

Characterization of Supply-Side Market Actors: Scoping Study Final Report

**Massachusetts Energy Efficiency Programs' Commercial &
Industrial Evaluation Contractor (CIEC)**

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Date: April 16, 2015







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1 EXECUTIVE SUMMARY

The goal of the Supply-Side Market Actors Project is to characterize the population of supply-side market actors and to develop an infrastructure that facilitates and prioritizes data collection from supply-side market actors for market studies, and program process and impact evaluations. Specifically, the objectives include:

- Supply Chain - Identify the trade allies that are involved in the HVAC supply chain, including production, distribution, specification, and installation of HVAC systems and equipment.
- Market Sectors – Assess the extent to which firms operate in different parts of the C&I market and for which types of trade allies there is overlap between the C&I and Residential markets.
- Sample Frames – Develop sample frames that furnish comprehensive coverage of the most important trade ally groups and help to eliminate duplication between C&I and Residential trade ally frames.
- Panel Design – Explore the opportunity to develop panels for certain types of trade allies that will effectively manage respondent burden and will increase the quality and comprehensiveness of information for both C&I and Residential trade ally studies.

Phase I of the project was a Scoping Study that focused on the development of a data collection framework for HVAC supply-side market actors. It assessed the feasibility and efficacy of using Program Administrator (PA) program databases, commercially available business data sources, and targeted in-depth interviews to identify the relevant supply-side market actors, develop market actor sample frames, and implement market actor panels to support ongoing C&I Evaluation Contractor (CIEC) data collection activities.

The Phase I study activities included:

- Massachusetts (MA) Commercial Building Characterization Study Data - Review of the data from the study and from the 2003 CBECS to develop a better understanding of the HVAC equipment used in MA buildings.
- Review of C&I HVAC Programs - Review of program information for both end user and upstream HVAC programs in order to understand the context for the participation of supply chain market actors.
- Program Database Data Mining - Collection of information on the participating and identified nonparticipating manufacturers and distributors from the HVAC Upstream Program, and analysis of HVAC projects listed in the PA end user program databases.
- Commercial Database Data Mining - Extraction and analysis of data from Dodge Reports, D&B, and ABI to develop comprehensive information on the population of HVAC supply chain market actors.
- Internet Research - Review of websites for manufacturers, distributors, mechanical engineers, and contractors to develop a better understanding of the markets that they serve.
- Targeted In-Depth Interviews - In-depth interviews with seven manufacturers, 14 distributors, 32 end users, and 30 engineers and contractors to understand how the supply chain market



actors interact with the MA HVAC energy efficiency programs, and to more broadly understand how they market their services and approach their work.

These research activities were successful in meeting or exceeding most of the Scoping Study objectives.

- **Data Collection Strategies** - The project identified data collection strategies that maximize the quality of information and minimize the burden on respondents, and presents options for implementing survey panels for targeted respondents from larger firms.
- **Sample Frames** - The project was able to either develop a sample frame or identify an effective strategy for developing a sample frame for each of the targeted supply side market actors.
- **Supply Chain** - The project was able to develop a better understanding of the role of different types of trade allies in the supply chain for HVAC systems and equipment, and to develop explicit supply chain maps for targeted manufacturers and equipment types.
- **Sales Tracking Data** - The project was able to determine the market actors that would need to participate in any HVAC equipment sales tracking research effort and identify opportunities and potential barriers to development of a sales tracking system.

This study was conducted as part of the Massachusetts Commercial and Industrial Evaluation Contract (CIEC) overseen by the Massachusetts Energy Efficiency Program Administrators (PAs) and the Energy Efficiency Advisory Council (EEAC) EM&V Consultants.

1.1 Data Collection Strategies

Research projects often have difficulty collecting information from HVAC supply chain market actors. Common problems include difficulty getting through gatekeepers, identifying the right respondent, and scheduling interviews. In addition, there is a special problem that some firms have a large presence in the marketplace for a particular type of equipment and would be sampled for every research project that needs information on that type of equipment. The Scoping Study identified a number of strategies that appeared to be successful in overcoming these challenges.

- **Project Specific Contacts** - The Dodge database has a project specific contact for each project. By using those contacts, the team was able to identify an individual who could speak about the specific project and more generally about program experiences.
- **End User Linked Contacts** - A similar strategy used by the Scoping Study was to contact an end user about their project, and then ask that end user contact to identify a contractor and/or mechanical engineer contact. Most end users were willing to furnish that contact, and more than two-thirds of the identified contractors and engineers agreed to participate in the in-depth interview.
- **Internet** - Most HVAC supply chain market actors have websites that describe their business and identify contacts for different products. By using those contacts, the project team was able to get past gatekeepers and directly approach a targeted respondent.
- **Interview by Professionals** - The project team did not have any difficulty getting the targeted number of interviews with each type of respondent. The completion rate for different groups



was between 20 percent and 70 percent in a relatively short time frame. (The field period for each type of interview was two to three weeks.) The interviewers were professionals who had a reasonably good understanding of the technical, management, and marketing issues raised by survey respondents.

However, it is difficult to implement these strategies for each new C&I study that needs to contact and interview HVAC trade allies. There are challenges in coordinating data collection processes across multiple studies when each study has its own research objectives, schedule, and sample frame. And, this is made even more challenging when the number of market actors is small (e.g., there are only about 18 manufacturers of RTUs selling products in MA; and, those same manufacturers are part of a small population of manufacturers of chillers). For that reason, the Scoping Study investigated the potential for developing panels for survey implementation for this group of market actors.

The survey asked respondents whether they would be willing to participate in a panel where they would be asked to respond to prioritized survey questions several times each year at predictable intervals. Almost all respondents that had some involvement with the program responded that they were willing to participate in such a panel. And, they preferred a panel that would provide them with two-way communication with program staff; they wanted to give feedback on the program and expected to hear about new developments in the program from the PAs. Individuals who had little or no involvement with the program did not see the value in participating in surveys, either as part of a panel or through an *ad hoc* contact. [Note: Contractor survey respondents were nominated by end users who had worked with them on specific HVAC installation projects. That mechanism was successful in gaining initial cooperation from contractors who have no involvement with the program.] For such organizations, participation in either *ad hoc* or panel data collection is likely to require a direct financial incentive, rather than market intelligence for participation. [Note: If a panel were developed where some respondents were compensated, it would be appropriate to compensate all panel members, even if they would be willing to participate without compensation.]

Recommendation #1 - The project team verified that a relatively small number of manufacturers, distributors, and mechanical engineers in the HVAC supply chain have a relatively large presence in the market. For that reason, getting market information or program feedback from those market actors requires a somewhat different data collection approach to gather comprehensive and good-quality information. And, it is clear that those market actors are willing to participate in a panel approach to data collection and that such an approach would help to make data collection more effective. We recommend that the PAs and EEAC move forward with the development of a panel for data collection from those market actors. While the most common response from respondents was they wanted "two-way communication" with the program as compensation for their participation, we recommend that the panel participants also should be compensated to further increase their commitment to respond on a continuing basis. [Note: The Scoping Study has already identified a number of individuals who would be responsive if they are contacted in the near future for panel participation. Those individuals would furnish a good start to the panels for manufacturers, distributors, and mechanical engineers.]

*Recommendation #2 - The project team found that some contractors actively market the PA programs, some always present options for qualifying and nonqualifying equipment to end users, some are responsive when end users request that they include qualifying equipment as one of the options, and some appear to discourage end users from purchasing qualifying equipment. The PAs and EEAC need to hear from all of those types of contractors to run effective programs. Since *ad hoc* data collection activities are more likely to get responses from contractors that are more engaged with the program,*



it is likely that such surveys would fail to give the PAs and EEAC a complete understanding of their programs. For that reason, the project team recommends that, in connection with the sample frame development in Recommendation #3, the PAs and EEAC authorize the C&I team to move forward with recruitment of a panel of C&I HVAC contractors that would facilitate better quality data collection from these market actors. And, the project team recommends that the panel include direct compensation for panel participants to ensure that the panel is appropriately balanced with contractors that have different levels of engagement with the program.

1.2 Sample Frame Findings and Recommendations

The Scoping Study examined each trade ally in the HVAC supply chain and found that the appropriate sample frame development methodology was different for each targeted analysis group.

- **Manufacturers** - There are a number of published lists of HVAC equipment manufacturers. However, those lists generally do not target specific equipment types and do not account for regional differences in distribution patterns. The project team found that, by starting with published lists, updating those with information from PA program databases, and then cross-referencing those lists with information from manufacturer and distributor websites, they were able to develop a comprehensive list of manufacturers for each type of HVAC equipment targeted by the Scoping Study (i.e., boilers, chillers, RTU package units, and ductless mini-splits). However, while they could gather information on which manufacturers are perceived to be the largest for each type of equipment, they were not able to identify any quantitative information that would allow one to compute market shares for each equipment type. While this is not a barrier to conducting an effective study, it means that the study would not be as statistically efficient as it would be if those data were available. [Note: Samples with probability proportional to size (PPS) are the most efficient; for any given sample size, a PPS sample will have a smaller confidence interval than a simple random sample (SRS). However, while the PPS sample is more efficient, a study can be conducted using SRS procedures if measure-of-size data are not available.]
- **Distributors** - The best sources of information for distributors were the Upstream Program participant lists, manufacturer websites, and commercial databases. There are a relatively small number of wholesale distributors for each type of equipment and they can be identified from those sources. Moreover, each distributor has its own website that characterizes the products that they sell. However, as with manufacturers, the project team was not able to identify any source that would furnish information on relative market shares.
- **Mechanical Engineers** - The F.W. Dodge database furnishes a rich source of data for firms that furnish engineering services to new construction and renovation projects. Moreover, since the Dodge database furnishes information on project size, it is possible to estimate the relative market share for a firm that furnishes engineering services. This sample frame would facilitate an effective and efficient design for any study that targeted data collection with mechanical engineers.
- **HVAC Installation Contractors** - The project had some success in identifying sources of information for HVAC installation contractors. The PA program databases were used to identify the contractors associated with projects that received incentives for HVAC equipment. Those identified contractors were then used to identify the most common SIC codes for HVAC installation contractors. Commercial databases were used to develop a list of businesses in those SIC codes, and then company websites were used to screen businesses for delivery of



C&I HVAC installation services. In addition, supply chain mapping for manufacturers and distributors helped to identify divisions of those companies that work directly with end users. The Scoping Study was able to identify an effective strategy for development of a comprehensive contractor sample frame, but additional work would need to be done to complete the development of the sample frame.

The project team was able to identify a strategy for all four groups of supply chain market actors. For manufacturers and distributors, they were able to develop comprehensive frames, but were not able to identify relative market shares. For mechanical engineers, they were able to develop a comprehensive frame with information on relative market shares. Finally, for HVAC installation contractors, they were able to identify an effective strategy, but were not able to develop a complete frame as part of this project.

Recommendation #3 - Based on the findings from the Scoping Study, the project team finds that it is possible to develop comprehensive frames for the targeted HVAC supply chain market actors. We recommend that the PAs and EEAC move forward with systematic sample frame development for manufacturers, distributors, mechanical engineers, and installation contractors so that those frames are available to any study that needs to contact those market actors, and to facilitate development of panels of market actors.

One common approach to development of a sample frame is to extract data from a commercial database for targeted NAICS and/or SIC codes. The data mining, Internet research, and IDIs conducted for this study highlight some of the ways that such an approach falls short. For example, for contractors it 1) misses divisions of manufacturers and distributors that work directly with end users, 2) may miss certain types of businesses that are not typically thought of as HVAC contractors (e.g., business consultants), and 3) furnishes a sample frame with many organizations that do not deliver the targeted services. By implementing the strategies developed in this Scoping Study (i.e., data mining from program databases, expanding the number of SIC codes included in the data extract from commercial databases, and using the Internet and brief screening interviews where necessary) one can develop a sample frame that has both high coverage of the eligible population and a higher percentage of sample frame units that are eligible for the survey.

1.3 Supply Chain Findings and Recommendations

The study looked at the HVAC equipment supply chain in two different ways: bottom-up and top-down. The bottom-up supply chain describes the most typical supply chain from the perspective of the "average" end user based on in-depth interviews with end users who installed new HVAC equipment. The top-down supply chain shows how the supply chain varies by manufacturer and equipment types.

From the end user perspective, the typical supply chain involves the following.

- End User - The end user decides to undertake a project that includes HVAC equipment. They ask a mechanical engineer to develop equipment specifications.
- Mechanical Engineers - The mechanical engineer develops HVAC specifications that are consistent with end user needs.
- End User - The end user hires a contractor to purchase and install the equipment according to the mechanical engineer's specifications.

- Contractor - The contractor get bids for equipment from distributors. They verify that the proposed equipment meets the specifications.
- Distributor - If the distributor stocks the equipment, they will furnish the contractor with a bid that meets the specifications. If the equipment is made to order, the distributor will work with the manufacturer to develop a price estimate.
- Manufacturer - The manufacturer supplies equipment to the distributor when ordered. For made-to-order equipment, the manufacturer will work with the distributor to develop a price for the equipment.

The Scoping Study also found that, at any point along the supply chain, a market actor may recommend to the end user that they upgrade the equipment specifications to take advantage of MA program incentives. Some contractors, mechanical engineers, and distributors are proactive with respect to using program incentives; they will always present that option to the end user. Other market actors are more passive; at the end user's request they will present options for using higher efficiency equipment.

However, to conduct effective research on supply chain market actors, research projects often need to take a top-down approach to identification of market actors. The market actors involved in any project are often a function of the specific distribution channels that can vary by manufacturer and equipment type. For example, it appears that a significant share of the HVAC equipment sold by the United Technologies Corporation (Carrier/Bryant/ICP) follow a "typical" distribution model. However, the largest distributor of United Technologies equipment has a special unit that works directly with end users on HVAC replacement projects. The research identified a number of other manufacturers and distributors that use distribution channels that differ from the "typical" model.

In addition, the research found that, in some cases, an organization will play more than one role in the supply chain. For example, the study found a number of companies that furnish both equipment design and equipment installation services. [Note: These companies were different from the ESCOs that work directly with the PAs on program implementation.]

Recommendation #4 - Based on the findings from the Scoping Study, the project team recommends that HVAC supply chain maps for manufacturers and distributors should be completed for each important manufacturer and equipment type so that future data collection and analysis projects are targeting the right respondents to research issues related to these market actors. [Note: They are already completed for seven manufacturers and 14 distributors for the four equipment types listed in the report. The manufacturer sample frames in Appendix A show that there are 18 RTU manufacturers, 21 chiller manufacturers, 25 ductless mini-split manufacturers, and 43 boiler manufacturers, with substantial overlap among those companies.] Mapping is particularly valuable for sample frame development for manufacturers and distributors, and for identifying departments or divisions of manufacturers and distributors that should be included in contractor sample frames.

1.4 Sales Data Tracking

The Scoping Study gathered information on whether equipment sales tracking data could be collected from manufacturers, distributors, and/or contractors in such a way that it would be possible to measure the change in the installation rates for qualifying equipment in MA. The project team learned the following about each potential sales tracking partner:

- **Manufacturers** - The survey respondents interviewed in the Scoping Study reported that their companies do not consistently track information on HVAC equipment by type and efficiency level.¹ In addition, most reported that they track sales by region rather than by state. And, if they were to look at sales data, the best that they would be able to do would be to report the location of the distributor or, in some cases, the contractor to whom they sold the equipment. They generally do not have end user data. [Note: Some manufacturers report that they send data on shipments to AHRI. Follow-up interviews with AHRI found that the manufacturers send them data on shipments by model number to locations with varying specificity. In most cases the location would be a distributor. However, our supply chain mapping found that manufacturers sell equipment directly to distributors, retailers, contractors, and end users.]
- **Distributors** - The survey respondents interviewed in the Scoping Study reported that their companies do not consistently track information on HVAC equipment by type and efficiency level. Since many are participating in the upstream HVAC program, they have a better idea about equipment efficiency levels for equipment that is covered by the Upstream Program than they do for the equipment that receives end user incentives. [Note: This makes it clear that distributors can track the sales of qualifying and nonqualifying equipment if they have the proper incentive.] However, except in cases where distributors receive end user addresses to validate upstream incentives, they do not have the address of the end user; they just have the address of the contractor who purchased and installed the equipment. Moreover, many distributors reported that they had gotten pushback from contractors when they asked to report the end user location for qualifying equipment.
- **Installation Contractors** - The Scoping Study conducted IDIs with only a few HVAC installation contractors because end users usually reported that the mechanical engineer, rather than the installation contractor specified the HVAC system and equipment. However, the study found that only about 20 percent of large C&I HVAC contractors could be identified as "participants" from the program tracking databases. Moreover, distributors report that they would need the support of contractors to report on MA end user installations of qualifying and nonqualifying equipment. Several distributors suggested that contractors could be paid to furnish these data.

The Scoping Study also learned that there are certain divisions of manufacturers that work directly with contractors and end users, and certain divisions of distributors that work directly with end users. Those sales would need special tracking procedures since they are outside the main distribution channels.

In their November 25, 2014, report the MA Cross Cutting research team made recommendations to the PAs and EEAC regarding collection of sales tracking data. The Scoping Study team collaborated with the Cross Cutting team (e.g., certain IDI questions were specified by the Cross Cutting team) and can furnish some information that may be helpful to the Cross Cutting team as they consider their recommended approach to sales tracking.

1. **Upstream Program Collaboration** - The Cross Cutting team recommended that the sales tracking data "Build on the Upstream HVAC Program's distributor data collection to obtain

¹ While there were only seven manufacturer respondents, the companies interviewed represented more than 60 percent of HVAC sales nationwide according to the "Mass Save Upstream HVAC and HP Initiative Work Paper" that was completed as part of the Upstream Program development process.



market share data for commercial RTUs" from "Independent distributors." This project obtained some additional information that may help to broaden that recommendation.

- a. Type of Distributor - The participating Upstream Program has agreements with all types of distributors, including independent distributors, manufacturer-owned distributors, and manufacturers' representatives. Since all are currently reporting data using the Upstream Program format, the sales tracking effort might include all distributor types, not just independent distributors.
 - b. Equipment Types - The Upstream Program includes incentives for and reports on both unitary and split air conditioning systems, as well as air source heat pumps, water source heat pumps, and ground source heat pumps. [Note: The PA programs for furnaces, boilers, and chillers are still at the end user level.]
2. HARDI Data Collection - The Cross Cutting team recommended an effort to "encourage D&R to obtain and make available for sale HARDI data for commercial HVAC equipment." As noted above, that might be most appropriate for furnaces, boilers, and chillers that still receive end user incentives. However, only 1 of the 14 C&I distributors interviewed was aware of the HARDI data. Many more were familiar with the AHRI data.
3. Manufacturer Data Collection - The Cross Cutting team recommended "researching the ability of manufacturers to provide meaningful state-level HVAC sales data" for manufacturer distribution networks. The Scoping Study found that many manufacturers already report shipment and sales data to AHRI by model number. From that perspective, it appears that manufacturer data could supplement any other data that are collected. But, since AHRI does not appear to be willing to sell the data, it seems that they would have to use the AHRI model, but not necessarily the AHRI data.
4. Manufacturer and Distributor Panel - The Cross Cutting team recommended "establishing a panel of manufacturers and distributors to provide qualitative data..." The Scoping Study found that most respondents were interested in participating in such a panel. In many cases, the C&I respondent was different from the residential respondent.

These findings generally support many of the Cross Cutting team recommendations, but also offer ways to potentially enhance the proposed strategies.

Recommendation #5 - The Scoping Study offers some new information to the Cross Cutting team related to sales tracking for Market Effects. It is likely that their proposed strategy might be modified in some ways by these findings. The C&I team is prepared to respond to any questions from the Cross Cutting team that could help with their effort.

Recommendation #6 - The PA Upstream Program has already made a significant investment in collecting information on qualifying equipment for verification of program incentives. It seems that the "shortest path" to robust sales tracking data might be to furnish monetary incentives to a sample of participating and nonparticipating distributors and contractors to expand their reporting to cover both the qualifying and nonqualifying equipment covered by the Upstream Program. However, even if that strategy is "prioritized" for certain types of equipment, the Cross Cutting team appropriately suggests that the most effective long-term strategy is to explore all channels for collecting data (e.g., the AHRI data collection model).

2 INTRODUCTION

The goal of the Supply-Side Market Actors Project is to characterize the population of supply-side market actors and to develop an infrastructure that facilitates and prioritizes data collection from supply-side market actors for market studies, and program process and impact evaluations. Specifically, the objectives include:

- Supply Chain - Identify the trade allies that are involved in the HVAC supply chain, including production, distribution, specification, and installation of HVAC systems and equipment.
- Market Sectors – Assess the extent to which firms operate in different parts of the C&I market and for which types of trade allies there is overlap between the C&I and Residential markets.
- Sample Frames – Develop sample frames that furnish comprehensive coverage of the most important trade ally groups and help to eliminate duplication between C&I and Residential trade ally frames.
- Panel Design – Explore the opportunity to develop panels for certain types of trade allies that will effectively manage respondent burden and will increase the quality and comprehensiveness of information for both C&I and Residential trade ally studies.

Phase I of the project was a Scoping Study that focused on the development of a data collection framework for HVAC supply-side market actors. It assessed the feasibility and efficacy of using Program Administrator (PA) program databases, commercially available business data sources, and targeted in-depth interviews to identify the relevant supply-side market actors, develop market actor sample frames, and implement market actor panels to support ongoing C&I Evaluation Contractor (CIEC) data collection activities.

The Phase I study activities included:

- Review of C&I HVAC Programs - Reviewing MA PA C&I HVAC programs to identify the different opportunities for end users and upstream market actors to participate in the PA programs.
- Program Database Data Mining - Using available PA program databases to identify the population of end users and upstream market actors that are directly participating in the PA programs.
- Commercial Database Data Mining - Using available commercial databases (D&B, ABI, Dodge, and other sources) to identify the population of businesses that are engaged in the production, distribution, specification, and installation of HVAC equipment in Massachusetts.
- Targeted In-Depth Interviews – Contacting identified organizations (e.g., manufacturers, distributors, engineering consultants, contractors, and end users) to develop information on the best approach for market actor data collection (e.g., which job title(s) for each topic, what type of contact, the maximum frequency of contact(s), and with what incentive), to identify the best list(s) of market actors (e.g., commercial business lists or membership organization lists), and to obtain preliminary information on the scope of activities undertaken by each contacted organization.
- Recommendations - Making recommendations for developing market actor sample frames and panels for collecting information from market actors.



The purpose of this report is to present the findings and recommendations from the Phase I Scoping Study with respect to the following issues:

- Sample Frames – Building sample frames that effectively “represent” the population of each type of supply-side market actor involved in the production, distribution, specification, and/or installation of HVAC equipment in Massachusetts businesses and institutions.
- Supply Chain - Identifying the trade allies that are involved in the HVAC supply chain, including production, distribution, specification, and installation of HVAC systems and equipment.
- Data Collection Strategy – Identifying data collection strategies that maximize the quality of information collected by coordinating sampling and prioritizing data collection across program sectors and business types, thereby minimizing respondent fatigue.
- Development of Panels – Where appropriate, implementing survey panels that give survey respondents a predictable schedule of contacts, and that minimize repeated collection of background attitudinal and business information.
- Sales Tracking Data - Furnishing information on the most effective strategies for tracking HVAC equipment sales by type and efficiency level.

The focus of the Phase I Scoping Study was on the HVAC equipment supply chain.² Where feasible and appropriate, the study examined how energy management systems and commissioning are integrated with, complementary to, or separate from the HVAC market in Massachusetts. In addition, the study looked at common issues related to research efforts being undertaken by the Residential and Cross Cutting Research teams. Finally, the study coordinated with the PA C&I Program Staff because those staff have a direct relationship with HVAC distributors that are participating in the C&I upstream HVAC program.

This study was conducted as part of the Massachusetts Commercial and Industrial Evaluation Contract (CIEC) overseen by the Massachusetts Energy Efficiency Program Administrators (PAs) and the Energy Efficiency Advisory Council (EEAC) EM&V Consultants.

3 HVAC EQUIPMENT

The types of HVAC equipment used in C&I buildings are diverse because of differences in the amount of floor space that needs to be conditioned, the configuration of floor space (e.g., small footprint multistory vs. large footprint single story), and demands of the building end users (e.g., office space vs. retail). Early in the Scoping Study it became clear that the HVAC supply chain is quite different for the different types of HVAC equipment; there are important differences in the equipment manufacturers, distribution channels, and specification processes. Because of the number of different equipment types and the complexity of mapping the supply chain for each equipment type, the study focused on the C&I HVAC equipment types that represent the major share of program opportunities.

² As reported in the 2012 C&I Customer Profile Report, HVAC was 10% of the electric projects and 21% of electric impacts. For gas, HVAC was 28% of the projects and 52% of the impacts. The 2014 Market Effects workshops prioritized both C&I HVAC and Residential HVAC as high-priority targets for research.



Two data sources furnish information on the types of C&I HVAC equipment used in MA. The 2003 CBECS data furnish estimates of the HVAC equipment types for the Northeast Census Region from an in-person interview conducted by the Energy Information Administration (EIA).³ The MA Existing Building Market Characterization Study furnishes MA-specific information from the 2013 telephone survey conducted for the MA CIEC. The CBECS survey has the advantage of being conducted through in-person interviews, but it is for the entire Northeast Region and is quite out of date. The MA survey furnishes current information for MA, but the telephone interview format makes it more difficult to get high-quality data on building equipment. [Note: The Existing Buildings On-Site Assessments Project is collecting information for a sample of buildings and will furnish more precise information on certain topics, including HVAC equipment.]

Tables 1 and 2 present information on C&I heating equipment. Table 1 presents estimates from the MA CIEC survey; Table 2 furnishes CBECS estimates. Each table presents information in two ways; the first set of columns shows the distribution weighted by the number of buildings, while the second column shows the distribution weighted by building kWh (MA survey) or building square footage (CBECS). The findings include:

- Boilers - The MA survey shows that boilers were used in almost one-third of buildings and furnished heat to 40 percent of the buildings when weighted by kWh; boilers are the most prevalent heating equipment for MA C&I buildings.
- Packaged Heat RTUs - The MA survey shows that, while RTUs are only used in one in ten C&I buildings, they are used in 17 percent of buildings when weighted by kWh.
- Furnaces - The MA survey shows that 28 percent of buildings use furnaces for heat, but when buildings are weighted by kWh, they are used by only 13 percent of the population.

