

NMR

Nexus Market Research

**Scoping Study on Market Penetration Tracking of  
Energy-Efficient Motors and Packaged HVAC Systems  
in New England and New York**

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**Submitted to:**

**Cape Light Compact**

**Efficiency Vermont**

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**National Grid**

**NSTAR Electric**

**New York State Energy Research & Development Authority**

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## Executive Summary

This report summarizes recommendations and findings from a scoping study of options for tracking the market penetration of NEMA-Premium motors and qualifying commercial HVAC units in the Northeast, sponsored by members of Northeast Energy Efficiency Partnerships, Inc. (NEEP), including Cape Light Compact, Efficiency Vermont, Fitchburg Gas and Electric Light Company, National Grid, NSTAR Electric, New York State Energy Research & Development Authority (NYSERDA), Public Service of New Hampshire, and Western Massachusetts Electric Company. This work was conducted by Nexus Market Research, in conjunction with Shel Feldman Management Consulting and Dorothy Conant.

The team believes that opportunities for successful development of tracking systems are relatively feasible (for motors) or ultimately negotiable (for commercial HVAC units) through cooperation with manufacturers' associations in the relevant industries. Accordingly, the team recommends that the sponsors focus their near-term efforts on expanding relationships with, and working through, these associations to track shipment data in both of the markets under consideration. Moreover, the sponsors should continue to collaborate with the Consortium for Energy Efficiency (CEE) in these efforts, taking advantage of budding cooperation between CEE and the two key associations, the National Electrical Manufacturers Association (NEMA), in the motors market, and the Air-Conditioning and Refrigeration Institute (ARI), in the commercial HVAC market. These recommendations involve less cost and effort in comparison with the alternatives most fully considered, i.e. collecting distributor or dealer data. This collaboration may also be useful in setting the stage for participation in a broader group of funders interested in tracking systems (while avoiding multiple requests of the manufacturers). It would also have the potential of building a positive relationship with ARI despite previous disagreements with the sponsors' efforts to increase the HVAC equipment qualifying standards.

In making these recommendations, the NMR team has considered the feasibility and usefulness of other options as well. In particular, the team considered the strengths and weaknesses of attempting to build a tracking system based on reports from individual manufacturers, as well as one based on reports aggregated by industry associations. It also considered systems based on reports from individual distributors/dealers and from distributor/dealer associations, as well as hybrid solutions. (Systems based on data collected directly from end-users, either through surveys or site visits, are discussed in the report. However, such systems were not considered at length since both the sponsors and the research team deemed them far too expensive in both time and cost.) Data for these analyses were obtained from published reports, Internet searches, consideration of technological solutions, interviews with other energy-efficiency experts, implementation contractors, association executives and staff, equipment manufacturers, and distributors/dealers.

Important factors supporting the recommended approaches are the fact that the associations already enjoy strong relationships and credibility with most manufacturers in their markets and that they already collect some information on their respective industries. Moreover, they each represent a single point of contact, simplifying the task of developing an ongoing relationship, crafting confidentiality agreements, and maintaining an effective communication link. Furthermore, individual manufacturers in both markets indicated that they would not be likely to

cooperate in a tracking system *unless* it was coordinated through their industry association. Finally, data collected from these associations would be unbiased and meet the additional need of sponsors for comparative data from regions in the country without active programs. In contrast, the research team notes that attempting to work with distributors/dealers would entail the development and nurturing of hundreds of contacts throughout the participating states. Furthermore, no guarantee exists that the sponsors would be able to secure cooperation with a majority of the distributors/dealers in either market or that it would be possible to obtain an unbiased sample from which it would be possible to project to the entire market. These problems further suggest that it would be extremely difficult to develop a useful hybrid system that would supplement association shipment data with data on final sales. Finally, the research team believes that obtaining reliable, representative data from distributors/dealers in comparison states or regions would be even less achievable than obtaining those data from program participants on an ongoing basis.

The data that would become available, if the associations were to agree to work with the sponsors, would themselves have certain strengths and weaknesses. Since manufacturers tend to supply most original equipment manufacturers (OEMs)—at least the larger ones—directly, it is likely that the reports to sponsors could have such sales netted out. The reports are also likely to be as readily disaggregated at the state level as at the regional level—or, in the case of motors shipments, even at the level of the “trading area,”<sup>1</sup> ensuring the availability of comparable information for non-program areas on an ongoing basis. However, some information desired by the sponsors (e.g., sales by motor type) might not be available, at least in the early iterations of the system. In addition, some sources of sales to customers in the Northeast are not accounted for by association members, adding some uncertainty to the results and/or requiring supplementary data collection or costs. Of perhaps the greatest concern, the data source is manufacturer shipments to distribution points in each state, not final sales, leaving the issue of cross-border sales as an additional source of uncertainty.

The problem of identifying the role of sponsors’ programs in changing the market penetration of qualifying products can be addressed with the recommended approaches. These approaches would provide the ability to monitor changes in market penetration by both time and location, thus allowing for both simple trend analyses and more complex approaches to the attribution problem, such as regression modeling.

While making these parallel recommendations for working with NEMA and ARI, the NMR team notes that the current state of progress differs in the two markets. CEE and various sponsors have worked successfully with NEMA for the last several years, particularly in establishing the NEMA-Premium-motor standards. As a result of that experience and discussions that took place as part of this scoping study, NEMA invited a letter requesting the data reports of interest to the sponsors (which was tendered by CEE, with input from the project manager and members of the research team), and began consideration of extended data-sharing at the June 2003 meeting of their Board of Governors. As indicated in CEE’s monthly on-line newsletter, “NEMA’s members have responded favorably to CEE’s formal request to their Executive Board for the

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<sup>1</sup> NEMA members currently report (dollar) sales volumes for motors, disaggregated according to 155 trading areas. Of these, 18 lie in the sponsors’ territories. These include one each in NH, RI, and VT; three in MA; three in CT; one in NYC and eight in the remainder of NY (excepting one on Long Island).

tracking and sharing of motors shipment data. CEE is requesting that data be sorted by state or trading area, and the energy-efficiency level of the motors. NEMA members are currently working on an agreement among the 14 companies that hold NEMA Premium licensing agreements to determine what all members will be expected to provide.” In contrast, ARI has some reticence about working with utilities and energy efficiency groups, based on previous disagreements about standards. Accordingly, developing a productive relationship around the need to track market penetration of unitary HVAC units will require additional time and trust-building.

As part of this study, the NMR team also explored the potential and feasibility of a longer-term technological approach. In this method, termed the “out-of-the-box” approach, the relevant equipment (all or a sample of units, depending upon costs and related considerations) would be shipped with electronic tags installed by the manufacturers. These tags would include information on the manufacturer, the model number, and the efficiency level of the equipment, and would transmit that information plus the location (at least as accurately as the nearest identified cellular tower) when the unit is installed and activated. The team determined that the concept appears to be feasible and that two electronics manufacturers may be interested in conducting the research development and demonstration (RD&D), with the expectation that they would receive the deployment contract, should the sponsors or others in the energy industry wish to pursue the opportunity. Furthermore, the team notes that additional capabilities might be built into this technology, such as the ability for demand response programs to signal the HVAC equipment. These other capabilities would increase the costs involved, but may be highly attractive to many utilities that would otherwise have no interest in the technology, possibly increasing both the pool of funders and the value to electronics manufacturers (thus expanding the number who may wish to partner and/or the attractiveness of the terms they might offer).

# 1. Report Overview and Recommendations

## 1.1 Introduction

This is a report on a scoping study on market penetration tracking of energy-efficient motors and packaged HVAC systems.

