WHEN TRUST MATTERS

CT EEB X1939 Early Retirement: Phase II Research

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Presentation Overview

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Program, Objectives and Approach Overview

ER Programs Overview

- ER programs target equipment that would have continued to operate until the end of its useful life without program intervention
- The first ER programs released that were included in this impact evaluation are competitive bid programs and include:
  - 2 rounds of large chillers (600 tons and up)
  - Roof top units (RTU) - Program across CT and MA
  - Boilers

Program	Number of Awarded Projects	Annual Program Reported Electric Savings (kWh)	Lifetime Reported Electric Savings (kWh)	Annual Program Reported Gas Savings (MMBtu)	Lifetime Reported Gas Savings (MMBtu)
2019 Chiller Program	4	2,654,180	30,118,355	N/A	N/A
2020 Chiller Program	1	421,502	4,280,870	N/A	N/A
2020 Boiler Program	5	116,783	727,235	38,797	447,023
2020 RTU Program	13	1,512,734	12,216,908	4,452	44,521
Total	**23**	**4,705,199**	**47,343,368**	**43,249**	**491,544**

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X1939 Evaluation Objectives

Objective	Source	Applicable Programs
1. Provide feedback on ER program design, including which gross and net parameters are relevant for ER programs	Best Practices/ER Design Research (Phase I)	Early Retirement
2. Ensure accounting for dual baseline calculations where applicable	Best Practices/ER Design Research (Phase I)	All programs with existing equipment baselines
3. Ensure that the program is equipped to handle non-energy impacts for ER projects	Best Practices/ER Design Research (Phase I)	All programs with existing equipment baselines
4. Optimize the process effectiveness and efficiency for ER programs	Best Practices/ER Design Research & CT ER Impact Eval (Phase I and II)	Early Retirement
5. Use program EM&V to assess the performance of ER programs and to better inform the design of ER programs	CT ER Impact Eval Research (Phase II)	Early Retirement

Evaluation Overview

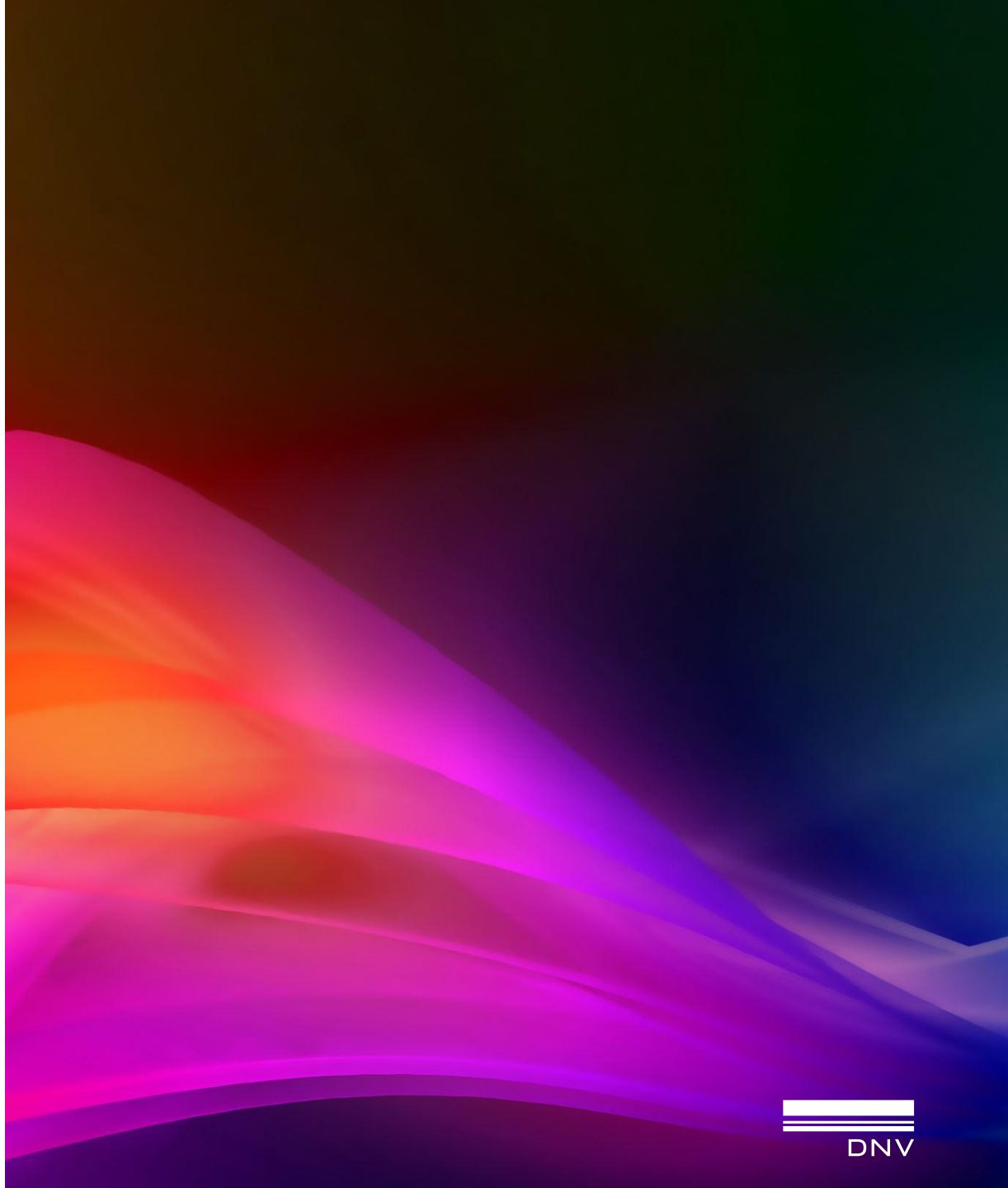
Prior Phase 1 Scope: Best Practices Research

