

C1902 ECB Baseline and NTG, Upstream Non- Lighting NTG, and Code Compliance Study Work plan

FINAL

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SUBMITTED TO:
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Section 1 Overview

This document presents a scope of work, developed for the Connecticut Evaluation Administrator (EA) Team, for the completion of the C1902 study. The study includes four main components: 1) calculate market baseline values for non-residential measures; 2) estimate net-to-gross (NTG) values for the Energy Conscious Blueprint (ECB) program; 3) measure non-residential new construction code compliance; and 4) estimate NTG values for the Upstream Non-Lighting program. The study will be performed by NMR Group and its subcontractors DNV and Brightline Group. The team will solicit feedback from manufacturers, distributors, contractors, retailers, implementation vendors, and architectural and engineering firms through market interviews and online surveys, will conduct participant surveys, and will review compliance documents and drawings to update baseline values, improve the alignment of savings and program attribution calculations with baseline assumptions, and document the level of code compliance.

Figure 1 presents the team structure and roles for the key team members.

Figure 1. Key Team Member Roles



1.1 BACKGROUND

The ECB program offers incentives for new construction, major renovation, and tenant fit-out projects, as well as new (or end-of-useful-life replacement) equipment projects. The most recent impact evaluation of the ECB program was completed for program years 2017-18. This study will integrate NTG and market baseline research and analysis components to support improved

accuracy of gross and net savings estimates for use in future versions of the Connecticut Program Savings Document (PSD). The study will also account for potential future program changes, recommend program changes to increase program attribution, and estimate the program's impact on the market as a whole.

A key challenge for the ECB-related elements of this study is that the ECB program structure changed in August 2020 from a format that saw mostly prescriptive measure-level projects, to a four-path program with an increased emphasis on whole building projects. Given the nature of program changes, and program staff's expectations for the program going forward, the NMR team plans to focus the ECB NTG component of the evaluation primarily on the current program's Path 2 ("Whole Building Energy Use Intensity Reduction") and Path 4 ("Systems" – the program's prescriptive, more measure-focused path), which program staff have indicated are most analogous to the offerings available in the prior iteration of the program.¹ We will explore program Paths 1 and 3 to the extent relevant as well (e.g., via market actor interviews and potential engagement with 2021 program participants), and will identify research questions related to those program paths for further investigation in future studies.

Connecticut's utilities plan to increase efforts to improve non-residential code compliance and increase savings through code-related efforts. This study will help lay the groundwork for future evaluation of code-related efforts by measuring code compliance in the current code cycle and establishing a reference point for comparison with future compliance levels.² The research will also include gathering market actor insights and reviewing best practices to help ensure the future evaluability of utility code development and compliance efforts, in support of the Companies, DEEP, and the Connecticut Energy Efficiency Board (EEB) Evaluation Committee.³ This code compliance component of the study is an addition to the original scope outlined in the RFP. Connecticut's statewide building code update is on roughly a two-year update schedule. It was last updated in 2018, and the prior version was adopted in 2016. A new version was scheduled for adoption in October of 2020, but due to Covid pandemic-related delays the code updates currently under development are not expected to take effect until 2022.⁴

The C&I Upstream Non-lighting Program in Connecticut offers incentives for HVAC equipment such as air conditioning, air-source heat pumps, boilers, and furnaces, as well as commercial

¹ The previous version of the program had both whole building and prescriptive paths, and the majority of projects utilized the prescriptive path. The whole building path under the old program was most similar to "Path 2" under the new program structure, which focuses on whole building EUI as the primary metric. The volume of activity for those types of whole building projects has remained similar to what took place under the old program structure. The new program structure introduces some different timing requirements and incentive calculations. The greatest uptick in program activity under the new program structure has been with Path 1 (Net Zero Energy) projects. Program staff expect that the volume of activity for the prescriptive path (now called Path 4) will remain about the same as under the old program.

² Section 2.3 of the 2021 CL&M Plan discussed the code savings attribution efforts the Companies will undertake during the next three-year plan, including both code compliance support and code development efforts. Measuring code savings attribution is outside the scope of the C1902 project.

³ Eversource and UI.

⁴ <https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Building-and-Fire-Code-Adoption-Process>

kitchen equipment, including freezers, fryers, griddles, and refrigerators. The Program has evolved in the equipment it offers and the market actors it targets for rebates, with recent efforts to promote midstream and upstream rebates to contractors and distributors, focusing on specific market sectors (e.g., increased promotion of commercial kitchen equipment for the restaurant sector). Connecticut's Upstream Non-lighting Program offers some of the same equipment as the Massachusetts Program, and the same implementation vendor and many of the same distributors are active in the programs in both states. This study will estimate NTG values for Connecticut's upstream program, leveraging evaluation methods and findings from a similar study NMR and DNV are conducting of the Massachusetts program—which is scheduled for completion in the spring of 2021.

1.2 STUDY OBJECTIVES AND APPROACH

As noted, this study will include four primary components—baseline measurement, ECB NTG analysis, code compliance research, and upstream non-lighting NTG analysis. The study will provide the EEB and the Companies with improved ECB gross and net savings estimates, improved upstream non-lighting net savings estimates, and insights that can be used to inform future program planning.

The objectives of this study are to:

1. Update measure-level baseline values for true new construction and replacement on failure
2. Update net-to-gross ratios (NTGR) for true new construction (i.e., end use-level and whole building values to the extent feasible).
3. Ensure alignment between baseline and free ridership assumptions
4. Document current code compliance and gather data to support future evaluation and attribution of savings for code compliance and development efforts
5. Determine NTGRs for the Upstream Non-Lighting Program, and gain insight into customer market event (e.g., replace on failure, new construction)

The overall approach to achieve the study objectives is summarized below:

Baseline approach. The market baseline component of this study will rely predominantly on market actor interviews (n=20), online surveys (n=325), and a review of compliance documents and drawings, with site visits to a limited number of participant facilities, as appropriate. The study will cover all the measure categories described in the lost opportunity section (section 2) of the PSD. Additional details on the measure categories is included in [Table 3](#) in [Section 2.4.1](#). The surveys will include the most common equipment types and sizes for the PSD measure types.

ECB NTG approach. The NTG component of this study will use the participant self-report method, along with market actor interviews and an expert panel to arrive at a NTGR that accounts for FR, participant spillover (PSO), non-participant spillover (NPSO), and market effects (ME). The self-report surveys will include both participant and non-participant components and will include questions to gauge the sensitivity of outcomes to different program conditions.

The survey approach will utilize guidance provided by DNV to the Massachusetts baseline framework⁵ on integrating ISP baselines and NTG evaluations. The Massachusetts baseline framework says that an ISP baseline represents a market “average,” but program participants might not be typical market actors; therefore, it is still important to evaluate NTG for measures with ISPs. This study will also apply the advice provided in the Massachusetts baseline framework for how to measure intermediate efficiency FR in a way that is compatible with ISPs and avoids double counting. To accomplish this, the project will follow a phased approach, where we first gather data and determine ISPs, then craft and conduct NTG data collection that takes those ISPs into account.

