

MEMORANDUM

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From: Rich Hasselman, Tetra Tech

Cc: Lynn Hoefgen and Monica Nevius, NMR, and Pam Rathbun, Tetra Tech

Date: March 22, 2018

Re: Interim Net to Gross Coordination Observations and Considerations

The Massachusetts Special and Cross Cutting evaluation team, led by NMR Group, is coordinating the measurement of net-to-gross (NTG) across studies, sectors, and evaluation teams. The purpose of this work is to provide input on NTG measurement, identify and address any inconsistencies in measurement, and identify for the PAs considerations related to NTG approaches, samples, algorithms, and (eventually) reporting. This memorandum describes the activities of the coordination function and shares observations and considerations that emerged from the suite of residential and nonresidential NTG studies initiated in late 2016 or 2017. The Special and Cross-Cutting (SCC) team will continue to provide coordination as these studies are completed. This memo presents a brief background on the coordination task, provides some observations and considerations for future NTG studies identified as part of the 2017 coordination activities, and summarizes the methods and nature of input to each study.

Background

Early in 2017, the Program Administrators (PAs) identified a need both to coordinate the measurement of NTG across studies being carried out for different sectors by different evaluation teams and to ensure that all studies including NTG measurement follow the guidelines recommended in the Cross-Cutting Net-to-Gross Methodology Research Study (TXC08). In 2017, three evaluation contractor teams – Residential, Commercial/Industrial, and Special and Cross-Cutting – began NTG studies. Additionally, in 2016, the C&I Baseline Framework study initiated a change in the way that C&I baselines are determined, integrating industry standard practice (ISP) baseline conditions, and necessitating that NTG measurements take the ISP baseline into consideration.

To support these needs, the SCC team completed the following tasks:

- Provided C&I and Residential sector expertise to review Stage 3 work plans, sampling strategies, and data collection instruments
- Provided guidance to each evaluation team about presenting data collection information and study results in accordance with the TXC08 General Approach, which advocates using a specific format for summarizing results for use in reporting
- Assisted with sample coordination to reduce customer and market actor burden

As the studies are completed, the Special and Cross-Cutting team will provide a review of findings and reported results.

The current policy context for net savings in Massachusetts is to have net-to-gross ratios locked-in for a three-year period. The three-year period is for the next planning cycle, meaning that NTG ratios are prospective in that they are determined at the end of the current three-year plan cycle for application in the subsequent plan cycle. There has been discussion of potential policy changes that would shift when NTG ratios are applied only to the next future year, with the option of changing them annually to reflect changes in program delivery or the market. No decisions about this potential policy change have been made. However, to inform this ongoing discussion, to the degree possible, the Special and Cross-Cutting team notes the relevancy of its current observations and considerations in the context of either the current three-year prospective NTG estimation cycle or the potential one-year prospective NTG estimation cycle.

Observations and Considerations

As part of the 2017 NTG coordination activities, the Special and Cross-Cutting Team (the SCC Team) provided feedback on plans to eleven NTG studies. The SCC Team also looked across the studies to identify methodological similarities and differences, logistical issues in NTG data collection, and opportunities to improve NTG studies in the future. These are summarized below.

Observation 1: *The current NTG studies rely on data collected over one year after program activities have taken place. This practice creates risk of survey or interview respondents not being able to accurately recall project or program details and/or the decision maker having left the company. An emerging trend in the U.S.^{1,2,3} is to conduct a series of rolling samples and surveys that collect free ridership data close to the time of program intervention. Spillover results would need to be identified at a later date, once spillover projects have had a reasonable chance to be completed.*

¹ Violette, Daniel M.; Rathbun, Pamela. (2017). *Chapter 21: Estimating Net Savings – Common Practices: Methods for Determining Energy-Efficiency Savings for Specific Measures*. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578. <http://www.nrel.gov/docs/fy17osti/68578.pdf>

² The Independent Evaluation Monitor, Arkansas Technical Reference Manual, Version 7.0, Arkansas Public Service Commission, 2017.

³ Energy Trust of Oregon. (2016). *Fast Feedback Results – 2015 Report*. <https://www.energytrust.org/wp-content/uploads/2017/11/2015-Fast-Feedback-Report.pdf>

Consideration 1: Massachusetts should consider testing approaches to conducting NTG surveys on a rolling basis (e.g., quarterly or semi-annually), with free-ridership surveys being conducted soon after project completion and spillover surveys being conducted approximately one year after project completion. Whether conducted as part of a three-year or one-year NTG cycle, or whether a single year's program or multiple program years serve as the basis for net-to-gross ratios, the rolling sample approach may be useful for conducting NTG free-ridership research. In a rolling sample, spillover savings may be difficult to identify as participants surveyed closer to project implementation will not have had as much time to develop spillover projects as those with a larger gap between program project implementation and subsequent spillover projects. Some consideration will be needed for capturing spillover savings if a rolling sample is used in the context of single-year NTG studies. One option may be to develop spillover survey results with a one-year lag to free-ridership results. In a one-year NTG policy, the effect would be to separate the free-ridership results from the spillover results in terms of sample and underlying measures. For example, Year 2 free ridership results could be combined with spillover results from Year 1 participants to develop the NTG ratio for Year 2.

Observation 2: *The current quality of program participation tracked data and the current practice of providing that data to evaluation teams creates risks for NTG accuracy and a logistical challenge for testing a rolling sample and survey approach. For example, in the recent TXC49 study, 50% of the sample was missing a contact (decision-maker) name, and 53% of the sample was missing phone numbers. Similarly, the TXC35 team found that the entirety of the C&I upstream hot water sample did not contain contact (decision-maker) names or phone numbers. Additionally, the TXC35 team found that many of the firms listed as distributors in the C&I upstream HVAC data were actually contractors. The team was able to connect many of these contractors with a distributor using outside research, though this led to a delay in scheduling surveys. The TXC34 team found that the vast majority of contractors whose data were gathered via rebate forms included a firm name but not a contact name, and 16% of residential customers who had received rebates were missing email addresses. Having contact details for all program participants would ensure that the evaluation teams are talking with the correct decision-makers about the correct projects. Incomplete data increases the amount of time and scope of activities needed to complete a survey, resulting in increased costs. In addition, the participant data records for 2016 were not available until the summer of 2017, risking timely completion of NTG surveys.*

Consideration 2: The PAs and evaluation teams should review customer tracking data practices and work to develop a system that will minimize critical missing data. Additionally, the PAs and evaluation teams should work on developing a system that makes participant contact and measure information available in a timely manner and, ideally, facilitates developing a process for selecting and fielding surveys on a rolling basis. In some cases, the most up-to-date and best contact information may be held by program or implementation staff who work closely with individual customers or trade allies, rather than retained in project tracking data. In such cases, the program or implementation staff will need to provide evaluators with contact information in a timely manner. .

Observation 3: *For the 2017 NTG estimates, many studies were initiated with short turnaround in order to provide prospective NTG results in time for the 2019–2021 plan cycle. A constrained timeline magnifies logistical or methodological complexities. For example, receiving incomplete participant details or delayed trade ally information can impact response rates. Additionally, complex issues, such as implementing NTG in the context of C&I industry standard practice baselines, or coordinating contacts with a finite number of program participants and installation contractors, may not be resolved, leading to incomplete implementation of NTG theory. For example, the evaluation teams had challenges coordinating residential HVAC participant and market actor contacts in the narrow time frame across the multiple studies.*

Consideration 3: The PAs should consider developing a high-level strategic NTG evaluation plan stretching across the programs in parallel with the development of each three-year strategic evaluation plan. Having a strategic perspective on priorities, methods, and timing for NTG evaluations well in advance of the need to field studies would enable the PAs and their evaluation contractors to sequence the efforts, develop related work plans in a timely manner, and develop a system to allocate customer and trade ally data for sampling. Issues that arise during the three-year cycle could be addressed proactively, rather than in response to the short-term needs of specific studies. A strategic NTG measurement plan may also help evaluation teams coordinate sampling and leverage the activities and results from other studies.

Observation 4: *While there is a self-reported NTG methodology consistently applied across the commercial & industrial sector, there are no specific self-reported NTG questions or algorithms for the residential sector. Although the approaches and methods of individual studies are suitable, the lack of consistency makes it difficult to compare NTG results and cost-effectiveness across programs. If the PAs and EEAC decide to follow the example of C&I evaluation and integrate ISP into additional residential baselines,⁴ then consistency in NTG self-report methods across studies would be especially important.*

Consideration 4: The PAs should consider formalizing methodologies, including specific questions and analytical algorithms, for use in the residential sector. The methodologies would address end-user and market actor self-reported free-ridership and spillover, including how to reconcile them. Multiple methods are likely to be needed to address the differences in program design, delivery, and underlying gross savings philosophy in the residential sector, along with the ability of a method to capture the expected forms of program influence. The description would also identify which aspects of the methodology are subject to modification based on variations in technologies and programs. Finally, where gross savings are adjusted for ISP baselines, the methodology should make sure it is not “double discounting” for ISP effects.