- Literature review of ER programs
- Interviews of Program Managers and CT Trade Allies
- Review of CT Program Data

Interim Deliverable –Presentation and memo documenting findings and recommendations. *Completed in 2021*

Current Phase 2 Scope: Impact Evaluation

- Desk review of all 23 projects in the 4 CT ER programs
- In-depth participating customer interviews, census attempt, 10 completed



Gross Impact Results, Findings and Recommendation

Impact Evaluation Results – Early Retirement Factor Realization Rates (ER RR)

Program/Measure	Population	Desk Reviews Completed	Customer Interviews Completed	First Year Elect. ER RR	First Year Gas ER RR	Lifetime Electric ER RR	Lifetime Gas ER RR
2019 and 2020 Chiller Programs	5	5	3	100%	N/A	100%	N/A
2020 Boiler Program	5	5	1	100%	100%	100%	100%
2020 Roof Top Unit Program	13	13	6	47%	80%	66%	80%
Total Combined	**23**	**23**	**10**	**88.4%**	**98.5%**	**93.7%**	**98.8%**
Relative Precision				±23%	±4%	±12%	±3%

- ER RRs were generally high, savings and lifetime calculations were robust and reasonable.
- RTU primary adjustments were on the early retirement baseline and non-installed project
- Recommend using combined ER RR for all programs combined into each of the total values shown above
- These values are new to the TRM

Impact Evaluation Results – Total Combined RR

Program	First Year Elect. RR	First Year Gas RR	Lifetime Electric RR	Lifetime Gas RR
X1939 Realization Rates	88.4%	98.5%	93.7%	98.8%
C1635 Energy Opportunities Impact Evaluation Realization Rates	102.1%	76.5%	102.1%	76.5%
Total Combined	**89.8%**	**75.0%**	**96.0%**	**75.7%**
Total relative precision at 90% confidence	±41%	±14%	±38%	±14%

- This study's primary research focused on early retirement considerations
- Evaluation team multiplied the ER RR by the non-ER RRs from a previous commercial evaluation: C1635 Energy Opportunities Impact Evaluation
- This combination is to account for adjustments in the actual performance and operation of the equipment and present a comprehensive view of the measures' realization rates

Customer Interviews – Event Type Determination Findings

Key Baseline Questions	Response Summary
What motivated your company to replace the [Chiller/Boiler/RTU]?	50% Responded the existing equipment had failed or was performing poorly, though this alone does not indicate that the baseline was inappropriate
You said that you replaced the existing equipment because it had failed or was performing poorly, what aspects of the performance were you unhappy with?	60% component failure, 20% not hitting temp set points, 10% very old, 10% NA
How frequently were you making routine repairs?	10% Every 4-6 weeks, 10% Every 8 weeks, 10% Every few months, 10% Couple times per year, 20% General maintenance, 30% Once per year, 10% Don't know
Existing Age of equipment	10% (significantly older than useful life), 60% (near or just past useful life), 30% (less than or at useful life)

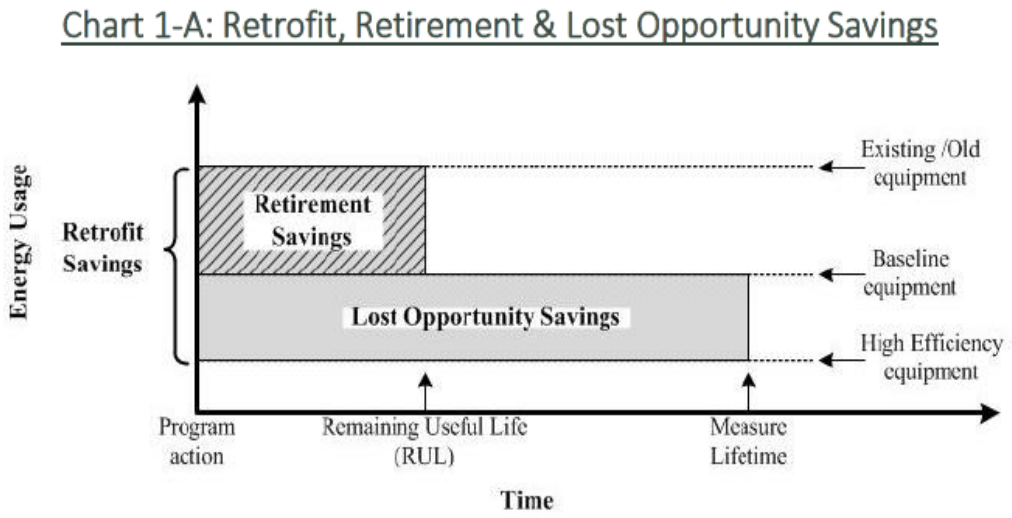
- DNV adjusted the baseline in 3 cases
- When existing equipment was “performing poorly” but well before the EUL (e.g. only 5 years old) and/or the respondent estimated that it would have run for 5 more years, we currently allow ER
- When sufficient supporting documentation was provided, such as BMS data proving operation, DNV continued to use the ER characterization