The CBECS survey furnishes similar results to those from the MA C&I Building Characterization Survey. Boilers are clearly the most important heating equipment for MA C&I buildings that were included in the Scoping Study analysis. Both RTUs and furnaces are important sources of heating equipment for MA C&I buildings. Because the RTUs are part of the HVAC Upstream Program and because they also furnish cooling (see Tables 3 and 4), they were included as a focus for the Phase I study.

³ The national Commercial Buildings Energy Consumption Survey (CBECS) furnishes national and regional data on commercial buildings. The most recent published survey furnished data for 2003. The 2012 survey is being processed and will be available some time in 2015. The 2003 CBECS data furnish information for the Northeast Region of the United States.

Table 1

Heating Equipment Types by Number of Buildings and Share of kWh

(MA C&I Building Characterization Study - 2013)

Heating Equipment Type	Building Level Weighted Percentage	kWh Weighted Percentage⁴
Heat Pump	5 %	5 %
Furnace	28 %	13 %
Other Portable Equipment	1 %	1 %
District Heat	3 %	6 %
Boilers	29 %	40 %
Package Heating Units	9 %	17 %
TOTAL *	75 %	82 %

*Remainder of responses were Don't Know or Refused.

Table 2

Heating Equipment Types by Number of Buildings and Share of Floor Space (Square Footage)

(2003 CBECS - Northeast Census Region)

Heating Equipment Type *	Building Level Weighted Percentage	Square Footage Weighted Percentage
Heat Pump	6 %	9 %
Furnace	43 %	28 %
Individual Heating Units	17 %	21 %
District Heat	2 %	10 %
Boilers	31 %	48 %
Package Heating Units	13 %	23 %
Other	3 %	5 %
None	7 %	2 %
TOTAL	100 %	100 %

*More than one type may be used in a building.

Tables 3 and 4 present information on C&I cooling equipment. Table 3 presents estimates from the MA CIEC survey; Table 4 furnishes CBECS estimates. The findings include:

⁴Two different weights were developed for the project tables. The first shows the share of buildings "represented" by each interviewed building. The second shows the share of kWh "represented" by each interviewed building. Since the number of buildings and the annual kWh were both part of the building sample frame, the responding buildings would be weighted back to those population statistics.

- Packaged AC Units - The MA survey shows that packaged AC units were used in 22 percent of buildings and furnished cooling to 35 percent of the buildings when weighted by kWh; packaged AC units are the most prevalent cooling equipment for MA C&I buildings.
- Chillers - The MA survey shows that 14 percent of buildings use chillers for cooling, but when buildings are weighted by kWh, they are used by 29 percent of the population.
- Individual AC Units - The MA survey shows that 14 percent of buildings use individual AC units for cooling, but this represents only 6 percent of buildings when weighted by kWh.

The CBECS survey furnishes similar results to those from the MA C&I Building Characterization Survey. Packaged AC units are clearly the most important cooling equipment for MA C&I buildings that were included in the Scoping Study analysis. Both chillers and individual AC units are important sources of cooling for MA C&I buildings. Because chillers are responsible for a larger share of the buildings in terms of kWh, they were included as a focus for the Phase I study.

Table 3

Cooling Equipment Types by Number of Buildings and Share of kWh

(MA C&I Building Characterization Study - 2013)

Cooling Equipment Type	Building Level Weighted Percentage	kWh Weighted Percentage
Individual AC Units	14%	6%
Split AC Systems	5%	7%
Split Heat Pump	6%	4%
Package AC Units	22%	35%
Central Chillers	14%	29%
TOTAL *	61%	81%

*Remainder of responses were Don't Know or Refused.

Table 4

Cooling Equipment Types by Number of Buildings and Share of Floor Space (Square Footage)
(2003 CBECS - Northeast Census Region)

Cooling Equipment Type *	Building Level Weighted Percentage	Square Footage Weighted Percentage
Residential Type	20%	19%
Heat Pump	8%	10%
Individual AC Units	25%	29%
District Chillers	1%	5%
Central Chillers	1%	14%
Package AC Units	28%	46%
None	28%	15%
TOTAL	100 %	100 %

*More than one type may be used in a building.

The focus of the research in the Phase I Scoping Study is on boilers, package units for heating and cooling, and chillers. Boilers and chillers tend to be used in multi-story C&I buildings, while package units are more often used for single-story buildings, even if those buildings are quite large in terms of square footage. While furnaces represent a greater share of the heating market than RTU package units, RTUs are important for both heating and cooling end uses, and are of particular interest because of the Upstream Program incentive.

The Scoping Study also included a fourth equipment type: ductless mini-split heat pump systems. This equipment is being used extensively in both new construction and renovations. It is used for new construction because it eliminates the need for ducts. It is also being used for renovations, and appears to be a convenient way to add cooling to buildings that do not currently have ducts. Moreover, with the advent of cold climate heat pumps, this equipment has the potential to replace older inefficient boilers with higher efficiency heating equipment without adding ducts.

4 PA HVAC PROGRAMS

The analysis of the MA C&I Building Characterization Study shows the number of different types of equipment that are installed in C&I buildings. It is also useful to think about the opportunities for installing energy efficient equipment. The major opportunities include:

- **New Construction/Additions** - When a new building is constructed, HVAC equipment must be specified and installed.
- **Planned Replacements** - Some building owners will have a planned replacement schedule for their HVAC equipment when the equipment exceeds its useful life. Often this replacement will occur before equipment failure so that the business does not experience any loss of use of the building.
- **Emergency Replacements** - Sometimes equipment fails and needs to be replaced. These projects have the shortest time horizon for replacements.

- Energy Efficiency Retrofits - In some cases, energy efficient HVAC equipment can substantially pay for itself in terms of energy savings, especially if incentives are offered to reduce the incremental cost of such equipment.

The Massachusetts PAs have developed programs to address each of these markets, as well as all of the different types of equipment. The End User programs⁵ include:

- Equipment Programs - Programs that specifically list Chillers and Gas-Fired Heating Equipment.
- Custom Measures - For New Construction, Replacement of Failed Equipment, and Retrofit of Existing Buildings.
- HVAC System Components - Programs that address other HVAC components such as VSD motors for New Construction, Replacement of Failed Equipment, and Retrofit of Existing Buildings.

In addition, the PAs have recently implemented an Upstream Program for distributors to encourage them to stock qualifying equipment by paying them a direct incentive for sales of qualifying units. The upstream programs have replaced the end user programs for certain types of equipment, including:

- Air Conditioning Systems
 - o Air Cooled Unitary (package units) and Split Air Conditioning Systems⁶
 - o Water and Evaporatively Cooled Air Conditioning Systems
- Heat Pump Systems
 - o Air Cooled
 - o Water Cooled
 - o Ground Water
 - o Ground Loop
- Controls and Motors
 - o Dual Enthalpy Economizer Controls
 - o Demand Control Ventilation
 - o ECM Motors for HVAC Fans

The set of MA programs is designed to cover the complex array of C&I HVAC equipment and to address all aspects of the potential HVAC equipment replacement opportunities.

5 HVAC MANUFACTURERS

The Scoping Study examined the following questions related to the collection of information from HVAC manufacturers.

⁵ The end user programs pay incentives directly to the building owner in which the HVAC equipment is installed.

⁶ Unitary systems have all air conditioning system components in the same unit. Commercial grade equipment is often referred to as package units. Many larger package units are installed on roof tops (i.e., Roof Top Units or RTUs.) Often the RTU package unit will include both heating and cooling systems.

- Sample Frames - Is it possible to develop a list of manufacturers for each type of equipment that has a high coverage rate and that includes information on the relative market share for each manufacturer?
- Supply Chain - Is it possible to map the HVAC supply chain from the perspective of the manufacturer in terms of how the HVAC equipment gets from the manufacturer to the end user?
- Survey Respondents - What company title would be the best respondent for each type of information sought by the MA PAs? Under what circumstances would a panel approach to data collection improve the amount and quality of information furnished by manufacturers?
- Corporate Initiatives - Are manufacturers willing to share information on corporate initiatives with respect to production and stocking patterns?
- Sales Tracking Data - Are manufacturers able to furnish MA-specific information on HVAC equipment sales that would facilitate tracking of equipment by energy efficiency level? If so, under what circumstances would they be willing to share that information with the MA PAs?
- Feedback on Program Design and Implementation - Are manufacturers willing to provide feedback on MA program design initiatives? Are manufacturers able to furnish feedback on MA PA energy efficiency programs based on their program experiences?

The Scoping Study activities that helped to address these questions included:

- Data Mining
 - o Upstream Program Participation - The Mass Save website for the upstream HVAC incentive program includes a list of all participating manufacturers.
 - o End User Program Participation - Many of the PA program participation databases included the manufacturer name for HVAC equipment that was replaced.
 - o Internet Search for Manufacturers - Most manufacturers actively market their HVAC products through websites, can easily be identified through a search for certain types of equipment, and often furnish information on their corporate strategy with respect to energy efficiency.
 - o Leveraging Distributor Information - The research on HVAC distributors also helped to identify HVAC equipment manufacturers; most distributor websites include a comprehensive list of the manufacturers whose equipment the distributor sells.
- In-Depth Interviews
 - o Manufacturer Interviews - The project team conducted in-depth interviews with seven HVAC manufacturers of various types. [Note: Appendix E furnishes a copy of the IDI guide administered to manufacturers.]
 - o Distributor Interviews - The project team conducted in-depth interviews with 14 HVAC distributors. [Note: Some interviews furnished information on both manufacturers and distributors. In three cases, the manufacturer also directly distributes the equipment. In one case, a manufacturers' representative could answer questions about the

manufacturer and the equipment distribution.] [Note: Appendix F furnishes a copy of the IDI guide administered to distributors.]

One study activity that was not particularly useful with respect to manufacturers was data mining of commercial databases. This data mining looked at MA business listings and attempted to identify the dominant SIC codes for the targeted market actor. This was not successful for manufacturers because many are corporations that produce a wide variety of products and because many do not even have a Massachusetts office.

5.1 Sample Frames

The project was able to develop a comprehensive sample frame of manufacturers for each of the equipment types targeted by the Scoping Study (i.e., boilers, chillers, RTU package units, and ductless mini-splits). And, the study was able to qualitatively assess which manufacturers were considered by knowledgeable informants to be the largest. However, the project was not able to develop information on the relative market shares of each manufacturer for each equipment type.

The process for developing the sample frame involved the following procedures.

- **Program Participants** - The initial list of equipment manufacturers was developed from program databases, including the manufacturers that were listed as participants in the upstream HVAC incentive program and the manufacturers that were listed in the PA program databases for equipment receiving program incentives. The equipment types manufactured by each company were developed by consulting the manufacturer's website.
- **Internet Search** - The project team used the Internet to identify additional manufacturers for each type of equipment. The company websites furnished information on whether the equipment was available for sale in Massachusetts.
- **In-Depth Interviews** - Interviewed manufacturers were asked to review the list of manufacturers to identify other companies that were also active in the market.
- **End Users** - Each interviewed end user was asked to report on the manufacturer of the equipment that they installed.
- **Participating and Nonparticipating Distributors** - In a complementary activity, the project team developed a list of participating and nonparticipating distributors. Websites for those distributors were consulted to identify manufacturers of the distributed equipment.

These procedures were able to develop a list of manufacturers for each equipment type, and to estimate the program participation rate of those manufacturers in the upstream program.

- **Boilers** - The project identified 43 boiler manufacturers selling equipment in MA.
- **Chillers** - The project identified 21 chiller manufacturers selling equipment in MA.
- **Package units** - The project identified 18 manufacturers selling package units in MA. Six of the 18 were listed as participating in the upstream HVAC incentive program.
- **Ductless Mini-Splits** - The project identified 25 manufacturers selling ductless mini-splits in MA. Nine of the 25 were listed as participating in the upstream HVAC incentive program.



It is important to note that the manufacturers participating in the MA programs may represent a large share of the overall market, even if they do not include the majority of companies producing a particular type of equipment. For example, in the packaged equipment market, the program lists only six of the 18 manufacturers that are selling this equipment. However, the six program participants are known to have the largest market share.

Appendix A furnishes tables with lists of manufacturers for each type of equipment.

5.2 Supply Chain

The project team was able to map the supply chain for the seven manufacturers interviewed in the Phase I study. While at least part of the mapping was able to be done through Internet research, the in-depth interviews were required to verify the distribution patterns. A key finding from the research was that the supply chain varies considerably by manufacturer and by equipment type.

The supply chains for seven manufacturers are presented in Appendix B. The manufacturers are United Technologies Corporation (Carrier/Bryant/Payne/ICP), Johnson Controls (York), Ingersoll Rand (Trane/American Standard), Lennox, Lochinvar, ClimateMaster, and Panasonic. The following furnish examples how supply chains can vary by manufacturer and equipment type.

United Technologies Corporation (UTC), the corporate parent for Carrier, Bryant, Payne, and ICP, has a supply chain that fits with the common understanding of an HVAC supply chain; in general, their HVAC equipment goes from the manufacturer to a distributor, from the distributor to a contractor, and from the contractor to an end user.

- Distributors - There are three major distributors of UTC, two of which are independent and one for which Carrier has a partial ownership interest.
- DCNE Supply Chain - DCNE is an independent distributor of UTC HVAC equipment. They sell boilers in three ways: to retail outlets, to contractors, and directly to end users. The sales to retail outlets tend to be for smaller equipment. The sales to end users tend to be for large and expensive system. It appears that most sales are to contractors.
- R.J. Murray Supply Chain - R.J. Murray has two departments; the residential department sells to retailers and the commercial department sells to contractors. [Note: Limited geographic scope.]
- Carrier Enterprise/Homan's Associates Supply Chain - UTC has a small ownership stake in CE/Homan's. No IDI was conducted with this distributor, so the supply chain was not mapped for them.

UTC has equipment in all four markets (e.g., boilers, chillers, package units, and ductless mini-splits). And, it appears that their distribution network is the same for all four types of equipment.

Ingersoll Rand, the corporate parent for Trane and American Standard, has a supply chain that relies on a manufacturer-owned distribution network for C&I equipment.

- Distributors - There are three major distributors of Trane products, one of which is company-owned and two of which are independent.

- Trane Supply Chain - Trane is a manufacturer-owned distributor of Trane package units. They have two units, a performance contracting unit that works directly with end users and a commercial sales unit that sells to contractors.
- Independent Distributors - S.G. Torrice and Air Purchases sell residential package units to contractors.

Ingersoll Rand sells chillers, package units, and ductless mini-splits. They appear to have the same distribution network for all three types of equipment. [Note: Chillers are not sold to the residential markets.]

ClimateMaster Inc. manufactures heat pumps, including geothermal heat pumps. S.J. Ginns serves as the manufacturers' representative for ClimateMaster and is responsible all sales in the Northeast market. They work directly with contractors and dealers; they do not sell directly to end users.

5.3 Findings from In-Depth Interviews

The project team reached out to ten manufacturers and was able to complete seven in-depth interviews. Five of the seven respondents were regional sales managers. One was the President of the distributor that serves as the Manufacturer's Representative for New England. The other was the manager of the manufacturer's consulting division.

The survey respondents were generally forthcoming with information about the equipment that they sell, the distribution channels that they use, and the way that they interact with the MA energy efficiency programs. But, most of the survey respondents were not able to furnish more detailed information about the MA HVAC markets and indicated that, in most cases, they know only the location of the distributor, not the location of the end user where the equipment was installed. In this section, we list the key information objectives and the distribution of responses from the seven interviewed respondents.

Topic #1 - If the PAs needed information on the listed C&I HVAC equipment markets, would there be one respondent or more than one for the manufacturer?

The IDI asked the respondent to indicate whether he or she would be the best contact to furnish information on all of the listed HVAC equipment markets. Four of the respondents indicated that they would be the best contact for all questions related to C&I HVAC equipment. Three of the respondents suggested that several different respondents would be appropriate; some have separate equipment markets by size, while others had different managers for each HVAC distribution channel.

Topic #2 - Is the manufacturer able to identify the specific location in which their HVAC equipment was installed, either in terms of the state or the ZIP code?

None of the survey respondents are able to identify the specific installation location for all of their equipment. Most indicated that they could identify the state and ZIP code of the distributor and/or contractor to which they sold the equipment. [However, most also noted that they do not currently track their sales in that way.] Some indicated that they did have the installation location for HVAC equipment when they sold directly to the end user, or when the equipment participated in a special program. However, a number of manufacturers sell their equipment to distributors located in MA who sell equipment to contractors outside MA. And, a



number of manufacturers sell equipment to distributors that are located outside MA who have part of MA as their designated service area. So, more precise information on sales in MA would require collaboration with the distributors.

Topic #3 - Does the manufacturer have information on the share of their equipment that is used for new construction vs. renovation markets, and for planned or emergency replacements?

Most of the respondents reported that they do not track their equipment sales in that way and do not have much information on the share of their equipment that is used in different markets. Some of the respondents furnished estimates of new construction vs. renovations, and of commercial vs. residential equipment sales. However, none of the respondents were able to identify a specific source for their estimate; they reported that it was just based on experience.

Topic #4 - Would the respondent be willing to furnish information to the PAs periodically on a confidential basis? [Note: It was suggested that the respondent could be offered a financial incentive, as well as aggregated market-level findings.]

All of the respondents expressed a willingness to participate in this type of information-gathering process. However, rather than receiving a financial incentive or aggregate market information, the respondents were more interested in having a two-way conversation with the PAs on program design and implementation. And, in some cases, their willingness to continue to participate would be dependent on whether they perceived that the PAs were making effective use of the information that they furnished.

*Topic #5 - Do the respondents know the share of their equipment that received incentives through the **Upstream Program** and do they perceive that it has had a positive impact on sales of high-efficiency equipment?*

The respondents did not have good information on the share of equipment that was receiving incentives, and in one case, the manufacturer respondent was not aware that their MA distributor was one of the top producers in the program. Many of the respondents perceived that that the MA programs were having a positive impact on the sales of high-efficiency equipment. But, none of the respondents had reliable statistics on the share of equipment that was high efficiency, and most explicitly indicated that their company did not track nor would they easily be able to acquire such statistics.

*Topic #6 - Do the respondents know the share of their equipment that received incentives through the **End User programs** and do they perceive that it has had a positive impact on sales of high-efficiency equipment?*

The respondents did not have good information on the share of equipment that was receiving incentives. Among those manufacturers that sold boilers and/or chillers, many perceived that that the MA programs were having a positive impact on the sales of high-efficiency equipment. But, none of the respondents had reliable statistics on the share of equipment that was high efficiency, and most explicitly indicated that their company did not track nor would they easily be able to acquire such statistics.

Topic #7 - Do the respondents perceive that the Mass Save programs are considered by manufacturers when they are making decisions on production and stocking of high efficiency equipment for a market?

All of the respondents agreed that programs have some impact. One respondent reported that "without the incentives, the market is highly price-driven." However, most respondents qualified that response with specific barriers to that influence. For example, one manufacturer said that "the programs influence distributors more than manufacturers." Another said that "most of their equipment is made to order, so the incentives don't affect stocking patterns." And, several respondents reported that their production and distribution is regional; state-level programs have some impact, but they need to plan for the overall region.

Topic #8 - Are the respondents aware of sources of information on the sales of HVAC equipment by the level of efficiency?

Three of the seven respondents indicated that their companies furnished data to and got information from AHRI. One respondent mentioned McGraw-Hill and IHS Economist.

These responses help to characterize the role of the manufacturer in the HVAC supply chain. In general, they show that most manufacturers are not directly engaged in the MA HVAC equipment market or with MA HVAC equipment energy efficiency programs.

5.4 Sales Tracking Data

The project team interviewed a limited number of manufacturers. However, four of those manufacturers represent over 60 percent of the market nationwide, so their sales tracking capabilities are highly relevant to any future data collection efforts. The IDI responses suggest that the manufacturers would not be a good source of information for tracking the sales of HVAC equipment by type and efficiency level for a number of reasons.

- Tracking Data - It does not appear that the sales managers of manufacturers routinely focus on quantifying sales by equipment type and efficiency.
- Location Data - It appears that manufacturers look at their markets by region and not by state. They can identify the state and ZIP of the distributor or contractor that purchased the equipment, but they cannot verify the specific location where the equipment was installed.

Several of the manufacturer respondents mentioned AHRI data. They indicated that their company furnishes data to AHRI and they get back reports from AHRI. However, it was not clear if these reports track the efficiency level of HVAC equipment or track shipments with needed geographic specificity.

While the manufacturers do not appear to be a good source of data for sales tracking, some manufacturer sales are direct to contractors and/or end users. For those sales, a sales tracking system would be forced to include some divisions of the manufacturer's organization.

6 HVAC DISTRIBUTORS

The Scoping Study examined the following questions related to the collection of information from HVAC distributors.

- Sample Frames - Is it possible to develop a list of distributors for each type of equipment that has a high coverage rate and that includes information on the relative market share for each distributor?
- Survey Respondents - What company title would be the best respondent for each type of information sought by the MA PAs? Under what circumstances would a panel approach to data collection improve the amount and quality of information furnished by distributors?
- Corporate Initiatives - Are distributors willing to share information on corporate initiatives with respect to stocking patterns?
- Sales Tracking Data - Are distributors able to furnish MA-specific information on HVAC equipment sales that would facilitate tracking of equipment by energy efficiency level? If so, under what circumstances would they be willing to share that information with the MA PAs?
- Feedback on Program Design and Implementation - Are distributors willing to provide feedback on MA program design initiatives? Are distributors able to furnish feedback on MA PA energy efficiency programs based on their program experiences?

The Scoping Study activities that helped to address these questions were:

- Data Mining
 - o Upstream Program Participation - The Mass Save website for the upstream HVAC incentive program includes a list of all participating distributors. In addition, the PA program staff have a list of known distributors that are not yet participating in the Upstream Program.
 - o Data Mining of Commercial Databases - D&B and ABI were used to identify the SIC code for participating and known distributors. Those databases were then used to identify additional distributors that were not yet known to the program.
 - o Internet Search for Distributors - Most distributors actively market their HVAC products through websites, and can easily be identified through a search for certain types of equipment.
 - o Leveraging Manufacturer Information - The research on HVAC manufacturers also helped to identify HVAC equipment distributors; most manufacturer websites include a comprehensive list of the distributors that sell their equipment in a particular location.
- In-Depth Interviews
 - o Manufacturer Interviews - The project team conducted in-depth interviews with seven HVAC manufacturers of various types. Those manufacturer respondents furnished some information on distributors. [Note: Appendix E furnishes a copy of the IDI guide administered to manufacturers.]
 - o Distributor Interviews - The project team conducted in-depth interviews with 14 HVAC distributors. [Note: Some interviews furnished information on both manufacturers and distributors. In three cases, the manufacturer also directly distributes the equipment. In one case, a manufacturers' representative could answer questions about the



manufacturer and the equipment distribution.] [Note: Appendix F furnishes a copy of the IDI guide administered to distributors.]

This combined set of activities furnished comprehensive information on HVAC equipment distributors and the roles that they play in the HVAC supply chain.

6.1 Sample Frames

The project was able to develop a comprehensive sample frame for each of the equipment types targeted by the Scoping Study (i.e., boilers, chillers, package units, and ductless mini-splits). However, while IDI respondents perceived that participating distributors covered a large part of the market, the project was not able to identify any quantitative information on the relative market shares of each distributor for each equipment type.

The process for developing the sample frame involves the following procedures.

- **Program Participants** - The initial list of equipment distributors was developed from program databases, including the distributors that were listed as participants in the upstream HVAC incentive program and the distributors that were targeted by the PA program staff but were not yet participating.
- **Commercial Databases** - The list of distributors was sent to D&B and ABI to identify the SIC codes under which those distributors were categorized by the database vendors. Three SIC codes contained the majority of the identified distributors. The database vendors then supplied lists of the top 100 businesses (in terms of employment) in those SIC codes in MA.
- **Internet Search** - The project team used the Internet to review the websites for all identified distributors and characterize them in terms of their participation in each of the targeted HVAC equipment markets.
- **In-Depth Interviews** - Interviewed distributors were asked to review the list of distributors to identify other companies that were also active in the market.
- **Manufacturers** - In a complementary activity, the project team developed a list of manufacturers. Websites for those manufacturers were consulted to identify distributors of their equipment.

These procedures were able to develop a list of distributors for each equipment type, to characterize those distributors in terms of distributor types (i.e., manufacturer-owned, manufacturers' representatives, or independent) and to estimate the program participation rate of those distributors in the upstream program.

- **Boilers** - The project identified 57 boiler distributors that sell equipment in MA.
- **Chillers** - The project identified 15 chiller distributors selling equipment in MA.
- **Package units** - The project identified 30 distributors selling package units in MA. Fifteen of the 30 were listed as participating in the upstream HVAC incentive program. Another three of the 30 were known to the PA program staff, but are not currently participating.

- Ductless Mini-Splits - The project identified 41 distributors selling ductless mini-splits in MA. Fifteen of the 41 were listed as participating in the upstream HVAC incentive program. Another seven of the 41 were known to the program staff, but are not currently participating.

It is important to note that the distributors participating in the MA programs may represent a large share of the overall market even if they do not include the majority of companies producing a particular type of equipment. For example, in the package equipment market, the program lists only 15 of the 30 distributors that are selling this equipment. However, the 15 program participants are known to have a large market share in MA.

Appendix C furnishes tables with lists of distributors for each type of equipment.

6.2 Supply Chain

The project team was able to map the supply chain for the seven manufacturers interviewed in the Phase I study. While at least part of the mapping was able to be done through Internet research, the in-depth interviews were required to verify the distribution patterns. A key finding from the research was that the supply chain varies considerably by manufacturer and by equipment type. The supply chains for the interviewed manufacturers are presented in Appendix B.

The distributor interviews were an important source of information for the supply chain maps. Often, a distributor has several different distribution channels for HVAC equipment. For example, DCNE is an independent distributor of United Technologies Corporation (Carrier/Bryant) products. DCNE distributes equipment in three ways; to retail outlets, to contractors, and directly to end users. For many of the manufacturers, the supply chain was completed below the distributor level only for those distributors that were interviewed because the manufacturers do not have information on the ways that distributors market the equipment that they sell.

6.3 Findings from In-Depth Interviews

The project team reached out to 25 distributors and was able to complete 14 in-depth interviews. The respondent and company characteristics included:

- Respondent Title
 - o Five of the fourteen respondents were executives—Owner, President, or Vice President.
 - o Four were sales managers.
 - o Four had other management positions (e.g., Operations Manager).
 - o Two did not have their title listed on the website.
- Company Type
 - o Seven of the companies were manufacturers' representatives.
 - o Three of the companies were manufacturer-owned.
 - o Four of the companies were independent distributors.