Observation 5: *Consensus panels emerged as a common practice across many of the studies. These consensus panels, made up of evaluators, PA representatives, and EEAC*

⁴ The User-Defined Reference Home (UDRH) used by the Residential New Construction (RNC) Program is an ISP baseline. However, the RNC Program does not rely on self-reporting for NTG estimates.

members, review retrospective evaluation findings to develop prospective NTG results. Until the 2017 and 2018 studies, this approach had been used only for residential upstream lighting sales.

Consideration 5: With consensus panels becoming an important approach to developing prospective NTG results, the PAs should consider reviewing the processes and approaches these panels take to developing 2019–2021 prospective NTG metrics. While there is not an industry standard around using such panels, there is a risk of inconsistency or variability in the approaches take within Massachusetts. A review of the current studies’ approaches and lessons learned would be beneficial to develop standard approaches for use in Massachusetts for future evaluations.

NTG Study Methods and Key SCC Team Observations

As part of the TXC45 NTG research coordination effort, the SCC Team met with the different evaluation teams to identify existing and planned studies across all evaluation areas and sectors that involved measuring NTG. [Figure 1](#) summarizes the studies reviewed. [Appendix A](#) provides more detail on the studies’ methods and technologies. Once identified, the SCC team reviewed study documents, including Stage 1 and Stage 3 work plans, draft survey instruments, sample plans, and/or algorithms for determining NTG.

1.1 NTG STUDY METHODS

The 2011 NTG frameworks prepared for the C&I and residential sectors,⁵ and the 2017 Cross-Cutting Net-to-Gross Methodology Research Study (TXC08)⁶ documented the types of methods that may be used to determine NTG. In the 2017–2018 time frame, five primary methods from the 2011 NTG frameworks were used to determine NTG, though “Other” methods were also common. The methods are not mutually exclusive, but can complement one another to provide multiple perspectives on NTG that are reconciled in a final NTG consensus result. These methods include the following:

1. Market sales data analysis, sales/shipment data – This method uses actual sales/shipment data to determine the total net effect of the program. The most common approach is a cross-sectional comparison area method, in which post-program sales/shipment data are compared with data from a non-program comparison area (or multiple comparison areas) for the same point in time.
2. Market sales data analysis, self-reported – This method uses self-reports of sales/shipments.

⁵ Tetra Tech; KEMA; NMR Group, Inc. (2011). Cross-Cutting (C&I) Free-Ridership and Spillover Methodology Study Final Report. Massachusetts Program Administrators, and NMR Group, Inc. and Tetra Tech (2011). Cross-Cutting Net to Gross Methodology Study for Residential Programs – Suggested Approaches. Final report prepared for the Massachusetts Program Administrators.

⁶ Net-to-Gross Methodology Research – TXC08, Prepared for the Massachusetts Program Administrators, March 24, 2017.

3. Self-reported counterfactual, supply side actors – This method uses self-reports from supply side actors on their promotional activity and sales with and without the program.
4. Self-reported counterfactual, end users/decision makers – This method uses self-reports from end-users or key decision makers about their likelihood of purchasing equipment absent program existence and the influence of the program on purchases outside of the program.
5. Structured expert judging – This method is used to develop a consensus estimate to consolidate results from multiple estimation methods or complex data. A Delphi panel of industry experts is most often used, although a consensus panel of PA staff, EEAC consultants, and evaluation consultants has also been used.
6. Other – Other methods used in 2017–2018 include building modeling, onsite saturation visits, new construction baseline studies, and secondary research. (The latter identifies previous relevant NTG results from other jurisdictions, which are used to develop or inform a NTG estimate for a particular Massachusetts program.)

Figure 1 provides a snapshot of 2017–2018 studies that included NTG measurement, along with the primary method(s) used to estimate NTG. Some key takeaways from the figure are as follows:

- Structured expert judgement methods, either using a Delphi panel of industry experts or a consensus panel of PA staff/EEAC/evaluation consultants, is the most common method used to arrive at a prospective NTG estimate, with consensus panels relying on the range of information gathered as part of a study.
- Both market actor and end-user/decision-maker self-report methods continue to be a dominant method to estimate NTG. Studies using self-reports tend to collect data from both market actors and end-users.
- Upstream programs rely on market sales/shipment data, as well as other methods, to estimate NTG. This includes the use of baseline research studies to partially substitute for market sales data.

[Appendix A](#) provides tables with more detail about each study, the specific methods used for each study, and the evaluation teams primarily responsible for leading or supporting each study. [Appendix B](#) provides examples of algorithms used in NTG studies.

Figure 1: 2017-2018 Massachusetts NTG Studies and Methods

Study	Market sales data analysis – sales/shipment data	Market sales data analysis – self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
NTG for Early Retirement of Heating and Cooling Equipment (Res 36)			■	■		
Residential HVAC NTG and Market Effects Study (TXC34)			■	■	■	
Multifamily impact evaluation study (Res 44)				■	■	
Residential New Construction CCSI Attribution (TXC48)					■	<i>Delphi panel baseline</i>
RLPNC 17-5 – General Products Consumer NTG Survey; RLPNC 17-4 Smart Strip Literature				■	■	
RLPNC LED Studies (16-2, 17-9, 17-10, 17-11, 17-12)	■	■	■		■	<i>Saturation studies in MA and NY</i>
Upstream HVAC/Heat Pump Program NTG and Market Effects Study (TXC35)		■	■	■	■	<i>Leverage other studies</i> <i>Review AHRI high efficiency model share</i>
Upstream LED Net-to-Gross Study (P78)			■	■	■	<i>Site visits</i>
Non-residential Code Compliance Enhancement Initiative Attribution Assessment (TXC47)					■	<i>Prior non-res new construction baselines</i>
Updating NTG Ratios for C&I (TXC49)			■	■		<i>Test ISP baseline questions</i>
C&I Lighting and Controls Market Effects Study (P53)		■	■		■	<i>Leverage existing market studies</i>

1.2 SCC TEAM CROSS-STUDY OBSERVATIONS

During the development of workplans, sample plans, and the implementation of the NTG studies noted in [Figure 1](#), the SCC team made several additional methodological observations. These observations help support the considerations presented earlier in the memo. As the studies analyze their data and develop prospective NTG conclusions in 2018, the SCC will add to this initial set.

Use of Sales Data

For NTG evaluations of upstream programs or for studies investigating market effects, the lack of sales data continues to be a challenge. Across the eleven studies, only the RLPNC LED research (RLPNC LED 16-2, 17-9, 17-10, 17-11, 17-12) used market-level sales data to directly inform NTG results. Even within that study, only a partial market sales dataset is being used, as some channels are represented by self-reporting from a panel of consumers. Particularly for HVAC equipment, purchased data has historically been expensive and only represented a limited market share, if it can be obtained at all. Manufacturers are limited in their ability to share sales data, partly due to controls on that data by AHRI. In the opinion of the SCC team, it is unlikely that sales data widely covering the Massachusetts market will become available. This will force evaluations to rely on partial-market sales data in combination with other evaluation research to inform NTG and market effects savings.

Integrating Participant and Trade Ally Research

Several studies' work plans describe a process that integrates participant self-reports and trade ally self-reports. As a common tactic for evaluation, the process allows for a reconciliation of multiple sources of NTG information or gives context for adjusting retrospective participant self-reports to reflect a prospective NTG metric. In the TXC08 study (2017), the SCC team identified guidance provided by Prah & Associates, *et al.*,⁷ on combining supply-side and end-user self-report results, which could be adapted to serve as a portion of the Massachusetts NTG framework. For the 2017-2018 NTG evaluations, the SCC team is taking the guidance from this memo into account when reviewing the process each evaluation team proposes to use to integrate information from multiple sources of self-reported NTG.

Coordinating Data Collection

In an effort to reduce participant and market actor burdens, leverage data collection across NTG research activities, and generally avoid conflicts between evaluation research teams, the evaluation teams work to coordinate their data collection activities. The major challenge to coordination has been in sharing a single data collection instrument between two or more studies. While successful, the process for doing so for HVAC studies in 2017 proved to be time consuming and introduced elements of risk into individual studies. This coordination

⁷ PA Consulting Group. *Integrating Supply-Side Results with End-User Net-to-Gross Self-Reports*. Memo to the Public Service Commission of Wisconsin, March 21, 2008.

primarily took place between the TXC34, RES36, and the C&I P77⁸ studies. (There has also been less intensive coordination with TXC34, RES36, RES28 and RES29, and between TXC35 and C&I P77.) Interweaving the different goals of the studies into one instrument was particularly time-consuming, and meant additional PA work groups reviewed each instrument. When RES36's evaluation plan shifted midstream, it delayed finalization of the instrument and caused ripple effects for the other studies' schedules. Challenges receiving complete program data from which to sample further magnified these effects. To some degree, the challenge reflected the sheer number of studies undergoing planning and implementation in a constrained time frame. Long-term strategic planning and the developing of a rolling sample and data collection should help facilitate future efforts to coordinate and leverage data collection across studies.

