Memorandum

To: Rhode Island Energy

From: Lima Hossain, Jun Suzuki, and Doug Bruchs, Cadeo

Date: September 26, 2024

Re: Measure Life Study: Findings Summary FINAL

Introduction

Given Rhode Island Energy's focus on lifetime energy savings, reliable measure life assumptions are critical. Building on our previous review of high and medium priority measures in Phase I, Cadeo conducted a comprehensive review of measure life assumptions for a subset of remaining low priority prescriptive measures in Rhode Island Energy's 2023 Technical Reference Manual (TRM) and benefit-cost ratio (BCR) models. This Phase II review ensures that Rhode Island Energy leverages the best available sources for measure life assumptions across its entire measure portfolio, further increasing the reliability and accuracy of reported lifetime energy savings.

For Phase II of the study, Cadeo reviewed 126 low priority measures[1] across all sectors (commercial, residential, and income eligible). Our review confirmed the viability of current measure life assumptions where appropriate and, when necessary, offered recommendations for replacement with reliable alternative values or sources.

Study Goals

The two primary research goals of this study are:

1. Ensure measure life assumptions (all sectors and fuels) align with most recent research and evaluation efforts in Rhode Island or industry best practices from outside Rhode Island.
2. Recommend updated measure life values, when appropriate and possible, using existing information.

Memo Organization

The memo includes four sections:

- Recommendations: Measure Life Updates
- Methodology

[1] The 126 low priority measures reviewed in Phase II are part of the approximately 300 unique measures initially identified in Phase I after consolidating duplicative entries from the TRM and BCR models. This approach allowed for a comprehensive review of Rhode Island Energy's entire portfolio of unique prescriptive measures, with in-depth analysis focused on this subset of low priority measures.

- Key Findings: Current Source Scoring
- Key Findings: Research Alternative Sources

Cadeo also developed a separate **Measure Life Study Documentation workbook** as a supplementary deliverable to Rhode Island Energy. This format was chosen due to the extensive scope and detail of our team's analysis, as it allows for more comprehensive documentation than a memo. The workbook builds upon the summary information in this memo and details the measure prioritization, current source scoring, and alternative sources research for every reviewed measure.

Recommendations: Measure Life Updates

The team conducted in depth research for alternative sources for a subset of 50 measures selected by RI Energy[2], resulting in three distinct categories of updates:

1) Measures that require updates to the measure life and source updates: 12 out of 50 (24%); these measures are summarized in Table 1.
2) Measures that required an updated source (i.e., no change to the measure life): 25 out of 50 (50%); summarized in Table 2.
3) For these remaining measures (13 out of 50, 26%), where an alternative source was not identified, the team verified that the current source is still the best available; summarized in Table 3. This was done by reviewing and comparing the measure source to other regional Technical Reference Manuals (TRMs). In most cases, regional TRMs cited the same source for this category of measures.

[2] To remain within the scope and budget, we aligned with RI Energy to conduct in-depth alternative sources research for 50 low priority measures. In Task 2, the team completed a comprehensive review of 126 low priority measures. Of those 126 low priority measures, 77 measures were flagged for update. RI Energy then selected a subset of 50 low priority measures from the 77 flagged measures for the Cadeo team to further explore in Task 3 (alternative sources research).