The survey respondents were generally forthcoming with information about the equipment that they sell, the distribution channels that they use, and the way that they interact with the MA energy efficiency programs. But, most of the survey respondents were not able to furnish more detailed information about the MA HVAC markets and indicated that, in most cases, they know only the



location of the contractor, not the location of the end user where the equipment was installed. Distributors that participate in the Upstream Program have good information on the share of eligible equipment that was receiving incentives because they are required to track those data to receive incentives. However, they had little or no information on what share of eligible boilers and chillers—which offer downstream incentives—were receiving incentives. In this section, we list the key information objectives and the distribution of responses from the 14 interviewed respondents.

Topic #1 - If the PAs needed information on the listed C&I HVAC equipment markets, would there be one respondent or more than one for the distributor?

The IDI asked the respondent to indicate whether he or she would be the best contact to furnish information on all of the listed HVAC equipment markets. For all seven of the distributors that are manufacturers' representatives, there is one contact for all markets. The manufacturer-owned distributors and the independent distributors tended to have more divisions and more offices, many of which operated independently. Six of the seven respondents for those distributors listed more than one contact to gather comprehensive information about their sales.

Topic #2 - Is the distributor able to identify the specific location in which their HVAC equipment was installed, either in terms of the state or the ZIP code?

Among the seven distributors that are manufacturers' representatives, only one indicated that they could identify the location of the end user since they are engaged in equipment commissioning. Most of these distributors can identify the contractor locations, but some only sell to distributors.

Similarly, none of the manufacturer-owned or independent distributors would be able to track sales to end users. The best that they can do is to track sales by contractor ZIP code. While it is expected that most contractors sell to end users in the state in which they are located, that is not likely to be universally true. Three of the distributors identified special markets in which they either have a direct relationship with the end user or deliver the equipment to the end user; for those markets they could identify the final installation location.

Many of the distributors did mention that they are required to get end user location for the HVAC upstream program.

Topic #3 - Does the distributor have information on the share of their equipment that is used for new construction vs. renovation markets, and for planned or emergency replacements?

Most of the respondents reported that they do not track their equipment sales in that way and do not have much information on the share of their equipment that is used in different markets. Some of the respondents furnished estimates of new construction vs. replacements; the most common estimate was that new construction accounts for about 25 percent while replacement accounts for 75 percent. One distributor indicated that they had recently installed a new computer system that was designed to track that type of information. Another distributor noted that Carrier furnishes them with a report that projects industry trends, but that they "back into the data using information on housing starts and commercial building construction."

Topic #4 - Would the respondent be willing to furnish information to the PAs periodically on a confidential basis? [Note: It was suggested that the respondent could be offered a financial incentive, as well as aggregated market level findings.]

Most of the respondents expressed a willingness to participate in this type of information-gathering process. However, the respondents interpreted the question in a number of different ways. Some of the manufacturer representatives suggested that it was more appropriate for the manufacturer's regional manager to respond to such questions. At the other end of the spectrum, some of the manufacturers' representatives expressed interest in having a utility program manager attend meetings with their distributors and contactors to give them information about the program. Some of the independent distributors were interested in having a discussion with the PA program managers about their program design; one was concerned about whether incentive levels were large enough and another talked about incentivizing equipment systems rather than equipment. Two of the respondents did explicitly reference the financial incentive, but mainly from the perspective that the PA programs should pay the distributors for needed data to offset the costs of collecting and processing the information.

Topic #5 - Do the respondents know the share of their equipment that received incentives through the Upstream Program and do they perceive that it has had a positive impact on sales of high-efficiency equipment?

All of the distributors that sold equipment that qualified for the Upstream Program appeared to have a good understanding of the program. [Note: All of the distributors who sold package units and/or ductless mini-splits that were interviewed were program participants.] Moreover, because they had to document the equipment sale and delivery to the end users, they have a good idea of the share of their equipment sales that received incentives. Most of the respondents indicated that the program has had a positive impact on the sales of high-efficiency equipment, but none of the respondents had explicitly tracked how the percentage of sales that were high efficiency had changed as a result of the program.

Some respondents had concerns about the upstream program. A number of the respondents said that the program involved more work for the distributor to track information on the sales of qualifying equipment. Two of the respondents stated that the program has a cash flow issue; they order the equipment from the manufacturers at a price that is higher than the price for which they are selling the equipment. It appears that they have to pay the manufacturer for the equipment before they receive the equipment incentive, thereby creating negative cash flow for the company.

Topic #6 - Do the respondents know the share of their equipment that received incentives through the End User programs and do they perceive that it has had a positive impact on sales of high-efficiency equipment?

All of the distributors that sold equipment that qualified for the end user programs appeared to have some understanding of the program. However, since they do not apply for or receive the incentive, they do not know what share of their qualifying equipment actually receives end user incentives. Several of the respondents also reported that there is some confusion with respect to the program branding; they are unclear why the incentives are marketed under both the GasNetworks Program and the Mass Save Program. As with the upstream program,



they perceive that the program is having an impact on sales of high-efficiency equipment. However, since they are not reporting on the sales of qualifying units, they do not explicitly track that information in their systems.

Topic #7 - Do the respondents perceive that the Mass Save programs are considered by manufacturers when they are making decisions on production and stocking of high-efficiency equipment for a market?

Nine of the fourteen respondents reported that the MA programs are having an impact on distributor stocking decisions in general and on their stocking decisions in particular. Most of those reported the programs as having a "major impact" and that they are "stocking a lot more high-efficiency equipment now than they did a few years ago." One of the fourteen respondents said that they started to stock high-efficiency equipment, but that it was not purchased, so they have stopped that practice. Four of the fourteen distributors do not stock equipment; they custom order equipment or are involved in buy-sell arrangements.

Topic #8 - Are the respondents aware of sources of information on the sales of C&I HVAC equipment by the level of efficiency?

Five of the fourteen respondents indicated that they are aware the manufacturers report data to ARHI. One respondent said that he sees reports on equipment from GAMA, which was absorbed by AHRI in 2008. The other eight respondents were not aware of any tracking data on equipment sales.

These responses help to characterize the role of the distributor in the HVAC supply chain. In general, they show that most distributors are quite engaged in the MA HVAC equipment market and with MA HVAC equipment energy efficiency programs. They have a particularly good understanding of the upstream programs since they are direct participants. While they are aware of the end user programs, they do not have a good understanding of how they influence markets because they are not directly involved with the program incentives.

6.4 Sales Tracking Data

The IDI responses suggest that the distributors could furnish some information for tracking the sales of HVAC equipment by type and efficiency level.

- **Tracking Data** - It appears that distributors, particularly manufacturer-owned distributors and independent distributors, are more likely to have data on equipment sales by equipment type and efficiency than are manufacturers because distributors are required to track this information for qualifying equipment in the Upstream Program. However, they don't currently track data in the way that it might be requested for all equipment sales, and it might be costly for them to collect and report the information to the PAs.
- **Location Data** - Distributors generally can track their sales to a particular contractor. While the contractor does not always install the equipment in the state where they are located, distributor respondents believed that many of their contractors work only in their local area.

And, to the extent that some distributors work directly with end users, it is also possible to track those sales from distributors. However, the distributors would not have information on manufacturer sales that are direct to contractors or end users.

7 MECHANICAL ENGINEERS

The Phase I Scoping Study conducted IDIs with 32 end users and asked them to identify the individual or company that was responsible for developing the HVAC equipment and system specifications. In almost every case, they identified a mechanical engineer as having the most influence over the final HVAC specifications. For most projects, the end user identified the general type of HVAC system that they wanted, the mechanical engineer developed the system specifications, and the installation contractor purchased the HVAC equipment from a distributor. Among all of the potential design professionals (i.e., architects, electrical engineers, and mechanical engineers) the mechanical engineer was the professional most directly involved in the HVAC supply chain. For that reason, this report focuses on mechanical engineers rather than other design professionals.

The Scoping Study examined the following questions related to the collection of information from mechanical engineers.

- **Sample Frames** - Is it possible to develop a list of mechanical engineers that has a high coverage rate and that includes information on the relative market share for each company?
- **Survey Respondents** - What company title would be the best respondent for each type of information sought by the MA PAs? Under what circumstances would a panel approach to data collection improve the amount and quality of information furnished by mechanical engineers?
- **Feedback on Program Design and Implementation** - Are mechanical engineers willing to provide feedback on MA program design initiatives? Are mechanical engineers able to furnish feedback on MA PA energy efficiency programs based on their program experiences?

The Scoping Study activities that helped to address these questions included:

- **Data Mining of Dodge Database** - The Dodge database was used to develop a list of mechanical engineers associated with New Construction and Renovation projects.
- **Linked In-Depth Interviews** - The project team conducted in-depth interviews with end users from the PA program database, the Dodge New Construction projects database, and the Dodge Renovation projects database. As part of that interview, end users were asked to identify the individual or organization that was most influential in the specification of the HVAC equipment. In 26 of the 32 interviews, the end user identified a mechanical engineer. In most cases, the identified company was a consulting engineer. However, end users also named some companies that served as both the general contractor and engineer for the project. In a few cases, the end user reported that the engineering department within their own company took responsibility for HVAC specifications.

This combined set of activities furnished comprehensive information on mechanical engineers that have a role in HVAC equipment specification.

7.1 Sample Frames

The project was able to develop a comprehensive sample frame of MA mechanical engineers using the Dodge database. F.W. Dodge is a subsidiary of McGraw-Hill that collects information on C&I building projects, including new construction, additions, and renovations. They have a network of reporters that use a variety of sources to identify planned construction projects and to report on market actors



associated with projects, including the building owner, the general contractor, the architectural firm(s), and the engineering firm(s).

For period from 2010 to 2013, the Dodge reports included information on \$18.6 billion in new construction projects; 87 percent of those projects listed a firm that was furnishing mechanical engineering services. For that same period, the Dodge reports included information on \$5.3 billion in building renovation projects; 46 percent of those projects listed a firm that was furnishing mechanical engineering services.

Each project has an estimated project value that can be used as a measure of size for the project (i.e., an indicator of the total square footage associated with the building). And, by adding the project value for all projects in which an engineering consulting firm is participating, it is possible to get an estimate of the amount of work done by each engineering consulting firm each year.

The following statistics were developed for the period from 2010 through 2013 for New Construction and Additions.

- Number of Firms - 410 firms were listed as having furnished mechanical engineering consulting services for one or more projects.
- Top Ten Firms - The top 10 firms were associated with about 50 percent of all new construction/addition projects listed in Dodge as having a mechanical engineer.

The following statistics were developed for the period from 2010 through 2013 for Building Renovations.

- Number of Firms - 254 firms were listed as having furnished mechanical engineering consulting services for one or more projects.
- Top Ten Firms - The top 10 firms were associated with about 50 percent of all building renovation projects listed in Dodge as having a mechanical engineer.

In total, 551 mechanical engineering firms were identified by using the F.W. Dodge data. However, 13 of those firms are responsible for more than 50 percent of all projects that use mechanical engineers.

Appendix D furnishes tables with lists of the top ten mechanical engineers for New Construction/Additions and the top ten mechanical engineers for Building Renovations.

7.2 Supply Chain

The Scoping Study found that among design professionals (i.e., architects and engineers), mechanical engineers are most often mentioned with respect to HVAC equipment specification. The supply chain appears to including the following:

- End User - The end user decides to undertake a project that includes HVAC equipment. They ask a mechanical engineer to develop equipment specifications.
- Mechanical Engineers - The mechanical engineer develops HVAC specifications that are consistent with end user needs. It does not appear that engineers specify a particular equipment brand, rather the specifications that the equipment should meet.

- End User - The end user hires a contractor to purchase and install the equipment according to the mechanical engineer's specifications.
- Contractor - The contractor get bids for equipment from distributors. They will verify that the proposed equipment meets the specifications.
- Distributor - If the distributor stocks the equipment, they will furnish the contractor with a bid that meets the specifications. If the equipment is made to order, the distributor will work with the manufacturer to develop a price estimate.
- Manufacturer - The manufacturer supplies equipment to the distributor when ordered. For made-to-order equipment, the manufacturer will work with the distributor to develop a price for the equipment.

The mechanical engineer is part of the supply chain since they develop the equipment specifications. However, in most cases, it appears that the mechanical engineer is not in a direct line between the end user and the manufacturer.

7.3 Findings from In-Depth Interviews

The project team conducted 32 in-depth interviews with mechanical engineers. The engineers were identified in the following way:

- End Users - The project team conducted IDIs with 32 end users; eleven interviews were with businesses that received end user incentives from the PA programs, eleven were with businesses that were listed in the Dodge renovation projects, and ten were with business that were listed in the Dodge new construction projects database.
- "Linked" HVAC Consultant - For 26 of those projects, the project team conducted an interview with the professional identified by the end user as having had the greatest influence on the HVAC specifications. In all cases, the linked HVAC consultant was a mechanical engineer; 20 of these worked for engineering consultants, 4 worked for ESCOs, and 2 worked for contractors.
- Dodge List Mechanical Engineers - In addition to the 26 "linked" interviews, the project team conducted 5 interviews with mechanical engineers from the Dodge list and the PA program databases.

In general, the mechanical engineers were aware of and understood the MA PA programs. They varied considerably in terms of whether they were active or passive participants in the programs.

Topic #1 - Who initiated the project ... the end user, the mechanical engineer, or the HVAC contractor? What are the engineer's perceptions of the programs?

Among the 12 projects that were identified from the PA program databases, there were a number of different sources for project initiation:

- PA Programs/ESCOs - For four of the projects, the primary source of influence was a combination of activities from the MA PA programs and ESCOs that are partners with one or more of the PAs.

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- End User Engineers - For two of the projects, the end user actively pursued project incentives in partnership with the engineering department of their company.
 - End Users - For four of the projects, the end user asked the engineering consultant to specify qualifying equipment.
 - Contractor/Engineer - For two of the projects, the contractor or engineer recommended that the end user consider using the PA programs.

For about one-half of the projects, the decision to install qualifying HVAC equipment was at the initiative of the end user, while for the other one-half, the ESCO, engineer, or contractor was influential.

Among the 10 projects that were identified as renovation projects from the Dodge databases, one-half of the projects reported that they received program incentives. Among those that received incentives, all of the projects were initiated by the end user. The mechanical engineers varied with respect to their involvement.

- Active Participants - Of the five participating projects, two had mechanical engineers that reported that they encourage end users to make use of the programs.
- Passive Participants - Of the five participating projects, three had mechanical engineers that are willing to help end users apply for incentives, but expect the user to request qualifying equipment.
- Nonparticipants - Of the five nonparticipating projects, only one of the mechanical engineers indicated that he presented the end user with options for specifying qualifying equipment. For three of the nonparticipating projects, the mechanical engineer was not comfortable in specifying equipment that qualified for the incentives. One project had a performance-based contract for which the contract did not wish to use the MA program incentives.

Among the 10 projects that were identified as new construction/addition projects from the Dodge databases, one-half of the projects reported that they received program incentives. Among those that received incentives, four of the five projects were initiated by the end user. The mechanical engineers varied with respect to their involvement.

- Active Participants - Of the five participating projects, three had mechanical engineers that reported that they encourage end users to make use of the programs.
- Passive Participants - Of the five participating projects, two had mechanical engineers that are willing to help end users apply for incentives, but expect the user to request qualifying equipment.
- Nonparticipants - Of the five nonparticipating projects, only one of the mechanical engineers indicated that he presented the end user with options for specifying qualifying equipment. For three of the nonparticipating projects, the mechanical engineer reported being comfortable in specifying equipment that qualified for the incentives, but that they leave that decision to the end user. For one project, the mechanical engineer was unaware of the program incentives.



These responses suggest a fairly high level of engagement among mechanical engineers. Twenty-four end users identified a non-ESCO mechanical engineer as the most influential party involved in equipment specification. The remaining six end users identified an ESCO (four projects) or an HVAC contractor (two projects). The 24 mechanical engineers reported the following.

- Active Participants - Eight of the 24 indicated that they actively alert end users to the benefits of program participation.
- Passive Participants - Twelve of the 24 indicated that they are able to respond effectively when the end user requests that they specify qualifying equipment.
- Nonparticipants - Four of the 24 indicated that they are not particularly comfortable with the program HVAC equipment specifications. Of those, only one was not aware of the PA programs.

It appears that, for the most part, mechanical engineers are aware of the MA programs and that they are knowledgeable about the program requirements. It is possible that the most fruitful area for engagement would be in terms of working to increase the rate at which mechanical engineers market the program to end users.

Topic #2 - If the PAs needed information on the listed C&I HVAC equipment markets, would there be one respondent or more than one for the mechanical engineering consultant?

The IDI asked the respondent to indicate whether he or she would be the best contact to furnish information on all of the listed HVAC equipment markets. The responses varied by the type of project:

- Program Participants - For seven of the ten projects, the respondent indicated that one person would be able to answer all of the questions. For three projects, the respondent said that one person would answer sales and operations questions, while a different person would be appropriate to answer more technical questions.
- Renovation Projects - For four of the ten projects, the respondent indicated that one person would be able to answer all of the questions. For five projects, the respondent said that more than one person would be appropriate, with two respondents suggesting that a different person would be appropriate to answer each of the three topics listed. One respondent did not answer the question.
- New Construction Projects - For eight of the ten projects, the respondent indicated that one person would be able to answer all of the questions. For two projects, the respondent said that one person would answer sales and operations questions, while a different person would be more appropriate to answer more technical questions.

Topic #3 - Would the respondent be willing to furnish information to the PAs periodically on a confidential basis? [Note: It was suggested that the respondent could be offered a financial incentive, as well as aggregated market level findings.]

The IDI asked the respondent to indicate whether he or she would be willing to participate in a panel that would respond to questions several time per year. The responses varied by the type of project:

- **Program Participants** - For six of the ten projects, the respondent indicated a willingness to participate. For four projects, the respondent said that they did not see value to participation.
- **Renovation Projects** - For seven of the ten projects, the respondent indicated a willingness to participate. For three projects, the respondent said that they did not see value to participation.
- **New Construction Projects** - For seven of the ten projects, the respondent indicated a willingness to participate. For three projects, the respondent said that they did not see value to participation.

Many of the respondents who were willing to participate in the panel were interested in being sure that this was a two-way communication; the respondent would respond to the questions as long as they saw that their information was being used effectively. A few respondents indicated that they would participate as long the interviews stayed in the range of 15 minutes.

When a respondent said that he or she would not be interested in participating in a panel, the respondent most often indicated that he or she does not have much involvement with the MA programs and therefore did not see any benefit from responding to the surveys.

7.4 Sales Tracking Data

It does not appear that there is any role for mechanical engineers in tracking equipment sales. While they develop specifications for HVAC equipment and sometimes advocate for program participation, they usually are not directly involved with the purchase or installation of the HVAC equipment.

8 HVAC CONTRACTORS

The Phase I Scoping Study conducted IDIs with 32 end users and asked them to identify the individual or company that was responsible for developing the HVAC equipment and system specifications. In almost every case, they identified a mechanical engineer as having the most influence over the final HVAC specifications. For most projects, the end user identified the general type of HVAC system that they wanted, the mechanical engineer developed the system specifications, and the installation contractor purchased the HVAC equipment from a distributor using the specifications.

The Scoping Study examined the following questions related to the collection of information from HVAC contractors.

- **Sample Frames** - Is it possible to develop a list of HVAC contractors that has a high coverage rate and that includes information on the relative market share for each company?
- **Survey Respondents** - What company title would be the best respondent for each type of information sought by the MA PAs? Under what circumstances would a panel approach to data collection improve the amount and quality of information furnished by HVAC contractors?
- **Feedback on Program Design and Implementation** - Are HVAC contractors willing to provide feedback on MA program design initiatives? Are HVAC contractors able to furnish feedback on MA PA energy efficiency programs based on their program experiences?

The Scoping Study activities that helped to address these questions were:

- **Data Mining of PA Program Databases** - Many of the PA program databases have information on the contactors associated with projects that receive program incentives. The project team identified the projects that include HVAC equipment and developed a list of contractors associated with those projects.
- **Commercial Database Mining** - The project team sent the list of program contractors to D&B and ABI to identify the SIC codes associated with the listed businesses. The project team then asked D&B to furnish a list of businesses in the targeted SIC codes to identify other contractors with similar characteristics.
- **Internet Search to Characterize Contractors** - The project team reviewed the list of the top 100 contractors, identified those that were program participants, and assessed which of the program nonparticipants furnished HVAC services to C&I end users in MA.
- **Linked In-Depth Interviews** - The project team conducted in-depth interviews with end users from the PA program database, the Dodge New Construction projects, and the Dodge Renovation projects. As part of that interview, end users were asked to identify the individual or organization that was most influential in the specification of the HVAC equipment. In six of the 32 interviews, the end user identified an HVAC contractor. However, in all of those cases, the contractor was an organization that furnished both contracting and engineering services. So, the contractor IDIs have limited value in helping to understand HVAC contractors that focus mainly on HVAC installation.

This combined set of activities furnished good information on how to identify HVAC contractors, but fell short of the goal of characterizing the interaction of HVAC contractors with the MA programs.

8.1 Sample Frames

Unlike the mechanical engineers, HVAC contractors are not separately listed in the Dodge database. And, unlike manufacturers and distributors, where there are a limited number of businesses, there are thousands of firms listed in the D&B data as HVAC contractors. [Note: There are 4,498 firms listed for MA in SIC 1711.] So, it is not possible to do an Internet search for all relevant businesses.

The project was able to develop an effective strategy for building a sample of HVAC contractors, but a complete list of contractors was not developed.

The process for developing the sample frame involved the following procedures.

- **Program Participants** - The initial list of HVAC contractors was developed from program databases by identifying the contractor listed for projects that received HVAC incentives.
- **Commercial Databases** - The list of HVAC contractors was sent to D&B and ABI to identify the SIC codes under which those distributors were categorized by the database vendors. One SIC code contained almost one-half of the identified HVAC contractors. The database vendors then supplied lists of the top 100 businesses (in terms of employment) in that SIC code in MA.
- **Internet Search** - The project team used the Internet to review the websites for the top 100 HVAC contractors. For each, the team assessed whether the contractor was a program participant and whether the contractor was active in the C&I HVAC market.

This process was able to identify the SIC codes associated with HVAC contractors and to develop procedures for developing sample frames for different kinds of contractors.

Table 5 shows the results of the D&B match for participating HVAC contractors. Close to one-half of contractors were listed in D&B under SIC 1711 - Plumbing, Heating, and Air Conditioning Services. However, 28 percent of the participating contractors were listed in other related trades, including Electrical Work, Lumber and Building Materials, and General Residential Materials. In addition, ESCOs that work in MA are sometimes listed as Engineering Consultants or Business Consultants and represent about 8 percent of participating contractors.

Table 5
Participating HVAC Contractors by SIC Code (D&B Listings)

SIC Code	Number of HVAC Contractors	Percent of HVAC Contractors
1711 - Plumbing, Heating, and Air Conditioning	78	42%
1731 - Electrical Work	16	9%
5211 - Lumber and Building Materials	12	7%
1521 - General Contractors – Residential	7	4%
8711 - Engineering Consultants	7	4%
8748 - Business Consultants	7	4%
5084 - Wholesale - Machinery and Equipment	7	4%
Other Codes	47	26%
TOTAL	134	100 %

To develop a comprehensive sample frame, it would be appropriate to include businesses from more than one of those SIC codes. However, while many of the businesses in SIC 1711 could be expected to furnish C&I HVAC services, it would not be as common for such services to be offered by firms listed in other SIC codes. Through an Internet search of businesses, it is possible to make the sample frame more efficient.

The project team tested this procedure for SIC 1711. Table 6 shows the results of that exercise. D&B furnished a list of the top 100 businesses in terms of the number of employees. The research found that 16 of the 78 participating C&I HVAC contractors were among the top 100 HVAC contractors in MA. Sixty additional businesses in that list delivered C&I HVAC services according to their websites, while 24 of the listed businesses delivered other services (e.g., residential HVAC services, plumbing services). For this list of contractors, 16 of 76 that supply C&I HVAC services were listed in program databases, suggesting that the contractor program participation rate was about 20 percent.

Table 6

Characterization of HVAC Contractors in SIC Code 1711 (D&B Listings)

Status	Number of HVAC Contractors	Percent of HVAC Contractors
Participating C&I HVAC Contractor	16	16 %
Nonparticipating C&I HVAC Contractor	60	60 %
Not a C&I HVAC Contractor	24	24 %
TOTAL	100	100 %

By repeating that same process for a number of the listed SIC codes, the project team could develop a sample frame of HVAC contractors that strikes an appropriate balance between population coverage (i.e., including a large percentage of the total number of eligible businesses) and sample efficiency (i.e., having a large percentage of businesses eligible for the study to reduce screening costs).

While the project team has identified a method for constructing a sample frame, information on market share was not readily available from the identified data sources. Relative market share could be determined by further research and collaboration with contractors.

8.2 Supply Chain

The Scoping Study found that most end users rely on HVAC contractors to place orders for HVAC equipment according to the specification developed by mechanical engineers. The supply chain appears to consist of the following:

- End User - The end user decides to undertake a project that includes HVAC equipment. They ask a mechanical engineer to develop equipment specifications.
- Mechanical Engineers - The mechanical engineer develops HVAC specifications that are consistent with end user needs. It does not appear that engineers specify a particular equipment brand, rather the specifications that the equipment should meet.
- End User - The end user hires a contractor to purchase and install the equipment according to the mechanical engineer's specifications.
- Contractor - The contractor get bids for equipment from distributors. They will verify that the proposed equipment meets the specifications.
- Distributor - If the distributor stocks the equipment, they will furnish the contractor with a bid that meets the specifications. If the equipment is made to order, the distributor will work with the manufacturer to develop a price estimate.
- Manufacturer - The manufacturer supplies equipment to the distributor when ordered. For made-to-order equipment, the manufacturer will work with the distributor to develop a price for the equipment.



Some HVAC contractors appear to deliver more comprehensive services; their staff includes both mechanical engineers and HVAC installation technicians. However, for the majority of end users interviewed for the Scoping Study, those two functions were separate.

8.3 Findings from In-Depth Interviews

The IDIs included six firms that might be considered to be HVAC contractors. However, four of them were actually ESCOs that have contractual relationships with one or more MA utilities, while two of them were firms that have both engineering staff and HVAC installation staff.

8.4 Sales Data Tracking

It appears that sales data tracking would require some cooperation of or collaboration with HVAC contractors. The Upstream Program has found that participating distributors already get some pushback from contractors when they are asked to identify the HVAC equipment installation location so that the program can verify installation. However, since sales data tracking ideally would require identification of sales to both qualifying and nonqualifying equipment, it might be more difficult for distributors to get those data from contractors. For that reason, some partnership with HVAC contractors might be needed to get a high coverage rate for any sales data tracking to the end user level. If sales tracking to contractor location is adequate, no collaboration with contractors would be necessary.

