APPENDIX B: SUMMARY OF MODEL INPUT AND ASSUMPTION UPDATES

To: MPSMT

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Cc: RI Energy

Date: 2023-04-06

Re: MPS Refresh – Summary of Model Input and Assumption Updates

1 Context

The following memo documents the changes made to model inputs and assumptions for the Rhode Island MPS Refresh ("Study Refresh") relative to the original study conducted in 2019.[1]

2 Model Input and Assumption Updates

The Study Refresh focused on updating data sources and input data anticipated to have a significant impact (+/- 20% of a measure's savings) on study results. The following sections document these changes following a similar structure as Appendix F – Study Inputs and Assumptions in the original study report.

2.1 Measure Characterization

- Baselines for measures included in the original study were updated to reflect the appliance standards updates in Rhode Island's Appliance and Equipment Energy and Water Efficiency Standards Act of 2021[2] and Code of Federal Regulations. In most cases, the updated standards increased measure baselines to the previous measure upgrade efficiency levels. Where feasible, higher efficiency upgrades were characterized for these measures. In cases where higher efficiency upgrades are not feasible (e.g., limited to no higher efficiency models commercially available), the measures were eliminated. These changes are in Table 1.

[1] Rhode Island Market Potential Study 2021-2026

[2] Appliance and Equipment Energy and Water Efficiency Standards Act of 2021

Table 1. Measure Baseline Updates (New Standards)

Measure Name	Market	Fuel	Previous Baseline	Previous Upgrade	New Baseline (Standard)	New Upgrade
Dishwasher	Commercial	Electric	Non-Energy Star	Energy Star v.2.0	Energy Star v.2.0	Energy Star v.3.0
Dishwasher	Commercial	Gas				
Fryer	Commercial	Electric				
Hot Food Holding Cabinet	Commercial	Electric				20% better than Energy Star v.2.0
Oven Combination	Commercial	Electric		Energy Star v.2.2	Energy Star v.2.2	Energy Star v.3.0
Oven Combination	Commercial	Gas				
Oven Convection	Commercial	Electric				
Oven Convection	Commercial	Gas				
Steamer High Efficiency	Commercial	Electric		Energy Star v.1.2	Energy Star v.1.2	20% better than Energy Star v.1.2
Steamer High Efficiency	Commercial	Gas				
Low Flow Showerhead	Commercial	Electric	2.5 gpm	2 gpm	2 gpm	1.5 gpm
Low Flow Showerhead	Commercial	Gas				
HVAC Boiler < 300 kBtu/h Tier 1	Commercial	Gas	82% AFUE	90% AFUE	84% AFUE	95% AFUE
HVAC Boiler < 300 kBtu/h Tier 2	Commercial	Gas				
Steam Boiler	Commercial	Gas	80% AFUE	82 % AFUE	82% AFUE	85% AFUE
Fryer	Commercial	Gas	Non-Energy Star	Energy Star v.2.0	Energy Star v.2.0	Measure eliminated
Faucet Aerator	Commercial	Electric	2.25 gpm	1.5 gpm	0.5 gpm	
Faucet Aerator	Commercial	Gas	2.25 gpm	1.5 gpm	0.5 gpm	
HVAC Boiler < 1000 kBtu/h[3]	Commercial	Oil	82% TE	86% TE	87% TE	
Boiler >= 1000 kBtu/h[3]	Commercial	Oil	82% TE	85% TE	87% TE	
ASHP (65,135) kBtu/h CEE Tier1[4]	Commercial	Electric	COP 3.3	COP 3.4	COP 3.4	

- New construction measures were updated to assume that the 2021 IECC will be adopted in 2023 without amendment and in place starting in 2024. However, the study assumes new construction projections passing through RI Energy programs adhering to this standard will not materialize until 2025, which aligns with the assumption employed in the original study. The savings improvement assumption for 2021 IECC relative to 2018 IECC was updated to 8.5% and 10% for residential and non-residential measures, respectively, based on assumptions provided by RI Energy.
- For measures not impacted by updated appliance standards, characterizations were updated to reflect the most recently available electronic version of the Rhode Island Technical Resource Manual (TRM).[5] Updates included revisions to measure savings, costs, effective

[3] Code of Federal Regulations, effective Jan 10, 2023
[4] Code of Federal Regulations, effective Jan 1, 2023
[5] As provided by RI Energy ("TRM_DB_2023Plan_Final.xlsx")

useful life (EUL), impact factors (i.e., net-to-gross factors and realization rates), and load factors (i.e., summer peak coincidence factors and seasonal savings distributions). These updates focused on the measures contributing at least 80% of overall savings in the original study. A detailed table of the measure inputs used in the Study Refresh is provided in the detailed results workbook.

- For C&I lighting measures, lifetime savings were calculated using the average adjusted measure lives (AML) as estimated in Table 3-3 of the August 2022 Rhode Island C&I Lighting Market Characterization and Adjusted Measure Life Study. [6] Relative to the original study, this decreased lifetime savings for these measures as the original study estimated lifetime savings as a function of the LED's effective useful life (EUL) as opposed to the AML.
- For demand response measures, incremental costs were adjusted to reflect the assumption that advanced metering infrastructure will be rolled out to the entire RI Energy customer base during the study period in alignment with RI Energy's AMI business case plan. The adjustments assume AMI will allow communication capabilities with DR equipment, thereby reducing the initial costs associated with telemetry for applicable measures.