Standard Upstream and Downstream Methods

The 2017–2018 NTG studies developed research for both upstream and downstream programs. The SCC team saw nothing unusual in the methods and approaches selected, although many utilized data sources that fell outside the 2011 NTG frameworks (reflected as “Other” methods in [Figure 1](#)). The use of data sources not identified in those frameworks exhibits an evolution of NTG approaches not previously envisioned during the development of the frameworks. All upstream program evaluations utilized market actor self-reports, though there were some differences between upstream studies, reflecting the data that was available. For downstream programs, self-reports from market actors and participants were a common element, reflecting standard industry practice, though the use of market actor self-reports differed across the studies. In reviewing the workplans and sample plans, the SCC team saw nothing unusual. As an example of “Other” data sources, the use of baseline research studies to partially substitute for market sales data reflected a creative leveraging of available information that provided context for a consensus panel to consider when determining prospective NTG metrics.

While the SCC team did not identify major deviations from industry evaluation practices in the core use of available information, we do note that the 2011 NTG frameworks do not provide a basis for determining prospective NTG. In particular, the use of consensus panels and the integration of data sources was not addressed in the 2011 framework documents. Both topics may be worth revisiting in a future update of those frameworks. Their presence simply reflects the evolution of NTG evaluation practices and data. Their ongoing use, while appropriate, may lead to substantial deviation from the 2011 frameworks, with the result being that the 2011 frameworks have less of a significance in terms of the practice of NTG research in Massachusetts. Consensus panels are a useful approach to reconciling multiple methods and developing prospective NTG estimates.

⁸ The C&I P77 study focused on upstream hot water impacts – not a NTG study. However, the market actors for P77 and several NTG studies overlapped, necessitating coordination.

1.3 NEXT STEPS

As part of the tasks outlined in the TXC45 workplan the Special and Cross Cutting team plans to move forward in several areas. These include:

- 1) Participate in ongoing discussion related to TXC49 and P73 net to gross analysis and adjustment;
- 2) Continue ongoing review of net-to-gross studies being completed in 2018, with expert review on their data collection, analysis, and their application to determine prospective NTG results; and
- 3) Engage with PAs on the considerations outlined in this memo and determine which ones, if any, will be addressed moving forward.

Appendix A

Table 1 (Residential) and Table 2 (C&I) provide more detail about each study, the specific methods used for each study, and the evaluation teams primarily responsible for leading or supporting each study. Table 3 (Residential-oriented) and Table 4 (C&I-oriented) show the end-use technologies included in each of the 2017–2018 Massachusetts NTG studies.

Table 1: NTG Approaches for Massachusetts Residential Programs used in 2017-2018 Evaluations

Key to Methods Used in 2017-2018 Evaluations*	2011 framework recommended method used	Method used but not suggested in the 2011 framework	Method applied but not used for NTG estimation
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Study	Market sales data analysis – sales/shipment data	Market sales data analysis –self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
NTG for Early Retirement of Heating and Cooling Equipment (Res 36) Evaluation Team: Lead – Res Support – S/CC			Structured web/phone survey with sample of participating market actors to provide consistency checks and context for participant FR estimates	Structured web survey with sample of 2016 participant end-users, stratified by measure level. FR only (not SO).		
Residential HVAC NTG and Market Effects Study (TXC34) Evaluation Team: Lead – S/CC Support – Res			Structured web/phone survey with sample of participating contractors at the measure level to estimate FR, NPSO, and market effects progress indicators	Structured web survey with sample of 2016 participant end-users, stratified at the measure level to estimate FR. PSO, and market effects progress indicators	Consensus panel consisting of PA staff, EEAC consultants, and evaluation consultants to review self-report results and develop final NTG estimates	

INTERIM NTG COORDINATION OBSERVATIONS

Study	Market sales data analysis – sales/shipment data	Market sales data analysis –self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
<p>Multifamily impact evaluation study (Res 44) Evaluation Team: Lead – Res Support – S/CC</p>				<p>Samples of 2016 participating apartment renters, participating and non-participating condominium owners, and participating and non-participating property managers / owners for FR, PSO, and NPSO</p>	<p>Optional Delphi study among condominium and property owner / managers, to confirm survey findings and provide additional context to the research</p>	
<p>Residential New Construction CCSI Attribution (TXC48) Evaluation Team: Lead – S/CC Support – Res</p>					<p>Delphi panel of RNC experts reviews baseline studies, results of code training surveys, summaries of code changes, etc. and develops counterfactual estimates for specific measures</p>	<p>Building modeling of Delphi panel’s counterfactual estimates</p>

INTERIM NTG COORDINATION OBSERVATIONS

Study	Market sales data analysis – sales/shipment data	Market sales data analysis –self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
<p>RLPNC 17-5 – General Products Consumer NTG Survey*; RLPNC 17-4 Smart Strip Literature Evaluation Team: Lead – Res Support – S/CC</p>				<p>Structured web survey using sample of 2016 participant end-users for FR and PSO</p>	<p>Panel consisting of PA staff, EEAC consultants, and evaluation consultants to review survey results and develop prospective NTG estimates</p>	
<p>RLPNC 16-2 Supplier Interviews; RLPNC 17-9 Onsite Saturation Visits; RLPNC 17-10 – Sales Data LED NTG Modeling; RLPNC 17-12 Lighting Decision Making; RLPNC 17-11 – Net-to-Gross Consensus Estimation Process Evaluation Team: Lead – Res Support – S/CC</p>	<p>RLPNC 17-10 – Sales Data LED NTG Modeling: 2016 point-of-sale data and national consumer panel data combined with program spending per household, program age, and demographic variables from 38 states.</p>	<p>RLPNC 17-12 Lighting Decision Making: InfoScout panelists in MA & NY – Difference in self-reported lighting purchases to estimate NTG</p>	<p>RLPNC 16-2 Supplier Interviews: Samples of participating market actors to estimate market share by bulb type with and without program support</p>		<p>RLPNC 17-11 – Net-to-Gross Consensus Estimation Process: Consensus panel consisting of PA staff, EEAC consultants, and evaluation consultants to review retrospective NTG estimates from other RLPNC studies and develop prospective NTG estimates</p>	<p>RLPNC 17-9 Onsite Saturation Visits: Revisits to Samples of homes in MA and NY for lighting inventories for two NTG estimates based on 1. Difference in change in saturation in MA & NY, and 2. Difference in observed new bulbs in MA & NY</p>

Table 2: NTG Approaches for Massachusetts C&I Programs used in 2017-2018 Evaluations

Key to Methods Used in 2017-2018 Evaluations*	2011 framework recommended method used	Method used but not suggested in the 2011 framework	Method applied but not used for NTG estimation
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Study	Market sales data analysis – sales/ shipment data	Market sales data analysis – self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
Upstream HVAC/Heat Pump Program NTG and Market Effects Study (TXC35) Evaluation Team: Lead – S/CC Support – C&I		In-depth interviews with 2016 distributors – collect total market sales information by equipment type.	In-depth interviews with active and non-active 2016 distributors – assess program influences and percent of eligible sales outside of program.	Structured participant CATI survey - nested sample of customers of the interviewed distributors.		<i>May leverage TXC49 results, as well as residential HVAC NTG/Market Effects study results.</i> <i>High efficiency model data review – review of AHRI directory to assess market size and share of models that qualify as high efficiency</i>

Study	Market sales data analysis – sales/ shipment data	Market sales data analysis – self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
<p>Upstream LED Net-to-Gross Study (P78) Evaluation Team: Lead – C&I Support – S/CC</p>			<p>Use information from the C&I Lighting and Controls Market Effects Study (P53) regarding distributor perspectives of sales absent the program and effect of program influence on sales now and in the future.</p>	<p>Structured participant CATI survey (2016) to assess FR and SO. Analysis will include questions from TXC35 asking customers to provide an estimate of how much more they would be willing to pay for the equipment they purchased.</p>	<p>NTG Consensus group of EEAC members, PAs, and consultants – review of compiled NTG data from end user and distributor surveys and other relevant research findings from LED Lighting Market Monitor Study (P75) and C&I Lighting Controls Market Effects study (P53) to agree on 2016 retrospective and prospective 2019-2021 NTG ratios.</p>	<p><i>Site visits to a sub-sample of participating customers who were surveyed – inventory LED equipment type and other lighting technologies</i></p> <p><i>May include an optional non-participant lighting inventory</i></p>
<p>Non-residential Code Compliance Enhancement Initiative Attribution Assessment (TXC47) Evaluation Team: Lead – S/CC Support – C&I</p>					<p>Delphi Panel of at least 10 experts on commercial new construction and code compliance – review compiled information from baseline studies, models of energy savings, CCSI training information and participant surveys, and projected code changes to</p>	<p>Non-residential new construction baseline studies from 2012, 2014, 2017, modeling results from new building Institute</p>