Table 1. Recommended Updates for Measure Life Sources and Values

Measure Name, Fuel, & Sector	Existing Measure Life	Recommended Measure Life	Net Change in Measure Life	Rationale for Change	Existing Source	Recommended Source
Central Heat Pump, Electric, Residential	20	16	-4	A neighbor state TRM offers best (more relevant origin) source.	X2001A Conneticut ML update	Navigant 'ComEd Effective Useful Life Research Report', May 2018
Combo Condensing Boilers, Gas, Residential	23	20	-3	Cadeo identified most up-to-date (relevant origin, robust, and recent) source as close to neighbor state TRM.	Measure Life Study for MA joint utilities (2005)	Guidehouse (2021). Comprehensive TRM Review (MA19R17-B-TRM)
Elec Res to HP ducted or mix ducted, Electric, Residential	18	15	-3	Cadeo identified most relevant (robust and recent) source because no neighbor state TRMs include this measure.	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures	RTF Ductless UES
ENERGY STAR Water Heater, Tankless, Gas, Residential	19	20	+1	Cadeo identified most up-to-date (robust and recent) source as close to neighbor state TRM.	DOE (2008). ENERGY STAR® Residential Water Heaters: Final Criteria Analysis. Prepared for the DOE.	RTF Residential Gas Heaters
Duct Insulation, Gas, Income Eligible	25	20	-5	Cadeo identified most up-to-date (robust and recent) source as close to neighbor state TRM.	Measure Life Study for MA joint utilities (2005)	RTF 2022
Ice Machines, Electric, C&I	8	9	+1	A neighbor state TRM offers (relevant origin and recent) best source.	Savings Calculator for ENERGY STAR® Certified Commercial Kitchen Equipment: Ice Machine Calcs	ComEd Effective Useful Life Research Report, May 2018.
Low pressure drop filter, Electric, C&I	5	10	+5	A neighbor state TRM offers best (relevant origin, robust, and recent) source.	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities,	Navigant 'ComEd Effective Useful Life Research Report', May 2018
Refrigerated beverage vending machine, Electric, C&I	10	5	-5	Cadeo identified most up-to-date (robust and recent) source as close to neighbor state TRM.	Measure Life Study for MA joint utilities (2005)	DEER 2014 EUL ID: Plug-VendCtrler
Room Air Cleaner, Electric, C&I	3	9	+6	A neighbor state TRM offers best (recent) source.	2/3rd of measure life for recycling - MA Common assumption	Savings Calculator for ENERGY STAR® Qualified Appliances (last updated October 2016).

Measure Name, Fuel, & Sector	Existing Measure Life	Recommended Measure Life	Net Change in Measure Life	Rationale for Change	Existing Source	Recommended Source
Water Heating, Electric, C&I	7	15	+8	Cadeo identified most relevant source because no neighbor state TRMs include this measure.	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities,	DEER 2014 EUL ID: WtrHt-Com
Water Heating Boiler , Gas, C&I	15	20	+5	Cadeo identified most relevant source because no neighbor state TRMs include this measure.	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and	C&I Measure Life Study: Project MA19C02-B-EUL Final Report
WCChill, Electric, C&I	23	20	-3	Cadeo identified most relevant source because no neighbor state TRMs include this measure.	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures	DEER 2014 EUL ID: HVAC-Chlr

Table 2. Recommended Updates for Measure Life Sources Only

Measure Name, Fuel, & Sector	Existing Measure Life	Existing Source	Recommended Source	Rationale for Change
Commercial Electric Fryer, Large, Electric, C&	12	Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Gas Fryer.	DEER 2014 EUL ID: Cook-ElecFryer	Cadeo identified most relevant source because no neighbor state TRMs include this measure.
HPWH Electric, Electric, Residential	13	Company Commercial New Construction Program.	Guidehouse 2021 - Savings Calculations MA21R39-E-HPWHQH_Task 3 Findings Spreadsheet	MA TRM offers best (robust and recent) source.
Programmable Thermostat - Gas, Gas/Electric, Income Eligible	19	Southern California Edison (2017). Residential Smart Thermostat Workpaper (Work Paper SCE17HC054,	Guidehouse (2021). Comprehensive TRM Review	MA TRM offers best (relevant origin, robust, and recent) source.
Boiler Forced Hot Water Pump, Electric, C&I	15	DEER 2008 EUL table	DEER 2014 EUL ID: HVAC-VSDSupFan	Cadeo identified most up-to-date (recent) source in the CA state TRM.
Boiler, Draft Fan, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2014 EUL ID: HVAC-VSDSupFan	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.

Measure Name, Fuel, & Sector	Existing Measure Life	Existing Source	Recommended Source	Rationale for Change
Combo Condensing Boiler/ Water Heater , Gas, C&I	20	GDS Associates, Inc. and Summit Blue Consulting (2009), Natural Gas Energy Efficiency Potential in	C&I Measure Life Study: Project MA19C02-B-EUL Final Report	MA TRM offers best (relevant origin, robust, and recent) source.
D2 VFD Secondary , Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Demand Circulator, Gas, C&I	15	Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
DHW ECM Pump, Electric, C&I	15	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities,	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
ECM Pump, Electric, C&I	15	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Exterior Lighting , Electric, C&I	15	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities,	Minimum DesignLights Consortium requirement	A MA TRM offers best (recent) source.
Heat, HW Pump, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2020 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Hot Food Holding Cabinet, Electric, C&I	12	Robert Mowris & Associates (2005). Ninth Year Retention Study of the 1995 Southern California Gas	EnergySTAR Commercial Food Service Equipment	EnergySTAR documentation provides the best (robust and recent) source.
Load Comp, 75HP, Electric, C&I	13	DOE (2016). Technical Support Document: Air Compressors. EERE-2013-BT-STD-0040-0082.	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.