The expert panel will share their perceptions of the ECB participant NTG survey results and provide insight to inform forward-looking NTGR estimates. The team will also leverage C1902's cross-cutting market actor interviews as a means of gaining insight into the program's influence on the market.

The NTG research will provide both backward-looking NTGRs that are in relation to code baselines, and forward-looking NTGRs that are in relation to the ISPs.

Code compliance approach. This component of the study will be informed by interviews with market actors including architects, engineers, and contractors familiar with the Connecticut commercial new construction market, interviews with DEEP and DAS officials, participation in two monthly Codes & Standards committee meetings, review of compliance documents and drawings, and COMCheck analysis to assess building compliance (n=42).

Upstream non-lighting NTG approach. This component will be informed by the literature review, as well as program tracking data review, program staff and implementation vendor interviews, and interviews and surveys with manufacturers, distributors, contractors, and customers.

Overview and integration of study components. Figure 2 presents a schematic summary of the overall project approach and the relationship between the baseline, code compliance, ECB NTG and Upstream NTG project components.

⁵ <https://ma-eeac.org/wp-content/uploads/MA-CIEC-stage-5-report-Baseline-Change-Effects-on-NTG-20180917-FINAL....pdf>

Figure 2: Overview of Approach and Relationship Between Project Elements

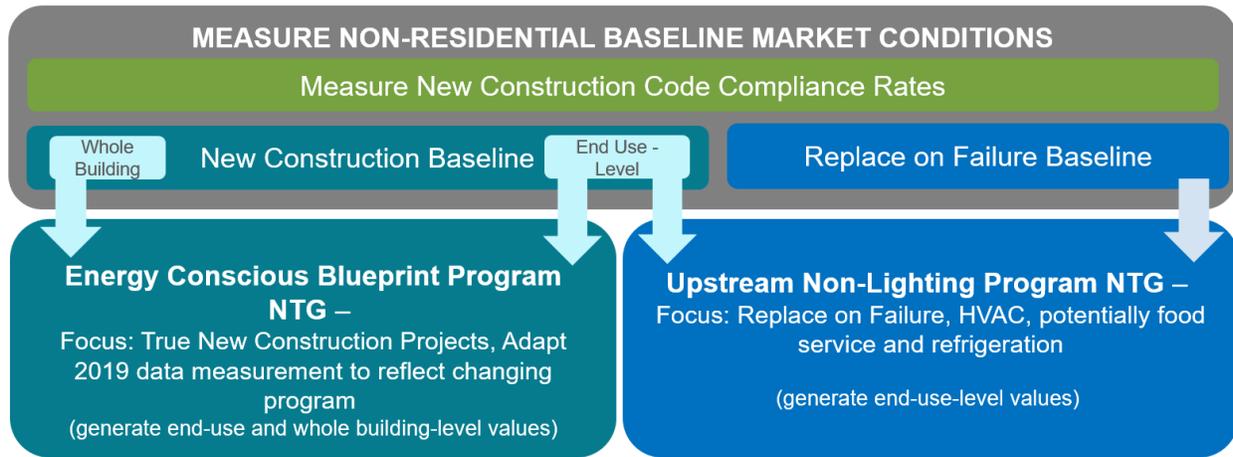


Table 1 presents a summary of data collection activities and their applicability to the various study components.

Table 1. Summary of Data Collection Activities for Various Study Components

Activity	Baseline	Code Compliance	ECB NTG	Upstream NTG
General population web survey (2019/2020Q1 NC) (n=325)	✓	✓	✓	
Literature/studies review	✓	✓	✓	✓
Market actor IDIs – architects/engineers/modelers (n=~10)	✓	✓	✓	
Market actor IDIs – distributors (n=~3 for baseline; up to 30 for upstream NTG)	✓	✓		✓
Market actor IDIs – contractors (n=~3)	✓	✓	✓	✓
Market actor IDIs – code officials/C&S committee (n=~2)	✓	✓		
Market actor IDIs – manufacturers (n=~2 for baseline; subset of distributor sample for upstream NTG)	✓	✓		
Program staff IDIs (n=~3)	✓		✓	✓
Implementation vendor IDIs (n=~2)				✓
Participant survey (ECB NTG n=125; Upstream NTG n=70 contractors, 70 customers)			✓	✓
Expert panel (n=~20)	✓	✓	✓	✓

✓ Includes ROF

The study will leverage recent and ongoing Connecticut evaluation research, as follows:⁶

- Recent baseline research conducted as part of Connecticut’s ECB impact evaluation (C1634) will provide a foundation for our literature review and input for scoping decisions regarding measure types.
- Ongoing research on commercial boiler and furnace baselines being conducted for the Connecticut PSD update study (X1931) will supplement our analysis for these key measure types.
- If available, interim results on program penetration and customer profiling from the ongoing non-SBEA process evaluation (C1901) will be used to inform scoping and sampling and avoid excessive customer survey burden from participating in multiple studies.

1.3 PROJECT MANAGEMENT

Standard operating procedures for project management of EEB studies dictate that NMR will follow these guidelines over the course of this study:

- Deliver monthly progress reports to the EA Lead in their prescribed format.
- Follow the Connecticut Evaluation Roadmap guidelines on communication.
- Communicate and coordinate with other contractors on related projects where appropriate.
- Report on project progress in weekly or bi-weekly calls with the EA Team for the duration of the project.
- Keep track of data requests, and any major issues with the data provided by the Utilities, such as lack of availability of suitable data for the evaluation.
- Provide copies of databases containing any energy model results used for analysis.

⁶ The study will also coordinate the research activity to incorporate anticipated changes to lighting controls chapter in PSD.

Section 2 Task Descriptions

Table 2 summarizes the tasks and deliverables that the NMR team will complete to carry out C1902.

Table 2: C1902 ECB NTG and Baseline – Task Summary and Deliverables

Task		Task Summary or Deliverable
1	Data Request Call, Workplan, and Kickoff	Draft workplan and hold data request meeting
		Conduct program design calls
		Hold kickoff and finalize workplan
2	Review of Program Data	Submit formal data request
		Review program data and materials
3	Literature Review	Conduct literature review
4	Primary Data Collection	Develop baseline and code compliance data collection instruments (survey and in-depth interview guides for program and implementation staff and market actors)
		Develop NTG questions for non-participant baseline survey
		Field baseline data collection
		Develop NTG participant survey instrument
		Develop expert panel materials (as appropriate)
		Field NTG participant surveys (2019 participants, and potentially 2021 participants)
		Conduct expert panel (as appropriate)
		Develop instruments for upstream manufacturer and distributor NTG interviews, and participating contractor and end-user NTG surveys
Field upstream market actor interviews and surveys		
5	Analysis, Reporting, and Final Presentation	Perform COMCheck analysis
		Interim results memo (summer)
		Comparison with previous studies
		Analyze data and draft report
		Submit draft report to EA Team
		Send draft report for public review
		Finalize report
Hold final presentation		

2.1 TASK 1: DATA REQUEST CALL, WORKPLAN, AND KICKOFF

Data request call. The NMR team held a data request call with the Utility staff to review and assess the feasibility of the data requests during the planning process.