9 FINDINGS AND RECOMMENDATIONS

The purpose of this report is to present findings and recommendations with respect to the following issues:

- **Data Collection Strategies** - Developing data collection strategies that maximize the quality of information and minimize the burden on respondents, and considering the option of implementing survey panels for targeted respondents from larger firms.
- **Sample Frames** - Identifying of the most effective strategies for developing sample frames for research on supply side market actors.
- **Supply Chain** - Determining the role of different types of trade allies in the supply chain for HVAC systems and equipment.
- **Sales Tracking Data** - Investigating whether it is possible to collect HVAC equipment sales data by equipment type and efficiency level from one or more of the trade allies identified in this research.

The Scoping Study was able to address all of these issues. In some cases, it furnishes direct answers to the questions posed by the project. In others, it furnishes recommendations for follow-up that will be able to address those questions.

9.1 Data Collection Strategies

Research projects often have difficulty collecting information from HVAC supply chain market actors. Common problems include difficulty getting through gatekeepers, identifying the right respondent, and scheduling interviews. In addition, there is a special problem that some firms have a large presence in the marketplace for a particular type of equipment and would be sampled for every research project



that needs information on that type of equipment. The Scoping Study identified a number of strategies that appeared to be successful in overcoming these challenges.

- Project Specific Contacts - The Dodge database has a project specific contact for each project. By using those contacts, the project was able to identify an individual who could speak about the specific project and more generally about program experiences.
- End User Linked Contacts - A similar strategy used by the Scoping Study was to contact an end user about their project, and then ask that end user contact to identify an installation contractor and/or mechanical engineer contact. Most end users were willing to furnish that contact, and more than two-thirds of the identified installation contractors and engineers agreed to participate in the in-depth interview.
- Internet - Most HVAC supply chain market actors have websites that describe their business and identify contacts for different products. By using those contacts, the project team was able to get past gatekeepers and directly approach a targeted respondent.
- Interview by Professionals - The project team did not have any difficulty getting the targeted number of interviews with each type of respondent. The completion rate for different groups was between 20 percent and 70 percent in a relatively short time frame. (The field period for each type of interview was two to three weeks.) The interviewers were professionals who had a good understanding of the technical, management, and marketing issues raised by survey respondents.

It is difficult to implement these strategies for each new C&I study that needs to contact and interview HVAC trade allies. There are challenges in coordinating data collection processes across multiple studies when each study has its own research objectives, schedule, and sample frame. And, this is made even more challenging when the number of market actors is small (e.g., there are only about 18 manufacturers of RTUs selling products in MA; and, those same manufacturers are part of a small population of manufacturers of chillers). For that reason, the Scoping Study investigated the potential for developing panels for survey implementation for this group of market actors.

The survey asked respondents whether they would be willing to participate in a panel where they would be asked to respond to prioritized survey questions several times each year at predictable intervals. Almost all respondents that had some involvement with the program responded that they were will to participate in such a panel. And, they preferred a panel that would provide them with two-way communication with program staff; they wanted to give feedback on the program and expected to hear about new developments in the program from the PAs. Individuals who had little or no involvement with the program did not see the value in participating in surveys, either as part of a panel or through an *ad hoc* contact. [Note: Contractor survey respondents were nominated by end users who had worked with them on specific HVAC installation projects. That mechanism was successful in gaining initial cooperation from contractors who have no involvement with the program.] For such organizations, participation in either *ad hoc* or panel data collection is likely to require a direct financial incentive, rather than market intelligence for participation. [Note: If a panel were developed where some respondents were compensated, it would be appropriate to compensate all panel members, even if they would be willing to participate without compensation.]

Recommendation #1 - The project team verified that a relatively small number of manufacturers, distributors, and mechanical engineers in the HVAC supply chain have a relatively large presence in the market. For that reason, getting market information or program feedback from those market



actors requires a somewhat different data collection approach to gather comprehensive and good-quality information. And, it is clear that those market actors are willing to participate in a panel approach to data collection, and that such an approach would help to make data collection more effective. We recommend that the PAs and EEAC move forward with the development of a panel for data collection from those market actors. While the most common response from respondents was they wanted "two-way communication" with the program as compensation for their participation, we recommend that the panel participants also should be compensated to further increase their commitment to respond on a continuing basis. [Note: The Scoping Study has already identified a number of individuals who would be responsive if they are contacted in the near future for panel participation. Those individuals would furnish a good start to the panels for manufacturers, distributors, and mechanical engineers.]

Recommendation #2 - The project team found that some contractors actively market the PA programs, some always present options for qualifying and nonqualifying equipment to end users, some are responsive when end users request that they include qualifying equipment as one of the options, and some appear to discourage end users from purchasing qualifying equipment. The PAs and EEAC need to hear from all of those types of contractors to run effective programs. Since ad hoc data collection activities are more likely to get responses from contractors that are more engaged with the program, it is likely that such surveys would fail to give the PAs and EEAC a complete understanding of their programs. For that reason, the project team recommends that, in connection with the sample frame development in Recommendation #3, the PAs and EEAC authorize the C&I team to move forward with recruitment of a panel of C&I HVAC contractors that would facilitate better quality data collection from these market actors. And, the project team recommends that the panel include direct compensation for panel participants to ensure that the panel is appropriately balanced with contractors that have different levels of engagement with the program.

9.2 Sample Frame Findings and Recommendations

The Scoping Study examined each trade ally in the HVAC supply chain and found that the appropriate sample frame development methodology was different for each targeted analysis group.

- **Manufacturers** - There are a number of published lists of HVAC equipment manufacturers. However, those lists generally do not target specific equipment types and do not account for regional differences in distribution patterns. The project team found that, by starting with published lists, updating those with information from PA program databases, and then cross-referencing those lists with information from manufacturer and distributor websites, they were able to develop a comprehensive list of manufacturers for each type of HVAC equipment targeted by the Scoping Study (i.e., boilers, chillers, RTU package units, and ductless mini-splits). However, while they could gather information on which manufacturers are perceived to be the largest for each type of equipment, they were not able to identify any quantitative information that would allow one to compute market shares for each equipment type. While this is not a barrier to conducting an effective study, it means that the study would not be as statistically efficient as it would be if those data were available. [Note: PPS samples are the most efficient; for any given sample size, a PPS sample will have a smaller confidence interval than an SRS sample. However, while the PPS sample is more efficient, a study can be conducted using SRS procedures if measure-of-size data are not available.]
- **Distributors** - The best sources of information for distributors were the Upstream Program participant lists, manufacturer websites, and commercial databases. There are a relatively small number of wholesale distributors for each type of equipment and they can be identified



from those sources. Moreover, each distributor has its own website that characterizes the products that they sell. However, as with manufacturers, the project team was not able to identify any source that would furnish information on relative market shares.

- Mechanical Engineers - The F.W. Dodge database furnishes a rich source of data for firms that furnish engineering services to new construction and renovation projects. Moreover, since the Dodge database furnishes information on project size, it is possible to estimate the relative market share for a firm that furnishes engineering services. The sample frame would facilitate an effective and efficient design for any study that targeted data collection with mechanical engineers.
- HVAC Installation Contractors - The project had some success in identifying sources of information for HVAC installation contractors. The PA program databases were used to identify the contractors associated with projects that received incentives for HVAC equipment. Those identified contractors were then used to identify the most common SIC codes for HVAC installation contractors. Commercial databases were used to develop a list of businesses in those SIC codes, and then company websites were used to screen businesses for delivery of C&I HVAC installation services. In addition, supply chain mapping for manufacturers and distributors helped to identify divisions of those companies that work directly with end users. The Scoping Study was able to identify an effective strategy for development of a comprehensive contractor sample frame, but additional work would be needed to complete the development of that sample frame.

The project team was able to identify a strategy for all four groups of supply chain market actors. For manufacturers and distributors, they were able to develop comprehensive frames, but were not able to identify relative market shares. For mechanical engineers, they were able to develop a comprehensive frame with information on relative market shares. Finally, for HVAC installation contractors, they were able to identify an effective strategy, but were not able develop a complete frame as part of this project.

Recommendation #3 - Based on the findings from the Scoping Study, the project team finds that it is possible to develop comprehensive frames for the targeted HVAC supply chain market actors. We recommend that the PAs and EEAC move forward with systematic sample frame development for manufacturers, distributors, mechanical engineers, and installation contractors so that those frames are available to any study that needs to contact those market actors, and to facilitate the development of panels of market actors.

One common approach to development of a sample frame is to extract data from a commercial database for targeted NAICS and/or SIC codes. The data mining, Internet research, and IDIs conducted for this study highlight some of the ways that such an approach falls short. For example, for contractors it 1) misses divisions of manufacturers and distributors that work directly with end users, 2) may miss certain types of businesses that are not typically thought of as HVAC contractors (e.g., business consultants), and 3) furnishes a sample frame with many organizations that do not deliver the targeted services. By implementing the strategies developed in this Scoping Study (i.e., data mining from program databases, expanding the number of SIC codes included in the data extract from commercial databases, and using the Internet and brief screening interviews where necessary) one can develop a sample frame that has both high coverage of the eligible population and a higher percentage of sample frame units that are eligible for the survey.

9.3 Supply Chain Findings and Recommendations

The study looked at the HVAC equipment supply chain in two different ways: bottom-up and top-down. The bottom-up supply chain describes the most typical supply chain from the perspective of the "average" end user based on in-depth interviews with end users who installed new HVAC equipment. The top-down supply chain shows how the supply chain varies by manufacturer and equipment types.

From the end user perspective, the typical supply chain involves the following.

- End User - The end user decides to undertake a project that includes HVAC equipment. They ask a mechanical engineer to develop equipment specifications.
- Mechanical Engineers - The mechanical engineer develops HVAC specifications that are consistent with end user needs.
- End User - The end user hires a contractor to purchase and install the equipment according to the mechanical engineer's specifications.
- Contractor - The contractor get bids for equipment from distributors. They will verify that the proposed equipment meets the specifications.
- Distributor - If the distributor stocks the equipment, they will furnish the contractor with a bid that meets the specifications. If the equipment is made to order, the distributor will work with the manufacturer to develop a price estimate.
- Manufacturer - The manufacturer supplies equipment to the distributor when ordered. For made-to-order equipment, the manufacturer will work with the distributor to develop a price for the equipment.

There are some important variations from the perspective of the end user. In some cases, the study found that end users have engineering and/or operations departments that take responsibility for specification and/or purchase of equipment. It is also true that many publicly-funded end users (e.g., schools or local government) have competitive bid policies that affect selection of HVAC equipment.

The Scoping Study also found that, at any point along the supply chain, a market actor may recommend to the end user that they upgrade the equipment specifications to take advantage of MA program incentives. Some contractors, mechanical engineers, and distributors are proactive with respect to using program incentives; they will always present that option to the end user. Other market actors are more passive; at the end user's request they will present options for using higher efficiency equipment.

However, to conduct effective research on supply chain market actors, research projects often need to take a top down approach to identification of market actors. The market actors involved in any project are often a function of the specific distribution channels that can vary by manufacturer and equipment type. For example, it appears that a significant share of the HVAC equipment sold by the United Technologies Corporation (Carrier/Bryant/ICP) follow a "typical" distribution model. However, the largest distributor of United Technologies equipment has a special unit that works directly with end users on HVAC replacement projects. The research identified a number of other manufacturers and distributors that use distribution channels that differ from the "typical" model.



In addition, the research found that, in some cases, an organization will play more than one role in the supply chain. For example, the study found a number of companies that furnish both equipment design and equipment installation services. [Note: These companies were different from the ESCOs that work directly with the PAs on program implementation.]

Recommendation #4 - Based on the findings from the Scoping Study, the project team recommends that the HVAC supply chain maps for manufacturers and distributors should be completed for each important manufacturer and equipment type so that future data collection and analysis projects are targeting the right respondents to research issues related to these market actors. [Note: They are already completed for seven manufacturers and 14 distributors for the four equipment types listed in the report. The manufacturer sample frames in Appendix A show that there are 18 RTU manufacturers, 21 chiller manufacturers, 25 ductless mini-split manufacturers, and 43 boiler manufacturers, with substantial overlap among those companies.] Mapping is particularly valuable for sample frame development for manufacturers and distributors, and for identifying departments or divisions of manufacturers and distributors that should be included in contractor sample frames.

9.4 Sales Data Tracking

The Scoping Study gathered information on whether equipment sales tracking data could be collected from manufacturers, distributors, and/or contractors in such a way that it would be possible to measure the change in the installation rates for qualifying equipment in MA. The project team learned the following about each potential sales tracking partner:

- **Manufacturers** - The survey respondents interviewed in the Scoping Study reported that their companies do not consistently track information on HVAC equipment by type and efficiency level.⁷ In addition, most reported that they track sales by region, rather than by state. And, if they were to look at sales data, the best that they would be able to do would be to report the location of the distributor or, in some cases, the contractor to whom they sold the equipment. They generally do not have end user data. [Note: Some manufacturers report that they send data on shipments to AHRI. Follow-up interviews with AHRI found that the manufacturers send them data on shipments by model number to locations with varying specificity. In most cases the location would be a distributor. However, our supply chain mapping found that manufacturers sell equipment directly to distributors, retailers, contractors, and end users.]
- **Distributors** - The survey respondents interviewed in the Scoping Study reported that their companies do not consistently track information on HVAC equipment by type and efficiency level. Since many are participating in the upstream HVAC program, they have a better idea about equipment efficiency levels for equipment that is covered by the Upstream Program than they do for the equipment that receives end user incentives. However, except in cases where distributors receive end user addresses to validate upstream incentives, they do not have the address of the end user; they just have the address of the contractor who purchased and installed the equipment. Moreover, many distributors reported that they had gotten pushback from contractors when they asked to report the end user location for qualifying equipment.

⁷ While there were only seven manufacturer respondents, the companies interviewed represented more than 60 percent of HVAC sales nationwide according to the "Mass Save Upstream HVAC and HP Initiative Work Paper" that was completed as part of the Upstream Program development process.

- Installation Contractors - The Scoping Study conducted IDIs with only a few HVAC installation contractors because end users usually reported that the mechanical engineer, rather than the installation contractor, specified the HVAC system and equipment. However, the study found that only about 20 percent of large C&I HVAC contractors could be identified as "participants" from the program tracking databases. Moreover, distributors report that they would need the support of contractors to report on MA end user installations of qualifying and nonqualifying equipment. Several distributors suggested that contractors could be paid to furnish these data.

The Scoping Study also learned that there are certain divisions of manufacturers that work directly with contractors and end users, and certain divisions of distributors that work directly with end users. Those sales would need special tracking procedures since they are outside the main distribution channels.

In their November 25, 2014, report the MA Cross Cutting research team made recommendations to the PAs and EEAC regarding collection of sales tracking data. This Scoping Study collaborated with the Cross Cutting team (e.g., certain IDI questions were specified by the Cross Cutting team) and can furnish some information that may be helpful to the Cross Cutting team as they consider their recommended approach to sales tracking.

1. Upstream Program Collaboration - The Cross Cutting team recommended that the sales tracking data "Build on the Upstream HVAC Program's distributor data collection to obtain market share data for commercial RTUs" from "Independent distributors." This project obtained some additional information that may help to broaden that recommendation.
 - a. Type of Distributor - The participating Upstream Program has agreements with all types of distributors, including independent distributors, manufacturer owned distributors, and manufacturers' representatives. Since all are currently reporting data using the Upstream Program format, the sales tracking effort might include all distributor types, not just independent distributors.
 - b. Equipment Types - The Upstream Program includes incentives for and reports on both unitary and split air conditioning systems, as well as air source heat pumps, water source heat pumps, and ground source heat pumps. As such, it might be appropriate to build on the Upstream Program reporting for a broader set of equipment types, not just RTUs. [Note: The PA programs for furnaces, boilers, and chillers are still at the end user level.]
2. HARDI Data Collection - The Cross Cutting team recommended an effort to "encourage D&R to obtain and make available for sale HARDI data for commercial HVAC equipment." As noted above, that might be most appropriate for furnaces, boilers, and chillers that still receive end user incentives. However, only one of the 14 C&I distributors interviewed was aware of the HARDI data. Many more were familiar with the AHRI data.
3. Manufacturer Data Collection - The Cross Cutting team recommended "researching the ability of manufacturers to provide meaningful state-level HVAC sales data" for manufacturer distribution networks. The Scoping Study found that many manufacturers already report shipment and sales data to AHRI by model number. From that perspective, it appears that manufacturer data could supplement any other data that are collected. But, since AHRI does not appear to be willing to sell the data, it seems that they would have to use the AHRI model, but not necessarily the AHRI data.

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4. Manufacturer and Distributor Panel - The Cross Cutting team recommended "establishing a panel of manufacturers and distributors to provide qualitative data..." The Scoping Study found that most respondents were interested in participating in such a panel. In many cases, the C&I respondent was different from the residential respondent.

These findings generally support many of the Cross Cutting team recommendations, but also offer ways to potentially enhance the proposed strategies.

Recommendation #5 - The Scoping Study offers some new information to the Cross Cutting team related to sales tracking for Market Effects. It is likely that their proposed strategy might be modified in some ways by these findings. The C&I team is prepared to respond to any questions from the Cross Cutting team that could help with their effort.

Recommendation #6 - The PA Upstream Program has already made a significant investment in collecting information on qualifying equipment for verification of program incentives. It seems that the "shortest path" to robust sales tracking data might be to furnish monetary incentives to a sample of participating and nonparticipating distributors and contractors to expand their reporting to cover both the qualifying and nonqualifying equipment covered by the Upstream Program. However, even if that strategy is "prioritized" for certain types of equipment, the Cross Cutting team appropriately suggests that the most effective long-term strategy is to explore all channels for collecting data (e.g., the AHRI data collection model).

10 APPENDIX A - HVAC MANUFACTURERS BY EQUIPMENT TYPE

10.1 Boilers

Manufacturer	Brands
AERCO International	AERCO
Altherm Ltd	Altherm
Baxi Heating UK Ltd	Baxi
Bosch Thermotechnology	Bosch
Boyertown Furnace Co	Solaia
Bradford White Corporation	LAARS, Laars
Bryan Steam	Bryan
Buderus	Buderus
Burnham Commercial	Burnham
Camus Hydronics Ltd	Camus
Chromolox	Chromalox
Cleaver-Brooks	Cleaver-Brooks
Columbia Boiler Co	Columbia
Crown Boiler Co	Crown
DDR Americas	Dedietrich
ECR International	Argo, Dunkirk, Pennco, Ultimate, Utica
Fulton Companies	Fulton
Granby Industries	Granby, Kerr
Heat Transfer Products	HTP, Munchkin
Lanair Products LLC	Lanair
Lennox International Inc	Lennox
Lochinvar LLC	Lochinvar
Marathon Heater Co	Logwood
Mestek Inc	Hydrotherm, RBI
Navien Inc	Navien
New York Thermal Inc	NTI
New Yorker Boiler Co Inc	New Yorker
PB Heat LLC	PB HEAT, Peerless
Pensotti North America	Pensotti
QHT Incorporated	Biasi
RW Becket Corp	Beckett
Rheem Manufacturing Co	Raypak
Rinnai Corp	Solaia
Slant/Fin Incorporated	Slant/Fin
Smith Cast Iron Boilers	Smith
Thermo Dynamics Boiler Co	Thermo Dynamics
Triad Boiler Systems	Triad

Manufacturer	Brands
Triangle Tube	Prestige, Triangle Tube
US Boiler Co	US Boiler
United Technologies Corp	Bryant, Carrier
Viessmann Group	Viessmann
Weil-McLain	Weil-McLain
Williamson-Thermoflo	Thermoflo, Williamson

10.2 Chillers

Manufacturer	Brands
Acme Engineering Services	Acme
Aqua Products Co Inc	Aqua
Arctic Chiller Group Ltd	ArctiChill, Arctic Cool, FreezeCo Systems
Broad USA Inc	Broad USA
CES Group LLC	Mammoth
Daikin Industries	Daikin
Delta T Systems	Delta T Systems
Drake Refrigeration Inc	Drake
Dunham Bush	Dunham Bush
Heatcraft Refrigeration Products	Bohn
Henry Technologies Canada	Chil-Con
Ingersoll Rand	Trane
Johnson Controls Inc	York
Mestek Inc	Applied Air, Spacepak
Motivair Corporation	Motivair
Multiaqua Inc	Multi-Aqua
Tecogen	Tecogen
Tecumseh Products Co	Tecumseh
United Technologies Corp	Bryant, Carrier
Water Furnace International Inc	Water Furnace
Yazaki Energy Systems Inc	Yazaki

10.3 Ductless Mini-Splits

Manufacturer	Brands	Participant
AB Electrolux	Frigidaire	No
CES Group LLC	Mammoth	No
ComfortStar	ComfortStar	No
Daikin Industries	Daikin, Goodman	Yes
ECR International	EnviroAir	No

Manufacturer	Brands	Participant
Fortress	Fortress	No
Friedrich	Friedrich	No
Fujitsu	Fujitsu	Yes
Garrison	Garrison	No
Haier Group	Haier	No
Heat Controller	Century, Comfort-Aire	No
Ingersoll Rand	American Standard, Trane	Yes
Johnson Controls Inc	York	Yes
LG Corporation	LG	Yes
Lennox International Inc	Lennox	Yes
Mitsubishi Group	Mitsubishi	Yes
Modine Manufacturing Co	Modine	No
Panasonic Corporation	Panasonic	No
Pridiom	Pridiom	No
Rheem Manufacturing Co	Rheem, Ruud	Yes
Samsung	Samsung	No
Sealed Unit Parts Co Inc	Sea Breeze	No
Thermal Zone	Thermal Zone	No
Toshiba Carrier Corporation	Toshiba	No
United Technologies Corp	Bryant, Carrier, Payne	Yes

10.4 Rooftop Units

Manufacturer	Brands	Participant
Air Replacement Engineered Systems	ARES	No
Air Specialties	Air Specialties	No
CES Group LLC	Governair, Mammoth, Maytag, Westinghouse	No
CaptiveAire Systems	CaptiveAire	No
Concepts and Designs Incorporated	CDI	No
Daikin Industries	Daikin, Goodman	Yes
Hart & Cooley Inc	Hart & Cooley	No
Ingersoll Rand	American Standard, Trane	Yes
Interline Brands Inc	Garrison	No
Johnson Controls Inc	Coleman, Johnson Controls, York	Yes
Lennox International Inc	Lennox	Yes
Mestek Inc	Applied Air	No
Modine Manufacturing Co	Modine	No
Nortek Global HVAC LLC	Tappan	No
Rheem Manufacturing Co	Rheem, Ruud	Yes
USA Coil & Air	USA Coil & Air	No

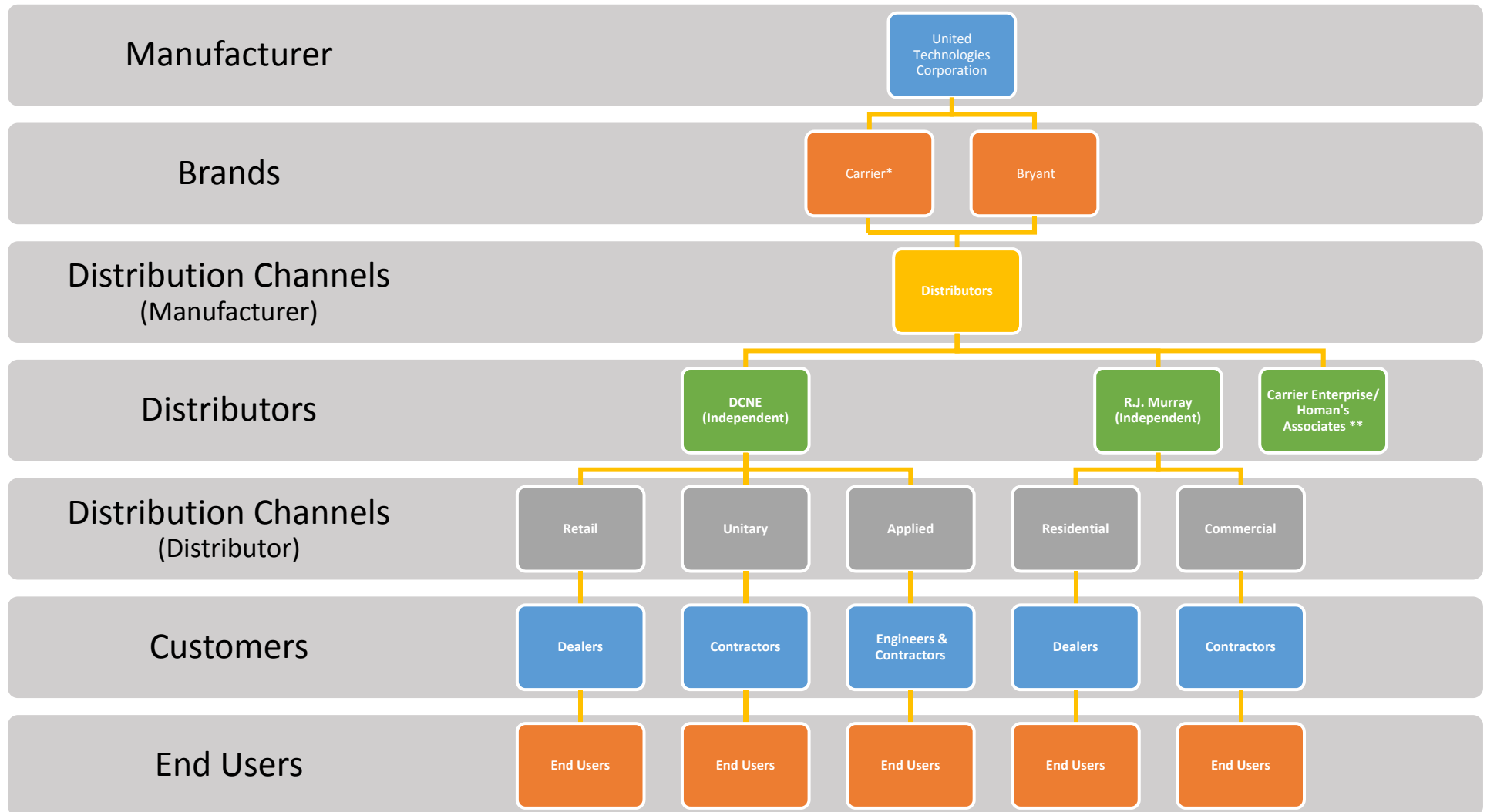


Manufacturer	Brands	Participant
United Technologies Corp	Arcoaire, Bryant, Carrier, Comfortmaker, Payne	Yes
XeteX Inc	XeteX	No