Measure Name, Fuel, & Sector	Existing Measure Life	Existing Source	Recommended Source	Rationale for Change
LOADCOMP, Electric, C&I	15	https://www.regulations.gov/document/EERE-2013-BT-STD-0040-0082	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Make Up Air Fan , Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
ODP, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Performance Lighting , Electric, C&I	15	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities,	Minimum DesignLights Consortium requirement	MA TRM offers best (recent) source.
Process - Cool Pump , Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Process Exhaust Fan, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Pump, Water Source Heat Pump, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2014 EUL ID: HVAC-WSHP	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Sensors, Electric, C&I	10	Measure Life Study for MA joint utilities (2005)	Baseline Categories and preliminary Out Year Factors are described at a high level in DNV GL, ERS (2018). Portfolio Model Companion Sheet.. Additional background on the baseline categorization given in DNV GL, ERS (2018). Portfolio Model Methods and Assumptions – Electric and Natural Gas Memo.	MA TRM offers best (recent) source.

Measure Name, Fuel, & Sector	Existing Measure Life	Existing Source	Recommended Source	Rationale for Change
Spray Valve, Electric HW, Electric, C&I	5	SBW Consulting. 2007. Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-05 Pre-Rinse Spray Valve Installation Program (Phase 2).	Measure life from U.S. DOE, "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Prerinse Spray Valves," December 2015, page 8-13."	DOE documentation offers best (robust and recent) source.
TEFC, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.
Water/Waste Pump, Electric, C&I	15	California Public Utilities Commission (CPUC), Energy Division (2008). EUL_Summary_10-1-08.xls.	DEER 2023 EUL	Cadeo identified most up-to-date (robust and recent) source in the CA state TRM.

Table 3. Measures With No Updates

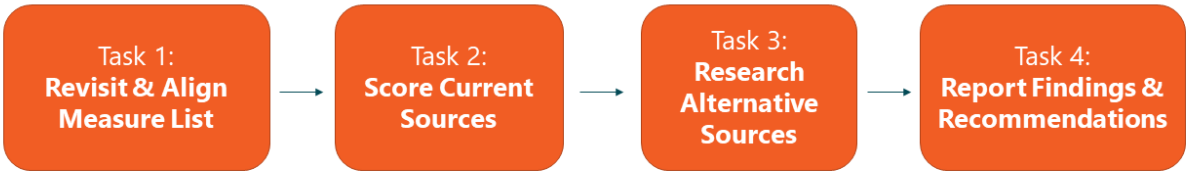
Measure Name, Fuel, & Sector	Existing Measure Life	Existing Source	Rationale
Air Sealing Kits, Electric, Residential	12	Measure Life Source: Rise Engineering (2015). Memo on Pilot Findings for LED inserts for Recessed Light Cans.	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
CoolSmart AC QIV ES, Electric, Residential	18	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
CoolSmart HP, Electric, Residential	18	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
Heating System Retrofit-Boiler, Electric, Residential	23	Guidehouse (2021). Comprehensive TRM Review (MA19R17-B-TRM)	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
Low E Storm Windows, gas heat, Gas/Electric, Residential	20	Pacific Northwest National Laboratory for the U.S. Department of Energy (2015). Energy Savings of Low-E Storm Windows and Panels across US Climate Zones	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.