Program design call. The team also held program design calls with the Companies to understand the programs.

Kickoff. We held a one-hour kickoff presentation to inform stakeholders of the planned approach in the last week of March.

Workplan. Following the Connecticut evaluation roadmap, the team developed this workplan, which defines the study tasks and incorporates insights from the program design meetings and data request meetings with Utility staff and the kickoff call.

2.2 TASK 2: REVIEW OF PROGRAM DATA

The NMR team will submit a formal data request for tracking data and customer data. The team will review the received data and conduct data cleanup. In addition, the team will purchase Dodge data to further supplement the customer data for a comprehensive dataset.

The Dodge data includes fields that provide information on the status of the buildings such as whether the project was permitted, in construction, or completed construction. It also has information that can be used to determine when the project was permitted, when the construction was undertaken, target completion date, square footage, and project type. The data includes contact information for key people such as the owner, architect, and the mechanical engineer.

Based on the results of the data review, the team will update the workplan with the EA Team. In the event there are delays in receiving the requested customer data, the NMR team will use past program data as an alternative data source for sample design.

The NMR team will review industry data to identify the most experienced engineering and architectural firms serving the Connecticut market to estimate the size of the market and its approximate structure and identify appropriate market actor interviewees and expert panelists.

2.3 TASK 3: LITERATURE REVIEW

The NMR team will conduct a literature review to lay the groundwork for a successful study and inform the baseline, NTG, and code compliance study components. We will build on literature review outcomes from the recent ECB impact evaluation and supplement that with a review of additional literature as needed.

Baseline. We will focus on any recently completed new construction baseline and potential studies in the neighboring states. We will determine the appropriateness of the researched data for application in Connecticut by considering study timing and rate of advancements in technology, among other factors. For each identified measure type, we will determine data gaps and devise a primary data collection plan that reflects findings from the secondary research.

ECB NTG. We will explore recent studies available for C&I new construction NTG analysis from peer jurisdictions along with recent studies on NTG methods best practices, and integration of shifting industry standard practice baselines on NTG analysis.

Code compliance. We will review prior research on code compliance in Connecticut—including the 2015 C19 C&I New Construction Baseline and Code Compliance study—and review literature on best practices for code compliance and development programs from neighboring jurisdictions, and other leading states in the country.

Upstream NTG. We will review recent research related to upstream programs and measures in CT and neighboring jurisdictions, including the CT HVAC Market Share Assessment (2019), MA C&I Upstream HVAC/Heat Pump and Hot Water NTG Study (2018), as well as preliminary results

from the ongoing MA C&I Upstream HVAC & Water Heater NTG (MA20X08-B) review. These sources will inform measure-level scoping and prioritization, research methods and survey questions, and provide benchmarks against which to compare our results.

2.4 TASK 4: PRIMARY DATA COLLECTION

This task will utilize the literature review conducted in the previous task to develop baseline and NTG survey instruments as well as expert panel materials for data collection. For the ECB program, we will collect data in two phases: (1) ISP baseline data collection, which will also be used for code compliance research, and (2) NTG data collection. For the Upstream program, data collection will occur in phased interviews and surveys, as detailed below. During active data collection phases, we will regularly update the EA team on our progress.

2.4.1 Task 4a – Baseline-Focused Activities

Market Actor In-Depth Interviews

The NMR team will review market data to identify an In-Depth Interview (IDI) sample of up to 20 market actors serving C&I customers in Connecticut. Interviewees will include distributors, contractors, manufacturers, architectural and engineering firms, energy modelers and code officials in order to represent a diverse mix of all major end-use types and business sectors. We propose a \$50 incentive for the market actor interviews.

The IDIs will obtain primary information about the market for, and practices associated with, electric and natural gas end-use equipment installations. This research will also assess perceptions of customers' willingness to install energy-efficient end-use equipment, and end user awareness of the ECB and Upstream programs. Qualitative feedback from the market actor IDIs will provide additional context to findings collected as part of the customer surveys. The IDIs will also incorporate questions to address code compliance and NTG-related topics, as discussed in further detail in 2.4.2.⁷

Web-Based Surveys⁸

Web surveys help mitigate declining response rates for telephone survey participation and take less customer time. They also allow for visual processing of information, which is easier than aural processing for many people.

We will ask survey respondents to upload pictures of equipment nameplates and as-built construction drawings using an online survey application. This functionality can increase data reliability closer to the levels that are possible with a site visit, but without the same costs or risks. For customers with concerns uploading the drawings, we will provide an in-person option to pick up or make copies of the drawings.

The NMR team anticipates completing 325 web-based surveys with customers (25% survey completion rate). We will address multiple measures in each survey, and our sampling assumes

⁷ The study will take into account the activities conducted during the C1634 study and will plan to avoid duplicative efforts.

⁸ We will use a specialized survey house to deploy and administer the web-surveys.

that each respondent will provide answers for at least three measure types. We expect the surveys to take about 45 minutes to complete. Survey respondents with completed surveys will receive a \$150 incentive.

The NMR team will conduct survey outreach and distribution via a combination of email and postal mailings. For a random sample of customers with email addresses obtained from the Dodge data and Utilities, we will first send a postcard notifying customers of the study, then attempt to reach them via email, with additional follow up messages as necessary to achieve sample targets.

To communicate the legitimacy of the study, we will coordinate with Utility staff to include contact information in recruitment letters. For larger managed accounts we will also include contact details for the key account managers. In addition, the NMR team will ensure that the Utilities' call centers are notified of the effort. Customers unable to complete the survey online will be provided with a call-in option if they prefer to take the survey over the phone.

We will use information gathered in the market actor surveys to draft and program measure-specific question sequences and answer choices in the web-based survey and provide the type of information needed to calculate standard practice baselines. We will conduct a limited number of follow-up phone calls for web-based survey respondents with inconsistent, unclear, or incomplete responses. For large or complex sites, the NMR team will provide the option to schedule a time to walk recruited customers through the virtual audit over the phone. This initial conversation will cover the types of data to be collected and the methods for collecting them. It will also be an opportunity for the NMR team to determine how much documentation and photo evidence the customer can readily provide for verification. At this time, the NMR team may also request that the auditor accompany the customer as a virtual guide during the audit.