11 APPENDIX B - HVAC SUPPLY CHAIN BY MANUFACTURER

11.1 United Technologies Corporation

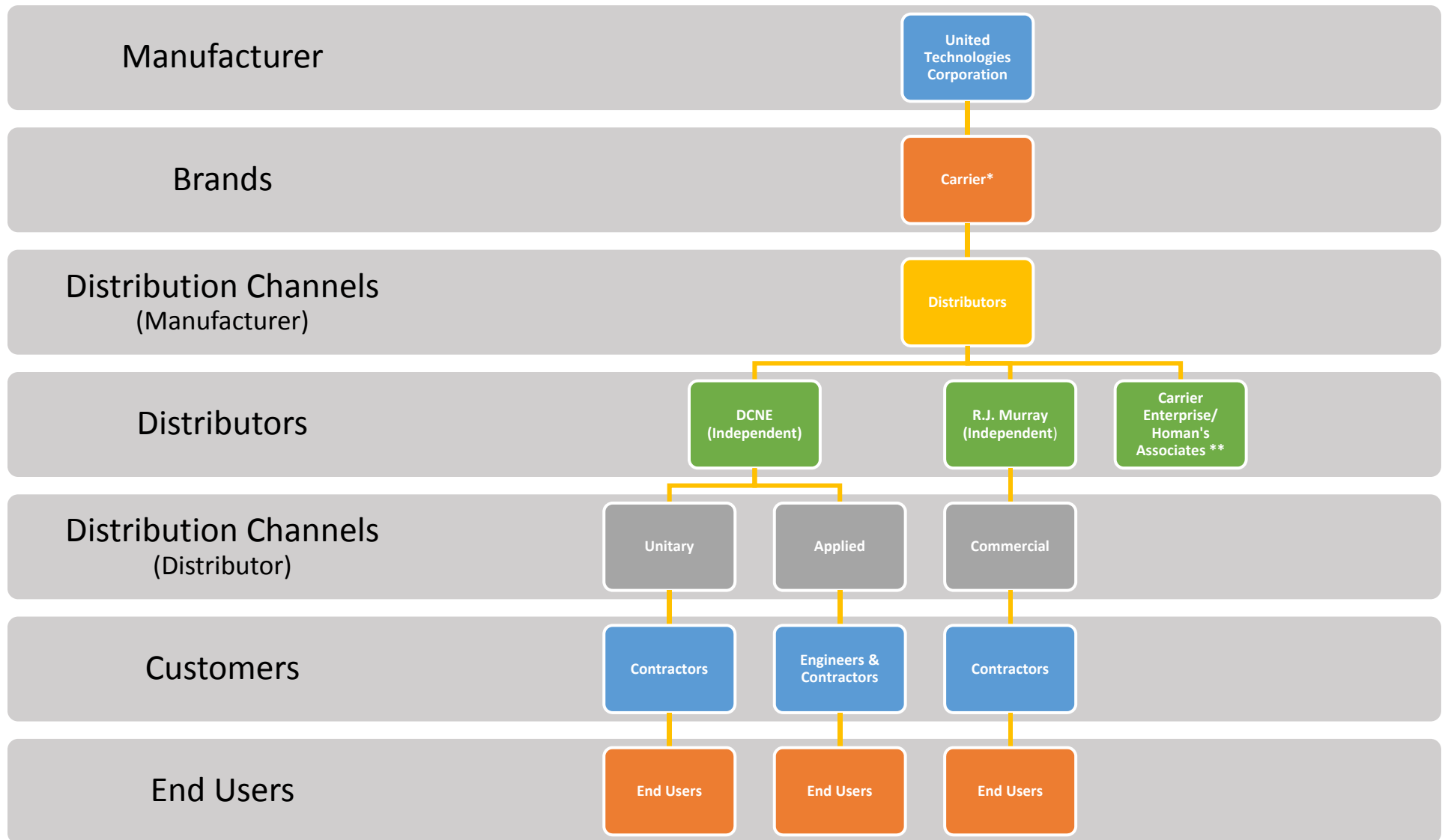
11.1.1 UTC Boiler Distribution Chart



* Carrier and Bryant have residential and commercial sales, but the distribution channels are identical.

** Carrier Enterprise/Homan's Associates is 20% owned by UTC/Carrier and 80% owned by Wastco.

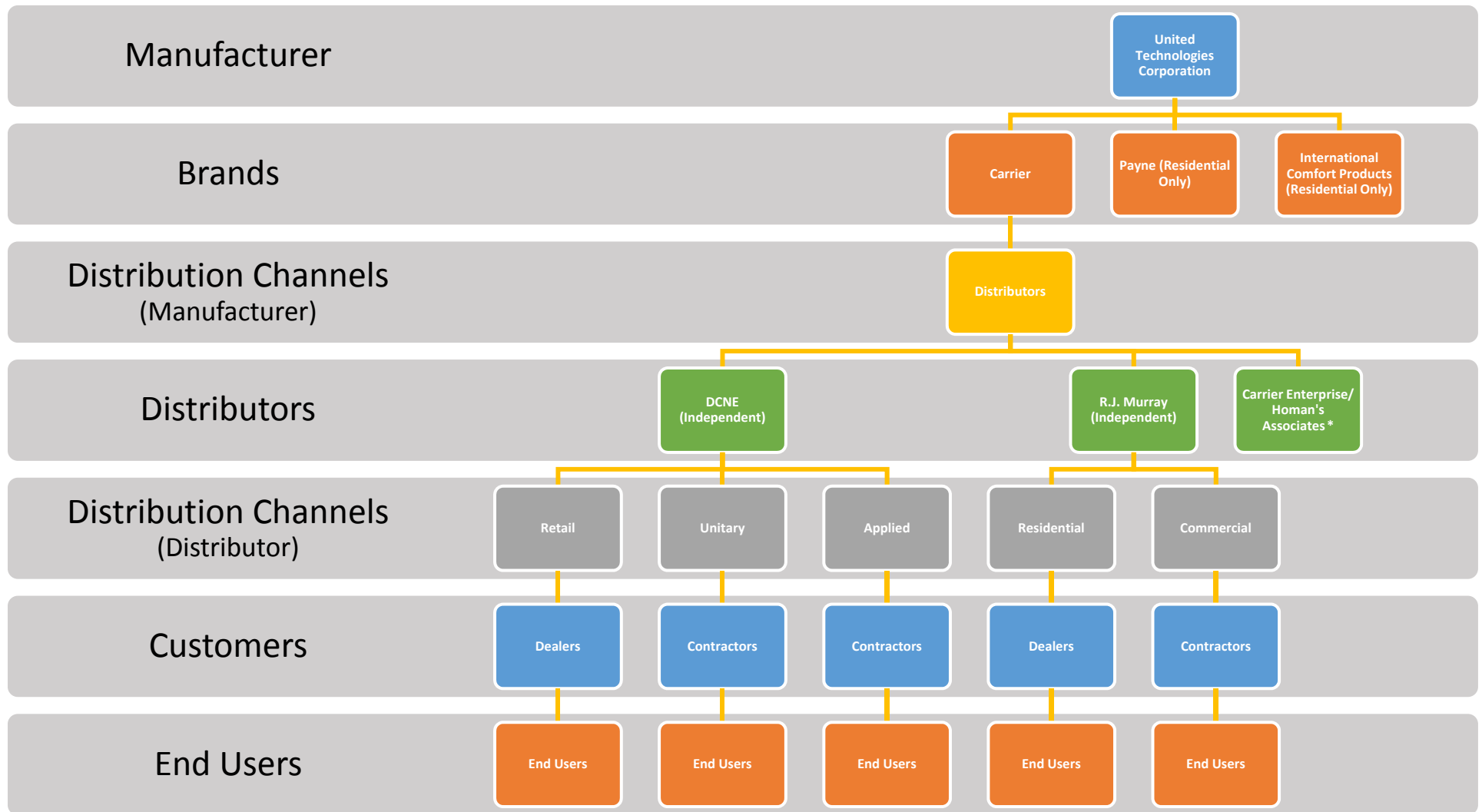
11.1.2 UTC Chiller Distribution Chart



* Carrier and Bryant have residential and commercial sales, but the distribution channels are identical.

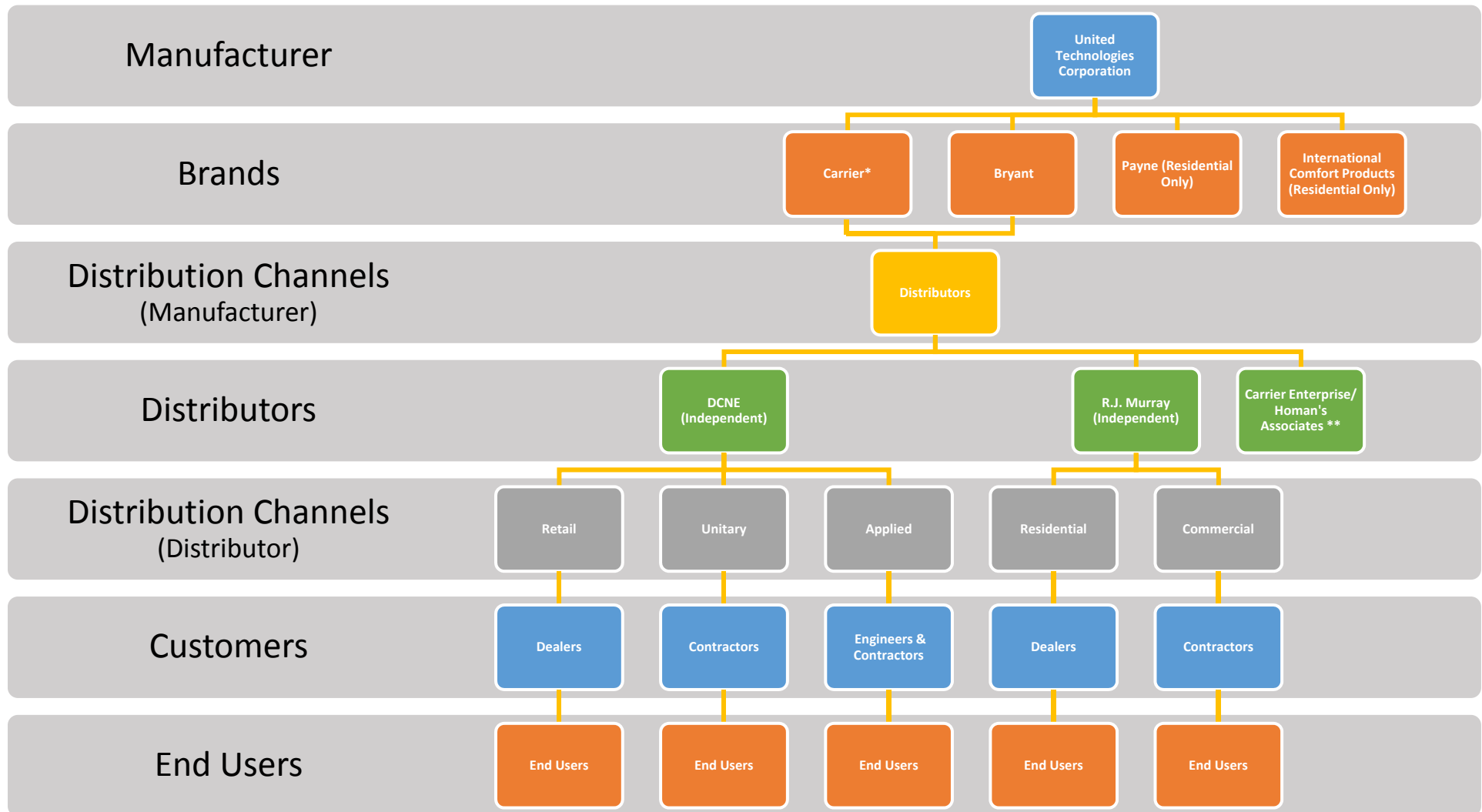
** Carrier Enterprise/Homan's Associates is 20% owned by UTC/Carrier and 80% owned by Wastco.

11.1.3 UTC Ductless Mini-Split Distribution Chart



* Carrier Enterprise/Homan's Associates is 20% owned by UTC/Carrier and 80% owned by Wastco.

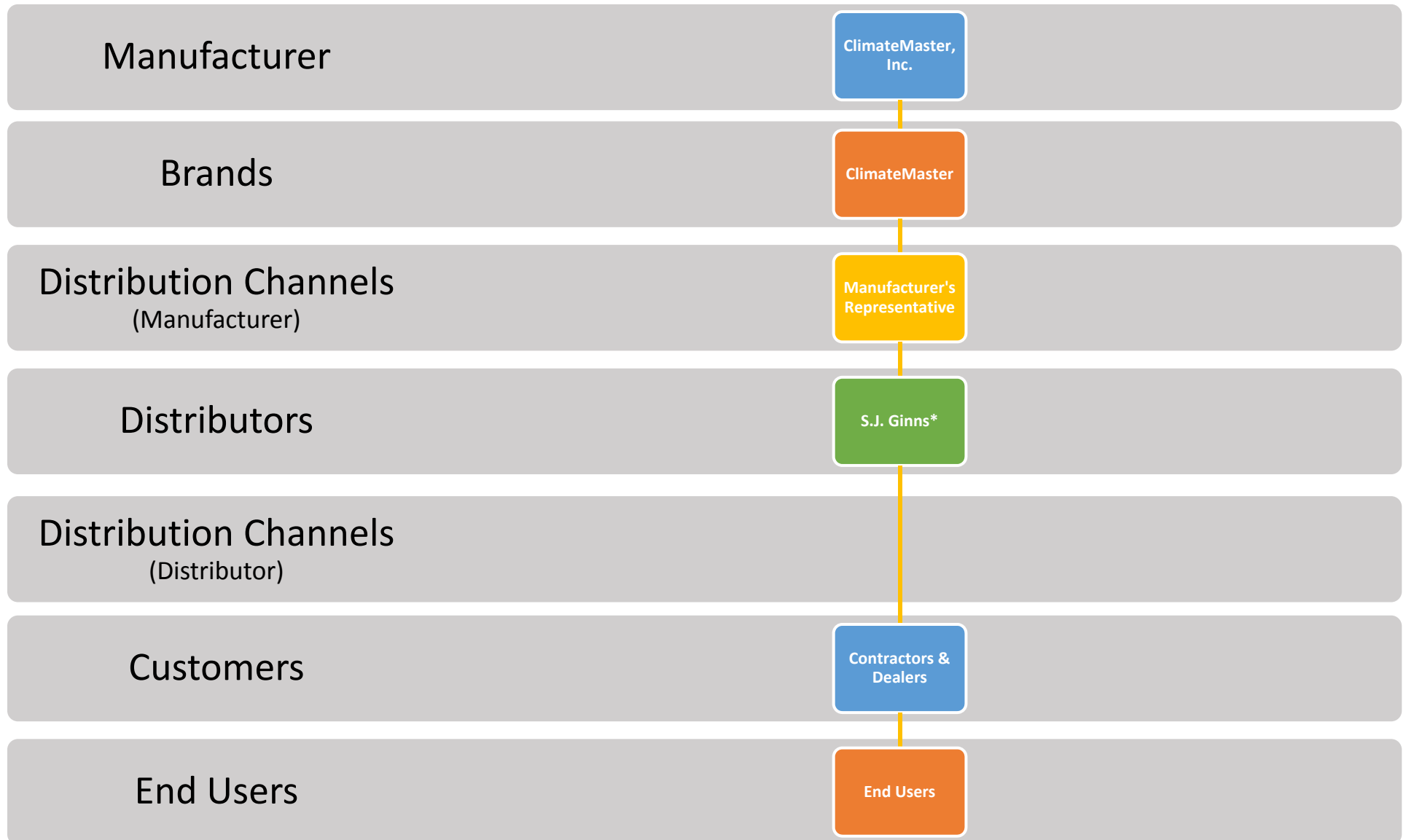
11.1.4 UTC Rooftop Unit Distribution Chart



* Carrier and Bryant have residential and commercial sales, but the distribution channels are identical.

** Carrier Enterprise/Homan's Associates is 20% owned by UTC/Carrier and 80% owned by Wastco.

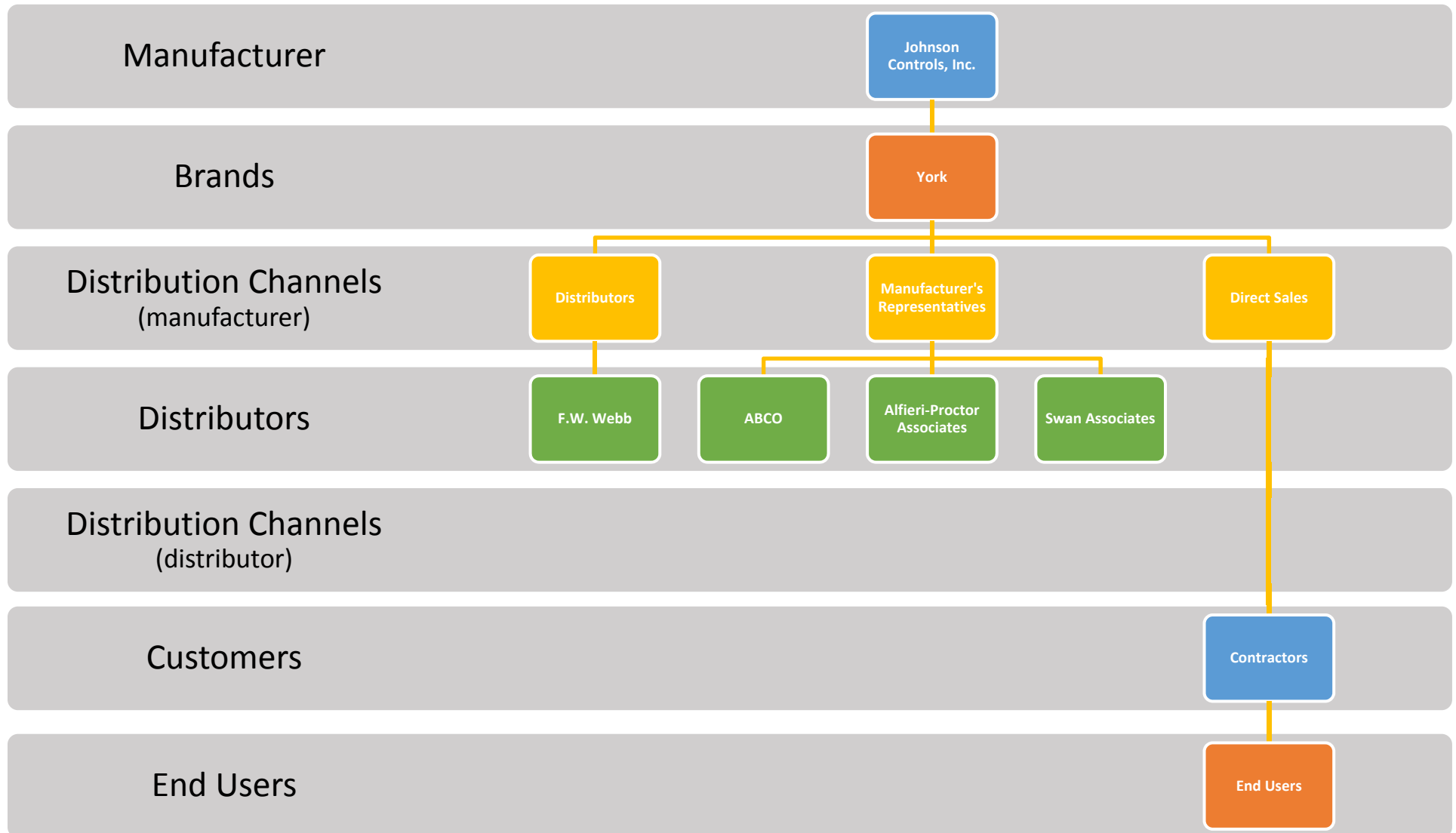
11.2 ClimateMaster Ground Source Heat Pump Distribution Chart



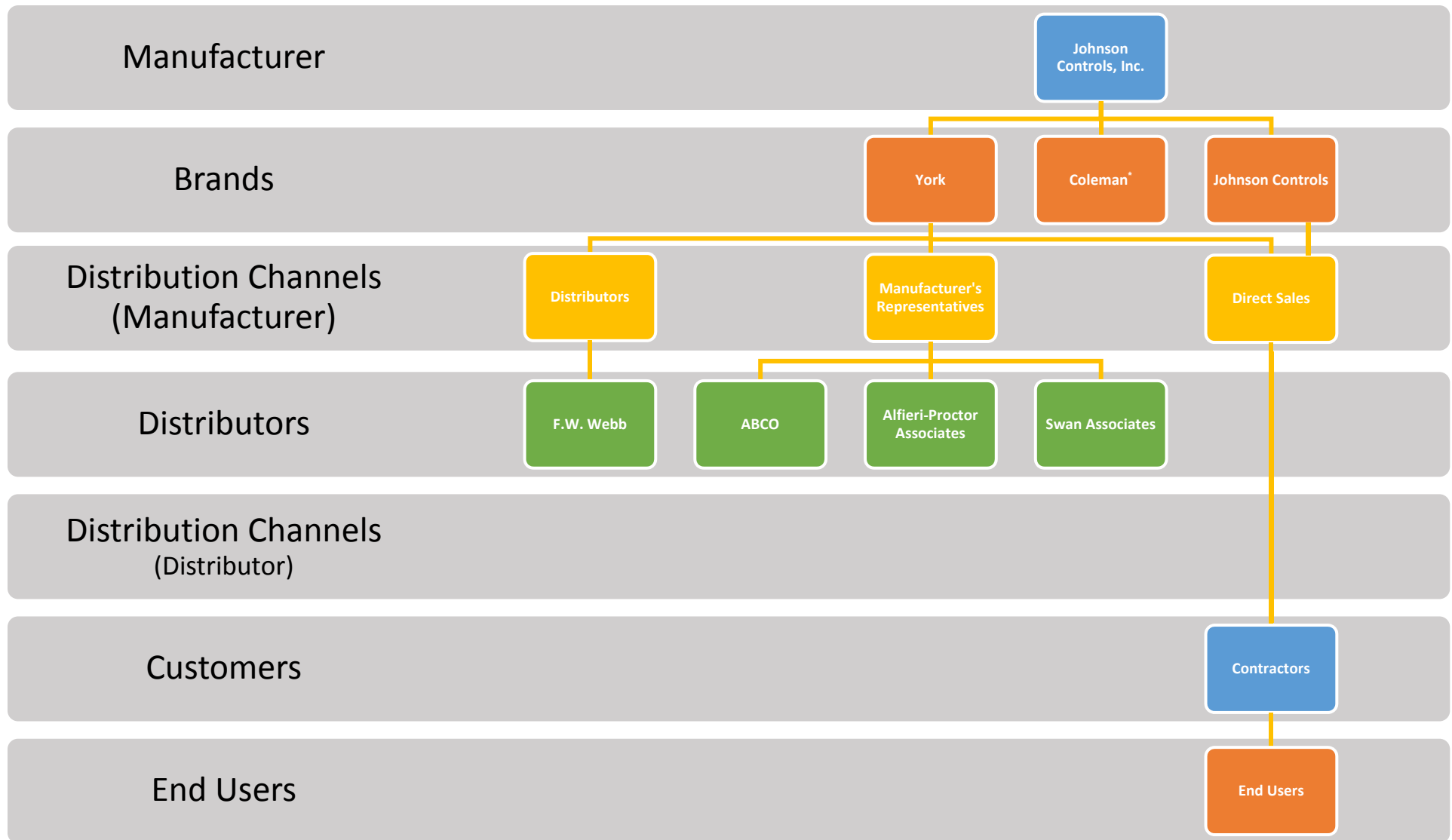
* S.J. Ginns is the manufacturers' representative that solely distributes ClimateMaster's products in Massachusetts.

