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Subject: Grocery Store Refrigerant Demonstration Draft Evaluation Plan
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Introduction

National Grid is planning a demonstration project to test how refrigerant-focused program interventions in grocery stores can deliver both energy and direct greenhouse gas savings. The demonstration will employ impact and process evaluation methods to gain a comprehensive understanding of challenges and benefits for refrigerant-focused measures.

The project will examine two measures:

- **Refrigerant Leak Reduction – Leak Detection Survey and Repair.** National Grid’s contractor will solicit 5 participating grocery stores with parallel DX refrigeration systems with high GWP refrigerants for detailed leak detection, measurement, and repair.
- **High-GWP Refrigerant Retrofits.** National Grid’s contractor will solicit 5 participating grocery stores to retrofit existing high-GWP refrigeration systems with a low-GWP refrigerant that is also expected improve system efficiency.

Phase 1 demonstration project evaluation results should be delivered by June, 2024 to inform the 2025-2027 Three Year Plan. Phase 2 of the demonstration will provide a more robust analysis but will not be available until December, 2024.

Objectives and Research Questions

Refrigerant Leak Reduction – Leak Detection Survey and Repair

1. What are the expected costs per project/site per year and what incentive support will be required?
2. What are the project energy savings associated with typical stores and as a function of refrigeration system size?
3. What are standard refrigeration system maintenance practices with regard to refrigerant leaks?
4. What are the direct GHG savings associated with reduced refrigerant emissions for typical stores and as a function of refrigeration system size?
5. What is the appropriate project baseline considering existing site conditions, regulatory requirements, standard maintenance practices, and the Evaluation Baseline Framework?

6. What are the customer benefits and costs experienced as a result of the project?
7. How can a commercialized utility program improve on the customer and contractor experience from the demonstration?

High GWP Refrigerant Retrofits

1. What are the expected costs per project/site per year and what incentive support will be required?
2. What are the project energy savings associated with typical stores and as a function of refrigeration system size?
3. What are the direct GHG savings associated with reduced refrigerant emissions for typical stores and as a function of refrigeration system size?
4. What is the appropriate project baseline considering existing site conditions, regulatory requirements, standard maintenance practices, and the Evaluation Baseline Framework?
5. What are the customer benefits and costs experienced as a result of the project?
6. How can a commercialized utility program improve on the customer and contractor experience from the demonstration?

Methodology

The demonstration evaluation should include two phases, a first phase intended to provide as much data as possible for input to the 2025-2027 Three Year Plan, followed by a second phase intended to capture longer term data to provide improved estimates of energy and refrigerant emission reductions. Given the small population, data collection is expected to take place at a census of participating sites. As such, participation in the evaluation should be considered a requirement for participation in the program. Both kinds of projects come with the same set of generalized approaches and generalized impact and process tasks:

Phase 1:

1. Estimate initial energy impacts.
2. Collect pre-installation refrigerant addition documentation and estimate initial refrigerant impacts.
3. Collect initial process findings about costs, customer, and contractor experience.

Phase 2:

1. Update energy impacts based on 1 year of post-metering.
2. For refrigerant leak reduction sites, update refrigerant impacts based on fresh top-up of refrigerant. For refrigerant retrofit sites, collect additional refrigerant documentation and repair leaks and top up refrigerant.
3. Update process findings based on follow-up interviews.

Phase 1 Tasks:

Task 0: Develop project documentation guidance and recruit customers

For each project type, develop a list of data collection requirements suitable for providing to contractors and customers that lists the desired information (e.g. what was installed, relevant baseline information, refrigerant system maintenance during the study, etc.). Include a checklist and data collection form for refrigerant detection survey and repairs to ensure consistent and detailed data collection.

Task 1: Assess historic refrigerant emissions

Assemble refrigerant records for the last two years for every participant. Records should include the type of refrigerant added, how much was added, and when it was added. For each project, estimate the refrigeration system capacity (in tons) and estimate the total refrigerant charge at full charge by inventorying each piece of the refrigerant system piping¹ and estimating the volume and density of refrigerant within each component.

For each project, divide the estimate refrigerant leakage by the total system charge to estimate the refrigerant leakage rate.

Task 2: Pre-metering of refrigeration system energy usage

For each project, measure the energy consumption and refrigeration system load prior project implementation. If trend data is available for a longer duration of the pre-period, use that. If not, conduct pre-installation metering for at least two weeks.²

Task 3: Initial installation of measures and post-metering of refrigeration system energy usage

After pre-metering is complete, implementation contractors will perform system upgrades. During the initial installation at all sites the HVAC technicians will top up the system with refrigerant. Continue metering after projects are installed to capture post-installation performance. Ideally, installations should be complete in time to include system performance during hot weather in post-installation metering periods.

Customers will be asked to maintain records of any system repair work performed during this time, particularly when refrigerant is added to the system.

Task 4: Six-month follow up site work – Refrigerant Leak Reduction participants only

Refrigerant leak reduction participants will undergo a second leak detection survey six months after the initial survey and undergo any new repairs. Any significant maintenance made to the system will be discussed with the customer. Record the refrigerant added and use this to estimate the leakage rate over 6 months and extrapolate to an annual leakage reduction rate.