NEEP's MotorUp<sup>2</sup> and NYSERDA's Premium Efficiency Motors programs encourage the purchase of high-efficiency non-OEM three-phase motors in Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont, using the National Electrical Manufacturer's Association (NEMA) premium efficiency standards. Not only is the "NEMA Premium" standard agreed on and subscribed to by most major manufacturers, but the term "premium efficiency" has historically been understood in the motor industry—among end-users as well as manufacturers and distributors—to denote the highest level of efficiency, entailing a price premium.

NEEP's Commercial HVAC Initiative<sup>3</sup> aims to establish CEE Tier 2 packaged HVAC equipment and installation as commonly accepted products and practices in Connecticut, Long Island, Massachusetts, New Hampshire, New Jersey, Rhode Island, and Vermont. NYSERDA's New York Energy Smart<sup>SM</sup> Program provides rebates/incentives for CEE Tier 1 equipment of 5.4 tons or less and CEE Tier 2 equipment up to 20 tons. CEE Tier 1 (equivalent to American Society of Heating, Refrigerating, and Air Conditioning Engineers [ASHRAE] standards), is approximately 12% more efficient than the federal minimum, and CEE Tier 2 is approximately 22% more efficient than the federal minimum.

The program sponsors recognize the importance of monitoring the effectiveness of these programs, both to assure themselves (as well as interested regulators and non-utility parties) that the public funds involved are being spent well and to obtain feedback that can help implementers adapt the programs to relevant market changes. For programs of this type, the crucial metrics—and the most difficult to monitor—are changes in the market penetration of the energy-efficient products promoted and their causal linkage to the intervention. Sales are directly correlated with energy and demand savings (the ultimate indicators) and a direct outcome of efforts to work effectively with key market actors and to increase end-user awareness and willingness to purchase energy-efficient equipment (more proximate indicators). To capture changes in market penetration of qualifying units, sponsors require reports of the sales of qualifying units relative to the sales of total units. Accordingly, the objectives of the scoping study are: 1) to identify and investigate alternatives for tracking market penetration, and 2) to assess and discuss the feasibility of various options for doing so.

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<sup>2</sup> Run by NEEP sponsors, including utilities in Connecticut, Massachusetts, New Hampshire, Rhode Island, Vermont, and New Jersey, as well as by NYSERDA and LIPA in New York.

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To address these objectives, the NMR team conducted the following background interviews and research:

**For Motors:**

- Applied Proactive Technologies (APT)
  - MotorUp management
  - Premium Efficiency Motors management
- KEMA-XENERGY
- Consortium for Energy Efficiency (CEE)
- Internet research
  - Input-output models
  - Department of Commerce reporting systems

**For HVAC:**

- Energy Center of Wisconsin
- MaGrann Associates
- KEMA-XENERGY
- American Council for an Energy-Efficient Economy (ACEEE)
- Consortium for Energy Efficiency (CEE)

**For the “Out-of-the-Box” Concept:**

- Internet research on products and companies related to location monitoring
- Interviews with five location monitoring product manufacturers

We also conducted depth interviews or E-mail correspondence with the following:

**For Motors:**

- National Electrical Manufacturers Association (NEMA)
- Electrical Apparatus Service Association (EASA)
- Six manufacturers
- Six distributors/dealers

**For HVAC:<sup>4</sup>**

- Air-Conditioning and Refrigeration Institute (ARI)
- Heating, Air-Conditioning, and Refrigeration Distributors International (HARDI)
- Seven distributors

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<sup>4</sup> As originally proposed, the study work plan called for interviewing the four major manufacturers of packaged HVAC equipment. However, the first manufacturer called cut the interview short, saying manufacturers belong to ARI for a reason—ARI is their industry association and it represents the views of its members. Therefore, we should be talking to ARI, not individual manufacturers. Follow-up conversations with CEE and ARI confirmed that this was the common attitude among manufacturers. Based on this information, and concern that pushing for interviews with the manufacturers at this time could potentially make it harder to get their support for sharing information later on, a recommendation was made to the sponsors that individual interviews with the big four HVAC manufacturers not be conducted at this time, and the sponsors agreed.

**For the “Out-of-the-Box” Concept:**

- Five manufacturers

On the basis of this scoping research, we make the recommendations outlined in the following sections, and described more fully in the subsequent chapters.

**1.2 Recommendations for Motors Tracking System**

Based on this research, the team believes that opportunities exist or may be developed to obtain shipment data from NEMA, the association representing the major domestic manufacturers of motors. Accordingly, the team recommends that the sponsors make every effort to forge an agreement for sharing shipment data on at least an annual basis. The team considers this a reasonably likely and highly attractive option for developing a tracking system and obtaining unbiased data in a cost-effective manner. The team recognizes that the data most likely to be provided would be less than ideal (and would require foregoing disaggregation by motor types). At the same time, the team believes that such an agreement would greatly advance knowledge and understanding of the market penetration of qualifying units, and would provide information of value for assessing and enhancing programs to support increases in energy efficiency. In addition, such an agreement may open the door to developing a more extensive data-sharing system, as a working relationship matures and each party becomes more familiar with the needs, concerns, and trustworthiness of the other.

A synopsis of key points follows. This synopsis is structured to move from lower-level market actors to higher-level actors, so that the reader can follow the logic by which various options were eliminated before reaching the research team’s recommendation. Additional support for the core recommendation may be found in following chapters of this report.

- This scoping study considered data collection from upstream and mid-stream market actors only. The initial and recurring costs and of an end-user based tracking system were deemed too great to merit further consideration.
- Interviews with motor distributors/dealers indicated several barriers that would be extremely difficult, if not impossible, to overcome within a reasonable time frame and budget. These include the following:
  - Computerized sales records are not standard. A number of distributors/dealers continue to rely on paper-and-pencil records; among the distributors/dealers who do have computerized records, no single software platform seems standard, suggesting that the development of a comprehensive system would require considerable time and many compromises
  - Key data may be missing from invoices. Some distributors/dealers do not record model numbers on invoices (for competitive reasons); not all distributors/dealers indicate whether a unit is a NEMA-premium motor
  - Providing sales information is seen as a hassle by those who hold it. Several distributors/dealers complain about the cost of current reporting requirements and view any additional information requests as unjustified burdens

- Distributors/dealers see no immediate incentive for providing the needed information. Feedback of information regarding total sales or the penetration of NEMA-premium efficient motors in the state is not perceived as being of value by most distributors/dealers; many distributors/dealers chafe at the removal of financial incentives from program sponsors (outside New York)
- Some distributors/dealers are concerned about the competitive value and confidentiality of any sales reports they may provide. Many distributors/dealers believe that the disclosure of information about their total sales would compromise their competitive position; furthermore, some were skeptical about the strength and enforceability of confidentiality agreements
- There is a lack of comparison data. The difficulties of enlisting distributors/dealers who are participating in the programs are likely to pale in significance when compared to the problems that would be faced in attempting to enlist nonparticipants, in any state or region

For these reasons, the research team believes that no tracking system aspiring to be a census of motors sales (as opposed to shipments) can be established in the near future. To do so would require considerable outlays of resources to create a system that is easy for distributors/ dealers to contribute reports, compensates distributors/ dealers for their effort, and credibly protects confidential information. In addition, it would require a great deal of time to meet with distributors/dealers and convince them to participate, in itself a time-intensive and expensive effort that would compete with other program activities and budgetary pressures.