RUL and Dual Baseline Calculation Finding

- ***From Phase I:***

  Use the values in the CT PSD where they are listed for RUL

- **Desk Review Findings:**
  - These programs had specified RULs in the CT PSD.
  - DNV found that the RULs used and the dual baseline calculations were appropriate for the projects in these three programs
  - Dual Baseline calculations were used in all cases to determine lifetime savings



Event Type Determination Findings

From Phase I:

Use of ER should require a preponderance of evidence such as trend data, metered data, dated photos/videos of operation, bid quotations or similar demonstrating that the pre-existing equipment either:

- *Is fully functional*
- *Needs only minor economically viable repairs (e.g. repair cost is < 20% of replacement cost) for continued operation*
- *Has run in failed or partially failed mode for more than two years*
- *Had failed but was replaceable with on-site in-stock inventory or back-up equipment similar in efficiency*

Recommendation: Clear, defensible documentation is the most important aspect in ensuring that savings are upheld through evaluation

- *Data format - Clear documentation of lifetimes as well as event types*
- *Preponderance of evidence – Information to document outlined in report*

- **Desk Review Findings:**
  - Generally not a lot of detailed supporting info on existing conditions
  - Most of what was in the project documentation consisted of narratives, and in some cases a few pictures
  - In some cases documentation characterized existing equipment condition as “poor” and demonstrated some failed functions
  - Tracking data not kept cleanly in one file, evaluators compiled multiple files to obtain the tracking information for all programs and sites

Recommendations

- **Recommendation**: Combine the early retirement factor realization rates (ER RRs) that were the result of this study with the most recent prospective savings realization rates for commercial electric and gas HVAC measures and apply them to any dedicated C&I custom early retirement offerings
- **Recommendation:** Preponderance of evidence needs to be bolstered with supporting info such as trend data, metered data, more conclusive photos or videos of operations
- **Recommendation:** Compile tracking data to ensure accurate reporting

NTG Results and Findings

Impact Evaluation Results – Net-to-Gross

Program/Measure	Population	Desk Reviews Completed	Customer Interviews Completed	Free-Ridership
2019 and 2020 Chiller Programs	5	5	3	11%
2020 Boiler Program	5	5	1	50%
2020 Roof Top Unit Program	13	13	6	11%
Total	**23**	**23**	**10**	**13%**

Recommend using total NTG factor here due to low survey representation from boiler program

Total Combined NTG Ratio

Factors	Ratio
Free ridership (FR)	0.13
Participant spillover (SO)	0.00
Total	**0.87**

NTG Findings

Overall Free-Ridership is fairly low

The majority of free ridership came from customers who would have installed the same efficiency equipment absent the program as what they installed through the program.

Total Net Evaluated Savings

Program Claimed Savings

Program	Number of Awarded Projects	Annual Program Reported Electric Savings (kWh)	Lifetime Reported Electric Savings (kWh)	Annual Program Reported Gas Savings (MMBtu)	Lifetime Reported Gas Savings (MMBtu)
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Program Evaluated Savings

Program	Number of Awarded Projects	Evaluated Net First Year Electric Savings (kWh)	Evaluated Net Lifetime Electric Savings (kWh)	Evaluated Net First Year Gas Savings (MMBtu)	Evaluated Net Lifetime Gas Savings (MMBtu)
2019 Chiller Program	4	2,071,590	23,507,411	N/A	N/A
2020 Chiller Program	1	328,983	3,341,224	N/A	N/A
2020 Boiler Program	5	91,149	567,608	25,267	294,098
2020 RTU Program	13	1,180,691	9,535,311	2,899	29,291
Total	**23**	**3,672,413**	**36,951,553**	**28,166**	**323,388**
Relative Precision		±46%	±25%	±43%	±25%

NEI Results

Non-Energy Impacts

- 7 of 10 respondents (out of 24 total participants) claimed non-energy benefits due to reduced O&M
- Majority estimated their value as being greater than energy cost savings
- Addition benefits also were identified:
  - Improved comfort/ventilation – Survey respondents indicated that their staff were more comfortable, which they also said improved morale
  - Improved reliability – New equipment is functioning without issues or causing shutdowns
- Based on the survey responses, a weighted average of $57,000 per year of additional impacts per site were reported for the ER portion of the project (RUL)
- **Recommendation:** While CT uses the Connecticut Efficiency Test (CTET), NEIs cannot currently be included in project screening, however they should still be quantified and tracked.

Questions?
Thank You