Measure Name, Fuel, & Sector	Existing Measure Life	Existing Source	Rationale
Heating System Retrofit, Electric, Income Eligible	17	Guidehouse (2021). Comprehensive TRM Review (MA19R17-B-TRM)	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
Pipe Wrap DHW, Electric, Income Eligible	15	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
Window AC Replacements, Electric, Income Eligible	12	GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
Building Exhaust Fan, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
CAIR Nozzle, Electric, C&I	15	Energy & Resource Solutions (2005), Measure Life Study. Prepared for The Massachusetts Joint Utilities, https://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
CT FAN, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
Non-refrigerated snack vending machine, Electric, C&I	10	Measure Life Study for MA joint utilities (2005)	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.
PEI H2O Pump, Electric, C&I	15	Measure Life Study for MA joint utilities (2005)	Cadeo confirmed that the existing/current source in the RI Energy TRM is the most up-to-date source. Other regional TRMs also cite the same source.

Methodology

Error! Reference source not found. illustrates the four tasks we completed for this study.

Figure 1: Roadmap of Tasks



During Phase I of this study, Cadeo developed a list of each prescriptive measure in the TRM and BCR model. We then prioritized the list of measures based on their respective contributions toward the portfolio's total expected lifetime energy savings in 2023. The measure prioritization exercise helped the team identify the most impactful measures (i.e., the high and medium priority measures) on which to focus their review for Phase I. The team also reviewed a subset of 45 low priority measures to ensure some representation of low priority measures.

For Phase II of the study, the team completed a comprehensive review of 126 low priority measures. RI Energy identified the subset of 50 low priority measures[2] by reviewing measures that were planned in the 2024-2026 Annual Plan. Measures that were planned and had higher savings were selected for in depth alternative sources research for Task 3:

A Subset of 50 Measures Reviewed for Task 3

1. Air Sealing Kits, Electric, Residential	18. Elec Res to HP ducted or mix ducted, Electric, Residential	35. Performance Lighting, Electric, C&I
2. Boiler Forced Hot Water Pump, Electric, C&I	19. ENERGY STAR Water Heater, Tankless, Gas, Residential	36. Pipe Wrap DHW, Electric, Income Eligible
3. Boiler, Draft Fan, Electric, C&I	20. Exterior Lighting, Electric, C&I	37. Process - Cool Pump, Electric, C&I
4. Building Exhaust Fan, Electric, C&I	21. Heat, HW Pump, Electric, C&I	38. Process Exhaust Fan, Electric, C&I
5. CAIR Nozzle, Electric, C&I	22. Heating System Retrofit, Electric, Income Eligible	39. Programmable Thermostat - Gas, Gas/Electric, Income Eligible
6. Central Heat Pump, Electric, Residential	23. Heating System Retrofit-Boiler, Electric, Residential	40. Pump, Water Source Heat Pump, Electric, C&I
7. Combo Condensing Boiler/ Water Heater, Gas, C&I	24. Hot Food Holding Cabinet, Electric, C&I	41. Refrigerated beverage vending machine, Electric, C&I
8. Combo Condensing Boilers, Gas, Residential	25. HPWH Electric, Electric, Residential	42. Room Air Cleaner, Electric, C&I
9. Commercial Electric Fryer, Large, Electric, C&I	26. Ice Machines, Electric, C&I	43. Sensors, Electric, C&I
10. CoolSmart AC QIV ES, Electric, Residential	27. Load Comp, 75HP, Electric, C&I	44. Spray Valve, Electric HW, Electric, C&I

11. CoolSmart HP, Electric, Residential	28. LOADCOMP, Electric, C&I	45. TEFC, Electric, C&I
12. CT FAN, Electric, C&I	29. Low E Storm Windows, gas heat, Gas/Electric, Residential	46. Water Heating Boiler, Gas, C&I
13. D2 VFD Secondary, Electric, C&I	30. Low pressure drop filter, Electric, C&I	47. Water Heating, Electric, C&I
14. Demand Circulator, Gas, C&I	31. Make Up Air Fan, Electric, C&I	48. Water/Waste Pump, Electric, C&I
15. DHW ECM Pump, Electric, C&I	32. Non-refrigerated snack vending machine, Electric, C&I	49. WCChill, Electric, C&I
16. Duct Insulation, Gas, Income Eligible	33. ODP, Electric, C&I	50. Window AC Replacements, Electric, Income Eligible
17. ECM Pump, Electric, C&I	34. PEI H2O Pump, Electric, C&I	

