p>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.</p>
<p>NMR/Tetra Tech, TXC34 Massachusetts Residential HVAC Net-to-Gross and Market Effects Study. July 2018. (Leveraged study from MA)</p>	<p>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.</p>
<p>Tetra Tech, Market-Rate Multifamily NEI – Phase I Final Memo. March 2018.</p>	<p>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.</p>

<p><u>Tetra Tech, Non-Energy Impact Framework Study Report. January 2018.</u></p>	<p><u>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.</u></p>
<p><u>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.</u></p>	<p><u>This MA study updated NTG for the following upstream equipment:</u></p> <ul style="list-style-type: none"> • <u>Ductless mini-split heat pumps</u> • <u>Electric water-source heat pumps</u> • <u>Air-cooled unitary/split central air conditioning (>5 tons)</u> • <u>Gas-fired storage water heaters between 76,000 and 300,000 BTU/hour</u> • <u>Gas-fired tankless water heaters between 180,000 and 199,900 BTU/hour</u>
<p><u>DNV GL, Evaluation of 2017 Demand Response Demonstration: C&I ConnectedSolutions. February 2018.</u></p>	<p><u>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.</u></p>
2017	
Study	Impact Descriptions
<p>ILLUME Advising, LLC, Rhode Island Home Energy Report Program Impact and Process Evaluation. August 2017</p>	<p>This study estimated realization rates for electric and gas savings for program years 2014 to 2016 using a billing analysis. The realization rates from this study were adjusted to remove potential double counted savings from HER and other energy efficiency programs.</p>
<p>Navigant, Rhode Island Energy Efficiency Program Customer Participation Study – Phase 1, October 2017</p>	<p>The study characterized participants and non-participants in several energy efficiency programs and identified customers that can be potentially targeted to increase participation.</p>
<p>NMR, 2017 Rhode Island Single-Family Code Compliance/Baseline Study, July 2017</p>	<p>This study yielded the final agreed upon baseline values to update the User Defined Reference Home (UDRH) in Rhode Island</p>
<p>ICF, 2017 Rhode Island Residential Code Savings Analysis</p>	<p>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.</p>

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	The 2018 RI plan includes ‘strategy electrification’ This study estimated savings from various types of heat pumps. savings values that resulted from this study.
DNV-GL, Impact Evaluation of MA C&I upstream Lighting Program (September 2017 Draft)	Draft results from the MA study were used for the 2018 RI plan; the RI leveraged study is expected to be completed at the end of 2017.
DNV-GL, Impact Evaluation of 2014 Custom HVAC Installations, September 2017	The study updated realization rates for customer 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 MA C&I Impact Evaluation of 2013 Custom Process Installations (August 2017 Draft)	The study updated realization rates for custom process projects, as part of a study leveraging the MA study of the same program element. Draft results from pooling the MA & RI samples were used for the 2018 RI plan. RI is currently working on a custom electric process evaluation leveraged on the MA study of the same program, and is waiting for MA to finalize their values.
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)	The 2018 RI plan C&I This study updated steam trap savings estimates were updated based on results from the MA study.
DNV-GL, Gas Boiler Market Characterization Study Phase II: Final Report, March 2017	This study updated The 2018 RI plan C&I condensing boiler savings estimates. were updated based on the results from the MA boiler characterization study.

<p>DNV-GL, MA45 Prescriptive Programmable Thermostats, March 2017</p>	<p>This study updated programmable thermostat deemed gas savings for C&I programs. The 2018 RI plan uses results from the MA programmable thermostat study.</p>
2016	
Study	Impact Descriptions
<p>DNV-GL, Impact Evaluation of 2014 Custom Gas Installations in Rhode Island Final Report, July 2016</p>	<p>This study is RI specific and yielded an energy realization rate for Custom Gas projects.</p>
<p>DNV-GL, Impact Evaluation of 2014 RI Prescriptive Compressed Air Installations Final Report, July 2016</p>	<p>This study is RI specific and yielded an energy realization rate for prescriptive compressed air compressors, dryers, and EE accessories.</p>
<p>DNV-GL, Impact Evaluation of 2012 National Grid-Rhode Island Prescriptive Chiller Program Final Report, July 2016</p>	<p>This study is RI specific and yielded an energy realization rate for prescriptive chillers.</p>
<p>DNV-GL, Multifamily Impact Evaluation, National Grid Rhode Island, January 2016</p>	<p>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 is has been improving tracking, savings estimations and verification processes in line with the study's recommendations.</p>
<p>Research Into Action, National Grid Rhode Island EnergyWise Single Family Process Evaluation, August 2016</p>	<p>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. The study will inform program design.</p>
<p>DNV-GL, Impact Evaluation of 2014 EnergyWise Single Family Program, National Grid Rhode Island, August 2016</p>	<p>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.</p>
<p>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.</p>	<p>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.</p>

<p>Cadmus Group; Large Commercial and Industrial On-Bill Repayment Program Evaluation, September, 2016</p>	<p>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.</p>
<p>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</p>	<p>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.</p>
<p>DNV GL, Stage 2 Results—Commercial and Industrial New Construction Non-Energy Impacts Study—Final Report, prepared for the Massachusetts Program Administrators, March 2016</p>	<p>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.</p>
2015	
Study	Impact Descriptions
<p>DNV-GL, Rhode Island Small Business Energy Efficiency Program Prescriptive Lighting Study: Final Report, July 2015</p>	<p>This study is RI-specific and yielded an energy realization rate for prescriptive lighting measures. For coincidence factors, the Company will continue to use values from the NEEP Evaluation, Measurement and Verification Forum.</p>
<p>Cadmus, Inc., High Efficiency Heating Equipment Impact Evaluation: Final Report, March 2015</p>	<p>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.</p>
<p>DNV-GL, Retrofit Lighting Controls Measure Summary of Findings: Final Report (MA), October 2014</p>	<p>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.</p>
<p>Tabors Caramanis Rudkevich, Avoided Energy Supply Costs in New England: 2015 Report, April 2015</p>	<p>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.</p>