Collecting complete sales data from a more limited sample of distributors/dealers may be feasible. While such a sampling approach may be less costly than a census-based approach, it would still require development of a standardized data entry system from a variety of recording approaches and securing cooperation from distributors/dealers. Moreover, such an approach would have to be viewed as providing a window into the market, but not a projectable sample of market operations, since it is highly likely that the sample of distributors/dealers that cooperates will be biased in its representation of ownership types, location, volume, etc.<sup>5</sup> Thus, a sample of distributors/dealers data may provide a useful adjunct to other data sources, or a recognizably fallible back-up approach. In itself, it cannot meet the minimum requirements of the sponsors; the tradeoff between the value of the information that would be gained from such a system and its costs would have to be judged carefully.

- EASA, the industry association to which many distributors/dealers belong, does not collect the type of data required by the sponsors. Moreover, the association enjoys far from universal membership.
- Interviews with executives representing individual domestic manufacturers are unequivocal in saying that they would expect requests for the type of information

<sup>5</sup> Furthermore, without a census against which to benchmark, it will not be possible to determine the degree of bias present in the results.

required by the sponsors to be directed to and processed by NEMA, the industry association that represents almost all of them.

- The recommendation to develop an agreement with NEMA in effect codifies efforts that are already under way.

As sponsors of the scoping study are aware, CEE has been developing a relationship with NEMA over the last several years. The research team's discussions with CEE yielded useful information about NEMA's capabilities and helped gain entrée with key contacts at the association.

The joint interview with CEE and NEMA confirmed the availability of much of the data deemed minimally acceptable by the sponsors of the scoping study and indicated that some level of cooperation in sharing those data might be feasible.<sup>6</sup> During further questioning, the research team learned that the critical decision regarding cooperation should come from NEMA's Board of Directors, which meets annually in June.

Accordingly, the research team suggested to the project managers that it would be useful to send a letter to the NEMA Board in time for this year's meeting, describing the need for the data, the specifics of what data would be needed, and how it would be used and protected. It was also stressed that this request should be channeled through CEE, to help establish what would be a single point of contact at a national level, thus alleviating the potential concern of the NEMA Board with regard to opening themselves up to a plethora of requests from individual program sponsors across the country.

As agreed by the project managers, CEE developed a letter and data request, with input from the research team. This was delivered to NEMA for their annual June Board meeting. NEMA's members have responded favorably to CEE's formal request to their Executive Board for the tracking and sharing of motors shipment data. CEE is requesting that data be sorted by state or trading area, and the energy-efficiency level of the motors. NEMA members are currently working on an agreement among the 14 companies that hold NEMA Premium licensing agreements to determine what all members will be expected to provide.

- The research team also considered the merits of developing a hybrid approach, combining some aspects of shipment data from NEMA and sales data from distributors/dealers. As indicated in the above discussion of a system using data from a sample of distributors/dealers, the team believes that the difficulties and costs of collecting data from even a sample of mid-market actors is likely to be rather high. It is not at all clear that the added value of being able to compare information from the two sources would justify the incremental costs involved.

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<sup>6</sup> The details of the request, which would require some comprising of the "minimally acceptable" data set, are discussed in the body of this report. It should also be recognized that the data in question represent shipments, not sales themselves. Nonetheless, the team believes these data would be sufficient for demonstrating program effects at a gross level, as discussed in the section on attribution.

### 1.3 Recommendations for HVAC Tracking System

Based on the research and interviews conducted, the NMR team recommends that the sponsors pursue the option of obtaining market penetration data from ARI, working through CEE.

Specifically, we recommend that the sponsors give top priority to working with ARI to get a data-sharing request on the agenda of the next ARI membership meeting in November.<sup>7</sup> The “Going for the Gold” request would ask ARI members to approve:

- Providing access to currently proprietary national shipment data by type, size and efficiency
- Adding shipments by state to their standard reporting
- Initiate tracking water source heat pump shipments by efficiency.

Based on our ARI interview this will not be an easy sell. It will require patience and tact. However, ARI’s Director of Public Policy was extremely cooperative<sup>8</sup> and indicated a willingness to work with the sponsors, through CEE, on developing a data request that could potentially be approved by ARI members. We believe ARI’s cooperative attitude is an encouraging sign.

The potential cost of obtaining access to ARI data is an unknown. ARI was not ready to discuss costs except to say that an offer by the sponsors to cover the incremental cost of producing a new report would be viewed positively. Should ARI agree to supply data, we expect the incremental costs will be reasonable given that:

- Manufacturers already supply most of the desired data to ARI on a routine basis
- The data the sponsors seek would be a subset of the current ARI national report: only three-phase units and only 30-ton-and-under units
- Addition of state-level data should be relatively straightforward because manufacturers already report residential product shipments by state
- The addition of water-source heat pump data by efficiency level should be relatively straightforward because they already report other equipment by efficiency level
- Sponsors would likely need to negotiate only one confidentiality agreement – with ARI.

We recommend initiating the effort through CEE. ARI believes their current dialogue with CEE is going well and is a good start toward resolving the issues that concern ARI members. We believe initiating any requests through CEE, which ARI members see as willing to work with the

<sup>7</sup> ARI member meetings are held twice a year - typically in November and March. Any request from the sponsors for access to currently proprietary data would have to be voted on at a member meeting

<sup>8</sup> We communicated with ARI’s Director of Public Policy three times. The initial interview lasted an hour and a half. He was extremely open and very willing to talk about issues the sponsors would need to address to overcome ARI membership’s current general distrust with respect to utilities. After the initial interview, he followed up with additional information on specific questions about data availability that he was unable to answer in the initial interview. Finally, he reviewed the text included under the heading “Approaching ARI” at the end of this section and verified that it accurately describes his view of what the sponsors would need to do to get a positive response to a request for access to ARI data.

industry, would likely provide the best chance of getting members to consider sharing information. Even with CEE's support, it may take some time to convince ARI members to seriously consider sharing data with utilities and other energy efficiency organizations. If ARI members agree to share data, they still may not be willing to supply everything the sponsors are seeking. However, an agreement to share anything should be seen as a very positive step. If the sponsors gain access to at least some currently proprietary data and can show ARI members that they can be trusted to meet their commitment to treat the information appropriately, and live up to any other commitments they make toward resolving program-related issues of concern to members, then the probability of being able to gain access to additional information in the future improves. A detailed discussion of issues important to ARI members and things the sponsors could do to improve their chances of gaining membership approval to share information is at the end of this section, included under the heading "Approaching ARI."

We recommend that the sponsors do not pursue collecting data from distributors unless it becomes clear that they will not be able to get access to ARI data. At that point the sponsors will need to decide if the cost of developing and maintaining a distributor-based data collection system is acceptable, especially given the uncertainty at the outset of being able to recruit a representative sample of distributors covering all major manufacturers. Given that many of the distributors selling the major brands are owned by the manufacturers supplying the individual distributors, we believe it is likely that the manufacturers refusing to supply shipment data through ARI would also refuse to allow their company owned distributorships to provide sales data.

We do not recommend pursuing a hybrid system incorporating manufacturer shipment and distributor sales data. If the ARI membership votes down a proposal to share information, we believe it is unlikely the four major manufacturers would be willing to go against the vote of their industry trade association and be willing to provide shipment data independently to the sponsors. If only some manufacturers are willing to provide shipment data, the sponsors would need to collect sales data separately from distributors selling equipment from the manufacturers not providing shipment data. Again, given that many of the distributors selling the major brands are owned by the manufacturers, we believe it is likely that the manufacturers refusing to supply shipment data would also refuse to allow their company-owned distributorships to provide sales data.