Study	Market sales data analysis – sales/ shipment data	Market sales data analysis – self-reported	Self-reported counterfactual – supply-side market actors	Self-reported counterfactual – end-users/decision makers	Structured expert judging	Others
					estimate NTG	
Updating NTG Ratios for C&I (TXC49) Evaluation Team: Lead – S/CC Support – C&I			Survey of influential vendors as identified by end-use survey respondents	Structured CATI survey with sample of C&I 2016 end-use participants segmented by end use and PA (2016) – FR and participant like spillover		Test of ISP questions for subsample of participants installing LED lighting, air compressors, and condensing boilers
C&I Lighting and Controls Market Effects Study (P53) Evaluation Team: Lead – C&I Support – S/CC		Distributor survey for shipment data to establish 2010-2012 sales differences between MA and selected comparison areas. Panel of distributors to report recent sales in MA and selected comparison areas	Surveys and interviews with market actors to inform market share, market actor and customer awareness, technology acceptance, and vendor practices.		Establish market effects baselines for linear LEDs and lighting controls; establish market effects NTG for high performance T8 and screw-base LEDs. Integrates findings from data collection activities.	Use of the Existing Building Market Characterization and the Market Share Assessment study to establish the validity of market actor self-reports; Literature and Codes & Standards review of non-MA areas

Table 3: Residential-Oriented NTG Studies and Technology for Massachusetts used in 2017-2018 Evaluations

Study	Technologies Included
NTG for Early Retirement of Heating and Cooling equipment (Res 36)	Hot water boiler, owner-occupied; Hot water boiler, non-owner occupied; Steam boiler; Furnace with ECM blower; Central A/C; Central heat pump (SEER≥16, HSPF≥8.5); Central heat pump (SEER≥18, HSPF≥9.6)
Residential HVAC NTG and Market Effects Study (TXC34)	Mini-split heat pump; Heat pump water heater; Central AC; Gas furnace; Gas boiler
Multifamily impact evaluation study (Res 44)	Lighting in-unit; Lighting common areas; Building shell in-unit; Building Shell common areas; DHW in-unit; DHW common areas; HVAC; C&I measures
Residential New Construction CCSI Attribution (TXC48)	Single-family residential new construction – whole building
RLPNC 17-5 – General Products Consumer NTG Survey*; RLPNC 17-4 Smart Strip Literature	Room air cleaners; Dehumidifiers; Dryers; Showerheads; Smart power strips
RLPNC 16-2 Supplier Interviews; RLPNC 17-9 Onsite Saturation Visits; RLPNC 17-10 – Sales Data LED NTG Modeling; RLPNC 17-12 Lighting Decision Making; RLPNC 17-11 – Net-to-Gross Consensus Estimation Process	LEDs overall, Standard LEDs, Reflector/flood LEDs, Specialty LEDs, Low income LEDs, Retail channels LEDs

Table 4: C&I-Oriented NTG Studies and Technology for Massachusetts used in 2017-2018 Evaluations

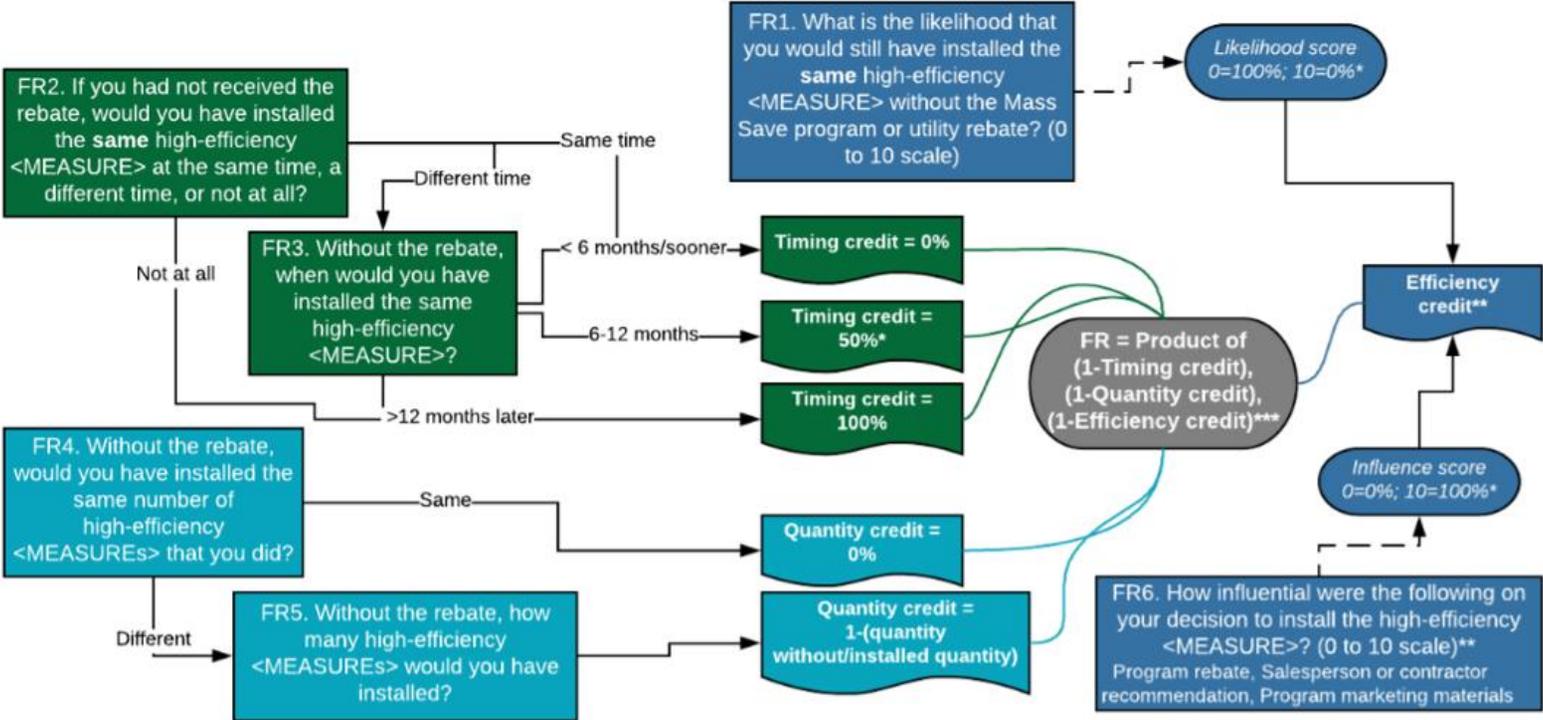
Study	Technologies Included
Upstream HVAC/Heat Pump Program NTG and Market Effects Study (TXC35)	Ductless mini-split heat pumps, electric water-source heat pumps, air-cooled unitary central air conditioning (>5 tons), air-cooled split system central air conditioning (>5 tons), gas-fired water heaters
Upstream LED Net-to-Gross Study (P78)	LED lighting products (screw-based and linear products)
Non-residential Code Compliance Enhancement Initiative Attribution Assessment (TXC47)	Lighting, HVAC, Building Envelope
Updating NTG Ratios for C&I (TXC49)	All electric and natural gas downstream end-uses
C&I Lighting and Controls Market Effects Study (P53)	High performance T8, commercial LED products, and lighting controls

Appendix B

Below, we present the structure of NTG algorithms and approaches for several of the NTG studies reviewed as part of the NTG Coordination task. For several NTG evaluations, multiple algorithms and pathways are presented, reflecting the multiple sources of NTG data being collected and used to arrive at retrospective NTG results used to inform prospective NTG estimates.

B.1 RESIDENTIAL HVAC NTG AND MARKET EFFECTS STUDY (TXC 34)

Figure 2: Participant Free-Ridership Algorithm (TXC34)



* Two sensitivity analysis methods apply a timing credit of 66% instead of 50%. Influence/likelihood scores incrementally change by 10% per rating point.
 ** Depending on the sensitivity analysis, we use maximum or average influence/likelihood scores.
 *** If participants installed only one measure through the program, the quantity credit will be excluded from the formula

Figure 3: Contractor Free-Ridership Algorithm (TxC34)