Baseline Web Survey Sample

The NMR team's sample plan will account for identified data gaps as well as priority project and measure types identified in the secondary research and market actor interviews. We will draw a large random sample of the general population of true new construction C&I customers using a combination of Dodge data and the program data made available by the Companies. The sample will be used to (1) conduct web-based surveys (with a phone-in option), (2) request site documentation from surveyed customers, and (3) target site visits for each sub-sector of customers that receives the web-based survey.

As illustrated in [Table 3](#), the NMR team estimates an aggregate sample size of 325 baseline surveys, with each survey covering at least three to five measure types. We expect lighting, HVAC (heating and cooling), drives, and kitchen equipment to be covered in majority of the surveys in addition to the other measures. The measure type list is consistent with the major measure types listed in the PSD. The survey will include questions to gauge the type and capacity of the equipment currently. Based on a proportionate stratified sample that achieves approximately a minimum 80/15 precision assuming a CV of 0.5. We will sample buildings permitted in 2019 and first quarter of 2020.⁹ Note that, based on the findings from the literature review, the sample size for measures may be adjusted/re-allocated (for example, measures that have already been

⁹ Limited to buildings permitted before first quarter of 2020 due to COVID-19.

adequately addressed in previous studies may either be removed or may receive reduced sample).

Table 3: Proposed Sample Plan for Baseline Surveys

Measure Type	Measure Description	Target Sample Size
Lighting	Lighting	30+
	Lighting controls	
HVAC & water heating	Chillers	30
	Unitary AC & heat pumps	30+
	Water & ground source heat pumps	25
	Demand control ventilation	20
	Natural gas fired boilers & furnaces	N/A
	Natural gas radiant heaters	20
	National gas-fired hot water heaters	30+
	Variable refrigerant flow HVAC	20
Drives		30+
	Custom (includes whole building/EUI)	30
Others	Commercial kitchen equipment	30+
	Commercial clothes washers	30
Statewide		325

Activities to Build on EUI Baseline Research

For the new EUI based whole building projects, we will conduct the following activities:¹⁰

- Include relevant questions in surveys for sampled whole building projects
- Calculate actual building EUIs using the building square-footage (from Dodge data and additional sources) and usage (obtained from the Companies)
- Draw on the research recently conducted in Massachusetts
- Gather additional perspective through discussions with expert panel

Site Documentation

During the surveys, we will request all surveyed customers to upload as-built construction drawings using an online survey application. These drawings will support both the baseline and code compliance research objectives. We anticipate receiving sufficient data for COMCheck analysis for about 20% of the surveyed customers.

On-Site or Virtual Surveys and Verification

¹⁰ This study will build upon the research already conducted in MA and provide CT with recommendations for exploration in future studies.

Depending on the length of the COVID-19 crisis, the NMR team will conduct on-site inspections at up to 15 facilities across Connecticut. The NMR team will use the web survey for pre-recruiting these 15 facilities for on-site visits. We will attempt to obtain the construction drawings prior to the site visit for ease of verification and data collection. In case drawings are not available prior to the site visit, takeoffs will be done onsite. Site-visits will be used to cover sites that are too complex or demanding for a survey approach or that are deemed to have poor quality survey data. In the case that our technicians are unable to, or severely limited in their ability to, conduct physical site visits for on-site verification, we will conduct site visits virtually. Virtual site visits will use the same program that we will offer along with the web survey for large facilities. We propose an additional \$150 incentive for customers willing to allow us to conduct on-site visits.

Each site visit will take approximately two to four hours, depending on the size and complexity of the facility. To ensure data quality and reduce the length of the site visit, technicians will photograph the equipment and nameplates and verify the key characteristics, such as efficiency levels, system size, and/or space served. We will provide all technicians with both electrical and infectious disease-related personal protective equipment. If drawings are available in advance, the technician will randomly select spaces to account for 15% of lighting fixtures for verification. The envelope details will be obtained from the drawings.

Our auditors will complete associated office work with each site visit as soon as possible after the completion of the visit. After auditors enter site data, highly trained members of the NMR team will conduct a thorough review of the on-site data to verify if the data makes sense and is not missing any key information. The NMR team will ask the auditor any necessary follow-up questions as part of the QC process. For missing data or follow-up questions for complex measures, we will contact customers to obtain the relevant additional information. Since data preparation and data cleaning is a critical component of collecting high-quality on-site data, the NMR team will make sure to create data collection tools (web-based or on-site) that minimize the possibility of data collection errors on-site. For most equipment, data points such as efficiency levels and special features can be determined from research using nameplate information.

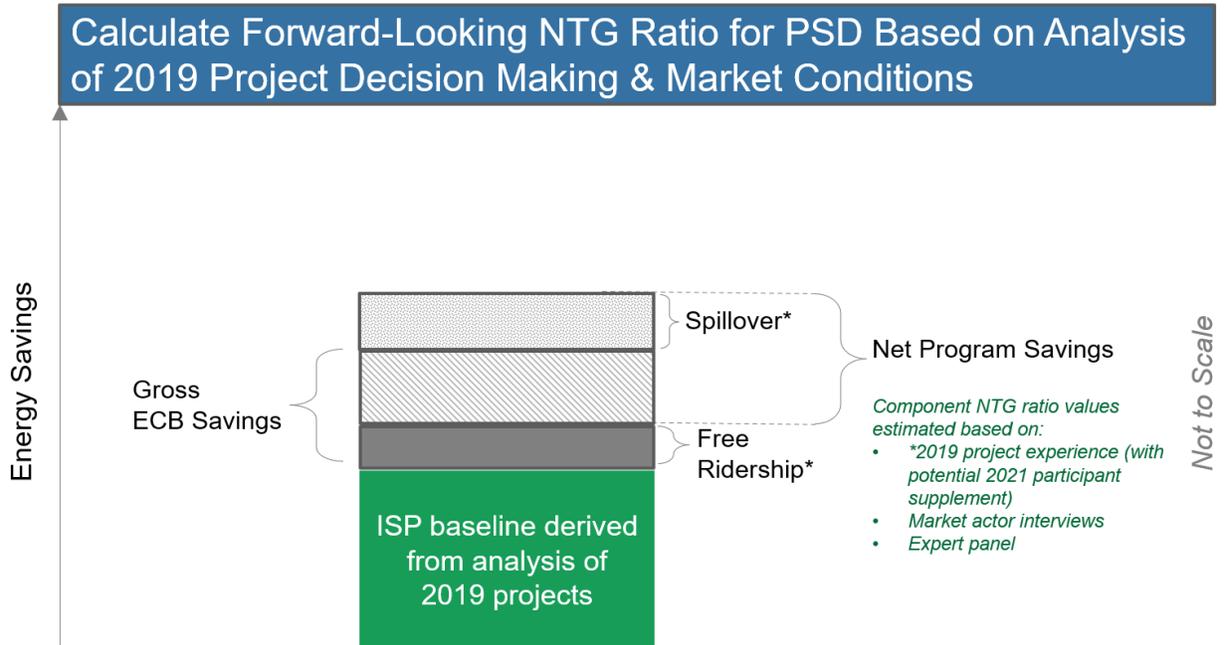
2.4.2 Task 4b – ECB NTG-Focused Activities