If ARI approves sharing the information they track, but does not immediately agree to add state-level data to their commercial tracking system, then an interim system based on national shipment data and distributor sales data from the states served by the sponsors' programs will be necessary. The sponsors need to have a way of showing regulators that the penetration of high-efficiency commercial and light industrial HVAC equipment is higher in the areas served by their programs. If ARI members agree to share at least some of their data with the sponsors, we believe there is a better chance of getting the major manufacturers to agree to have the distributorships they own supply sales data than if ARI refuses to share any data. The key to a cost-effective interim system will be to work through the manufacturers to get them to approve having their company-owned distributors supply state sales data. In some cases the manufacturers track sales data for their distributors, and in these instances it may be possible to get state-level distributor sales data directly from the manufacturer. If the collection of distributor

sales by efficiency cannot be streamlined by working through the manufacturers, the cost and time required to collect and aggregate distributor data for an interim hybrid system will approach the cost of setting up a full distributor-based tracking system.

### **Approaching ARI<sup>9</sup>**

The key to gaining access to ARI data is getting a majority vote of the membership to approve a data sharing proposal. This will not be an easy task. Based on the interview with ARI, it appears that members would probably reject a simple request to gain access to their data. The history of bad blood between utilities and the HVAC industry makes utility requests difficult to address. On one hand, the utilities are asking for information. On the other hand, the utilities are pushing for higher efficiency standards. There is reluctance to share data with utilities or others who are pushing things ARI members do not want. In particular, NEEP's efforts to push higher efficiency standards in Massachusetts make the industry reluctant to share information. Until these utility/industry issues are resolved, ARI said they are not sure their members would be willing to work with utilities. However, there is also some good news. ARI believes the current dialogue with CEE is going well and is a good start toward resolving the issues that concern ARI members. CEE is coming across as willing to work with the industry—at least the “new” CEE, based on changes ARI has seen in the last six months or so.

As part of the interview with ARI, we asked what the sponsors could do to overcome ARI member concerns related to sharing information. The response was to work on building trust first and worry about the data later. Initiating the effort through CEE, which, as mentioned above, is seen as willing to work with the industry, would likely provide the best chance of getting members to consider sharing information. At the same time, ARI members' current irritation with NEEP's efforts to tighten standards means any request involving them would be deemed suspect at this time.

The sponsors will need to convince ARI members that they are willing to work with them on resolving existing mistrust issues. Why should ARI members help the utilities if the utilities are not helping ARI members? If utilities and/or other groups ask for information and then do things the industry does not support, ARI members see no need to support their requests. (Despite existing mistrust issues, the ARI interviewee indicated he was pretty sure that members see the sponsors' programs as a good tool for marketing high efficiency equipment.)

What could the sponsors offer to gain acceptance from ARI members? One option would be working for consistency in rebate programs. The ARI interviewee believes members see the sponsors' programs as a good tool for marketing high-efficiency equipment. However, the proliferation of programs across the country with different requirements causes confusion and has negative effects on manufacturers. It is difficult for manufacturers to design products for different program specifications. Manufacturers want the utilities who offer rebates to establish a uniform set of criteria for rebate-qualifying equipment; making requirements uniform will make them manufacturer-friendly.

<sup>9</sup> As mentioned earlier, the information under this heading was reviewed by ARI's Director of Public Policy who verified that it accurately described his views.

Program sponsors could also offer to include manufacturers in program design efforts. The feeling at ARI is that there has been no industry feedback on or input into programs, and manufacturers know better what can be designed and made than industry outsiders. As an example of this they point out that there are no products available that meet Tier 2 requirements in some categories, and they do not understand the logic of specifying qualifying levels where no product is available.<sup>10</sup> The sense is that energy efficiency groups have agendas that do not always make sense and are not consistent with those of the HVAC industry. On a positive note, the sense ARI got out of their May meeting with CEE is that CEE is now more aware of this issue, as evidenced by CEE wanting to discuss residential specifications under revision and its interest in getting input from ARI and manufacturers.

Other specific offerings and arguments that could help gain agreement from ARI members to share information include:

- Provide more information about the current rebate programs.
- Explain that having access to ARI data would likely cost hundreds of thousands of dollars less than developing a system to collect data from individual distributors, and that the less the sponsors have to spend on data collection the more they can spend on rebates or other efforts to promote sales.
- Make it clear that the sponsors are willing to pay for ARI's costs for collecting more information and developing new reports.
- Express willingness to sign confidentiality agreements.
- Assure that all data supplied to the sponsors would be aggregated across all manufacturers—no brand or manufacturer-specific information would be requested or provided to recipients.
- Offer to provide regional- or state-level reports to distributors—something distributors are interested in so they can see how their sales of high-efficiency equipment compare to regional data.

Finally, it will be important to work closely with ARI in the development of any proposal to be submitted to ARI members for approval. ARI knows the key concerns of its members about sharing information better than anyone else and is in the best position to help structure requests in a way that will be most acceptable to members. Patience will also be key. Even if ARI members agree to share some data, they may not be willing to supply everything the sponsors are seeking initially. However, agreement to share anything should be seen as a very positive step. If the sponsors do gain access to at least some currently proprietary data and can show ARI members that they can be trusted to meet their commitment to treat the information appropriately, and live up to any other commitments they make toward resolving program-related issues of concern to members, then the probability of being able to gain access to additional information in the future improves.

<sup>10</sup> According to CEE there is only one commercial air-cooled air-conditioning Tier 2 category where there is zero product availability - split systems over 240,000 btu/h. There are product availability issues for Tier 2 heat pumps, but CEE indicated they will be discussing a potential spec revision to make product available. Complete information on product availability can be found at [http://www.cee1.org/com/hecac/ac\\_tiers/impcttbl.htm#1](http://www.cee1.org/com/hecac/ac_tiers/impcttbl.htm#1).

## Basis of Recommendations

There are advantages and disadvantages to both the ARI and distributor-based data collection options. Neither option will provide the sponsors with all the data needed in the near term. The above recommendations are based on the following facts and conclusions with respect to data availability and access:

### ARI Data

- ARI does not currently track some of the fields the sponsors are looking for—specifically shipments by state and factory-installed dual enthalpy economizer controls.
- Except for total shipments by size, ARI data are proprietary.
- Getting ARI members to report shipments by state is likely the only way to get reasonable data on the penetration of high efficiency equipment in non-program states, which will permit attribution of market effects to the sponsors' programs.
  - If only national data by efficiency level is available from ARI, it could at least provide a basis of comparison to estimates of the penetration of high efficiency equipment sales in the sponsors' program areas based on distributor sales data.

### ARI Data Access

- The key to gaining access to ARI data, and getting members to report additional data fields, is getting a majority of the members to vote to approve a data-sharing proposal.
- Getting ARI members to agree to share data will not be an easy task. ARI members believe the agendas of energy efficiency groups do not always make sense and are not consistent with industry goals.
- Accessing ARI data is the most cost efficient option because the sponsors would be building onto an existing tracking system, dealing with one data source, and would likely have to negotiate only one legal confidentiality agreement.

### Distributor Data Collection

- Distributor-based data collection is a very high-cost option with no assurances at the beginning that getting a representative sample of distributors agreeing to supply data will be achievable. In the interview with the person in charge of maintaining a distributor-based tracking system for the Energy Center of Wisconsin we learned:
  - It cost over \$100,000 to set up the Wisconsin system for tracking residential HVAC equipment sales—one that collects data from 13 distributors.
  - One major manufacturer, with control over its distributorships in Wisconsin, has refused to provide data for the tracking system.
- Both the initial cost of developing a distributor-based tracking system and ongoing data handling expenses would be high because of the large number of data points that would be required to provide acceptable market coverage.
  - We estimate there are 80 to 100 distributors for the four major manufacturers in the areas served by the sponsors' programs.
  - Based on Wisconsin's experience, aggregating individual distributor reports is a time-consuming process because the reports come in varying formats (everything

from hand-written faxed sheets to Excel spreadsheets) and there are frequently errors in the submitted data, which means someone has to check each individual data submission.