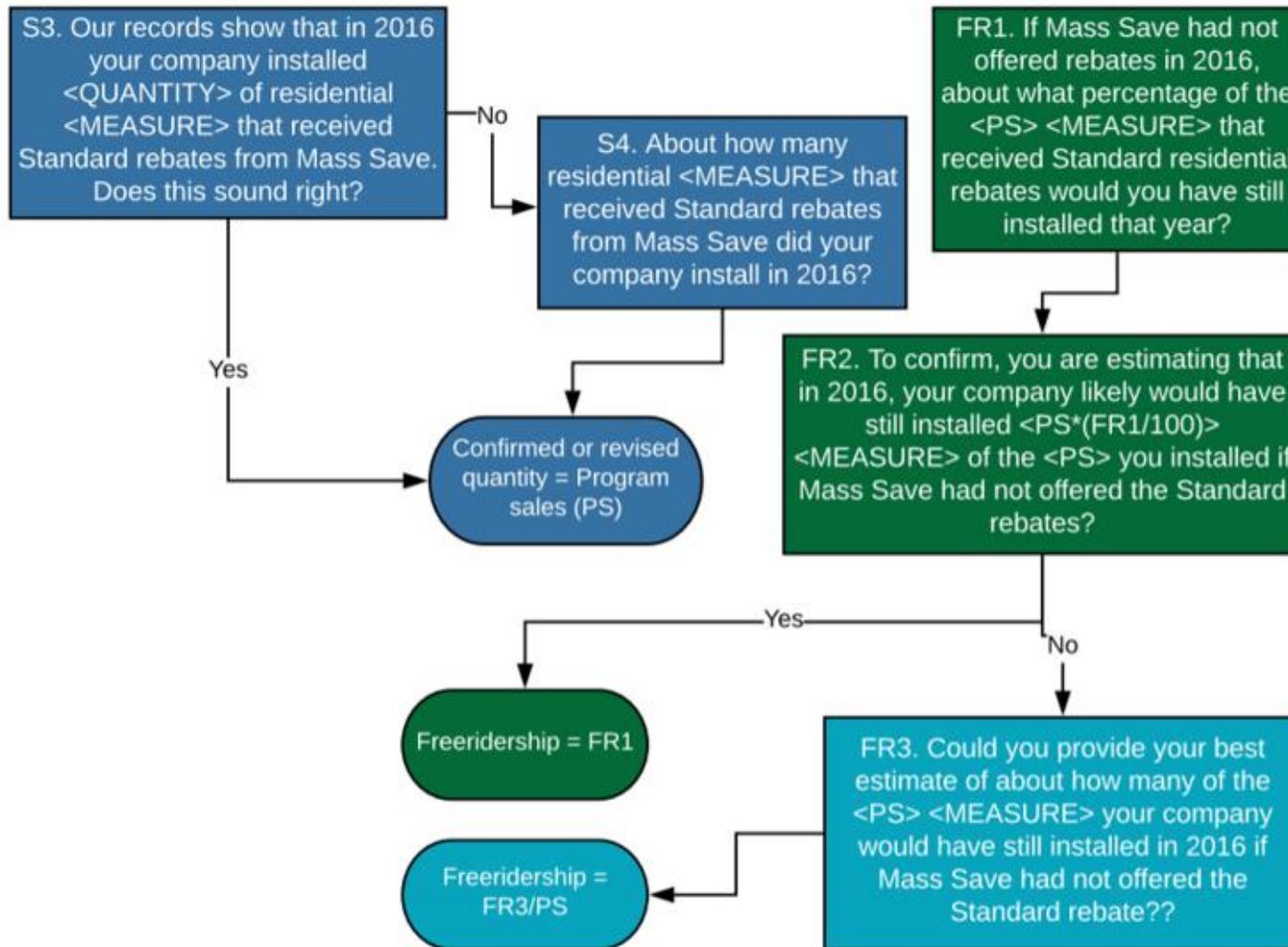


Figure 4: Free-Ridership Adjustment Method (TxC34)

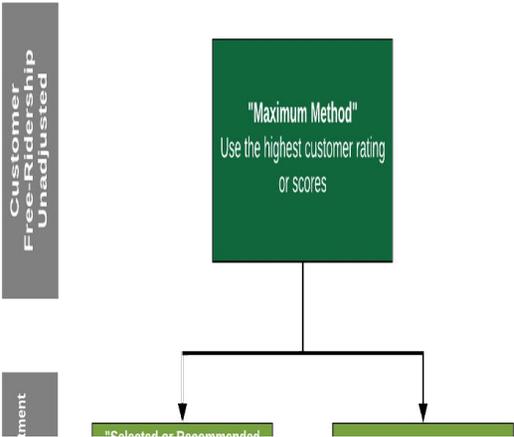
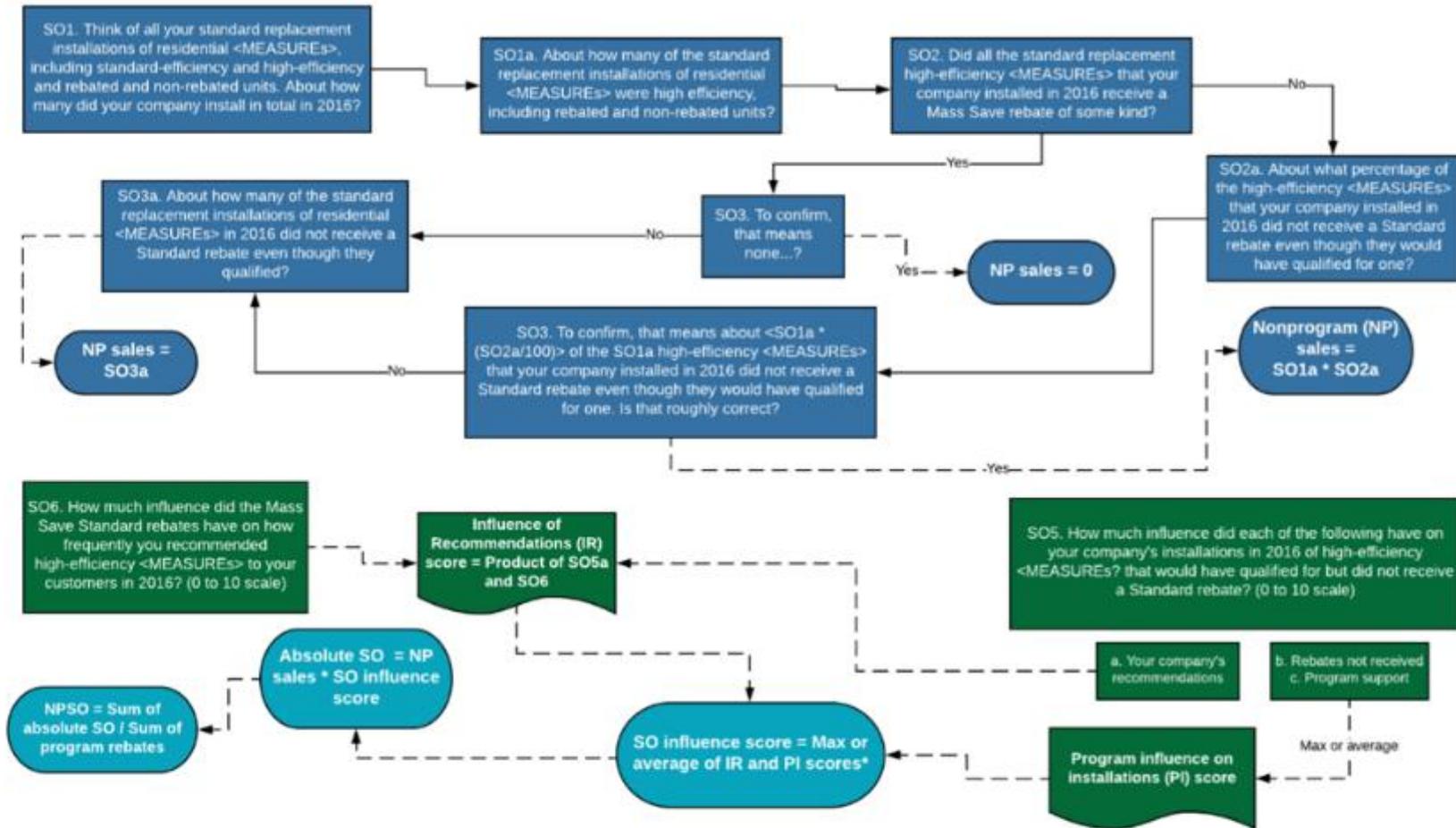
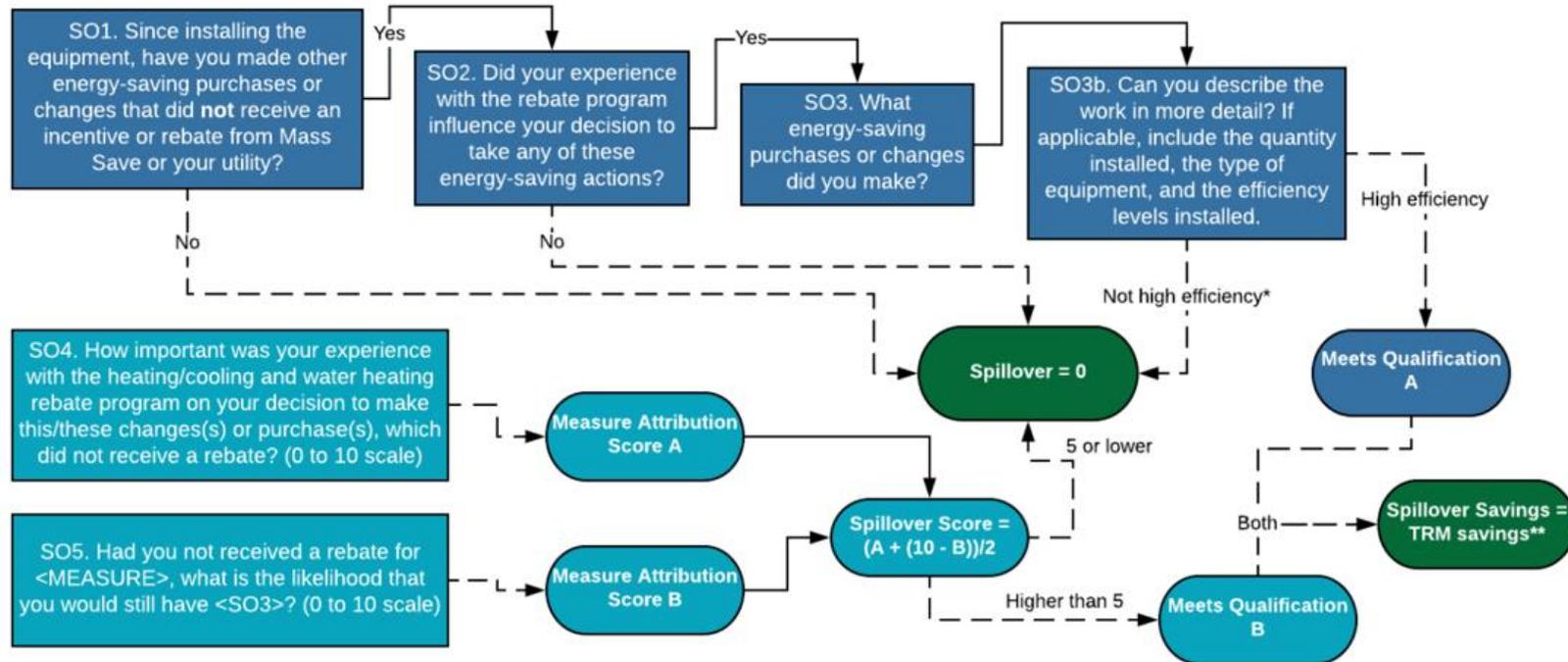