ECB NTG research methods will include: 1) mixed mode (web with telephone alternative) self-report participant surveys (n=125) sampled specifically for the NTG research, 2) surveys of non-participants (with a subset of baseline sites) conducted as part of the baseline study component, 3) market actor interviews (i.e., cross-cutting market actor interviews will include questions to inform ECB NTG); and 4) an expert panel to review the best available data on the evolving program and its influence on participants' decision making, and provide insight to inform estimation of current and forward-looking NTGR values. Results of these methods will inform estimates of both backward-looking (2019) and forward-looking NTGRs.

Figure 3 provides an overview of how the participant survey will inform the NTGR estimate, and how this component of the C1902 project relates to both the baseline and code compliance project components. As shown, the team will adapt market baseline and NTG values derived primarily from analysis of 2019 projects to estimate both backward-looking and forward-looking NTG estimates. Market actor interviews, an expert panel, and a potential 2021 supplement to the

sample of program participants will inform the team’s conversion of 2019-based values to forward-looking values.

Figure 3. Approach for Using 2019 Market and Project Data to Inform Forward-Looking NTG Ratio Values



Mixed-mode Participant Surveys¹¹

The survey questions will follow best practices for self report approach NTG survey instrument development and scoring for C&I customers, drawing on the latest insights and methodological refinements available in the literature.

The survey instrument will address the following topics:

- energy efficiency-related investment motivation
- decision making processes and priorities
- project timing
- the program’s influence on timing, efficiency level and quantity of efficiency measures
- barriers to help inform how potential changes to the program would likely affect free ridership (FR) and spillover.

It will also include multiple intention and influence questions and clarifying questions to resolve any inconsistency in responses. Survey respondents will receive a \$50 incentive.

¹¹ We will use a specialized survey house to deploy and administer the web-surveys.

A key approach we will use for the NTG surveys is to make sure the NTG question sequences integrate the findings from the ISP baseline research to ensure we can calculate NTGRs in relation to both code-minimum baselines or ISP baselines, without double-counting. The specific methods for accomplishing this will vary by measure, but the general approach will be to make sure the efficiency FR questions include choices that cover the levels of efficiency that the participant would have installed absent the program (e.g., code minimum, ISP, between ISP and what they installed through the program, and the efficiency level that they installed through the program). The ISPs that we use for the NTG questions will leverage the baseline study findings. We will adapt question content and structure as appropriate for use with participants who pursued the whole building program path.

ECB NTG Participant Survey Sample

For the NTG-focused participant survey, we will design a stratified random sample based on savings and project fuel type. Additionally, we will further stratify each sample by project type (i.e., whole building project path vs. measure-specific prescriptive path) to reflect the differences in the nature of decision making for those two project types. The PSD includes NTG factors by end use and fuel (cooling, heating lighting, motors, etc.). We will provide results at the same resolution provided in the current PSD, with an additional value for whole building projects that will appear as a sub-set of custom projects.

As illustrated in [Table 4](#), the NMR team will target sample sizes for electric and gas project types based on a proportionate stratified sample that achieves approximately a minimum 90/10 precision assuming a CV of 0.5. The NMR team anticipates completing 125 participant surveys with multiple end-uses covered in each survey. The team will refine the sampling targets early on in the project based on a review of program data. The team will also assess the size of the new construction market as a whole to better understand the proportion of all new buildings that participate in the program. If the program participants make up a large portion of the new construction market as a whole this will present challenges with overlapping baseline (general population) and ECB NTG participant samples.¹²

Table 4: Proposed Sample Plan for Participant Survey NTG Data Collection

Fuel Type	Program Participation (2020) ¹	% of Statewide ECB Participation ²	Target Sample Size
Electric	977	65%	65
Gas	521	35%	60
Statewide	1,498	100%	125

¹ To be updated once program data obtained.

² 2019-2021 Conservation and Load Management plan.

Potential Supplemental Sample of 2021 Participants

¹² If the Connecticut experience is similar to that of Massachusetts it's possible that program participants will make up a large portion of the new construction market as a whole and there will be minimal differences between the general population baseline sample and the sample of program participants. For ECB program participants who complete the baseline survey we will include language letting them know they may also be invited to participate in an additional survey, with possibly higher incentives paid for this group.

Recognizing the significant program changes that took place for in 2020 for the program's whole building pathways, engaging with 2021 program participants could provide valuable context to inform estimation of forward-looking whole building NTG values. The team will monitor 2021 program participation levels during the course of the project, and late in course of the project will consult with the EA Team to determine whether additional sampling of 2021 program participants would be a worthwhile addition to the study. If the volume of 2021 participants who have passed through the key decision-making phase of the program (i.e., past the schematic design phase) is deemed large enough, the team will consider conducting a survey or interviews with 2021 program participants to provide valuable context for the current program experience, its influence on decision making, and how it differs from the experience of 2019 program participants. The size of the sample of 2021 participants would be based on a review of program participation levels and available study resources.

The team anticipates that the volume of 2021 participants may be low due to the economic impacts of the COVID-19 pandemic, but some engagement with 2021 program participants could provide a valuable supplement to the findings from other data sources, and reference point for use in triangulating values from the various data sources.

Baseline Web Survey – ECB NTG-Focused Questions

We will include a limited number of ECB NTG-related questions in the baseline-focused general population web survey. We will ask respondents whether they are current or past participants in the ECB program. For past participants (i.e., those who participated in ECB prior to 2019) we will ask how their previous program participation affected future decision making to provide data that will inform estimation of program spillover and market effects. We will ask non-participants whether they are familiar with the program and gather information to understand how decision making differs from that of participants, with an effort to discern program influence. We will take steps to ensure there is no double counting of input gathered from customers who may participate in both the baseline web survey and the participant ECB NTG survey.

Market Actor Interviews

We will incorporate ECB NTG-focused questions into the cross-cutting market actor interviews (n=20). Question topics will include:

- Estimated percentage of sales/projects that are ECB program participants relative to total projects/sales.
- The ECB program's influence on timing, efficiency, and quantity of efficiency measures, asking questions in a way that is appropriately tailored to both whole building and prescriptive pathways.
- Perceptions of customer awareness of the ECB program.

As noted previously in Section 2.4.1, we will interview a range of market actors involved in providing services through the ECB program, including distributors, contractors, architectural and

engineering firms, and energy modelers. We plan to offer a \$50 incentive to encourage interview participation.