- It would likely be at least a year from the time distributor recruitment started to the production of the aggregated data report.
- Many distributors do not currently track and report on the fields the sponsors want, but say they would probably be able to do so with some additional work or by accessing and merging multiple sources. Sponsors will not know how complete or consistent the data are until after they have paid for them, contracted with a third party to aggregate the data, and had the opportunity to review aggregated data—a risky proposition.
- Some distributors rely on the manufacturers they represent to process all sales data. Obtaining data from these distributors likely would require working directly through the manufacturers, who are likely to refuse to provide data through their distributorships if they refuse to provide data through ARI.
- Each distributor would likely have to review with its legal counsel any confidentiality agreement to protect their data—a labor-intensive, time-consuming and expensive process.
- It is highly unlikely that a representative sample of distributors from a non-program area could be recruited to supply data.

#### 1.4 Recommendations for Follow-Up on the “Out-of-the-Box” Approach

As an adjunct to this scoping project, we conducted a preliminary assessment of an “out-of-the-box” approach for market penetration tracking: a system of devices that could communicate location and model numbers of all (or a sample of all) integral motors and packaged commercial HVAC systems, in order to allow the estimation of penetration of energy-efficient units within the sponsors’ areas, as well as comparison areas. We identified five companies with what seem to be relevant products through an Internet search, and then we interviewed these five companies. Two companies have the most closely related products, and are interested in exploring product development with the study sponsors: LoJack Corporation of Westwood, MA, and Laipac Technology, Inc. of Toronto Canada.

Our initial assessment is that such a product is technically feasible. Advantages of this approach include the ability to estimate penetration not only for New York and New England, but also for other areas with active energy efficiency programs, for areas without such programs, and nationally. This capability would greatly enhance assessment of attribution of market effects to energy efficiency programs. The characteristics of such a product and its application would resemble the characteristics of retail products most commonly used for stolen vehicle tracking and recovery, including the following:

- Data transmission and collection via cellular technologies and negotiated data transmission accounts (i.e., similar to a bulk-purchase of cell-phone subscriptions), with location unit installation established based on the nearest cellular tower
- Location, model identification, and operation data management through a contractor, with data accumulated electronically and reported monthly or quarterly

- Power supply provided by the same power source used for the motor or HVAC system itself, with minimal power requirements
- Activation of the data transmitter when the host product (motor or commercial HVAC unit) is first installed and energized.
- Data consisting minimally of model number and location (the nearest cellular tower), and possibly operating hours for as long as the cellular account remains open.

Other system characteristics are less clear, and would depend on the sponsors' objectives and resources:

- **Sampling versus census.** A sampling approach would require that each cell of interest for minimally acceptable data—for example, for motors, horsepower category and premium vs. non-premium, which equals ten cells—would have sufficient numbers of devices randomly installed to provide reliable samples for New England and separately for New York. This would require several thousand units annually. A census approach, in which precision of estimates would not be an issue and the ideal data reporting would be achievable, would require hundreds of thousands of units annually for HVAC, and millions for motors. From the manufacturing perspective, a census approach would probably be easier and cheaper.
- **Performance capabilities.** Performance capabilities could include load control. Utilities would not know who had the units, but they could tell their customers that any HVAC unit built after a certain year would allow load control capabilities given the user's permission—or this information could come from the manufacturer—and the customer could initiate it. While this capability would add to the cost of individual units, it might draw the interest of utilities in areas without extensive energy efficiency programs but with extensive demand response programs, and thus help cover the cost. This option and the sales opportunities offered might also increase interest—and competitive pricing—among manufacturers of the devices.
- **Cost.** Product development for this system would not be tremendously expensive; while one company said the work could be accomplished for \$40,000 or under, we believe it is safer to say \$100,000. However, deployment would be quite expensive—probably in the high six figures to the low seven figures range annually with a sampling approach, and into eight figures with a census approach<sup>11</sup>. However, we should emphasize that all of these cost estimates are very general, and could be higher or lower. Presumably, too, the cost could be shared with other utilities having energy efficiency programs—those in California, the Pacific Northwest, Wisconsin, and possibly elsewhere. With load control capabilities included, the potential areas of interest are greatly expanded, as is the potential for cost recovery through demand savings.
- **Potential uses in other equipment.** Such a product could also be used for market penetration tracking for appliances, or for load control with residential central air conditioning units, commercial chillers, or boilers. Such adaptations would also have the potential of lowering unit costs.

<sup>11</sup> Based on a per-unit cost of \$40 to \$100, and assuming that thousands or tens of thousands of units would be needed for a sampling approach, and a few hundred thousand units for a census approach.

- **Attracting the interest of manufacturers.** For the system to work, all major motors and/or motors manufacturers would have to participate. Hence the data would have to be packaged in such a way as to make it useful for them. Possibilities include providing breakdowns of installations of their products compared to the industry as a whole by area, (premium) energy efficient vs. standard efficiency, plus any other characteristics that are tracked, such as size and type. The technology could also be designed to capture key operating characteristics, thus alerting manufacturers or their certified service people of problems, further increasing the value of the devices and the range of potential financial contributors. The motors and HVAC research shows that it is probably best to work on securing manufacturers' cooperation through their associations.

The HVAC and motor market players we talked to expressed interest in such a product, although we interviewed them before the likely product characteristics were clear, and they all said they would have to know more before discussing in detail their willingness to participate. In any case, involving HVAC and motor manufacturers at this point appears to be premature. Instead, we recommend the following four initial steps:

1. Approach utilities and related organizations about their interest in funding the product development stage.
2. Develop product specifications based on the number and types of utilities and related organizations expressing interest.
3. If the utilities and related organizations are positively inclined, discuss the concept with NEMA and ARI (and other associations in targeted industries) to gauge their interest before going forward with product development.
4. After the product funding has been secured and the interest of manufacturers has been assessed, solicit proposals from LoJack and Laipac, plus any other candidates that can be identified.

If the sponsors decide not to pursue all of these initial steps, we recommend revisiting this general approach within two or three years, given the rapid development of technology and decreasing costs. It remains to be seen whether the time has come for this idea, but at the very least its time appears to be coming.

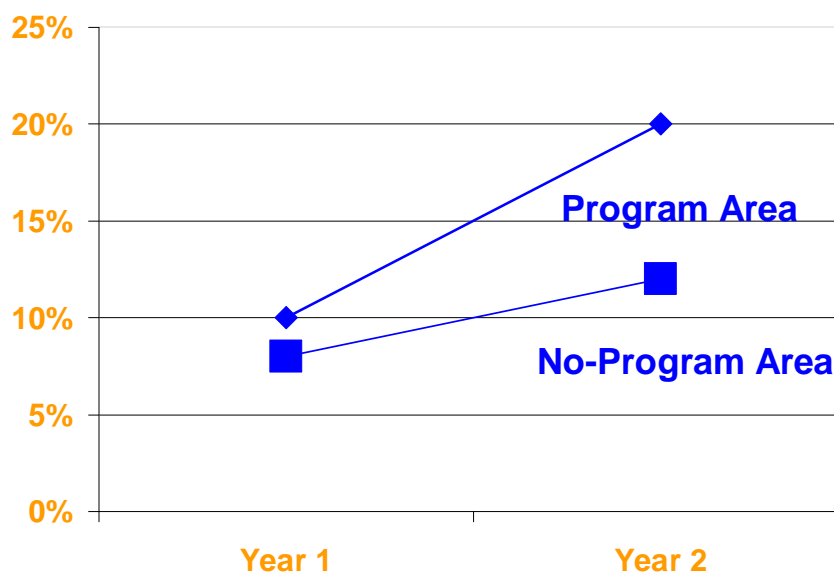
## 1.5 Attribution of Market Effects

As outlined above, we recommend continued efforts to secure shipment data from manufacturers' associations—NEMA and ARI—as the primary data source for estimating market penetration of energy-efficient motors and packaged commercial HVAC. If such data become available, they will also permit attribution of market effects to the sponsors' programs much better than the primary alternative data source, which is regular collection of sales data through dealers and distributors.