Figure 5: Non-Participant Spillover Algorithm (Participating Contractor Survey) (TXC34)



* Depending on the sensitivity analysis method, we apply either the average or maximum values from SO5b and SO5c for the PI score and IR and PI scores for the SO influence score. IR, PI, and influence scores range from 0 to 1. Ratings of 0 (no influence) are equal to 0 and ratings of 10 (a great deal of influence) are equal to 1; ratings between vary by sensitivity method.

Figure 6: Participant Spillover Algorithm (TXC34)



* Efficiency specifications use TRM specifications for measures eligible for PA programs. For measures not offered by the PAs, we sought to determine if the measures were higher than federal standards. Customers were explicitly asked if appliances were ENERGY STAR-qualified.
 ** If Qualifications A and B are not *both* met, then spillover = 0. We used secondary sources to estimate savings for non-like measures if they were not available in the MA TRM. Spillover rates are equal to the sum of the saving associated with the spillover measures divided by the sum of the savings associated with respondents participating measures.

B.2 UPSTREAM HVAC/HEAT PUMP PROGRAM NTG AND MARKET EFFECTS STUDY (TXC35)

Figure 7: Casual Pathway Approach and NTG Algorithm (TXC35)

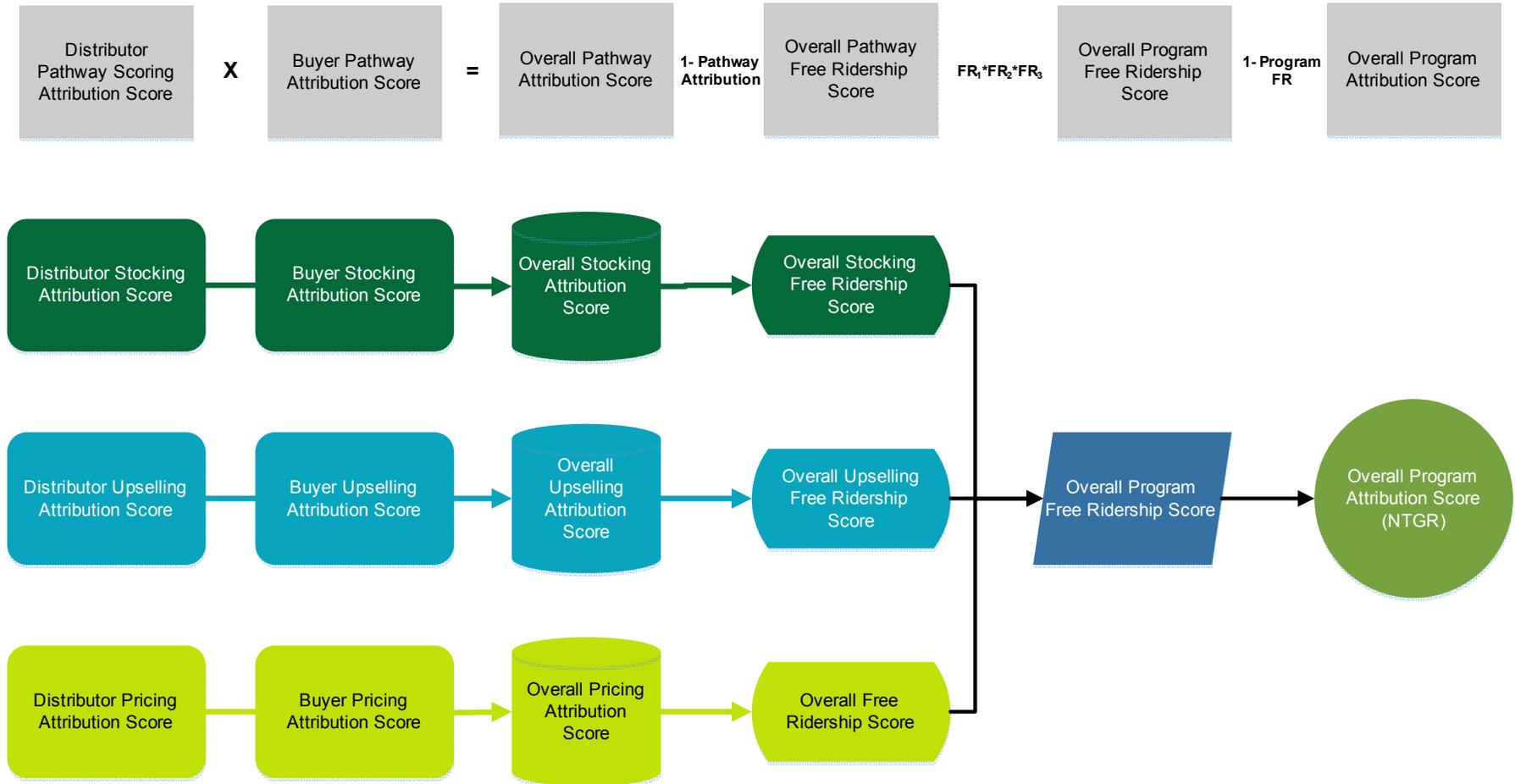


Figure 8: Distributor Casual Pathway (TXC35)