Rest of 126 Low Priority Measures Reviewed During Phase II

51. Advanced Power Strips, Electric, Residential	77. DMSHP, Partial Conversion, Residential	103. Motor/Drives, Non-HVAC, Electric, C&I
52. Aerator, Gas, Residential	78. Domestic Hot Water Measure, Oil, Electric, Income Eligible	104. MTVFD Secondary, Electric, C&I
53. Air Cooled AC, Electric, C&I	79. Dryer Most Efficient, Electric, Residential	105. Performance Lighting - Replacement Lighting, Electric, C&I
54. Basic Educational Measures, Electric, Income Eligible	80. Duct Sealing - 100 CFM reduction in leaks 15% of flow to 5%, Electric, Residential	106. Performance Lighting - Tier 1 Exterior, Tier 1 Interior, Tier 2&3 Exterior, Tier 2&3 Interior, Electric, C&I
55. Boiler, 95% AFUE < 300 MBU, Gas, C&I	81. ENERGY STAR Water Heater, Condensing, Gas, Residential	107. Pipe Wrap DHW, Electric, Residential
56. Central AC, Electric, Residential	82. Evap AC, over 20 T, Electric, C&I	108. Refrigerated Chef Base, Electric, C&I
57. Central Ducted HP, Fully Displaced, Electric, Residential	83. Exterior Lighting - EXT 24/7, EXT Dusk/Dawn, Electric, C&I	109. Refrigerator Brush, Electric, Residential
58. Central Ducted HP, Partially Displaced, Electric, Residential	84. Exterior Lighting - Lighting Controls - Exterior, Street Light Exterior, Electric, C&I	110. Refrigerator Glass Door, Electric, C&I
59. Chiller, Water Pump, Electric, C&I	85. Fluorescent w/ Elig Ballast, Electric, C&I	111. Refrigerator Solid Door, Electric, C&I
60. Clothes Washer, Electric, Residential	86. Forced Hot Water Boiler, Gas, Residential	112. Refrigerators, Electric, Residential
61. Combo Cond Furnace w/ Water Heater, 97% AFUE, Gas, C&I	87. Freezer Glass Door, Electric, C&I	113. Replacement Freezer, Electric, Income Eligible
62. Combo Furnace, Gas, Residential	88. Freezer Solid Door, Electric, C&I	114. Room AC Most Efficient, Electric, Residential
63. Compact Fluorescents, Electric, C&I	89. Glass front refrigerated coolers, Electric, C&I	115. Room Air Cleaners, Electric, Residential
64. Compact Fluorescents, Electric, C&I	90. Hand Wrapper, Electric, C&I	116. Room Response Control, Gas, Gas, Residential
65. Compact Fluorescents, Electric, C&I	91. Heat Pumps, Oil, Conversion, Income Eligible	117. Thermostatic Shut-off Valve, Electric, Income Eligible

66. Cond Storage Water Heater, 94% MIN 75-300, Gas, C&I	92. Heating System Outdoor T Reset, Gas, Income Eligible	118. Tricklestar Keyboard, Electric, Residential
67. Condensing Boiler, <= 300 mbh, 95% AFUE, Gas, C&I	93. Heating system replacement, Oil, Electric, Income Eligible	119. Upstream Lighting, Electric, C&I
68. Conveyor Broiler, Gas, C&I	94. Heating, HW Pump, Electric, C&I	120. VARICOMP, 75HP, Electric, C&I
69. DEEC, Electric, C&I	95. High Intensity Discharge, Exterior, Electric, C&I	121. VFD Secondary, Electric, C&I
70. Dehumidifier Most Efficient, Electric, Residential	96. Interior Lighting, Electric, C&I	122. VRF AC, Electric, C&I
71. Dehumidifier Recycling, Electric, Residential	97. Interior Lighting, Electric, C&I	123. Water source heat pump, Electric, C&I
72. Dehumidifier, Electric, Income Eligible	98. Lighting Controls - Daylight Dimming Controls, Electric, C&I	124. WiFi programmable thermostat with cooling (gas), Gas/Electric, Residential
73. Direct Fire Heater, Gas, C&I	99. Lighting Controls - Integrated Controls, Electric, C&I	125. WiFi Thermostat, Electric, Residential
74. Dishwasher - High Temperature Pots and Pans, Electric, Residential	100. Low Flow Showerhead, Gas, C&I	126. WSHP Pump, Electric, C&I
75. Dishwasher, Electric, C&I	101. Low Flow Spray Nozzle, Cooking, Gas, C&I	
76. DMSHP, Conversion, Residential	102. Mini Split Heat Pump QIV, Electric, Residential	

In Task 2, the team scored each measure's measure life source based on its origin, robustness, and age, as shown in Table 4**Error! Reference source not found.**. Measure life sources scored as "strong" indicate the current values are reliable and appropriate for use in Rhode Island, while "weak" indicates the measure life value source is less reliable for continued use and that Rhode Island Energy should consider adopting an alternative value. Sources rated as "moderate" fall between these two scores and required greater subjectivity.