With market penetration data there are two primary tools for attribution: assessing changes over time, and assessing geographic differences. If a program is effective, one would expect the market penetration of energy-efficient equipment to increase over time. Similarly, one would expect the penetration of energy-efficient equipment to be higher in areas with programs than in

areas without programs. However, if one has data over time but not over space, one cannot be sure whether the increases in market penetration are also occurring in areas without programs; if one has data over space but not over time, one cannot be sure if the higher penetration in the areas with programs is due to the program or to some other factor. Hence, attribution of market effects requires data over *both* time and space. The pattern that would allow one to attribute market effects to a program is to show *a higher rate of increase* in the market penetration of efficient equipment in areas with programs than in areas without programs, as depicted in Figure 1.1<sup>12</sup>.

**Figure 1.1: Comparisons Allowing Program Attribution**



The primary alternative data source—regular collection of sales data through dealers and distributors—will almost certainly lack the perspective of data over space, because our assessment is that it would be virtually impossible to collect ongoing sales data from dealers and distributors in a comparison area without an active program.

With a hybrid approach—national-only data from the relevant manufacturers’ association, plus distributor/dealer data in the sponsors’ areas—some degree of attribution over space is possible, but only through comparisons of market penetration in the program area to national data. Expected differences between the country as a whole and areas with programs would not be as great as differences between areas with and without programs, because national data includes the program areas.<sup>13</sup> Moreover, comparing different types of data—from associations (manufacturers) and from distributors—could introduce unknown sources of error.

<sup>12</sup> See D. Campbell and J. Stanley, *Experimental and Quasi-Experimental Designs for Research*. Boston: Houghton-Mifflin, 1963.

<sup>13</sup> The market penetration of qualifying units in the sponsors’ states could be netted out of the national data, *if* one had confidence in the projectability of the data from distributors/dealers in the program area to the entire state. (This has proved a useful approach for studies of energy-efficient lighting products in California and Wisconsin.) Unfortunately, the validity of such assumptions would seem highly questionable.

Of course, there are also unknown biases in associations' shipment data—primarily that the places to which motors and HVAC systems are initially shipped are not necessarily the places where they will end up; distributors and dealers often sell to contractors or end-users in different states. Insofar as equipment shipped to dealers/distributors in a state without a program crosses over to a state with a program (or vice versa), this is a problem for attribution. It is less of a problem in a large state like California where the population centers are relatively far from state borders; it is much more of a problem for the smaller states in the Northeast where many population centers are near state borders. Basically, program effects have to be large enough to compensate for unknown border-crossing effects.

Finally, the out-of-the box approach, should it come to fruition, could provide ideal data for attribution of market effects. Data could be disaggregated by state or even smaller geographic areas (the size of an area covered by a cellular tower). The data could also be collected and analyzed for a variety of time periods—i.e., by week, month, quarter, or year, which would allow tracking and attribution tied to specific promotions. A census approach would allow virtually unlimited analysis by geography, time, and product characteristics. This disaggregation capability would be greatly reduced, however, if a sampling rather than a census approach is taken, depending on the size of the cells.

Assuming state-by-state shipment data become available, one model for assessing attribution is provided by Rosenberg (2003).<sup>14</sup> In assessing the effectiveness of the Efficiency Vermont program, he developed regression models for the state-level market penetration of each of four energy-efficient major appliances, as a function of the presence or absence of active utility or regional incentive energy-efficiency programs, as well as state-level education characteristics and median income. Application of the model yielded statistical evidence that differences in market penetration were attributable to the presence of active energy-efficiency programs. Moreover, the resulting regression models were used to estimate the market penetration that could have been expected in Vermont in the absence of the program, and thus the magnitude of the effect of the program in that state (by comparing actual data with what would have been expected). Conceptually similar modeling is also discussed by Sebold and Fields (2001).<sup>15</sup>

<sup>14</sup> Rosenberg, M. 2003. "The Impact of Regional Incentive and Promotion Programs on the Market Share of ENERGY STAR® Appliances." Proceedings of the 2003 International Energy Program Evaluation Conference. In press.

<sup>15</sup> Chapter 7, "Market Dynamics and Estimating Market Effects" in Sebold, F., A. Fields, L. Skumatz, S. Feldman, M. Goldberg, K. Keating, & J. Peters. 2001. A Framework for Planning and Assessing Publicly Funded Energy Efficiency. Pacific Gas & Electric. (Study ID PG&E-SW040.) San Francisco CA.

## 2. Market Penetration Tracking of Premium-Efficiency Motors

The research team gathered and analyzed several sources of information in preparing this report. Key background material regarding the structure of the motors market was obtained from a review of an earlier study of the MotorUp program.<sup>16</sup> Variations in the nominal efficiency of motors within horsepower classes, as a function of type (Open Drip-Proof motor [ODP] vs. Totally Enclosed Fan-Cooled motor [TEFC]), speed (1200 rpm vs. 1800 rpm vs. 3600 rpm) and manufacturer was assessed based on information submitted to the California Public Utilities Commission.

Interviews included discussions with experts in the energy efficiency industry and different points in the motors industry itself. Those consulted in the first group included the leads for the motors program and the evaluation program at the Consortium for Energy Efficiency (CEE), as well as the primary author of the earlier study of the MotorUp program. In addition, research team members held an extensive interview with a senior staff member and the chair of the marketing department for industrial motors at a key manufacturers' association, the National Electrical Manufacturers Association (NEMA), jointly with representatives from CEE.<sup>17</sup> Team members also interviewed executives from six domestic manufacturers, representing the overwhelming majority of the units produced and sold in the U.S.

Members of the research team also conducted interviews with key mid-stream market actors, as well as contractor implementation leads for the MotorUp program and the NYSERDA's Premium Efficiency Motors program. The market actor sample, which was purposively selected, comprised six motor distributors/dealers, including equal numbers of participants in the MotorUp and Premium Efficiency Motors programs. All are participants in the program in their state, but they represent both single-location and chain/franchise outlets, some of which operate across several states. (Given the intent of the project as well as the time and budget available, the intent was not to obtain quantitative information from a statistically representative and generalizable sample, but to explore a limited number of issues in enough detail as to understand the range of variation in the market.) In addition, the research team has consulted with an executive of the key association of motor distributors and dealers, the Electrical Apparatus Service Association (EASA).

<sup>16</sup> XENERGY, Inc. 2001. *MotorUp Evaluation and Assessment*.

<sup>17</sup> The discussion guide for this interview and those for all other interviews discussed below were submitted for prior review by the research sponsors and modified in accordance with their comments and recommendations.