2.2 Market Characterization

- Residential customer population counts were updated based on U.S. Census estimates for Rhode Island, which suggests a slight decline in population over the last three years (~0.2% year-over-year decline).[7]
- Non-residential customer population counts were assumed to remain the same as in the original study due to a lack of data supporting revised population estimates.
- Market baseline data for non-residential lighting measures were updated to reflect the increasing saturation of LED lighting in the Rhode Island market based on the recent Rhode Island and Massachusetts studies on C&I lighting markets. [8, 9] Five key metrics were updated as described in Table 2.

[6] Rhode Island C&I lighting market report http://rieermc.ri.gov/wp-content/uploads/2022/11/rhode-island_ci-lighting-market-characterization-and-adjusted-measure-life-report_final.pdf
[7] U.S. Census QuickFacts Rhode Island
[8] Rhode Island C&I lighting market report http://rieermc.ri.gov/wp-content/uploads/2022/11/rhode-island_ci-lighting-market-characterization-and-adjusted-measure-life-report_final.pdf
[9] Massachusetts C&I lighting market report https://ma-eeac.org/wp-content/uploads/MA19C14-E-LGHTMKT_2019-CI-Lighting-Inventory-and-Market-Model-Report_Final_2020.04.06.pdf

Table 2. Market Characterization Updates for Lighting Measures

Metric	Update/ Change	Source
Percentage of linear lamps that are LED (Indoor)	Updated from 22% to 62%	Based on Rhode Island C&I lighting market characterization report
Percentage of Specialty bulbs that are LED (Outdoor)	Updated from 81% to 89%	Based on Massachusetts study on CI lighting market characterization
Percentage of Specialty bulbs that are LED (Indoor)	Updated from 36% to 60%	Based on the average change in the two metrics- percentage of linear lamps that are LED (Indoor) and percentage of Specialty bulbs that are LED (Outdoor).
Percentage of High Bay Lights that are Metal Halide (Indoor)	Updated from 64% to 40%	
Percentage of Exit signs which are LED	Updated from 59% to 83%	

- For demand response, we reviewed data from current program results and recalibrated results for the base year (2023) to align with reported levels of enrolled market participation for the 2022 program year.

2.3 Program Characterization

- Program cost characterization inputs were adjusted for inflation and real cost increases by comparing administrative costs normalized to savings levels for the 2020 plan year and 2023 plan year. The analysis found that administrative costs increased by 49% on average, which is above and beyond inflation. Based on this analysis, fixed and variable program cost characterization inputs were increased by 49% (including adjustments for inflation).
- Program incentive levels for energy efficiency were updated in accordance with the single achievable scenario modeled in the study as shown in Table 3.

Table 3. Program Characterization

Program	Mid Scenario (Original Study)	Ambitious Mid Scenario (Study Refresh)	Max Scenario (Original Study)
Residential Programs			
New Construction	75%	87.5%	100%
EnergyStar HVAC	75%	87.5%	100%
EnergyWise	84%	92.0%	100%
EnergyWise Multi Family	79%	89.5%	100%
Behavior Feedback	N/A	N/A	N/A
EnergyStar Lighting	75%	75%	100%
EnergyStar Appliances	75%	87.5%	100%
Low-Income SF	100%	100%	100%
Low-Income MF	100%	100%	100%
Heat Pump- Residential (Low income)	100%	100%	100%
Heat Pump- Residential	50%	75%	100%
Non-residential Programs			
New Construction	75%	87.5%	100%
Large Commercial Retrofit	75%	87.5%	100%
Small Business / Direct Install	85%	92.5%	100%
C&I Multifamily	90%	95.0%	100%
Heat Pump- Commercial	50%	75%	100%

2.4 Economic and Other Parameters

- Avoided costs were updated to reflect the values in RI Energy's 2023 BCR Model, which reflect the Avoided Energy Supply Cost (AESC) in New England 2021 report. Avoided cost values were treated in the same way as described in the original study.
- The real discount factor was updated to 0.14% based on the real discount factor used in RI Energy's 2023 BCR Model.
- Marginal retail rates (electricity and natural gas) were updated to the latest rates as provided by RI Energy. Oil and propane marginal retail rates were updated to reflect the updated values in AESC 2021 in the same manner as the original study.
- Emission factors for electricity were updated to reflect emission factors as documented in RI Energy's 2023 BCR Model.
- All monetary values throughout the study were inflated to 2024 real dollars based on the inflation index in Table 4. The inflation index was derived from the CPI for All Urban Consumers (CPI-U) as reported by the Bureau of Labor Statistics through the calendar year 2022. For 2023 and 2024, projections by Moody's Analytics are leveraged.[10]

[10] Moody's Analytic. *Dissecting the Consumer Price Index*. (February 2023).

Table 4. Inflation Index

Year	Inflation Index
2013	233.0
2014	236.7
2015	237.0
2016	240.0
2017	245.1
2018	251.1
2019	255.7
2020	258.8
2021	271.0
2022	292.7
2023	304.1
2024	311.4