Table 4. Scoring Guidelines

Key Factor	Strong	Moderate	Weak
Source Origin	From primary research sponsored by RI Energy and/or appropriately piggybacked[3] from Massachusetts	From research completed outside RI, but a similar climate or market, or a national source customized for RI	Data source not cited, unavailable, or not appropriate for RI
Source Robustness	Detailed primary research (e.g., metered data)	Focused secondary research (e.g., energy modeling)	High-level research (e.g., literature review)
Source Age	2017–present	2012–2016	Before 2012

[3] DNV GL, Rhode Island Piggybacking Diagnostic Study, January 14, 2020, http://rieermc.ri.gov/wp-content/uploads/2020/09/rhode-island-piggbacking-diagnostic-study-final-final-report-20200114.pdf.

Specifically, **Cadeo flagged any measure life sources scored as weak in any of the three categories (origin, robustness, and age) for potential replacement with an alternative source**. Because the measures are important to Rhode Island Energy's overall portfolio, **we investigated potential replacement sources for a subset of low priority measures that scored as weak or moderate in the categories described in** Error! Reference source not found.**.** In other words, unless a source for a measure scored as high in all three categories, our team explored the possibility that a better source could exist for the measure.

For Task 3, our team investigated the potential existence of a better source of measure life information for each measure we flagged with weak or moderate scores in the three rating categories (origin, robustness, or age). The team reviewed a subset of 50 low priority measures selected by the RI Energy team to stay within scope. The team determined that an alternative source is "better" if the new source did not have any weak scores in any of the three rating categories after applying the same scoring process described above in **Error! Reference source not found.**. The team recognizes there is some subjectivity to the scoring process and may recommend adoption of an alternative source—potentially as a stopgap—even if it reflects an imperfect but marginal improvement relative to the existing source.

Key Findings: Current Source Scoring

Using the scoring approach described in Task 2 of the Methodology section, Cadeo flagged 77 measures for potential updates of the total 126 low priority measures the team reviewed. Table 5**Error! Reference source not found.** shows the number and percentage of measures we flagged for updates based on the scoring guidelines (Table 4) with the measure priority breakdown. Most source updates were due to the age of the existing source and were scored as weak in the respective category. The team then researched alternative sources for replacement for a subset of 50 flagged low priority measures selected by RI Energy, further described in the next section.

Table 5. Measures Flagged for Update

Priority Ranking	# of measures reviewed	# flagged for update	% flagged for update
Low	126	77	61%

Key Findings: Research Alternative Sources

Cadeo researched alternative sources, including those used in other TRMs[4], primary research studies and DOE technical support documents for updated information on measure life assumptions. The team reviewed the alternative sources in detail to ensure the new source

[4] Cadeo reviewed the underlying sources in other regional TRMs (e.g., MA, CT, NY, IL, and Mid-Atlantic) to identify alternative sources for any measures that were flagged for update in Task 2.

matched the measure life definition listed in the Rhode Island Energy TRM[5]. Table 6**Error! Reference source not found.** describes our findings for alternative sources for the subset of 50 measures selected by RI Energy. Alternative sources were recommended if they scored better than the existing sources based on the scoring guidelines. For measures with no better sources found, alignment with other regional TRMs or stakeholder groups (MA Common Assumption) was noted where possible.

Table 6. Total Measures Reviewed and Count of Measures with Updates

Priority Ranking	# of measures with recommended updates	# of measures with no "better" source	Total
Low	37	13	50

[5] RI Energy TRM definition, Measure life includes equipment life and the effects of measure persistence. Equipment life is the number of years that a measure is installed and will operate until failure. Measure persistence takes into account business turnover, early retirement of installed equipment, and other reasons measures might be removed or discontinued.