## 2.1 The Motors Market

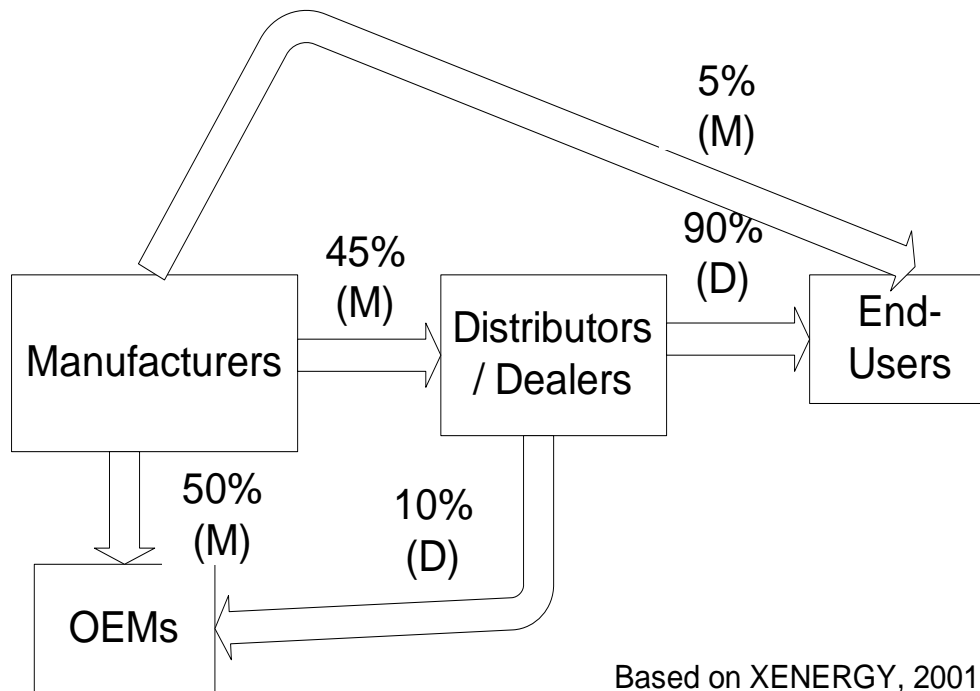
A review of key points about the motors market in the Northeast may help provide context for the remainder of this section. In particular, they may clarify part of the research team’s rationale for the recommendation to concentrate on developing agreements with the National Electrical Manufacturers Association (NEMA).

### Product flow

Approximately one-half of the motors sold in the Northeast are believed to go directly from motors manufacturers to other manufacturers (Original Equipment Manufacturers, or OEMs), who use them in their products, such as ventilation equipment.<sup>18</sup> In addition, it is estimated that about 5 percent of motors sold to distributors/dealers are then resold to OEMs. Thus, in determining the market penetration of NEMA-premium motors among end-users, it is important that these sales be eliminated, if possible. (This is of special concern since OEMs tend to be first-cost oriented in their choice of components and thus skew the distribution downward.)

Of the motors sold to end-users in the commercial and industrial sectors, the great majority (45 percent of all motors, or about 90 percent of those going to end-users) flow through distributors/dealers. However, a small percentage (approximately six percent of all motors, 10 percent of those sold to end-users) goes from distributors/dealers first to contractors, and only then to end-users. (See Figure 2.1 below.)

**Figure 2.1: Motors Product Flow**



<sup>18</sup> This summary of the market structure is drawn in part from XENERGY, Inc. 2001. *MotorUp Evaluation and Assessment*.

Accordingly, for tracking the penetration of NEMA-premium motors, relevant upstream market actors include contractors, distributors/dealers, and manufacturers. In addition, it is important to consider relevant industry associations, since they normally enjoy credibility with their members and often serve as intermediaries with other industries and agencies.

### **Contractors**

A relatively small percentage of motors are sold to end-users through this channel and (almost) all are obtained through distributors/dealers rather than directly from manufacturers. Moreover, the universe of contractors is both large and widely dispersed. For these reasons, it does not seem useful to expend resources to attempt to gather sales data from this channel. Still, sponsors should recognize that the existence of this channel complicates any effort to identify end-users, and thus the applications, run-times, and loadings of qualifying units through distributors/dealers alone.

### **Distributors/Dealers**

Traditionally, distributors/dealers have been described in terms of being members of chains/franchises or independents. A further breakdown may be made among chain/franchise distributors/dealers, into electrical supply houses and motion products dealers. The former carry a wide range of electrical products and components, while the latter typically offer a line of belting, gearing, bearings, drives, and other drive train products. Overall, electrical supply houses account for many more motor sales than do motion products dealers. However, motors may be responsible for a relatively small fraction of total store sales for individual electrical supply houses.

Functionally, it is also important to recognize that distributors/dealers differ in terms of their business model. Some make considerable effort to provide value-added services, such as assistance on the purchase/rewind decision and advice on motor purchases, or various specialized services. Others act more as order takers for what they treat as a commodity item. These characteristics are likely not only to affect the degree to which distributors/dealers promote NEMA-premium efficient motors, but also to help determine their interest and willingness to provide sales information to program sponsors. Taken together with the fact that there are well over three hundred distributors/dealers currently participating in the programs conducted by the sponsors, it becomes clear that developing a sales tracking system based on a census of distributors/dealers information is likely to pose an almost insurmountable problem.

### **Manufacturers**

The vast majority of motors sales in the Northeast are accounted for by eight to ten domestic manufacturers. No one is predominant, but two to three hold key positions. Offshore manufacturers are still relatively weak, but they may gain in market share and importance, should they be able to offer competitive pricing when the dollar regains strength.

The relatively small number of manufacturers reduces the difficulty of developing a system for tracking market penetration. However, the severe competition among relatively equal players, as

well as the growing threat of losing share to new entrants, suggests that the development of a sales tracking system based on information from individual manufacturers' would require considerable attention to mechanisms for ensuring that the underlying data are available only to parties divorced from the market and are carefully collated and "sanitized" before release.

### Industry Associations

Different associations represent market actors at the level of distributors/dealers and at the level of manufacturers. Independent distributors/dealers, responsible for approximately one-half of the motors sold, are represented by the Electrical Apparatus Service Association (EASA). This association does not collect sales information of the type sought by the program sponsors, however. A newer association, the Power Transmission and Distribution Association (PTDA), represents some of the chain/franchise distributors/dealers. Given the limited representation of distributors/dealers in EASA and PTDA, as well as the lack of experience of both associations in collecting data from their members, it does not appear useful to pursue the development of a sales tracking system through this channel.<sup>19</sup>

Most motors manufacturers belong to the National Electrical Manufacturers Association (NEMA).<sup>20</sup> The association collects extensive information on motor shipments from its members on a monthly basis. This includes data on shipments, by horsepower categories, of NEMA-premium motors, EPAct-qualifying motors, and non-EPAct motors in each of its defined trading areas. Moreover, it should be noted, CEE has been working with NEMA for several years to great effect, as evidenced by the agreements reached on consistent industry definitions of premium motors.

Obvious problems exist in relating shipments to a particular state to sales within that state, given that distribution centers may well serve more than one state. Nonetheless, the structure of the market and the history of contacts between market actors in the motors industry and participants in the energy efficiency industry suggest that further work with NEMA would be a useful direction to pursue.

## 2.2. Tracking System Data Requirements

The core of the tracking system envisioned in this report is one in which NEMA provides the sponsors with an annual report summarizing the shipments of all motors and of qualified motors in each of several designated horsepower categories from all members to distributors/dealers in each state. This system would meet the minimum requirements set forth by the sponsors at the outset of this scoping project, with one exception (the disaggregation of shipments into TEFC and ODP motors). Moreover, it contains some of the data elements considered to be components of an ideal tracking system.