¹ In some cases, drawings or specifications may be available from the customer for the refrigeration system inventory.

² Pre-metering should be conducted for more time (e.g. 6-8 weeks) if time is available, but it is most important to get both pre-metering and post-metering data during summer weather.

Task 5: Contractor and customer interviews

Towards the end of Phase 1, conduct interviews with contractors to assess barriers to future participation. Answer questions like these for contractors:

- What are typical refrigerant leak detection and correction practices conducted by you vs other contractors?
- How much harder was it to complete this work than what is typically done?
- What difficulties did they encounter?
- Would they be interested in doing more of it?
- What would make it easier for them?

Answer questions like these for customers/facility owners:

- Why did you decide to do this project?
- What do you see as the primary benefits of this project?
- What frustrations did you have with the project? How could these be alleviated?
- How likely are you to pursue similar projects at other facilities you own or recommend them to other facility owners?
- What recommendations do you have for utility programs trying to get more people to do these projects?

Task 6: Cost analysis

Document the refrigerant project costs associated with each of the projects, including individual cost components if possible.

Task 7: Phase 1 analysis and reporting

Complete analysis of Phase 1 data collected to estimate energy savings as a function of system load, system capacity, and outdoor temperature for both refrigerant retrofits and refrigerant leak reduction projects. Document all analyses in a Phase 1 draft findings presentation. After presenting results and getting feedback, prepare a Phase 1 demonstration findings memo documenting all findings from first phase of evaluating the demonstration.

Phase 2 Tasks:

Task 1: Long term post-installation metering

Continue metering each project for at least 12 months after project implementation. Customers should continue to document system repair work, including refrigerant top ups. If possible, identify other grocery projects in the custom program with conventional refrigerants to also receive long term metering. Use this data to estimate long term energy consumption patterns as function of system capacity, system load, and outdoor temperature across all seasons for both baseline systems and improved systems.

Task 2: Twelve-month follow up site work – All participants

For each refrigerant leak reduction site and refrigerant retrofit site, conduct a refrigerant leak survey, repair, and refrigerant top up 12 months after the initial project implementation. Estimate the amount of refrigerant that leaked since the last refrigerant top up.

Task 3: Customer follow-up interviews and meter removal

During the final site visit for meter removal perform final customer interview. Follow up on questions of interest from the customer interview, plus additional questions focused on long term benefits:

- For sites with refrigerant leak reduction:
 - Over the last year, did you experience fewer unscheduled maintenance issues than you typically would? What were the benefits (lower costs, less equipment downtime, better setpoint maintenance, less lost product)?
 - Did the refrigerant leak reduction project create any other problems for you?
 - How likely are you to pursue similar projects or recommend similar projects at other facilities?
- For sites with refrigerant retrofits:
 - Did you experience any unexpected maintenance issues or additional costs as a result of the retrofit?
 - Did you get the benefits that you were expecting?
 - How likely are you to pursue similar projects or recommend similar projects at other facilities?

Task 4: Revised cost estimates

Update cost estimates to include cost of conducting the follow-up refrigerant leak survey and repair visits.

Task 5: Updated analysis and reporting

Update analysis to include the extended metering data and additional leak detection and repair work. Present revised findings and update reporting memo.

Schedule

Phase 1 implementation and pre/post metering is expected to take place during summer and fall of 2023. All phase 1 data collection should be completed by spring of 2024, with presentation of draft findings in May and interim report due June 1, 2024.

Phase 2 data collection, analysis, and reporting will continue through fall of 2024, with final report expected by December 31, 2024.

Table 1: Schedule Overview

Year/Month	Study Task	Implementation Activity	Evaluation Activity
Phase 1			
June 2023	Task 0	Recruit participants	Planning
July 2023	Task 1-2	Recruit participants	Baseline refrigerant leakage; refrigerant inventory; install metering equipment
August 2023	Task 2-3	Implement measures	Pre/Post metering
September 2023	Task 3	Implement measures	Post metering
October 2023	Task 3		Post metering
November 2023	Task 3		Post metering
December 2023	Task 3		Post metering
January 2024	Task 3		Post metering
February 2024	Task 4	Refrigerant top-up and leak repair*	Post metering; Collect refrigerant added data
March 2024	Task 4-5	Refrigerant top-up and leak repair*	Post metering; Contractor and customer interviews
April 2024	Task 6-8		Data Analysis
May 2024	Task 6-8		Data Analysis
June 2024	Task 8		Interim Report Due
Phase 2			
July 2024	Task 1		Post metering
August 2024	Task 1		Post metering
September 2024	Task 2	Refrigerant top-up and leak repair – all participants	Post metering
October 2024	Task 3		Remove metering; Final customer interviews
November 2024	Task 4-5		Data analysis
December 2024	Task 5		Final report due

* Activity for Refrigerant Leak Reduction participants only

Budget Range

Evaluation of this demonstration is estimated to cost between \$200,000 and \$500,000. Implementation costs (project management, customer recruitment, project incentives, etc.) are additional.