11.3 Johnson Controls, Inc. (JCI)

11.3.1 JCI Chiller Distribution Chart

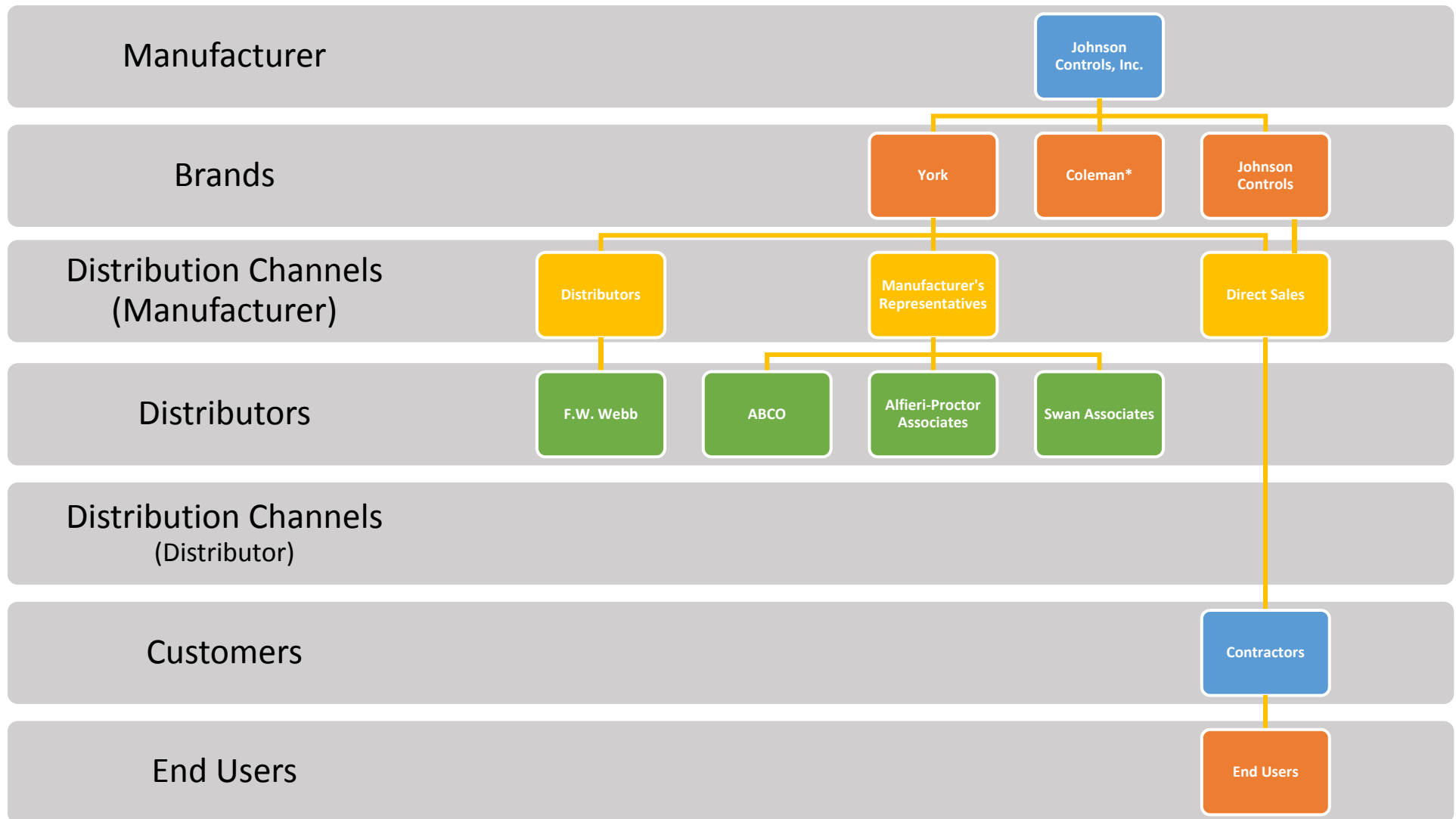


11.3.2 JCI Rooftop Unit Distribution Chart



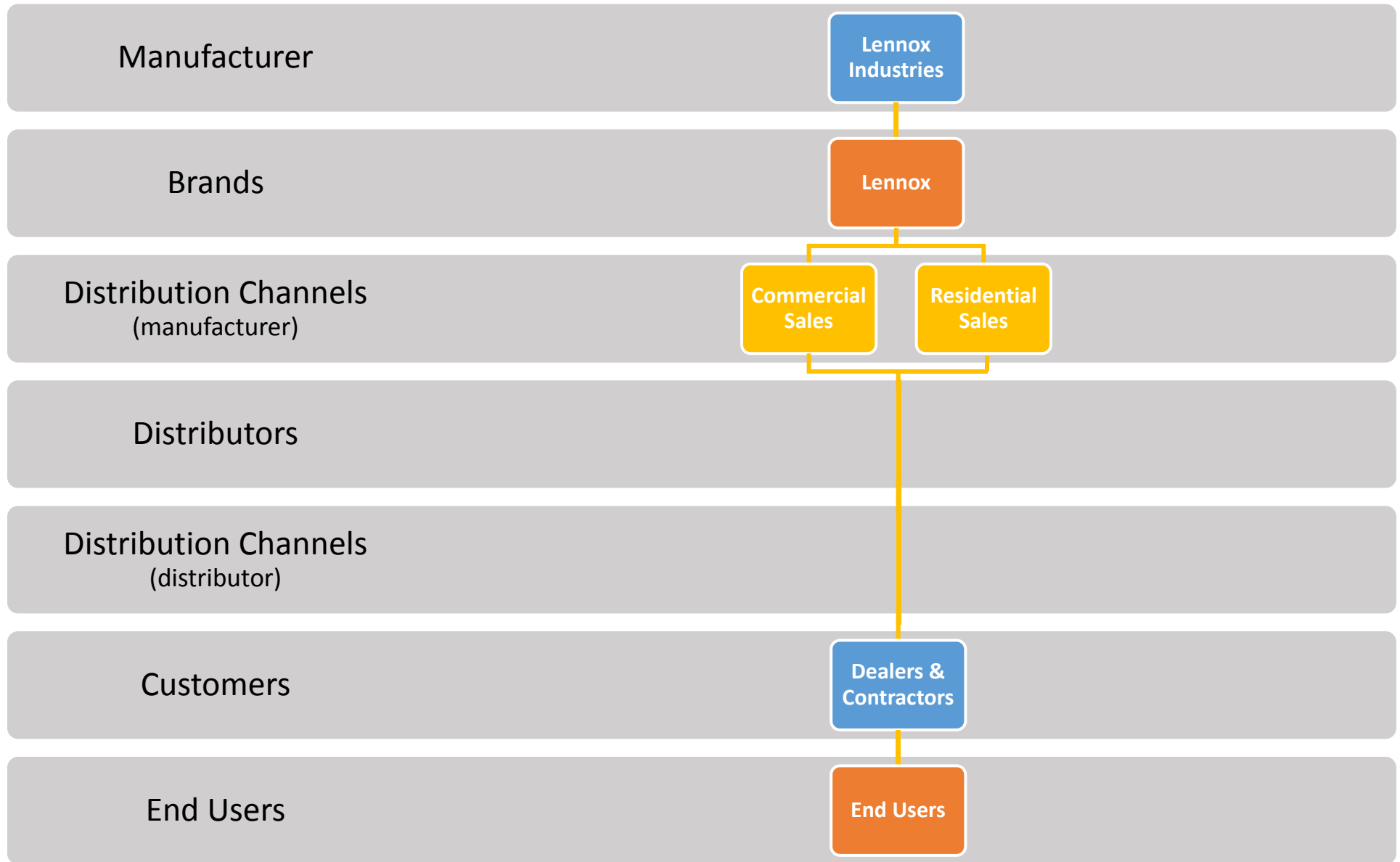
* Coleman is primarily a residential brand, but sells some light commercial products. (Not interviewed for this study)

11.3.3 JCI Ductless Mini-Split Distribution Chart



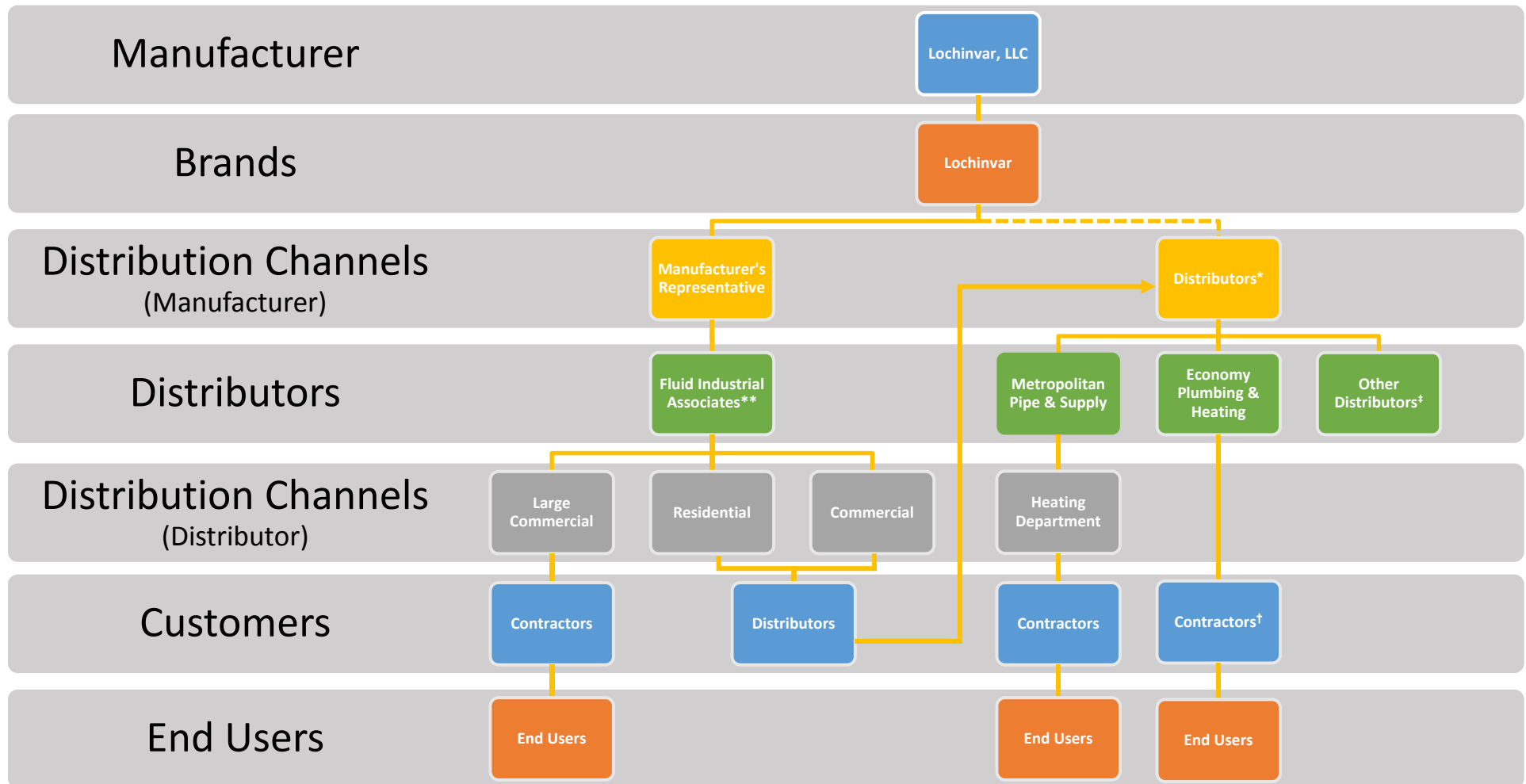
* Coleman is primarily a residential brand, but sells some light commercial products. (Not interviewed for this study)

11.4 Lennox International Inc. Rooftop Unit* Distribution Chart



* Lennox also manufactures and sells boilers and ductless mini-splits, but only through residential channels. All sales are through contractors and dealers.

11.5 Lochinvar Boiler Distribution Chart



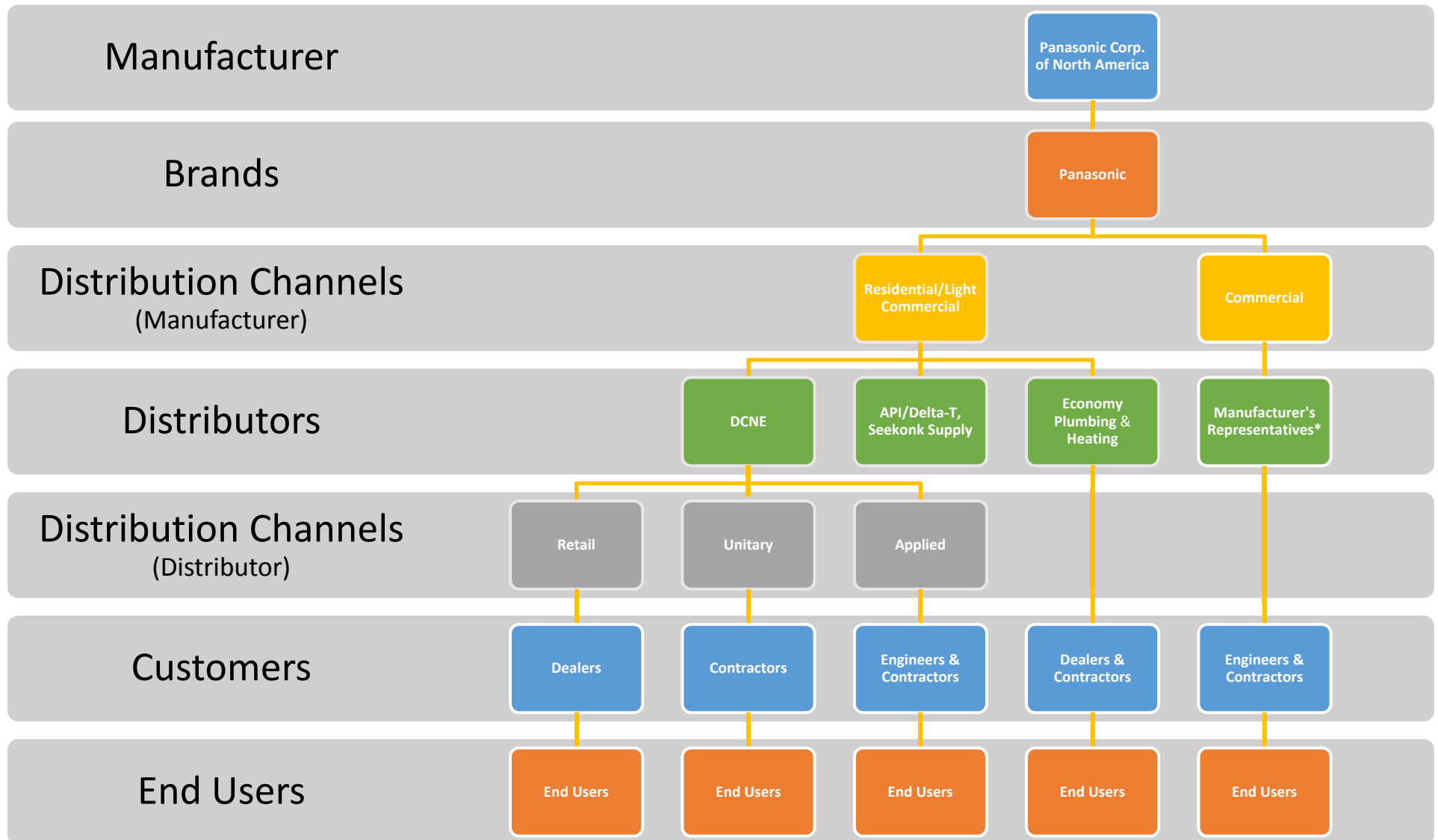
* Distributors typically get Lochinvar product from Fluid Industrial Associates' warehouse, but may occasionally order from the manufacturer through FIA.

** All Lochinvar sales go through Fluid Industrial Associates, Inc., Lochinvar's exclusive Manufacturers' representative.

† Economy Plumbing & Heating frequently delivers the equipment directly to end user addresses.

‡ The following 10 distributors were not interviewed for this study, but distribute Lochinvar products: API Delta T; Capco Energy Supply; D.H. Adams Co.; Dugan Supply Co.; Northshore Heating Supply Co.; Jomar Distributors Inc.; Needham Mechanical Systems; Plumbers Supply Co.; Premier Supply Group; Republic Plumbic Sup Co.

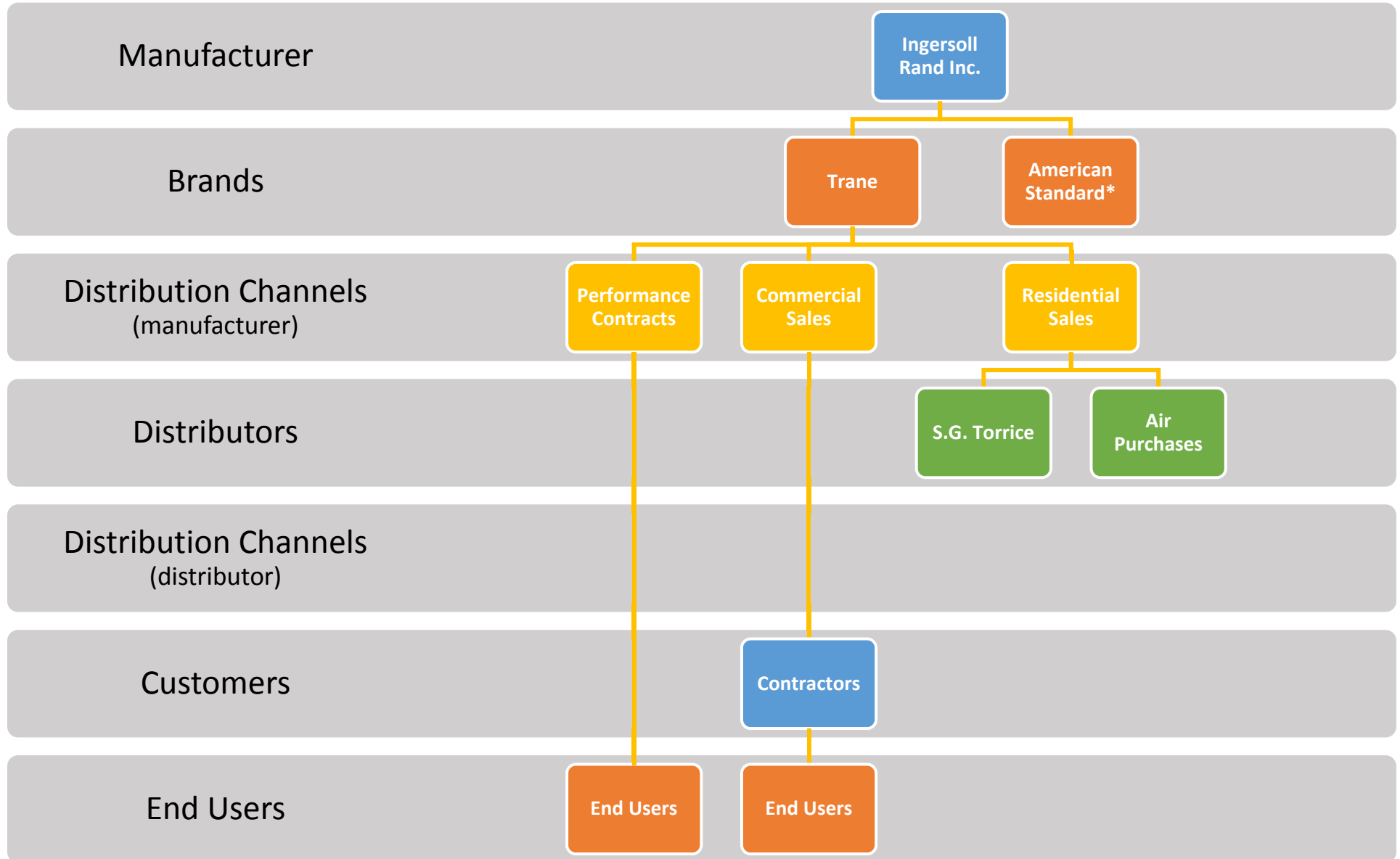
11.6 Panasonic Corporation Ductless Mini-Splits Distribution Chart



* Large commercial sales made through buy-sell specification representatives (not interviewed)

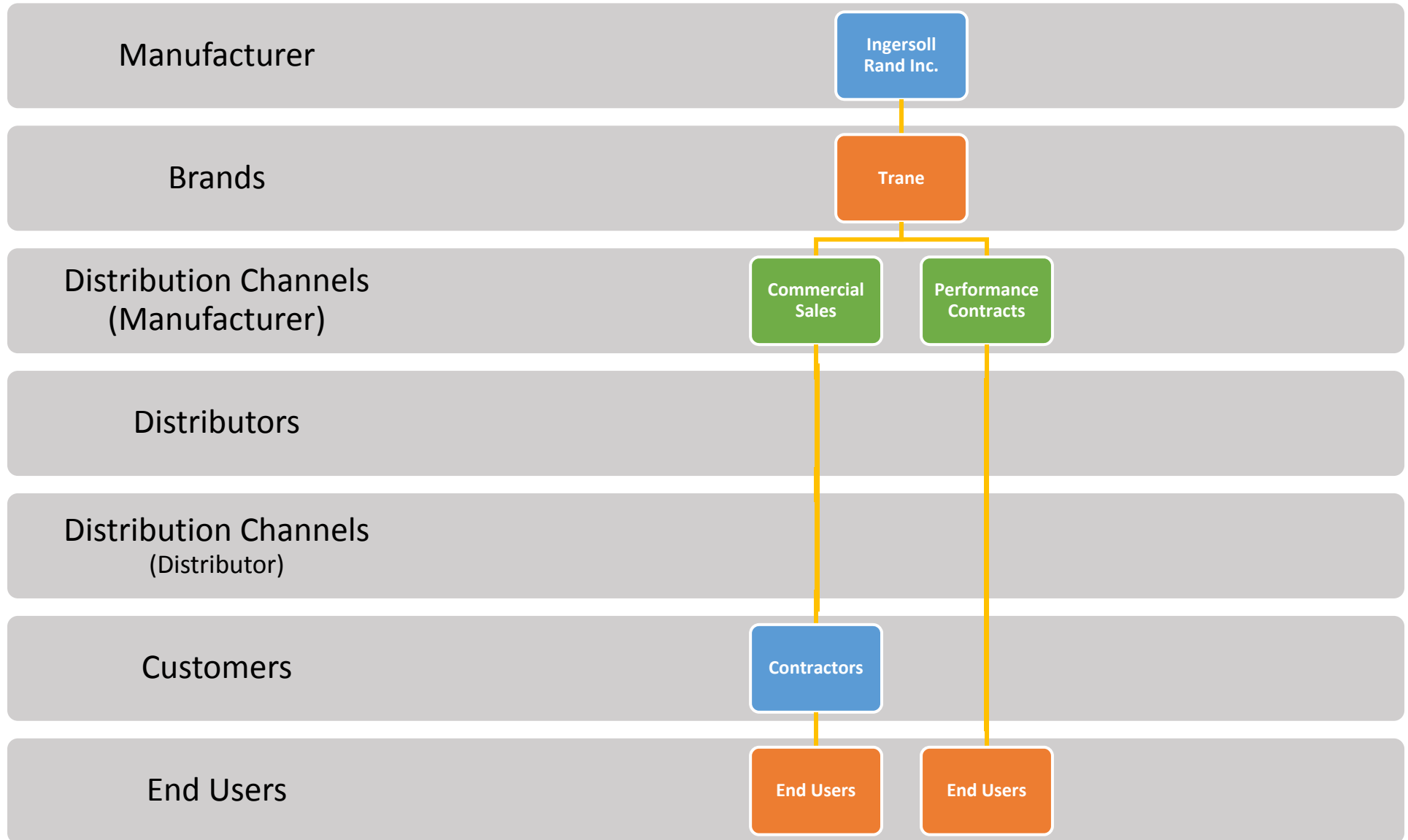
11.7 Ingersoll Rand Inc.

11.7.1 Ingersoll Rand Rooftop Unit Distribution Chart

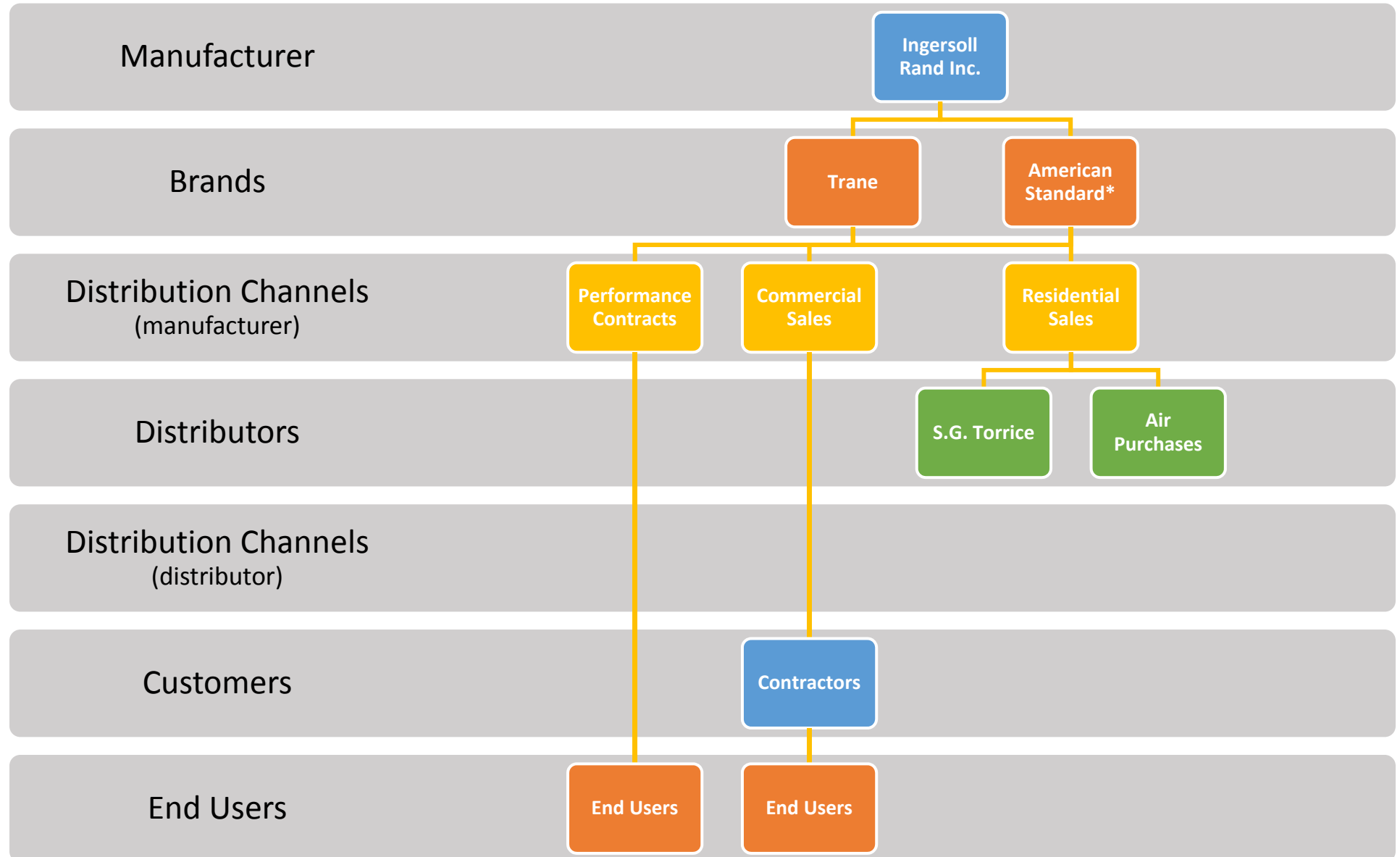


*American Standard is largely a residential brand with some light commercial sales; all sales are through Trane's residential distribution channels.

11.7.2 Ingersoll Rand Chiller Distribution Chart



11.7.3 Ingersoll Rand Ductless Mini-Split Distribution Chart



* American Standard is largely a residential brand with some light commercial sales; all sales are through Trane's residential distribution channels.