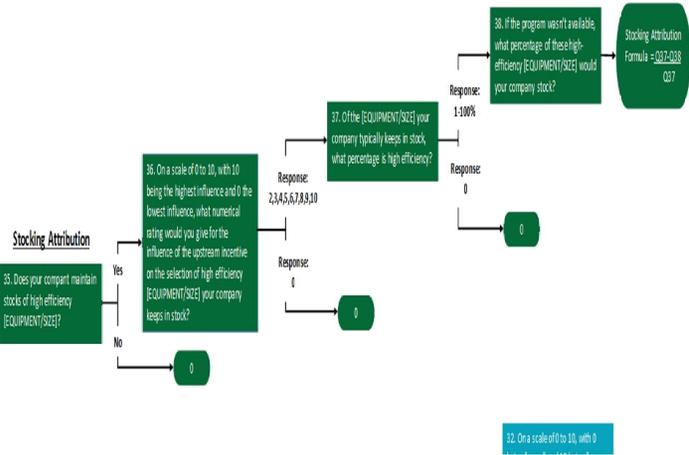
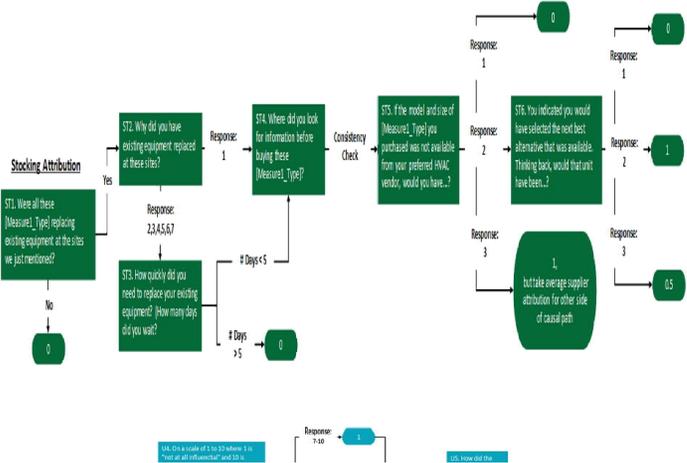
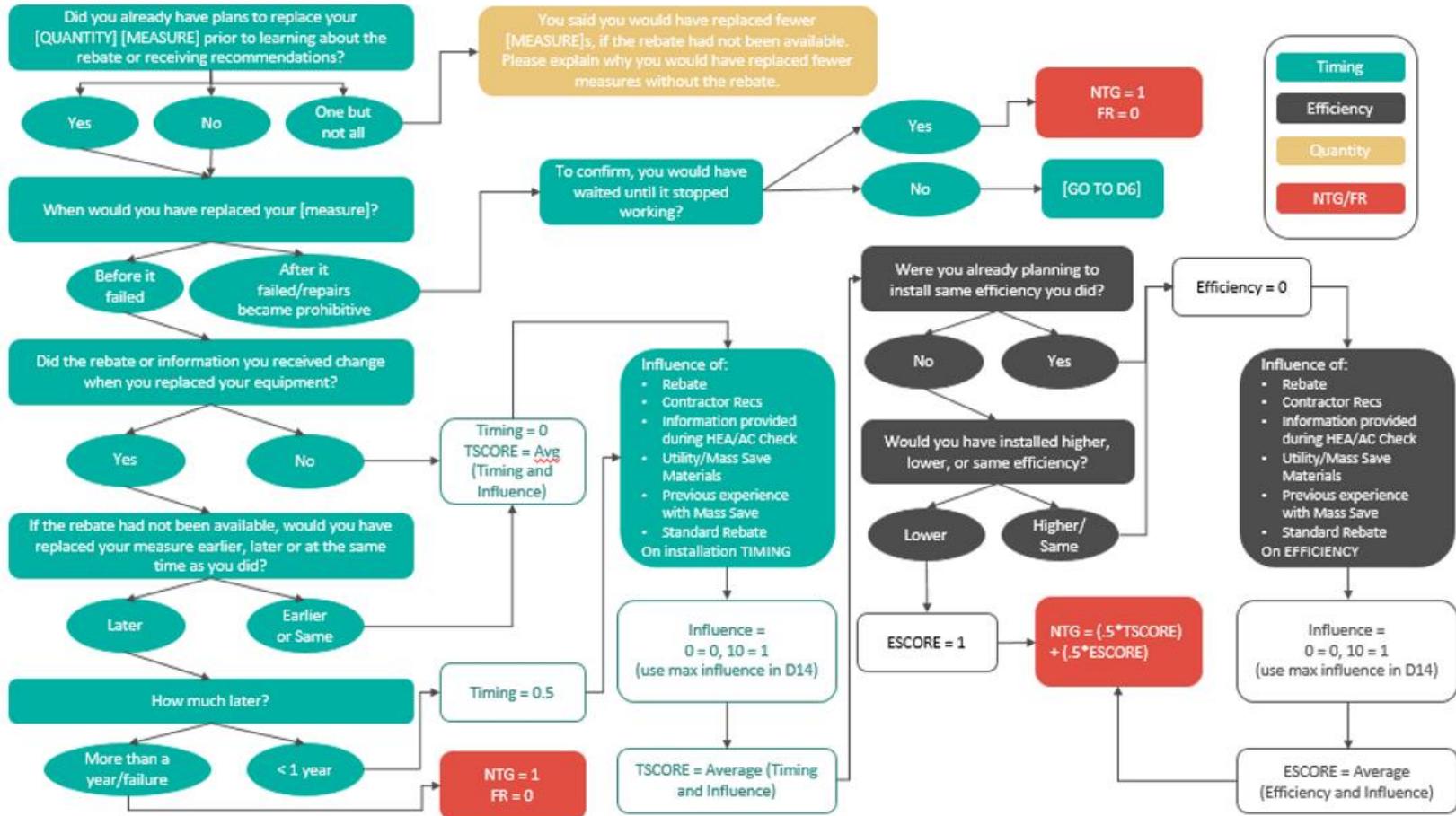


Figure 9: Buyer Causal Pathway (TXC35)



B.3 NTG FOR EARLY RETIREMENT OF HEATING AND COOLING EQUIPMENT (RES36)

Figure 10: Participant Free-Ridership Algorithm (RES36)



B.4 UPDATING NTG RATIOS FOR C&I (TxC49)

Figure 11: C&I Participant Replacement Type Algorithm (TxC49)

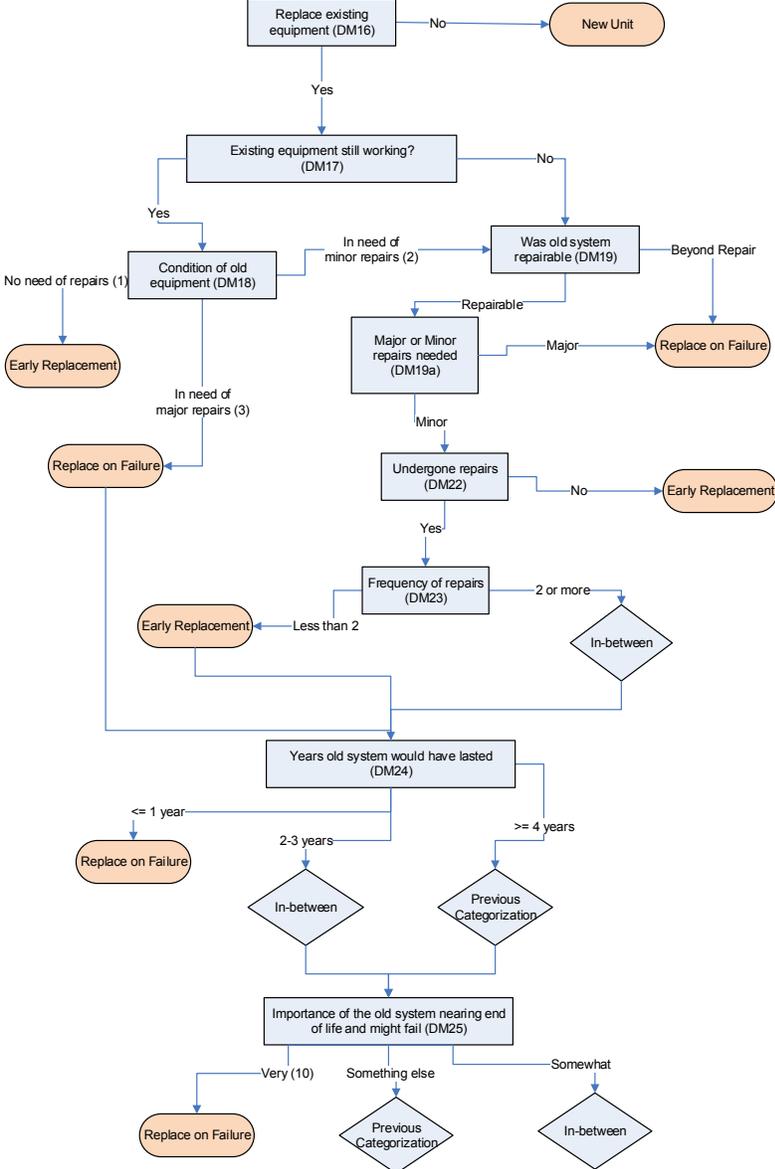
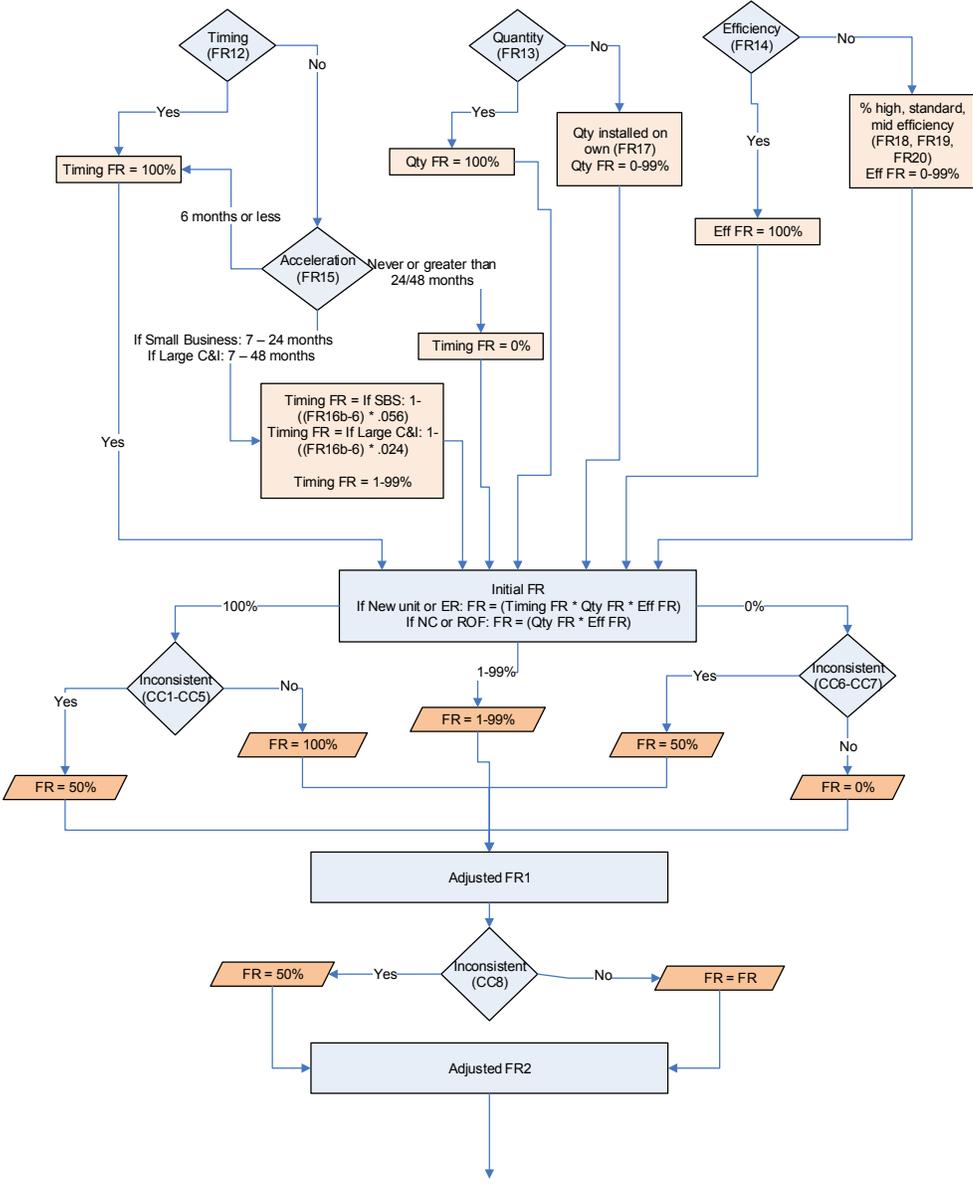