Expert Panel

As noted, the team plans to assemble a panel of experts to inform NTGR estimates. We will ask panelists to share their perceptions of the ECB participant NTG survey results, and to provide insight to inform forward-looking NTGR estimates. The expert panel will play an important role in considering the effects of changes in the program and market conditions since the period of decision making that will be the focus of data collection efforts (i.e., projects applying to the program during 2019 and Q1 2020). We believe, the panel could also provide valuable input on changes in construction demand and practices due to COVID-19, as well as other topics related to the baseline study that warrant further refinement and insight (e.g., EUI market baseline values).

The NMR team plans to select up to 20 experts serving Connecticut's new construction market who represent diverse perspectives to participate in the panel such as architects (3-4), engineers (3-4), manufacturers (2-3), trade association representatives (2-3), developers (2-3), and evaluation experts (2-3).

The team will leverage other study activities (e.g., baseline market actor interviews) to recruit participants for the panel. We plan to provide panelists a \$200 incentive for participation.

We will provide panelists with detailed information on the program including a description of the recent changes, NTG outcomes of studies in peer jurisdictions, results of the participant survey for this study, and findings from market actor and staff interviews. We will ask the panelists to consider the information provided and estimate the ratio of savings attributable to the ECB program, including a market effects component. Depending on available resources and input from the EA Team, the NMR team may pursue a second round of input from the expert panel. The NMR team would summarize and share results of the initial expert input with the full set of panelists, and then ask if any wish to adjust their initial estimates based on a review of the initial outcomes.

2.4.3 Task 4c – Code Compliance-Focused Activities

Market Actor In-Depth Interviews (IDIs)

The NMR team will include code compliance focused questions in the cross-cutting market actor interviews previously described (i.e., 20 market actors serving C&I customers in Connecticut). In addition, the team will interview program managers, two Codes and Standards (C&S) committee members, and two DEEP and DAS officials, and will attend two monthly Connecticut C&S committee meetings.

The IDIs will obtain information about compliance at various stages of the code cycle, primary sources of knowledge and information on code requirements & compliance, perspectives on the role of utilities in supporting compliance, and insights into program efforts to date and planned efforts going forward. This research will also assess the elements of the new code that are the furthest ahead of the standard practice and the areas that will need the most support and the type of support needed, which will help the stakeholder planning efforts.

COMCheck Analysis

The NMR team will use COMCheck analysis to assess the level of compliance for projects permitted in the middle of the current code cycle, as a reference point against which to measure future savings attributable to planned utility code compliance efforts. As part of the baseline data collection activities, the team anticipates completing 325 web-based surveys with customers. During the surveys, we will request supporting compliance/construction documents and drawings from all the surveyed customers. We anticipate receiving sufficient data for COMCheck analysis for about 20% of the surveyed customers (n=42).¹³ The construction drawings obtained through the surveys will provide the majority of the information required to conduct the COMCheck analysis such as the building characteristics, envelope characteristics, and building equipment characteristics (lighting, HVAC, pumps, fans, and water heating).

For buildings that may require additional details or clarification, the team will obtain the relevant information through phone calls with the customers. The team will appropriately coordinate this activity with the utility representatives.

2.4.4 Task 4d – Upstream Non-Lighting NTG-Focused Activities

The primary objective of the Upstream Non-Lighting NTG portion of this study is to establish prospective NTG ratios to be applied in the PSD for future program years. Secondary objectives include gaining insight into the types of market event (e.g., replace on failure, new construction) experienced by program participants, identifying barriers to participation among market actors with no or low levels of participation, and identifying any key differences between the CT and MA programs and markets from market actors serving both territories. The Connecticut Upstream HVAC and Foodservice program has not been previously evaluated—the PSD currently uses generic NTG values taken from Massachusetts.¹⁴

Measure prioritization and scope refinement.

Due to the variety of measure types and shifting incentive design for upstream offerings, the first phase of the Upstream NTG evaluation will include reviewing program tracking data and interviewing utility program staff and implementation vendor staff to:

- determine which measures contribute the largest share of savings for the program
- identify key changes in offerings, incentives, and strategies for targeting market actors
- identify measures that the program plans to further promote in future years

The team also plans to leverage insights from the literature review referenced above to guide the prioritization of measures for primary NTG research.

The NTG attribution approach will depend on the incentive design and targeted market actors, which has shifted over time and may differ by measure type. For example, measures have been incentivized both via contractor (or customer) rebates as well as distributor rebates (i.e., “instant

¹³ [COMCheck version 4.1.5](#)

¹⁴ Current NTG values are taken from NMR, DNV-GL, and Tetra-Tech, *Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study*, Aug. 14, 2018

rebates”), and these strategies have changed in recent years for measures including refrigeration and other kitchen equipment. In 2020, the Connecticut program offered instant rebates to distributors for eligible equipment shown in Table 5. The program also offered direct rebates to contractors and customers for the same set of equipment in 2020 and in prior years.

Table 5. Connecticut Upstream Non-Lighting Measure Offerings, 2020

Electric HVAC Equipment	Gas Heating and Water Heating Equipment	Gas Foodservice Equipment	Electric Foodservice Equipment
<ul style="list-style-type: none"> • Air Source Heat Pump Equipment (including ductless split systems) • Water Source Heat Pump Equipment • Heat Pump Water Heater • Unitary & Split System HVAC Equipment (including ductless split systems) • HVAC Controls 	<ul style="list-style-type: none"> • Storage-Type Domestic Water Heater • On-Demand Domestic Water Heater • Large Domestic Hot Water Boiler • Condensing Gas Hydronic Boilers (outdoor temperature reset required) • Non-Condensing Gas Hydronic Boilers • Condensing Gas Furnaces • Condensing Gas Unit Heaters • Natural Gas Infrared Radiant Heaters (low intensity) 	<ul style="list-style-type: none"> • Gas Fryer • Gas Griddle • Gas Spray Valve • Gas Combi Oven • Gas Convection Oven • Gas Conveyor Oven • Gas Rack Oven • Gas Steamer • Gas Infrared Broiler • Gas Dishwasher 	<ul style="list-style-type: none"> • Electric Ovens • Dishwasher High Temp & Low Temp • Electric Fryer • Electric Griddle • Food Holding Cabinet • Electric Ice Machine • Electric Steamer • Refrigerator, Solid Door & Glass Door • Commercial On-Demand Hand wrapping Machine • Freezer • Ultra-Low Temp Freezers

The Upstream NTG review is designed to leverage existing studies and research in other jurisdictions to inform measure-level prioritization, research methods, and survey questions, and to provide benchmarks against which to compare our results. Studies the team plans to review in this effort include:

- Massachusetts C&I Upstream HVAC NTG evaluation. Data collection for the Upstream NTG review is planned to leverage the work of the ongoing MA C&I Upstream HVAC & Water Heater NTG (MA20X08-B) review, although the extent of the efficiencies gained from MA20X08-B will depend on the level of similarities in program design and offerings in Connecticut, and the presence of overlapping market actors across the states. As part of the measure prioritization phase, the C1902 team will determine measures for which use of MA20X08B NTG results may be justified and expand NTG values by directly studying other measures not covered in MA20X08-B, or where results may not be applicable in Connecticut. The C1902 team will include staff from the MA20X08-B project team and will utilize the same survey and interview instruments (adapting to Connecticut where needed) as well as the code for cleaning and analyzing survey response data. In addition, Massachusetts market actor respondents who are also active in Connecticut will

be targeted for follow-ups with questions focused on key differences between the programs and markets in the two states. This will allow for a meaningful comparison of the results across states. The C1902 report will also include relevant findings from the MA20X08-B review of peer upstream HVAC initiatives that focused on opportunities to improve program participation.

- **Core C1902 ECB evaluation.** We have planned the Upstream NTG study activities to be coordinated with the timing and needs for data collection for the core ECB Baseline and NTG evaluation. In particular, interviews with distributors will be used to inform replace-on-failure (ROF) baselines for ECB measures that the sampled distributors supply. ECB program data includes equipment replacement projects and measures, and our review of this data will allow us to target measure-specific questions for relevant distributors about how they serve ECB participants in addition to Upstream participants. These questions will provide insight into any key differences in market baselines and customer decision making between downstream ECB ROF projects and Upstream projects.

Market actor interviews and surveys.

The team plans to complete interviews or surveys with distinct groups of market actors: distributors, contractors, and end-users where we have available contact information. We will also include select manufacturers within the sample of distributor interviews. Obtaining data from a variety of types of market actors will provide a broad perspective on program impacts, provide a crosscheck for data quality, help triangulate NTG values, and ensure we have enough data to calculate NTG values if we find challenges to obtaining end-user contact information. Interviews and surveys will target participants from 2019 and 2020. The timing of the interviews and surveys is planned to allow for preliminary NTG results to be provided by late summer, assuming timely provision of program data and interview/survey responses.

Table 6 summarizes a possible market actor data collection plan. The population and estimated sample sizes below reflect the Massachusetts population and estimated sample developed for MA20X08-B. The overall market and program population in Connecticut is expected to be substantially smaller than that in Massachusetts, and depending on the types of measures included, there may be more variation in the types of market actors included in the sample. The final sampling approach, including expected confidence level and precision for survey sampling, will be provided as part of a sample plan for review by the EA team.

Table 6. Market Actor Data Collection Activities

Market Actor	Type of Data Collection	Research Objective	Population*	Potential Sample Size*
Manufacturers	In-depth Phone Interviews	As with MA 20X08-B, the team will sample the distributor and manufacturers as a combined group based on application data.	60 (based on MA data)	Combined with Distributors
Active Distributor	In-depth Phone Interviews	Assess market baselines for ROF; assess free-ridership; assess market uplift; obtain feedback on initiative design, recent	50 (based on MA data)	Up to 20*

Market Actor	Type of Data Collection	Research Objective	Population*	Potential Sample Size*
Inactive Distributor	In-depth Phone Interviews	changes, and suggestions; and if inactive, obtain share of high efficiency sales, and understand barriers to participation. For distributors recently interviewed in MA, identify key differences in CT and MA programs/markets.	23 (based on MA data)	Up to 10*
Participating Contractors	Web-based survey	Determine program awareness and assess the influence of distributor promotion, price, and stocking practices on decision. Obtain feedback on program experience, and market event (ER/ROF/NC).	500 (based on MA data for priority technologies)	70*
Participating End-users	Web-based survey	Where end-user contact information is available—assess program awareness and the influence of distributor promotion and stocking practices on end user decision. Obtain feedback on program experience, and market event (ER/ROF/NC)	219 (based on MA data, where contact information available)	70*

*Samples will be adjusted based on the CT population, review of program data, and measure prioritization review. Web-based survey sample sizes are dependent on availability of email addresses.

The team plans to leverage the successful approach used for the MA20X08-B review, which resulted in a 100 percent response rate for distributor interviews. Specifically, we will engage the implementation vendor to introduce distributors to the interview team as a warm handoff. It is our understanding that the utilities use the same implementation vendor, Energy Solutions, across states, making this an attractive strategy. For distributors previously interviewed for MA20X08-B, the team will re-connect with existing contacts and obtain greater insight on CT-focused follow-up questions. As in MA, the team will provide a \$100 gift card for completed distributor IDIs and a smaller incentive for survey respondents.

We plan to sample distributors proportional to savings per technology and, if feasible, will use a nested sample of end-users and contractors associated with the selected distributors. For distributors identified as high priority contacts (i.e., representing substantial portions of the market per technology type) the team recommends a staged approach starting with distributor outreach and working with the implementation vendor to ensure we can contact these key distributors and obtain their feedback on the Upstream Program. For surveys of contractors and end-users, we will structure the survey instrument to have two pathways: one for end-users and one for contractors. The interviewer will confirm which group member they are interviewing as part of their introduction and follow the survey path based on the response. Once the quota is hit for either end-users or contractors, the survey will be terminated for that group and focus will turn to surveying the underrepresented group.

The team will ask distributors about total sales, program sales as a percent of all sales, and estimates of program-eligible high efficiency sales in the absence of the program. These

counterfactual questions assess the Upstream program’s influence on adoption of high-efficiency equipment and will inform NTG ratio estimates. The team also plans to explore the causal pathways of influence the program has on distributors, contractors, and to the extent feasible, end-users. The causal pathways are contingent on the contractor or distributor changing their behavior in response to the initiative, and this change in behavior influencing the behavior of end-users. This causal pathway influence manifests in several ways:

1. Stocking: The program influence on distributor stock, and how what was in stock influenced the contractor/end-user’s decision. This can have a substantial impact on the end-user in a replace-on-failure situation, when they need to replace the equipment as quickly as possible and what is on the shelf at that moment influences their decision.
2. Upselling: The program influence on encouraging the distributor to promote or upsell the high efficiency units, along with the associated impact on the contractor/end-user’s purchasing decision.
3. Price: The program influence on incentivizing the distributor to lower the price of the units, and the associated impact of that lower price on the contractor/end-user’s purchase decision.

Interview and survey instruments. The team plans to use the MA20X08-B interview guides as a starting point for updating questions for C1902. In addition to adding specific questions about the Connecticut program and market, the instruments will also include questions about the impact of COVID-19 on operations in order to support the application of prospective NTG values.