12 APPENDIX C - HVAC DISTRIBUTORS BY EQUIPMENT TYPE

12.1 Boilers

Distributor	Brands	Number of Locations
ABCO HVACR	Dunkirk, Friedrich, Modine, Slant/Fin	1
API/Delta T	Biasi, Chromalox, Crown, Lochinvar, Viessmann	4
Air Systems Technologies Inc	Bryant	1
B & D Supply	Crown	2
BE Crowley Inc	Smith	1
Bell Pump Service Co	Buderus, Columbia, Crown, Pennco, Utica, Weil-McLain	11
Bourneuf Corp	Burnham, Viessman	1
Capco Supply	Bosch, Buderus, Lochinvar, Viessmann	1
Carrier Enterprises	Bryant, Carrier	13
DCNE	Carrier	1
DH Adams Co Inc	Columbia, Dunkirk, Laars, Lochinvar, Peerless, Ultimate	2
Dugan Supply Co Inc	Knight, Lochinvar, Navien, Slant/Fin, Williamson	1
Economy Plumbing & Htg Sup Co	Baxi, Buderus, Hydrotherm, Laars, Lanair, Lochinvar, NY Thermal, Navien, Peerless, Slant/Fin, Triangle Tube, Viessmann	1
Edos Manufacturers Rep	Crown	1
Edward R Stephen Co Inc	Viessmann	1
Ellsworth Supply Company Inc	Buderus, Smith, Utica	1
Emerson Swan	CAP	1
FIA Inc	Lochinvar	1
FW Webb	Buderus, Burnham, HTP, Laars, Munchkin, Peerless, Rinnai, Weil-McLain	25
Frank I Rounds Co	Fulton	1
Interline Brands Inc	HTP, Hydrotherm	1
John Hoadley and Sons Inc	Buderus, Grundfos, HTP, Taco, Unico, Weil-McLain	1
Jomar Distributors Inc	Burnham, Dunkirk, Jomar, Lochinvar, Pensotti, Slant/Fin, Weil-McLain	1
Lennox	Lennox	1
Mass Control Center Inc	Crown, Dunkirk, Slant/Fin, Utica, Weil-McLain	1
Merrimac Industrial Sales Inc	Chromalox	1
Metromatic Mfg Co Inc	Slant/Fin, Smith, Utica	1
Metropolitan Pipe and Supply Co	Bell & Gossett, Hydrotherm, Lochinvar, Slant/Fin, Weil-McLain	1
Murray Supply Corp	Burnham, HB Smith, Slant/Fin	2
NE Combustion Products Inc	Aerco International, Bryan, Laars, Triad	1

Distributor	Brands	Number of Locations
Needham Mechanical Systems	Buderus, Dunkirk, Lochinvar, Weil-McLain	1
North Shore Heating Supply Co	Burnham, Hydrotherm, Lochinvar, Slant/Fin, Weil-McLain	1
Peabody Supply Company Inc	Burnham, Laars, Munchkin, Slant/Fin	1
Plumbers Supply Company Inc	Beckett, Buderus, Burnham, Lochinvar, New Yorker, Peerless, Slant/Fin, US Boiler, Viessmann, Weil-McLain	1
Premier Supply Group Inc	Buderus, Laars, Lochinvar, RBI, Slant/Fin, Smith, Viessmann	7
RJ Murray	Carrier	1
RL Gourley Co Inc	Raypak	1
Republic Plumbing Sup Co Inc	Burnham, Lochinvar, Navien, Slant/Fin, Viessmann	9
Robinson Supply Company	Laars, Prestige, Thermo Dynamics, Utica, Viessmann	6
S & A Supply Inc	Burnham, Crown, Munchkin, Peerless, Viessmann	2
Salem Plumbing Supply	Baxi, Biasi, Crown	1
Sales Marketing & Service Inc	Laars, Triangle Tube	1
Seekonk Supply Inc	Dunkirk, NTI, Navien, Pensotti	3
Sid Harvey Industries	Altherm, Bock Water Heaters, BrassCraft, Crown, ECR International, PB HEAT, PNA, SRGI, Thermo Dynamics, Viessmann, Weil-McLain	3
Snow and Jones Inc	Weil-McLain	2
Springfield Plumbing Supply Co Inc	Columbia, Hydrotherm, Logwood, Utica, Weil-McLain	1
Star Supply Co	Modine, Weil-McLain	1
State Supply Corp	Viessman	1
Supply New England Inc	HTP, Navien, Slant/Fin, Weil-McLain, Williamson	13
Sweeny Rogers Geraghty Inc	Weil-McLain	1
TE Corcoran Co Inc	Crown	2
URELL Inc	KN Series, Mestek, RBI, Smith	1
United Refrigeration Inc	Crown, Slant/Fin, Viessmann	5
WP Haney Co Inc	Argo, Dunkirk	1
Walter F Morris	NTI	1
Whitten Enterprises	Black Gold, Columbia	1
WinWholesale Inc	Buderus, Burnham, Crown, Granby, HTP, Kerr, Navien, Rinnai, Slant/Fin, Solaia, Viessman	6

12.2 Chillers

Distributor	Brands	Number of Locations
ABCO HVACR	Aqua, Bohn, Chil-Con, Multi-Aqua, Servel, Standard, Tecumseh	1
API/Delta T	Multi-Aqua, Unico	4
Air Systems Technologies Inc	Bryant	1
Alfieri-Proctor Associates	ArctiChill, Mammoth	1
FW Webb	Daikin, Drake, Dunham Bush, Multi-Aqua, Water Furnace, York	25
Frank I Rounds Co	Multi-Aqua	1
Johnson Controls	Johnson Controls, York	1
Johnstone Supply	Aqua, SpacePak	2
RL Gourley Co Inc	Yazaki	1
Stebbins-Duffy Inc	Broad USA, Daikin, Tecogen	1
Swan Associates	ArctiChill, Daikin, Mammoth, Motivair	1
Thermal Products Inc	Delta, Niagara, Packaged Systems	1
Thermatec Inc	Acme, Drake	1
Trane New England	Trane	1
United Refrigeration Inc	Drake	5

12.3 Ductless Mini-Splits

Distributor	Brands	Participant Status	Number of Locations
ABCO HVACR	Mitsubisihi	No *	1
API/Delta T	LG, Panasonic	Yes	4
Air Systems Technologies Inc	Bryant	No **	1
Brockton Furnance and Duct Distributors	Century, Comfort-Aire, Goodman	No *	1
Capco Supply	LG	No *	1
Carrier Enterprises	Carrier, Payne	Yes	13
DCNE	Carrier, Panasonic, Payne	Yes	1
DH Adams Co Inc	Fujitsu	No	2
Dugan Supply Co Inc	Comfort Star	No	1
Economy Plumbing & Htg Sup Co	LG, Panasonic	No	1
Ellsworth Supply Company Inc	Ruud	No	1
Emerson Swan	Haier, LG	No	1
Equipment Direct Sales Inc	EnviroAir	No **	1
FW Webb	Daikin, Haier, York	Yes	25
Homans Associates LLC	Mitsubisihi	Yes	3

Distributor	Brands	Participant Status	Number of Locations
Interline Brands Inc	Friedrich, Garrison	No	1
John Hoadley and Sons Inc	Rheem	No	1
Johnson Controls	York	Yes	1
Johnstone Supply	Comfort-Aire, Daikin, Friedrich, Fujitsu, Goodman	Yes	2
Jomar Distributors Inc	Comfort Star, EnviroAir	No**	1
Lennox	Lennox	Yes	1
Needham Mechanical Systems	LG, Mitsubishii	No**	1
Peabody Supply Company Inc	Modine	No	1
Plumbers Supply Company Inc	Fortress, Fujitsu	No**	1
RJ Murray	Carrier, Friedrich, Toshiba	Yes	1
Republic Plumbing Sup Co Inc	Samsung	No	9
Robinson Supply Company	EnviroAir, LG	Yes	6
S & A Supply Inc	Fujitsu	No*	2
SG Torrice	Mitsubisihi	Yes	6
SJ Ginns Associates Inc	Friedrich	Yes	1
Sales Marketing & Service Inc	LG	No**	1
Seekonk Supply Inc	Haier, Panasonic	No	3
Sid Harvey Industries	Fujitsu	No*	3
Snow and Jones Inc	Unknown	No	2
Supply New England Inc	Friedrich	No*	13
Swan Associates	Daikin	Yes	1
Sweeny Rogers Geraghty Inc	Fujitsu	No	1
Trane New England	Trane	Yes	1
United Refrigeration Inc	Daikin, Mitsubisihi, Sea Breeze	No*	5
WW Grainger	Friedrich, Frigidaire	No**	5
WinWholesale Inc	Fujitsu, LG	Yes	6

* Known to C&I Upstream Program but not currently participating.

** On Residential Program list, but not identified as a target by the C&I Program.

12.4 Rooftop Units

Distributor	Brands	Participant Status	Number of Locations
API/Delta T	Rheem	Yes	4
Air Industries Inc	USA Coil & Air	No**	1
Air Systems Technologies Inc	Bryant	No**	1
B & D Supply	Modine	No**	2
Brockton Furnance and Duct Distributors	Goodman	No*	1
Captive-Aire Systems Inc	CaptiveAire	No**	2
Carrier Enterprise	Bryant	Yes	13
DCNE	Carrier, Payne	Yes	1
Economy Plumbing & Htg Sup Co	Carrier, Goodman	No	1
Ellsworth Supply Company Inc	Ruud	No	1
Emerson Swan	Modine	No	1
FW Webb	Air Specialties, Hart & Cooley, York	Yes	25
Homans Associates LLC	Bryant	Yes	3
Interline Brands Inc	Garrison	No	1
John Hoadley and Sons Inc	Rheem	No	1
Johnson Controls	Johnson Controls, York	Yes	1
Johnstone Supply	CDI, Coleman, Daikin, Maytag, Westinghouse	Yes	2
Lennox	Lennox	Yes	1
Peabody Supply Company Inc	Modine	No	1
RJ Murray	Carrier	Yes	1
RP OConnell	ARES	Yes	1
Snow and Jones Inc	Comfortmaker	No	2
Springfield Plumbing Supply Co Inc	Modine	No	1
Star Supply Co	Daikin	Yes	1
Stebbins-Duffy Inc	Daikin, Lennox, XeteX	Yes	1
Supply New England Inc	Mammoth, Tappan	No*	13
Swan Associates	Daikin, Governair, Lennox, Mammoth	Yes	1
Trane New England	Trane	Yes	1
United Refrigeration Inc	Arcoaire	No*	5
WinWholesale Inc	American Standard, Johnson Controls	Yes	6

* Known to C&I Upstream Program but not currently participating.

** On Residential Program list, but not identified as a target by the C&I Program.

13 APPENDIX D - TOP 10 MECHANICAL ENGINEERS

13.1 Top 10 Mechanical Engineers – New Construction and Additions

Rank	Player Name	City	State	Percent of Market
1	Cosentini Associates	Cambridge	MA	8.4
2	B R + A Consulting Engineers	Watertown	MA	7.9
3	WSP Flack + Kurtz (Formerly Shooshanian Engrg)	Boston	MA	6.3
4	R W Sullivan Engineering Inc	Boston	MA	4.1
5	AHA Consulting Engineers	Lexington	MA	3.6
6	Wozny/Barbar & Associates Inc	Hanover	MA	3.4
7	Vanderweil Engineers	Boston	MA	3.0
8	Richard D Kimball Company Inc - RDK	Andover	MA	2.5
9	Garcia Galuska & DeSousa Inc (GGD)	Dartmouth	MA	2.5
10	WSP Flack & Kurtz	New York	NY	2.4
	TOTAL	-	-	44.1

13.2 Top 10 Mechanical Engineers – Renovations

Rank	Player Name	City	State	Percent of Market
1	R W Sullivan Engineering Inc	Boston	MA	4.4
2	RDK Engineers	Boston	MA	3.2
3	AHA Consulting Engineers	Lexington	MA	2.7
4	Garcia Galuska & DeSousa Inc (GGD)	Dartmouth	MA	2.2
5	Richard D Kimball Company Inc - RDK	Andover	MA	2.1
6	B R + A Consulting Engineers	Watertown	MA	2.1
7	Cosentini Associates	Cambridge	MA	1.9
8	WSP Flack + Kurtz (Formerly Shooshanian Engrg)	Boston	MA	1.9
9	Commercial Construction Consulting	Boston	MA	1.6
10	T M P Consulting Engineers Inc	Boston	MA	1.1
	TOTAL	-	-	23.2

14 APPENDIX E - MANUFACTURER IN-DEPTH INTERVIEW GUIDES

14.1 Broad-Based Manufacturer Interview Guide

- 1) **Products** - We have looked at your website and believe that you furnish products in the categories listed on the worksheet.

a) Have we correctly characterized your business?

b) Is there a different way that your company would group these products? Of those market segments, which would you say are your top three in terms of annual sales? *{Note: The worksheet lists the products for the targeted company respondent. But, not for any partner companies or brands. Follow-up questions will verify whether a different respondent is appropriate for different brands. But, that may get discussed here.}*

- 2) **Information** - The Mass Save program managers need to learn more about how your company does its business so that they can design and implement programs that increase the adoption of energy efficient technologies for commercial and industrial HVAC equipment and systems. They want to understand the best approaches to designing and marketing programs, the best ways to operate programs efficiently, and how to track program impacts. And, they understand that designs, operations, and impacts might be different for each market segment.

a) Would you recommend that they work with one contact at your company, a different contact for each market segment, a different contact depending on what kinds of questions are being asked (e.g. how to market programs vs. learning about whether the programs are operating efficiently), or some other approach?

b) What contacts would you suggest? *{Note: You will have to be responsive to the answer you receive. If the respondent suggests that the PAs should find one respondent per market segments or one respondent per research area, you will need to follow-up with questions about which individual or which department in his/her company would be targeted for the high priority segments. Be sure to probe for commercial vs. residential in terms of contacts.}*

- 3) **Manufacturer Sales Data** - We are trying to understand whether manufacturers are able to track either the ZIP code or the state where their equipment they sell has been installed, or is likely to be installed. And, we understand that this might vary by distribution channel and equipment type.

a) **Equipment Segment #1:**

What are your distribution channels for this equipment type?

For channel #1, are you able to identify either sales or shipments by ZIP code or by State?
{Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

-
- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.
-

For channel #2, are you able to identify either sales or shipments by ZIP code or by State?
{Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

-
- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.
-

For channel #3, are you able to identify either sales or shipments by ZIP code or by State?
{Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #4, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

b) Equipment Segment #2

What are your distribution channels for this equipment type?

For channel #1, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #2, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #3, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #4, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

c) Equipment Segment #3

What are your distribution channels for this equipment type?

For channel #1, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #2, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- _____

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #3, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- _____

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #4, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- _____

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

- _____

- 4) **Sources of Equipment Sales** - {Ask for each targeted market segment.} There are several different sources of demand for new HVAC equipment, including new construction, planned replacement, emergency replacement, and early replacement for energy efficiency retrofit.

What share of the market do you estimate each of those four markets represent? What is the source of those estimates?

a) Market Segment: _____

b) Market Segment: _____

c) Market Segment: _____

- 5) *{For each targeted market segment}* Using a variety of sources, we have been able to develop a list of the manufacturers for *{market segment}* HVAC equipment. Can you tell us if that list looks complete to you? *{Add any other manufacturers named.}* Can you tell us who you think are the three top sellers for this type of equipment?

a) Market Segment: _____

b) Market Segment: _____

c) Market Segment: _____

- 6) The Mass Save program managers are looking for insights about the HVAC industry and changes in the markets for HVAC equipment. This would help with program design and improve the program to meet the needs of the market. They are hoping that manufacturers of HVAC equipment such as *{name manufacturer}* can help with this. The general idea is that individuals representing the manufacturers would periodically provide input on a confidential basis. It would be an opportunity to provide more direct and frequent input to the Mass Save programs, and in return participants would receive a financial incentive as well as the aggregated market level findings and analysis. Please tell us your thoughts on how this might work best.

As we have more information the specifics of the panel someone may be reaching out to you - or the appropriate contacts you provide - over the next few months to invite you to participate.

- 7) {Ask of Upstream Participants} Your Light Commercial HVAC equipment distributors are participants in the Mass Save Upstream Incentive Program. In that program, distributors receive a direct incentive for qualifying equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

- 8) {For manufacturers of boilers or chillers} The Mass Save program offers incentives to end users for purchase of high-efficiency commercial {boilers or chillers}. Were you aware of those Mass Save incentives?
-
-

{If Yes, Ask}

About what percentage of your {boilers or chillers} sold in Massachusetts in the past year do you think received those incentives? *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency {boilers or chillers} in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

-
-
- 9) The Mass Save utilities are interested in learning more about how to influence equipment stocking patterns. Do you think that programs like the Mass Save end user incentive programs are considered by manufacturers when they are making decisions on production and stocking of high-efficiency equipment for a market?
-
-

Do you think that programs like the Mass Save Upstream Program have more or less impact on manufacturer decisions?

- 10) Are you aware of sources of information on the sales of HVAC equipment by level of efficiency that help in thinking about market trends. *{Probe for differences between commercial and residential.}*
-
-

14.2 Specialty Manufacturer Interview Guide

- 1) **Products** - We have looked at your website and believe that you furnish products in the categories listed on the worksheet.
- a) Have we correctly characterized your business? Is there a different way that your company would group these products?
-
-
- b) This interview is focusing mainly on commercial and industrial HVAC equipment. Which is larger in terms of total sales, your C&I market or your residential market. *{If they sell products in more than one C&I sector.}* And, in your C&I market, which segment accounts for most of your sales?
-
-
- 2) **Information** - The Mass Save program managers need to learn more about how your company does its business so that they can design and implement programs that increase the adoption of energy efficient technologies for commercial and industrial HVAC equipment and systems. They want to understand the best approaches to designing and marketing programs, the best ways to operate programs efficiently, and how to track program impacts. And, they understand that designs, operations, and impacts might be different for each market segment.

- a) Would you recommend that they work with one contact at your company, a different contact for each market segment {Note: Might just be C&I vs. Residential}, a different contact depending on what kinds of questions are being asked (e.g. how to market programs vs. learning about whether the programs are operating efficiently), or some other approach?

- b) What contact(s) would you suggest we work with? {Note: You will have to be responsive to the answer you receive. If the respondent suggests that the PAs should find one respondent per market segments or one respondent per research area, you will need to follow-up with questions about which individual or which department in his/her company would be targeted for the high priority segments.}

- 3) **Manufacturer Sales Data** - We are trying to understand whether manufacturers are able to track either the ZIP code or the state where their equipment they sell has been installed, or is likely to be installed. And, we understand that this might vary by distribution channel and equipment type.

Equipment Segment: _____

What are your distribution channels for this equipment type?

For channel #1, are you able to identify either sales or shipments by ZIP code or by State? {Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #2, are you able to identify either sales or shipments by ZIP code or by State?
{Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #3, are you able to identify either sales or shipments by ZIP code or by State?
{Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

For channel #4, are you able to identify either sales or shipments by ZIP code or by State?
{Record whether it is sales or shipments or both; whether by ZIP code or just by State.}

- You said that you are able to track {either sales or shipments} by {either ZIP or state} for {insert type} channels. About what percent of your {either sales or shipments} of this equipment type go through these channels.

- 4) **Sources of Equipment Sales** - {Ask for each market segment.} There are several different sources of demand for new HVAC equipment, including new construction, planned replacement, emergency replacement, and early replacement for energy efficiency retrofit. What share of the market do you estimate each of those four markets represent? What is the source of those estimates?

- 5) {For each market segment} Using a variety of sources, we have been able to develop a list of the manufacturers for {market segment} HVAC equipment. Can you tell us if that list looks complete to you? {Add any other manufacturers named.} Can you tell us who you think are the three top sellers for this type of equipment?

- 6) The Mass Save program managers are looking for insights about the HVAC industry and changes in the markets for HVAC equipment. This would help with program design and improve the program to meet the needs of the market. They are hoping that manufacturers of HVAC equipment such as {name manufacturer} can help with this. The general idea is that individuals representing the manufacturers would periodically provide input on a confidential basis. It would be an opportunity to provide more direct and frequent input to the Mass Save programs, and in return participants would receive a financial incentive as well as the aggregated market level findings and analysis. Do you have any thoughts on how this might work best?

As we have more information the specifics of the panel someone may be reaching out to you - or the appropriate contacts you provide - over the next few months to invite you to participate.

- 7) {Ask of Upstream Participants} Your Light Commercial HVAC equipment distributors are participants in the Mass Save Upstream Incentive Program. In that program, distributors receive a direct incentive for qualifying equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives? {If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}

Do you think that your company sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

- 8) {For manufacturers of boilers or chillers} The Mass Save program offers incentives to end users for purchase of high-efficiency commercial {boilers or chillers}. Were you aware of those Mass Save incentives?

{ If Yes, Ask }

About what percentage of your {boilers or chillers} sold in Massachusetts in the past year do you think received those incentives? *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency {boilers or chillers} in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

- 9) The Mass Save utilities are interested in learning more about how to influence equipment stocking patterns. Do you think that programs like the Mass Save end user incentive programs are considered by manufacturers when they are making decisions on production and stocking of high-efficiency equipment for a market?
-
-

Do you think that programs like the Mass Save Upstream Program have more or less impact on manufacturer decisions?

- 10) Are you aware of sources of information on the sales of HVAC equipment by level of efficiency that help in thinking about market trends. *{Probe for differences between commercial and residential.}*
-
-

15 APPENDIX F - DISTRIBUTOR IN-DEPTH INTERVIEW GUIDES

15.1 Independent Distributor Interview Guide

1) Products - We have looked at your website and believe that you furnish products in the categories listed on the worksheet.

a) Have we correctly characterized your business? Is there a different way that your company would group these products?

b) Of those market segments, which would you say are your top three in terms of annual sales? {Note: The worksheet lists the products for the respondent, including the manufacturer for which equipment is distributed and characterization of the distributor's relationship with the manufacturers.

2) **Information** - The Mass Save program managers need to learn more about how your company does its business so that they can design and implement programs that increase the adoption of energy efficient technologies for commercial and industrial HVAC equipment and systems. They want to understand the best approaches to designing and marketing programs, the best ways to operate programs efficiently, and how to track program impacts. And, they understand that designs, operations, and impacts might be different for each market segment.

a) Would you recommend that they work with one contact at your company, a different contact for each market segment, a different contact depending what kinds of questions are being asked (e.g., how to market programs vs. whether programs are being operated efficiently), or some other approach?

b) {Note: You will have to be responsive to the answer you receive. If the respondent suggests that the PAs should find one respondent per market segments or one respondent per research area, you will need to follow-up with questions about which individual or which department in his/her company would be targeted for the high priority segments. It is possible that the contact at the distributor will say that all of that information is best obtained from the manufacturer that owns them. Be sure to probe for Commercial vs. Residential.}

3) **OPTIONAL** {If the distributor has multiple locations.} **Multiple Locations** - We see that there are multiple locations for this business.

- a) Does each business location operate independently, or is there centralized management?

- b) Do you find that different locations have more or less experience with certain kinds of equipment?

- c) Is there one contact that would be able to furnish information on the company's sales and program experiences, or would the manager for each location be able to furnish better information?

- 4) **Sales Data** - We are trying to understand whether distributors are able to track either the ZIP code or state where the equipment sell has been installed, or is likely to be installed. And, we understand that this might vary by equipment type.

- a) For {equipment type #1} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- b) For {equipment type #2} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- c) For {equipment type #3} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- 5) **Sources of Equipment Sales** - {Ask for each targeted market as applicable.} There are several different sources of demand for new HVAC equipment, including new construction, planned replacement, emergency replacement, and early replacement for energy efficiency retrofit.

- a) What share of the market do you estimate each of those four markets represent?

b) What is the source of your estimates?

6) **{For each targeted market segment as applicable}** Using a variety of sources, we have been able to develop a list of the distributors for {market segment} HVAC equipment.

a) Can you tell us if that list looks complete to you? {Add any other distributors named.}

b) Can you tell us who you perceive are the three top sellers for this type of equipment?

7) The Mass Save program managers are looking for insights about the HVAC industry and changes in the markets for HVAC equipment. This would help with program design and improve the program to meet the needs of the market. They are hoping that manufacturers of HVAC equipment such as {name manufacturer} can help with this. The general idea is that individuals representing the manufacturers would periodically provide input on a confidential basis. It would be an opportunity to provide more direct and frequent input to the Mass Save programs, and in return participants would receive a financial incentive as well as the aggregated market level findings and analysis. Please tell us your thoughts on how this might work best.

You listed the equipment from the following manufacturers on your website companies you work with. {Name manufacturers listed in worksheet.} We would like to speak with representatives from these companies to gather information and provide input on the Mass Save programs. Who would you suggest we contact at these manufacturers? {You may need to follow up via email to get full contact information.}

As we have more information the specifics of the panel someone may be reaching out to you - or the appropriate contacts you provide - over the next few months to invite you to participate.

8a) **{For Upstream Participants}** You are a participant in the Mass Save Upstream Program Incentive Program for Light Commercial HVAC equipment. In that program, you receive a direct incentive for qualifying equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

8b) **{For Upstream Non-Participants}** You do not participate in the Mass Save Upstream Incentive Program for Light Commercial HVAC equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company would have sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year if you had participated?

Do you think that your company lost sales to other distributors because you do not participate?

9) **{For manufacturers of boilers or chillers}** The Mass Save program offers incentives to end users for purchase of high-efficiency commercial {boilers or chillers}. Were you aware of those Mass Save incentives?

{ If Yes, Ask }

About what percentage of your {boilers or chillers} sold in Massachusetts in the past year do you think received those incentives? *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency {boilers or chillers} in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

10) The Mass Save utilities are interested in learning more about how to influence equipment stocking patterns.

a) Do you think that programs like the Mass Save end user incentive programs are considered by distributors when they are making decisions on production and stocking of high-efficiency equipment for a market?

b) Do you think that programs like the Mass Save Upstream Program have more or less impact on distributor decisions?

11) Are you aware of sources of information on the sales of HVAC equipment by level of efficiency that help in thinking about market trends. *{Probe for differences between commercial and residential. Probe for HARDI data.}*

15.2 Manufacturer-Owned Distributor Interview Guide

1) Products - We have looked at your website and believe that you furnish products in the categories listed on the worksheet.

- a) Have we correctly characterized your business? Is there a different way that your company would group these products?

- b) Of those market segments, which would you say are your top three in terms of annual sales? {Note: The worksheet lists the products for the respondent, including the manufacturer for which equipment is distributed and characterization of the distributor's relationship with the manufacturers.

- 2) **Information** - The Mass Save program managers need to learn more about how your company does its business so that they can design and implement programs that increase the adoption of energy efficient technologies for commercial and industrial HVAC equipment and systems. They want to understand the best approaches to designing and marketing programs, the best ways to operate programs efficiently, and how to track program impacts. And, they understand that designs, operations, and impacts might be different for each market segment.

- a) Would you recommend that they work with one contact at your company, a different contact for each market segment, a different contact depending what kinds of questions are being asked (e.g., how to market programs vs. whether programs are being operated efficiently), or some other approach?

- b) {Note: You will have to be responsive to the answer you receive. If the respondent suggests that the PAs should find one respondent per market segments or one respondent per research area, you will need to follow-up with questions about which individual or which department in his/her company would be targeted for the high priority segments. It is possible that the contact at the distributor will say that all of that information is best obtained from the manufacturer that owns them. Be sure to probe for Commercial vs. Residential.}

- 3) **OPTIONAL** {If the distributor has multiple locations.} **Multiple Locations** - We see that there are multiple locations for this business.