<p>DNV-GL, Massachusetts 2013 Prescriptive Gas Impact Evaluation; Steam Trap Evaluation Phase 1, March 2015</p>	<p>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.</p>
<p>Cadmus, Inc., LED Incremental Cost Study – Modeling LightTracker LED and Halogen Pricing Data, June 2015</p>	<p>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.</p>
<p>Cadmus, Inc, Cool Smart Incremental Cost Study: Final Report, July 2015</p>	<p>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.</p>
<p>Cadmus, Inc., Lighting Interactive Effects Study Preliminary Results – Draft, April 2015</p>	<p>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.</p>
2014	
Study	Impact Descriptions
<p>DNV GL, 2014 , Impact Evaluation of National Grid Rhode Island C&I Prescriptive Gas Pre-Rinse Spray Valve Measure</p>	<p>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.</p>
<p>DNV GL, 2014 Impact Evaluation of National Grid Rhode Island Custom Refrigerator, Motor and Other Installations</p>	<p>Three custom electric end-uses, Refrigerator, Motor, and Other, were evaluated to provide updated realization rates. The RI results were combined with MA results from a parallel study in order to increase the statistical significance of the final results. The final energy realization rate is 84.8%</p>

<p>DNV GL, 2014 Impact Evaluation of Rhode Island Commercial and Industrial Upstream Lighting Program</p>	<p>This study examined the performance of lighting systems that were discounted at the distribution level. The evaluation included metering at Rhode Island project sites that was combined with the results of metering done in MA to yield more accurate impacts for lighting offered in this upstream initiative. The final energy realization rate is 80.3% for LEDs and 109.5% for fluorescents.</p>
<p>NMR Group, Inc., Northeast Residential Lighting Hours-of-Use Study</p>	<p>This multi-State study provided updated hours-of-use assumptions for residential lighting programs in various room types.</p>
<p>The Cadmus Group, Impact Evaluation: Rhode Island Income Eligible Services, Volume II The Cadmus Group, National Grid Income Eligible Services Process Evaluation</p>	<p>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.</p>
<p>National Grid, Macroeconomic Impacts of Rhode Island Energy Efficiency Investments REMI Analysis of National Grid's Energy Efficiency Programs</p>	<p>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.</p>
2013	
Study	Impact Descriptions
<p>KEMA, Inc., Impact Evaluation of 2011 Rhode Island Prescriptive Lighting Installations KEMA, Inc., Impact Evaluation of 2011 Rhode Island Custom Lighting Installations</p>	<p>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.</p>
<p>Energy Efficiency Messaging, Residential Energy Efficiency Program Communications Focus Groups</p>	<p>The study analyzed customers' perceptions of energy efficiency programs and messaging materials via focus group testing.</p>

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 $\pm 15\%$.
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 $\pm 23\%$, 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., Process Evaluation of the 2012 Bright Opportunities Program	This study provided net-to-gross ratios for the Commercial Upstream Lighting initiative offered in MA and RI, as well as a process assessment of this generally successful initiative.
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.
Opinion Dynamics (2013). Massachusetts Cross-Cutting Behavioral Program Evaluation Integrated Report.	This study provided an updated realization rate for savings from gas customers who participate in the Opt-out channel of the Home Energy Reports program.
2012	
Study	Impact Descriptions
KEMA, Inc., Impact Evaluation of the 2010 Custom –Industrial Process and Compressed Air impact evaluation, September, 2012	Study produced realization rates for energy, seasonal demand, and percent energy on peak for both programs. The RI results were combined with MA results from a parallel study in order to increase the statistical significance of the final results. The final energy realization rate is 92.7%.

<p>TetraTech, Final Report – Commercial and Industrial Non-Energy Impacts Study, (prepared for Massachusetts Program Administrators), June 29, 2012</p>	<p>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.</p>
2011	
Study	Impact Descriptions
<p>NMR Group, Inc., The Rhode Island Appliance Turn-In Program Process Evaluation, March 4, 2011.</p>	<p>Combined, these two studies assessed free-ridership rates and savings for the Rhode Island Refrigerator and Freezer Recycling program. In addition, the evaluation found that there were three distinct groups of refrigerators being recycled through the program – primary, secondary – replaced, and secondary – not replaced. The study produced updated free-ridership rates and savings for the three categories of refrigerators and freezers.</p>
<p>NMR Group, Inc., The Rhode Island Appliance Turn-In Program Impact Evaluation, October 2011.</p>	
<p>KEMA, Inc., Impact Evaluation of the 2009 Custom HVAC and 2008-2009 Custom CDA Installations, September 1, 2011</p>	<p>Study produced realization rates for energy, seasonal demand, and percent energy on peak for both programs. The RI results were combined with MA results from a parallel study in order to increase the statistical significance of the final results. The final energy realization rate for Custom HVAC is higher than the PY 2011 realization rate by about 10% (increased from 100.5% to 110.4%). The final energy realization rate for Custom CDA is higher than the PY 2011 realization rate by about 20% (increased from 97.2% to 119.6%).</p>
<p>KEMA, Inc., C&I Lighting Loadshape Project, Prepared for the Regional Evaluation, Measurement, and Verification Forum, June 2011.</p>	<p>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</p>
<p>KEMA, Inc., C&I Unitary HVAC Loadshape Project Final Report, Prepared for the Regional Evaluation, Measurement, and Verification Forum, June 2011.</p>	<p>From end use metering, the study produced updated diversity and equivalent full load hours for unitary HVAC measures</p>

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