Distributor Interviews

Table 7 Error! Reference source not found. includes a summary of the types of questions that will be asked of the distributors during the in-depth interviews. The team will use incentive information from the tracking data to determine what Upstream technologies each distributor sold and frame the questions per technology type.

Table 7. Distributor NTG Topics

Distributor Questions
General distributor background
Distributor feedback on the Upstream program and Incentive structure
Range of operations in Connecticut (and if applicable, Massachusetts)
Equipment type and sizes distributed
Causal pathway based on equipment type
Program attribution in 2019 and 2020 per technology type*
Prospective NTG in 2021 (estimates of sales with and without the Upstream program)*
What impact did the initiative have on your stocking of energy efficient products?
What impact did the initiative have on your promotion or upselling of energy efficient products?
What impact did the initiative have on the price of energy efficient products you offer?
What are the key differences in the MA and CT programs and markets for the equipment you provide?

*The team understands that the ongoing COVID pandemic has impacted businesses and that 2020 sales may not be typical of previous year sales and estimates. We are including COVID questions within the survey to better understand the impact of the pandemic on businesses. We will also differentiate attribution questions for projects completed prior to the onset of the COVID pandemic and those completed after.

Contractor Survey

The proposed contractor web surveys will incorporate contractors’ feedback regarding the impact the Upstream program had on the contractor’s practices and, in turn, their influence on end-user decision making. **Table 8 Error! Reference source not found.** shows some examples of survey question topics and how they tie to the causal pathway.

Table 8. Contractor NTG Topics

Contractor Question	End-user Attribution Categories
Did the distributor’s stock influence the product you recommended to the end-user?	Influence of Stock (Causal Pathway)
Was your decision to recommend products influenced by what the distributor told you?	Influence of Upselling (Causal Pathway)
Did you observe a more competitive price offered by program participating distributors, and did the price affect the end-user’s decision?	Influence of Price (Causal Pathway)
How did the Program influence your sales of energy-efficient equipment? Did the end-user request an efficient product?	Influence of Efficiency
Do you recommend high efficiency equipment? If so, what percent of the time is it accepted?	Impact of Initiative on contractor
What caused the customer to need a new piece of equipment—e.g., failure of existing equipment, new construction, renovation, etc.	Market event

End-user Survey

Prior upstream evaluations in Connecticut and Massachusetts have been unable to survey end-users of upstream programs due to limited availability of end-user contact information. The MA20X08-B evaluation is expected to overcome this challenge for certain end uses due to improved tracking of contact information by the implementation vendor. If end-user contact data are also available for some or all of the measures offered in Connecticut, the team would conduct a web-based survey of end-users, to better understand the impact the distributor and/or contractor had on the end-user’s decision. The team would also seek to understand the market event that caused the end-user to need the new equipment in the first place (for example, an existing equipment failure). **Table 9** summarizes the types of survey questions for end-users.

Table 9. End-user NTG Topics

End-user Question	End-user Attribution Categories
Had your existing unit failed or was it failing?	Influence of Stock (Causal Pathway)
Was your decision to buy influenced by what the distributor/contractor told you?	Influence of Upselling (Causal Pathway)
How much more would you have been willing to spend on the unit purchased?	Influence of Price (Causal Pathway)

End-user Question	End-user Attribution Categories
What was the minimum efficiency you were considering before buying?	Influence of Efficiency
What caused the customer to need a new piece of equipment—e.g., failure of existing equipment, new construction, renovation, etc.	Market event

2.5 TASK 5: ANALYSIS AND REPORTING

The NMR team’s analysis and reporting will adhere to the highest standards of quality. The NMR team will design the primary data collection instruments (the web survey and on-site visit tools) to facilitate synthesis of results across methods. We will ensure that data are collected and entered in a consistent manner by the user to improve accuracy and facilitate efficient analysis. We will share a final, cleaned dataset with the EA team. We will perform the analysis in industry standard data and statistical analysis tools, including Microsoft Excel, R, and SPSS.

We will present our results in a clear, concise, and well-designed report that focuses on pertinent results. We will produce graphical data visualizations throughout the report that convey our findings succinctly. We will provide results at several levels of detail. We will also present the results geared towards different audiences and uses. The NMR team will present the baseline results at the equipment/measure level. We will present NTG results at the end-use level, consistent with the format currently provided in the PSD, and we will provide a whole building level value as well to reflect the new structure of the ECB program. The NMR team will include recommendations for adjusting application of NTG values to account for the ISP baseline outcomes resulting from the market baseline study. Drawing on survey, interview, and expert panel outcomes, we will also identify factors that could drive changes in program attribution outcomes and will make recommendations for applying NTG outcomes under various forward-looking program scenarios.

We will provide the EA Team with an interim memo in August 2021 presenting draft results available to date for the baseline, code compliance, and upstream non-lighting NTG. As results start becoming available, we will start drafting a PowerPoint presentation for walk through with the EA Team. Once the presentation is approved, we will draft a report for the EA Team to review. The report will include the following details:

- Abstract including purpose, importance of the study, key results and if applicable key recommendations.
- Executive summary
- Body of report detailing the methods, activities, and results
- A chapter that compares results to the past studies in CT and to similar programs in other jurisdictions along with identification of key information such as deviations, trends, and best practice gaps, among others.
- Conclusions and recommendations
- Appendices with supporting details

Once the EA Team's comments have been addressed, we will issue a revised draft report for public review. Collaborating with the EA Team, we will address stakeholder comments. After EA Team approval, we will finalize the report and deliver an hour-long final presentation summarizing the report for the Utilities and stakeholders.

Section 3 Budget and Timeline

The budget for the study sums to \$680,000, with task-specific details listed in [Table 10](#). The anticipated study timeline is summarized in [Table 11](#). This budget reflects the original proposal for ECB NTG and baseline research, as well as costs for the additional code compliance and Upstream NTG research scope.

Study activities are planned to take place over a period of approximately 40 weeks after kickoff, with delivery of the final report planned for February 2022. This timeline will depend on the timing of the Utilities' data and assumes a modest contingency for delays in receiving data.

Table 10: Study Budget Breakdown

Task	Original (Baseline & NTG) Budget	Additional Code Compliance Budget	Additional Upstream NTG Budget	Total Budget
Task 1: Workplan and Kickoff Meeting	\$21,578	\$2,342.11	\$3,700.16	\$27,620
Task 2: Review of Program Data	\$27,416	\$5,166.98	\$8,163.01	\$40,746
Task 3: Literature Review	\$50,818	\$11,302.08	\$15,130.87	\$77,251
Task 4: Primary Data Collection	\$220,254	\$15,641.22	\$68,304.41	\$304,200
Task 5: Analysis and Reporting	\$137,473	\$51,778.15	\$40,932.08	\$230,183
Total	\$457,539	\$86,231	\$136,231	\$680,000

Table 11: Anticipated Study Timeline