- a) Does each business location operate independently, or is there centralized management?

- b) Do you find that different locations have more or less experience with certain kinds of equipment?

- c) Is there one contact that would be able to furnish information on the company's sales and program experiences, or would the manager for each location be able to furnish better information?

- 4) **Sales Data** - We are trying to understand whether distributors are able to track either the ZIP code or state where the equipment sell has been installed, or is likely to be installed. And, we understand that this might vary by equipment type.

- a) For {equipment type #1} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- b) For {equipment type #2} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- c) For {equipment type #3} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- 5) **Sources of Equipment Sales** - {Ask for each targeted market as applicable.} There are several different sources of demand for new HVAC equipment, including new construction, planned replacement, emergency replacement, and early replacement for energy efficiency retrofit.

- a) What share of the market do you estimate each of those four markets represent?

- b) What is the source of your estimates?

- 6) **{For each targeted market segment as applicable}** Using a variety of sources, we have been able to develop a list of the distributors for {market segment} HVAC equipment.

a) Can you tell us if that list looks complete to you? *{Add any other distributors named.}*

b) Can you tell us who you perceive are the three top sellers for this type of equipment?

- 7) The Mass Save program managers are looking for insights about the HVAC industry and changes in the markets for HVAC equipment. This would help with program design and improve the program to meet the needs of the market. They are hoping that manufacturers of HVAC equipment such as {name manufacturer} can help with this. The general idea is that individuals representing the manufacturers would periodically provide input on a confidential basis. It would be an opportunity to provide more direct and frequent input to the Mass Save programs, and in return participants would receive a financial incentive as well as the aggregated market level findings and analysis. Please tell us your thoughts on how this might work best.

We would also like to speak with someone familiar with the manufacturing side of your business to gather information and provide input on the Mass Save programs. Would you be the appropriate person to speak with? If not, who would you suggest we contact? *{You may need to follow up via email to get full contact information.}*

As we have more information the specifics of the panel someone may be reaching out to you - or the appropriate contacts you provide - over the next few months to invite you to participate.

- 8a) **{For Upstream Participants}** You are a participant in the Mass Save Upstream Incentive Program for Light Commercial HVAC equipment. In that program, you receive a direct incentive for qualifying equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

- 8b) **{For Upstream Non-Participants}** You do not participate in the Mass Save Upstream Program Incentive Program for Light Commercial HVAC equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company would have sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year if you had participated?

Do you think that your company lost sales to other distributors because you do not participate?

- 9) **{For manufacturers of boilers or chillers}** The Mass Save program offers incentives to end users for purchase of high-efficiency commercial {boilers or chillers}. Were you aware of those Mass Save incentives?

{ If Yes, Ask }

About what percentage of your {boilers or chillers} sold in Massachusetts in the past year do you think received those incentives? *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency {boilers or chillers} in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

10) The Mass Save utilities are interested in learning more about how to influence equipment stocking patterns.

c) Do you think that programs like the Mass Save end user incentive programs are considered by distributors when they are making decisions on production and stocking of high-efficiency equipment for a market?

d) Do you think that programs like the Mass Save Upstream Program have more or less impact on distributor decisions?

11) Are you aware of sources of information on the sales of HVAC equipment by level of efficiency that help in thinking about market trends. {Probe for differences between commercial and residential. Probe for HARDI data.}

15.3 Manufacturers' Representative Distributor Interview Guide

1) Products - We have looked at your website and believe that you furnish products in the categories listed on the worksheet.

a) Have we correctly characterized your business? Is there a different way that your company would group these products?

- b) Of those market segments, which would you say are your top three in terms of annual sales? {Note: The worksheet lists the products for the respondent, including the manufacturer for which equipment is distributed and characterization of the distributor's relationship with the manufacturers.

- 2) **Information** - The Mass Save program managers need to learn more about how your company does its business so that they can design and implement programs that increase the adoption of energy efficient technologies for commercial and industrial HVAC equipment and systems. They want to understand the best approaches to designing and marketing programs, the best ways to operate programs efficiently, and how to track program impacts. And, they understand that designs, operations, and impacts might be different for each market segment.

- a) Would you recommend that they work with one contact at your company, a different contact for each market segment, a different contact depending what kinds of questions are being asked (e.g., how to market programs vs. whether programs are being operated efficiently), or some other approach?

- b) {Note: You will have to be responsive to the answer you receive. If the respondent suggests that the PAs should find one respondent per market segments or one respondent per research area, you will need to follow-up with questions about which individual or which department in his/her company would be targeted for the high priority segments. It is possible that the contact at the distributor will say that all of that information is best obtained from the manufacturer that owns them. Be sure to probe for Commercial vs. Residential.}

- 3) **OPTIONAL** {If the distributor has multiple locations.} **Multiple Locations** - We see that there are multiple locations for this business.

- a) Does each business location operate independently, or is there centralized management?

- b) Do you find that different locations have more or less experience with certain kinds of equipment?

- 4) **Sales Data** - We are trying to understand whether distributors are able to track either the ZIP code or state where the equipment sell has been installed, or is likely to be installed. And, we understand that this might vary by equipment type.

a) For {equipment type #1} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

b) For {equipment type #2} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

c) For {equipment type #3} are you able to identify either sales or shipments by ZIP code or by State? Is that sales or equipment or both?

- 5) Sources of Equipment Sales - {Ask for each targeted market segment.} There are several different sources of demand for new HVAC equipment, including new construction, planned replacement, emergency replacement, and early replacement for energy efficiency retrofit.

a) What share of the market do you estimate each of those four markets represent?

b) What is the source of your estimates?

- 6) **{For each targeted market segment as applicable}** Using a variety of sources, we have been able to develop a list of the distributors for {market segment} HVAC equipment.

a) Can you tell us if that list looks complete to you? {Add any other distributors named.}

b) Can you tell us who you perceive are the three top sellers for this type of equipment?

- 7) The Mass Save program managers are looking for insights about the HVAC industry and changes in the markets for HVAC equipment. This would help with program design and improve the program to meet the needs of the market. They are hoping that manufacturers of HVAC equipment such as {name manufacturer} can help with this. The general idea is that

individuals representing the manufacturers would periodically provide input on a confidential basis. It would be an opportunity to provide more direct and frequent input to the Mass Save programs, and in return participants would receive a financial incentive as well as the aggregated market level findings and analysis. Please tell us your thoughts on how this might work best.

You listed the equipment from the following manufacturers on your website companies you work with. *{Name manufacturers listed in worksheet.}* We would like to speak with representatives from these companies to gather information and provide input on the Mass Save programs. Who would you suggest we contact at these manufacturers? *{You may need to follow up via email to get full contact information.}*

As we have more information the specifics of the panel someone may be reaching out to you - or the appropriate contacts you provide - over the next few months to invite you to participate.

- 8a) **{For Upstream Participants}** You are a participant in the Mass Save Upstream Incentive Program for Light Commercial HVAC equipment. In that program, you receive a direct incentive for qualifying equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

- 8b) **{For Upstream Non-Participants}** You do not participate in the Mass Save Upstream Program Incentive Program for Light Commercial HVAC equipment.

About what percentage of your Light Commercial HVAC equipment sold in Massachusetts in the past year received those incentives. *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company would have sold more high-efficiency Light Commercial HVAC equipment in Massachusetts in the past year if you had participated?

Do you think that your company lost sales to other distributors because you do not participate?

- 9) **{For manufacturers of boilers or chillers}** The Mass Save program offers incentives to end users for purchase of high-efficiency commercial {boilers or chillers}. Were you aware of those Mass Save incentives?
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-

{ If Yes, Ask }

About what percentage of your {boilers or chillers} sold in Massachusetts in the past year do you think received those incentives? *{If an answer is given, ask for the source of that information. Probe for internal tracking of HVAC by efficiency level.}*

Do you think that your company sold more high-efficiency {boilers or chillers} in Massachusetts in the past year because of this program?

How do you think that this program compared to programs in other jurisdictions in terms of program impacts? Why?

- 10) The Mass Save utilities are interested in learning more about how to influence equipment stocking patterns.

- 
- a) Do you think that programs like the Mass Save end user incentive programs are considered by distributors when they are making decisions on production and stocking of high-efficiency equipment for a market?

- b) Do you think that programs like the Mass Save Upstream Program have more or less impact on distributor decisions?

- 11) Are you aware of sources of information on the sales of HVAC equipment by level of efficiency that help in thinking about market trends. *{Probe for differences between commercial and residential. Probe for HARDI data.}*

16 APPENDIX G - LINKED END USER / CONTRACTOR IN-DEPTH INTERVIEW GUIDES

16.1 New Construction End User Interview Guide

- 1) We understand that you constructed a new building (major addition) at {address} during {year}. Our understanding is that the building was {describe building use, building size, project size, and other information readily available from the database and/or Internet}. Were there any other characteristics of this building project that you think are particularly important to understanding the building requirements?

- 2) To your knowledge, did the HVAC equipment receive a Mass Save incentive or rebate?

Did any other part of the project receive a Mass Save incentive or rebate?

- 3) IF PARTICIPATED - What was the source of the participation decision, internal or external?

- 4) IF INTERNAL: Was it a top down initiative from management or a bottom up initiative from a facility manager? {Probe for the sequence of events: Did management initiate a green building process? Or, did facility managers identify an opportunity that they then had to present to management? And, what do you perceive was the goal or objective of the individual or organization who initiated participation?

- 5) IF EXTERNAL: What organization(s) approached you with this idea? How did the external organization approach you with the idea for the project? What was the most effective selling point?

- 6) IF DID NOT PARTICIPATE: Were you aware of the Mass Save program's HVAC incentives? If yes, why did you decide not to participate?

- 7) We are interested in discussing the HVAC equipment specification and decision-making process. What internal individuals and/or organizations participated in the HVAC equipment specification process? We see from the Dodge database that the following contractors were involved in the project? Which of those were involved in the HVAC equipment specification process? And, who would you say was most influential in the final equipment specification?

- 8) What individuals and/or organizations made the final decision on the specific HVAC equipment that was purchased and installed? *{Note: It is important to understand whether this individual project had to be approved by management, or if this project was part of the project capital budget.}*

- 9) What type of HVAC equipment was installed? *{Probe for heating equipment and cooling equipment using categories on building information sheet.}* What is your perception of the efficiency level of the installed equipment? *{Probe for standard efficiency vs. high efficiency vs. cutting edge technology. There are two levels of efficiency for Light Commercial HVAC equipment incentives. Ask why they picked one over the other.}*

- 10) What is your perception of how the equipment was ordered and delivered? Did you purchase directly or did the contractor handle? Was it purchased from a distributor or directly from the manufacturer?

- 11) The Massachusetts utilities are interested in what they can do to more effectively market the HVAC equipment programs, operate these programs efficiently, and measure the program impacts. In your organization, who could give them the best information on:

- Program marketing including, who to target, what message to convey to the target, and how to reach the target?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Program operations including, responsiveness to questions, application procedures, on-going communications, and incentive processing?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Technical details on installed HVAC equipment including installation, commissioning, and equipment operations.

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

12) Based on your experiences with the utility programs, do you have any other comments you would like to make about the programs and their effectiveness?

13) What are your perceptions of the Mass Save energy efficiency programs?

14) What is your awareness of and perceptions of other green building programs?

16.2 New Construction Linked Contractor Interview Guide

- 1) We understand that you worked on the building construction (addition) project at {address} during {year}. Can you tell me a little more about your involvement with this project? *{Probe for: 1) helped with initial plans or got involved at later stage and 2) was focused only on HVAC system or worked on all building systems.}*

- 2) To your knowledge, did the HVAC equipment receive a Mass Save incentive or rebate? Did any other part of the project receive a Mass Save incentive or rebate?

- 3) IF PARTICIPATED - What was the source of the participation decision, internal to the organization or external?

- 4) IF INTERNAL: Was it a top down initiative from management or a bottom up initiative from a facility manager? *{Probe for the sequence of events: Did management initiate a green building process? Or, did facility managers identify an opportunity that they then had to present to management? And, what do you perceive was the goal or objective of the individual or organization who initiated the participation?}*

- 5) IF EXTERNAL - What organization(s) approached you with this idea? Was it your organization or another that got {End User} interested in the project? How was that done? What was the most effective selling point?

- 6) IF DID NOT PARTICIPATE: Were you aware of the Mass Save program's HVAC incentives? If yes, why did you decide not to participate?

- 7) What individuals and/or organizations participated in the HVAC and equipment specification process? And, who would you say was most influential in the final equipment specification?

- 8) What individuals and/or organizations made the final decision on the specific equipment that was purchased and installed? What do you perceive was their reason for selecting this equipment?

- 9) What type of HVAC equipment was installed? *{Probe for heating equipment and cooling equipment using categories on building information sheet.}* What is your perception of the efficiency level of the installed equipment? *{Probe for standard efficiency vs. high efficiency vs. cutting edge technology. There are two levels of efficiency for Light Commercial HVAC equipment incentives. Ask which was picked and why.}*

- 10) What is your perception of how the equipment was ordered and delivered? Did the end user purchase directly or did the contractor handle? Was it purchased from a distributor or directly from the manufacturer?

- 11) Thinking about new construction and addition projects, was this project typical in terms of specification and decision-making, or unique in some way?

- 12) The Massachusetts utilities are interested in what they can do to more effectively market the HVAC equipment programs, operate these program efficiently, and measure the program impacts. In your organization, who could give them the best information on:

- Program marketing including, who to target, what message to convey to the target, and how to reach the target?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Program operations including, responsiveness to questions, application procedures, on-going communications, and incentive processing?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Technical details on installed HVAC equipment, including installation, commissioning, and equipment operations.

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Panel Participation: The evaluation team is investigating the most effective method of collecting valuable feedback on Mass Save from contractors. One option is to ask companies like yours to participate in a periodic panel survey where you would be informed in advance of the schedule and length of questions. . For example, there might be three surveys each year, each with about 15 minutes of questions. What would you see as barriers to participating in a panel like that? What do you see as advantages? Would receipt of information and reports from the utilities make you more likely to participate in such a panel?

12A) Do you work in the Residential sector as well? You identified {insert person/title} would be the best person/title to ask about {insert topic}. Would that person answer about both C&I and Residential, or would someone else answer for Residential?

13) Based on your experiences with the utility programs, do you have any other comments you would like to make about the programs and their effectiveness?

14) What are your perceptions of the Mass Save energy efficiency programs?

15) What is your awareness of and perceptions of other green building programs?

16.3 Program Participant End User Interview Guide

1) We understand that your building at {address} participated in the Mass Save program in {year} and received incentives for {equipment type} and {other measures}. Can you tell me the scope and purpose of this project? *{Probe for: Project Cost, Project Duration, and Project Scope (e.g., part of building, whole building, multiple buildings)}*

2) Who initiated this project? Was it internal or external? *{The respondent may say that it was an internal decision to replace the HVAC equipment, but an external trade ally suggested the idea of using the utility incentive program. Since we are interested in the motivation for installing high-efficiency equipment, you should consider the project initiation to be external.}*

3) IF INTERNAL: Was it a top down initiative from management or a bottom up initiative from a facility manager? *{Probe for the sequence of events: Did management initiate a green building process? Or, did facility managers identify an opportunity that they then had to present to management? And, what do you perceive was the goal or objective of the individual or organization who initiated the project? And, what were the circumstances that led to this opportunity? {Probe for Emergency Replacement, Planned Replacement, Energy Efficiency Retrofit}}*

4) IF EXTERNAL: What organization or organizations approached you with this idea. How did the external organization(s) approach you with the idea for the project? What was the most effective selling point?

5) What individuals and/or organizations participated in the HVAC and equipment specification process? *{If not mentioned, ask about the influence of the contractor listed in the PA Program Database. Ask whether any other outside organizations - architects, engineers, or other}*

consultants - were involved in the program.} And, who would you say was most influential in the final equipment specification? *{Request information for the most influential outside contact, if there is one.}*

- 6) What individuals and/or organizations made the final decision on the specific equipment that was purchased and installed? *{Note: It is important to understand whether this individual project had to be approved by management, or if this project was part of the project capital budget.}*
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- 7) What type of HVAC equipment was installed? *{Probe for heating equipment and cooling equipment using categories on building information sheet.}* What is your perception of the efficiency level of the installed equipment? *{Probe for standard efficiency vs. high efficiency vs. cutting edge technology. There are two levels of efficiency for Light Commercial HVAC equipment incentives. Ask why they picked one over the other.}*
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- 8) What is your perception of how the equipment was ordered and delivered? Did you purchase directly or did the contractor handle? Was it purchased from a distributor or directly from the manufacturer?
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- 9) The Massachusetts utilities are interested in what they can do to more effectively market the HVAC equipment programs, operate these programs efficiently, and measure the program impact. In your organization, who could give them the best information on:

- Program marketing including, who to target, what message to convey to the target, and how to reach the target?
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- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?
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- Program operations including, responsiveness to questions, application procedures, on-going communications, and incentive processing?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Technical details on installed HVAC equipment, including installation, commissioning, and equipment operations.

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

10) Based on your experiences with the utility programs, do you have any other comments you would like to make about the programs and their effectiveness?

11) What is your awareness of and perceptions of the Mass Save energy efficiency programs?

12) What is your awareness of and perceptions of other green building programs?

16.4 Program Participant Linked Contractor Interview Guide

- 1) We understand that you worked with the project at {address} that participated in the Mass Save program in {year} and received incentives for {equipment type} and {other measures}. Can you tell me the scope and purpose of this project? *{Probe for: Project Cost, Project Duration, and Project Scope (e.g., part of building, whole building, multiple buildings)}*

- 2) Who do you perceive initiated this project? Was it internal to the organization or external? {If perceives that it was external, verify whether this organization or another was the initiator.}

- 3) If INTERNAL - Was it a top down initiative from management or a bottom up initiative from a facility manager? *{Probe for the sequence of events: Did management initiate a green building process? Or, did facility managers identify an opportunity that they then had to present to management?}* And, what do you perceive was the goal or objective of the individual or organization who initiated the project? And, what were the circumstances that led to this opportunity? *{Probe for Emergency Replacement, Planned Replacement, Energy Efficiency Retrofit}*

- 4) IF EXTERNAL - Was it your organization or another that got {End User} interested in the project? How was that done? What was the most effective selling point?

- 5) What individuals and/or organizations participated in the HVAC and equipment specification process? And, who would you say was most influential in the final equipment specification?

- 6) What individuals and/or organizations made the final decision on the specific equipment that was purchased and installed? What do you perceive was their reason for selecting this equipment?

- 7) What type of HVAC equipment was installed? *{Probe for heating equipment and cooling equipment using categories on building information sheet.}* What is your perception of the efficiency level of the installed equipment? *{Probe for standard efficiency vs. high efficiency vs.*

cutting edge technology. There are two levels of efficiency for Light Commercial HVAC equipment incentives. As the respondent to talk about why this project picked one over the other. }

- 8) What is your perception of how the equipment was ordered and delivered? Did the end user purchase directly or did the contractor handle? Was it purchased from a distributor or directly from the manufacturer?
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- 9) Have you participated in one, several, or many projects that received incentives from the Mass Save programs? Would you say that this project was typical of your experiences with other participating projects? If not, how was it different?
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- 10) The Massachusetts utilities are interested in what they can do to more effectively market the HVAC equipment programs, operate these programs efficiently, and measure the program impacts. In your organization, who could give them the best information on:
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- Program marketing including, who to target, what message to convey to the target, and how to reach the target?
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- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?
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- Program operations including, responsiveness to questions, application procedures, on-going communications, and incentive processing?
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- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Technical details on installed HVAC equipment, including installation, commissioning, and equipment operations?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Panel Participation: The evaluation team is investigating the most effective method of collecting valuable feedback on Mass Save from contractors. One option is to ask companies like yours to participate in a periodic panel survey where you would be informed in advance of the schedule and length of questions. For example, there might be three surveys each year, each with about 15 minutes of questions. What would you see as barriers to participating in a panel like that? What do you see as advantages? Would receipt of information and reports from the utilities make you more likely to participate in such a panel?

10A) Do you work in the Residential sector as well? You identified {insert person/title} would be the best person/title to ask about {insert topic}. Would that person answer about both C&I and Residential, or would someone else answer for Residential?

11) Based on your experiences with the utility programs, do you have any other comments you would like to make about the programs and their effectiveness?

12) What is your awareness of and perceptions of the Mass Save energy efficiency programs?

13) What is your awareness of and perceptions of other green building programs?

16.5 Renovation End User Interview Guide

1) We understand that your building at {address} was renovated during {year}. And, it appears to us that you changed your HVAC equipment and/or systems during that renovation. Can you tell us about the scope and purpose of this project? *{Probe for additional information on project cost, project duration, and project scope, including HVAC equipment and systems.}*

2) To your knowledge, did the HVAC equipment receive a Mass Save incentive or rebate? Did any other part of the project receive a Mass Save incentive or rebate?

3) IF PARTICIPATED - What was the source of the participation decision, internal or external?

4) IF INTERNAL: Was it a top down initiative from management or a bottom up initiative from a facility manager? *{Probe for the sequence of events: Did management initiate a green building process? Or, did facility managers identify an opportunity that they then had to present to management? And, what do you perceive was the goal or objective of the individual or organization who initiated participation?}*

5) IF EXTERNAL: What organization(s) approached you with this idea? How did the external organization(s) approach you with the idea for the project? What was the most effective selling point?

6) IF DID NOT PARTICIPATE: Were you aware of the Mass Save program's HVAC incentives? If yes, why did you decide not to participate?

7) We are interested in discussing the HVAC equipment specification and decision-making process. What internal individuals and/or organizations participated in the HVAC equipment specification process? We see from the Dodge database that the following contractors were

involved in the project? Which of those were involved in the HVAC equipment specification process? And, who would you say was most influential in the final equipment specification?

- 8) What individuals and/or organizations made the final decision on the specific HVAC equipment that was purchased and installed? *{Note: It is important to understand whether this individual project had to be approved by management, or if this project was part of the project capital budget.}*
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- 9) What type of HVAC equipment was installed? *{Probe for heating equipment and cooling equipment using categories on building information sheet.}* What is your perception of the efficiency level of the installed equipment? *{Probe for standard efficiency vs. high efficiency vs. cutting edge technology. There are two levels of efficiency for Light Commercial HVAC equipment incentives. Ask why they picked one over the other.}*
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- 10) What is your perception of how the equipment was ordered and delivered? Did you purchase directly or did the contractor handle? Was it purchased from a distributor or directly from the manufacturer?
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- 11) The utilities in Massachusetts are interested in what they can do to more effectively market the HVAC equipment programs, operate these programs efficiently, and measure the program impacts. In your organization, who could give them the best information on:

- Program marketing including, who to target, what message to convey to the target, and how to reach the target?
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- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?
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- Program operations including, responsiveness to questions, application procedures, on-going communications, and incentive processing?

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- Technical details on installed HVAC equipment, including installation, commissioning, and equipment operations.

- o If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- 12) Based on your experiences with the utility programs, do you have any other comments you would like to make about the programs and their effectiveness?

- 13) What are your perceptions of the Mass Save energy efficiency programs?

- 14) What is your awareness of and perceptions of other green building programs?

16.6 Renovation Linked Contractor Interview Guide

- 1) We understand that you worked on the building renovation project at {address} during {year}. As part of that project, the HVAC equipment and/or systems were changed. Can you tell me a little more about your involvement with this project? *{Probe for: 1) helped with initial plans or got involved at later stage and 2) was focused only on HVAC system or worked on all building systems.}*

- 2) To your knowledge, did the HVAC equipment receive a Mass Save incentive or rebate? Did any other part of the project receive a Mass Save incentive or rebate?

- 3) IF PARTICIPATED - What was the source of the participation decision, internal to the organization or external?

- 4) IF INTERNAL: Was it a top down initiative from management or a bottom up initiative from a facility manager? *{Probe for the sequence of events: Did management initiate a green building process? Or, did facility managers identify an opportunity that they then had to present to management? And, what do you perceive was the goal or objective of the individual or organization who initiated the participation?}*

- 5) IF EXTERNAL - Was it your organization or another that got {End User} interested in the project? How was that done? What was the most effective selling point?

- 6) IF DID NOT PARTICIPATE: Were you aware of the Mass Save program's HVAC incentives? If yes, why did you decide not to participate?

- 7) What individuals and/or organizations participated in the HVAC and equipment specification process? And, who would you say was most influential in the final equipment specification?

- 8) What individuals and/or organizations made the final decision on the specific equipment that was purchased and installed? What do you perceive was their reason for selecting this equipment?

- 9) What type of HVAC equipment was installed? *{Probe for heating equipment and cooling equipment using categories on building information sheet.}* What is your perception of the efficiency level of the installed equipment? *{Probe for standard efficiency vs. high efficiency vs. cutting edge technology. There are two levels of efficiency for Light Commercial HVAC equipment incentives. Ask the respondent to talk about why this project picked one over the other.}*

- 10) What is your perception of how the equipment was ordered and delivered? Did the end user purchase directly or did the contractor handle? Was it purchased from a distributor or directly from the manufacturer?

- 11) Thinking about building renovation projects that include changes in the HVAC equipment and/or systems, was this project typical in terms of specification and decision-making, or unique in some way?

- 12) The Massachusetts utilities are interested in what they can do to more effectively market the HVAC equipment programs, operate these programs efficiently, and measure the program impacts. In your organization, who could give them the best information on:

- o Program marketing: including, who to target, what message to convey to the target, and how to reach the target?

- If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- o Program operations: including, responsiveness to questions, application procedures, on-going communications, and incentive processing?

- If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- o Technical details on installed HVAC equipment, including installation, commissioning, and equipment operations?

- If the evaluation contractors were tasked with collecting information from these individuals, what would be the best approach? Would it be an email survey, a mail survey, a phone survey, an on-site visit, a focus group, or something else?

- o Panel Participation: The evaluation team is investigating the most effective method of collecting valuable feedback on Mass Save from contractors. One option is to ask companies like yours to participate in a periodic panel survey where you would be informed in advance of the schedule and length of questions. . For example, there might be three surveys each year, each with about 15 minutes of questions. What would you see as barriers to participating in a panel like that? What do you see as advantages? Would receipt of information and reports from the utilities make you more likely to participate in such a panel?

12A) Do you work in the Residential sector as well? You identified {insert person/title} would be the best person/title to ask about {insert topic}. Would that person answer about both C&I and Residential, or would someone else answer for Residential?



13) Based on your experiences with the utility programs, do you have any other comments you would like to make about the programs and their effectiveness?

14) What are your perceptions of the Mass Save energy efficiency programs?

What is your awareness of and perceptions of other green building programs? _____



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