Figure 12: C&I Participant Free-Ridership Algorithm (TXC49)



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Figure 13 (cont'd): C&I Participant Free-Ridership Algorithm (TxC49)

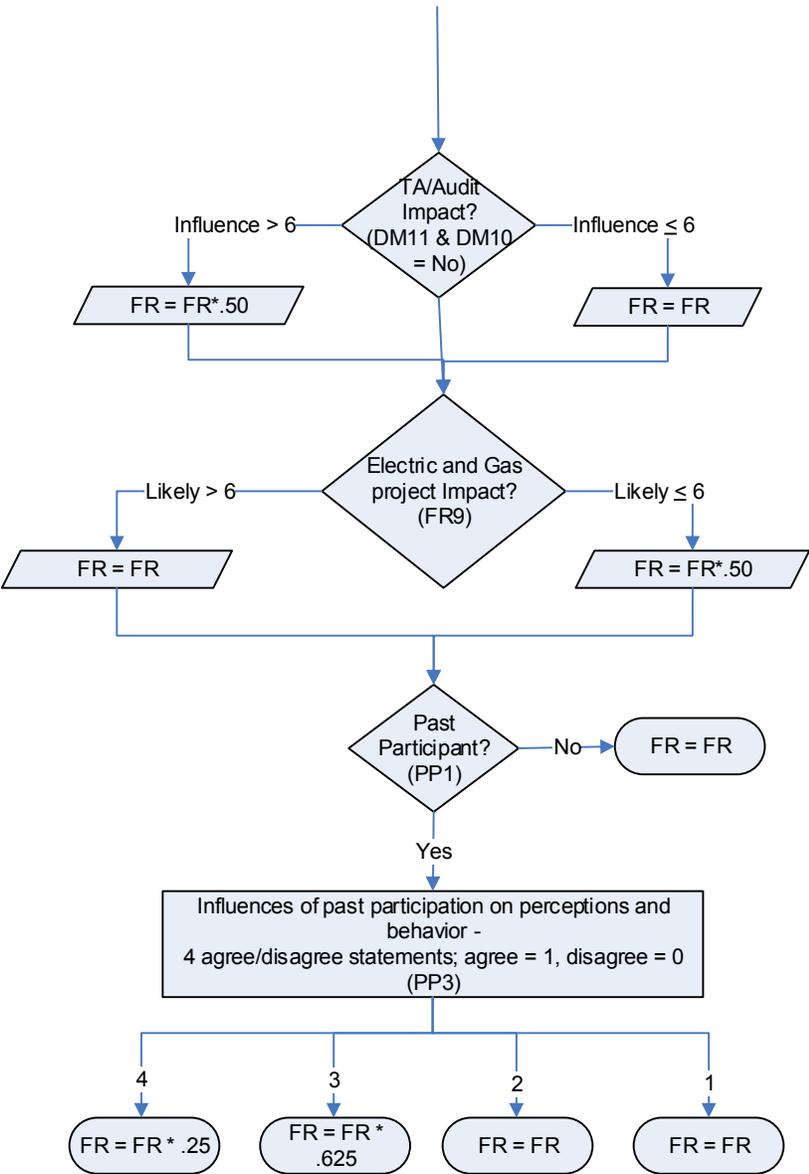


Figure 14: Free-Ridership Consistency Checks (TXC49)

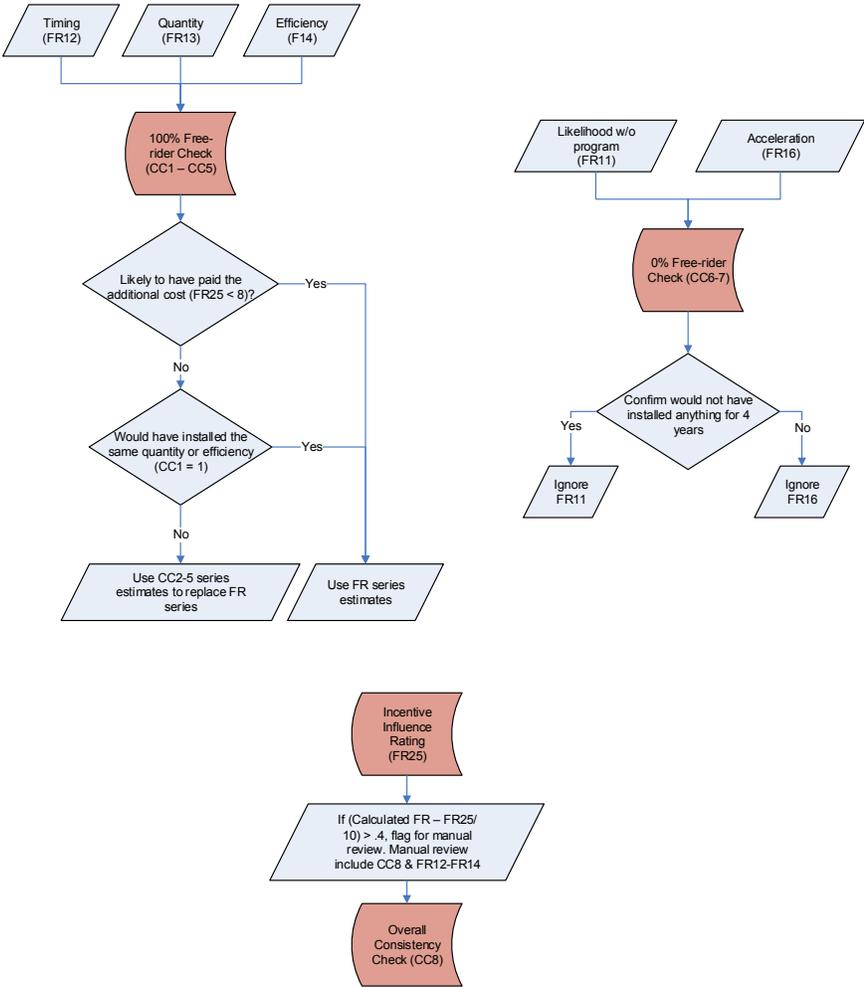


Figure 15: Vendor Trigger for Free-Ridership Survey (TXC49)

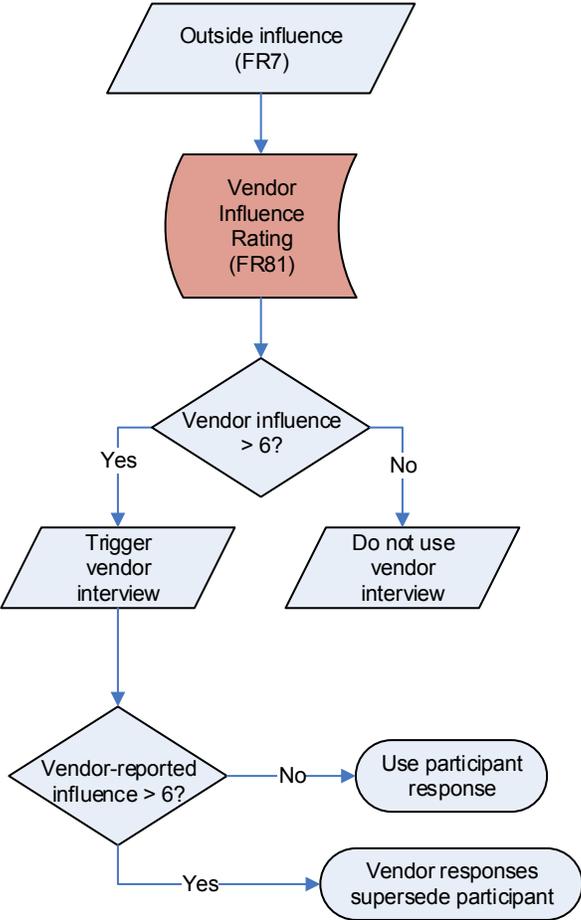


Figure 16: Participant Spillover Scoring (TXC49)