<sup>19</sup> This is not to suggest that expanding relationships with EASA and PTDA would be without value. For example, EASA recently included questions about active promotion of NEMA-premium motors and the percentage sold in its most recent member survey, at the suggestion of CEE.

<sup>20</sup> Among major domestic manufacturers, only Baldor is not a current member. However, Baldor does cooperate with NEMA on many issues and would not be barred from submitting sales data to a tracking system by the lack of membership. Moreover, incentives for cooperation exist, in that Baldor does adhere to the NEMA-premium standard for a substantial proportion of its products, and uses this in its promotions,

This section of the report summarizes and discusses the minimum information needed for tracking market penetration of NEMA-premium efficient motors, as well as the ideal data set, in Table 2.1. This table follows a brief discussion of the rationale behind the research team's recommendation, initial steps undertaken to develop a relationship with NEMA, and information gathered from manufacturers about the availability of the data needed.

### **Gathering Data through NEMA: Rationale and Initial Steps**

As suggested in the discussion of Market Structure, manufacturer data would be far easier and less costly to gather than distributor/dealer data, and would meet almost all of the minimally acceptable requirements and provide some data considered part of the ideal tracking system. NEMA includes almost all domestic motors manufacturers, enjoys high credibility with its members, and already collects a considerable amount of data from them. Accordingly, the association is a logical choice for collecting the data needed for a tracking system, if cooperative agreements can be achieved. Furthermore, interviews with individual manufacturers and with a NEMA executive and a staff member indicated that this is a useful route to pursue. Furthermore, during interviews with the research team, all manufacturers indicated reluctance to provide data to a third party other than NEMA. In contrast, all but one of the manufacturers said they would provide data to NEMA, if the membership decided to request it.

In a joint interview with the research team and CEE, NEMA indicated a willingness to consider sharing a major portion of the data needed by the sponsors. Under further questioning, they suggested that a formal data request be submitted for consideration at the annual (June) meeting of the NEMA Board of Governors. In discussing what might be requested, they indicated that the key consideration was to avoid asking for information that is not readily available through the manufacturers' current internal systems, since that would pose a significant problem for many companies that are currently short-staffed and under other severe pressures. Indeed, requests for such information would have the potential of eliminating interest in developing a cooperative relationship.

In further discussions with members of the research team and CEE, NEMA representatives specified the types of data that were likely to meet with a positive response from the membership. Of most importance with respect to the set of minimally acceptable data, they strongly recommended against requesting a breakdown between shipments of ODP and TEFC motors, since the separate reporting of these types would be problematic for some manufacturers. This issue is addressed briefly, below.

A formal request was developed and submitted through CEE soliciting annual unit shipment data; the form of the data requested is attached as an Appendix.<sup>21</sup> The data requested include annual shipments, with motors sold directly to OEMs netted out, broken down by efficiency

<sup>21</sup> The research team brought this opportunity to the attention of the project managers, who gave permission to proceed. In addition, the project managers were involved in the drafting of the formal request. NEMA has since indicated that the sense of the Board was favorable and that the next step is to ask individual members to comment on their ability to provide the data requested.

level (NEMA Premium and non-NEMA Premium), state to which shipped, in key size categories (1-5 hp, 6-20 hp, 21-50 hp, 51-100 hp, 101-200 hp, and 201-500 hp).<sup>22</sup>

Following the recommendation made by the NEMA representatives in a joint interview conducted by CEE and the NMR team, the letter omitted requesting that the data be broken down by motor type (ODP vs. TEFC). They indicated that few companies have those data readily available and that including that breakdown in the “must have” category would jeopardize the potential for a cooperative agreement. In assessing this issue, the research team recommended that the letter should omit this request: First, the team believes that cooperation with NEMA is the single most effective and least-cost opportunity to initiate a market penetration tracking system. Forging a working agreement with NEMA should be a paramount objective at this time. If this can be accomplished, it may be possible to enhance the system as the parties gain experience with the system and each develop an understanding of the needs and constraints of the other. Second, the team’s analysis of uncertainties (see the relevant section in this chapter) indicates that differences in the efficiencies of ODP and TEFC motors vary far less—and are far less systematic—than various other factors that are not addressed or cannot be addressed in the collection of market penetration data. The availability of data on motor type would reduce only slightly to the uncertainty of savings estimates; it would not reduce any uncertainty of the estimates of market penetration.

The data request did note that it would be useful to have the state level data reported by speed as well as horsepower—at some future date, if it is not feasible at this time. Disaggregation by speed was not included in the initial discussions of an ideal tracking system. However, the team recommends that these data be collected, if possible, given the potential of this information for reducing uncertainties regarding the efficiencies of the motors shipped. (See the section on Uncertainties for a fuller discussion of this issue.) Again, the lack of such data would not affect the estimates of market penetration. However, these data are relevant to estimates of savings and, in the judgment of the research team, more so than are data on motor type.

### **Data Availability**

The interviews with individual manufacturers indicate that most could provide the data requested. Of the six manufacturers interviewed, all are able to net out sales to OEMs. All six track shipments of NEMA-premium versus EPAct motors, although one respondent said it would be cumbersome to extract these data. (However, he expects this to be considerably easier by the end of 2003 when a new computer system is due to be on-line at his company.) Four out of the six interviewees said they track motor shipments by the horsepower ranges requested; one uses more aggregate ranges and one expects to be able to extract the data by horsepower ranges easily once the company’s new computer system is functioning.

<sup>22</sup> Shipments of motors in the 200-500 hp category were not included in the data requirements. They were included in the data request, at the suggestion of NEMA representatives, since those data are currently part of the association’s reporting system and CEE representatives indicated that efforts to address efficiencies in that category are likely in the near future. At the same time, it seems likely that many motors in that category are custom-built and may thus be omitted from reports. Thus, inclusion of this category should be considered a potential gain, but one to be examined in more detail.

Provision of state-level data would be more difficult. Two of the six manufacturers interviewed said they would be able to provide unit shipment data by state, and one will be able to provide state-specific data once the company's new computer system comes on-line. The remaining three track unit shipment data by more aggregate regions. These range from three very large regions covering the US to smaller regions, which might, however, cut across state boundaries. However, all the manufacturers interviewed, except the one discussed below, were willing to try to provide state-specific shipment data if NEMA requested it.<sup>23</sup> The interviews suggested that the major benefits that manufacturers envision are: first, that cooperation may help induce other program sponsors around the nation, as well as those in the Northeast, to work more closely with the industry and to develop and implement motor efficiency programs that are consistent, and thus easier to work with; second, cooperation with the sponsors and with CEE may lead to a system that satisfies other programs as well, eliminating multiple data requests.

Baldor Motors and Drives is the exception. Although they provide NEMA with annual data on shipments of NEMA Premium motors, they generally do not comply with other NEMA data requests. Their representative indicated that this practice is likely to continue since Baldor simply does not have the staff to assemble the type of data requested, especially state-level data.

The lack of data from Baldor would present a significant problem for the recommended system, since they have a strong presence in the Northeast. However, their representative indicated that the company might consider assembling some data if they were compensated for their efforts.<sup>24</sup>

### Minimum and Ideal Data Sets

Table 2.1 presents the minimally acceptable and ideal tracking system data, as defined by the sponsors at the outset of this study. Notes regarding data from manufacturers and their conformance with these requirements are included in the rightmost column.

<sup>23</sup> Currently, NEMA members (but not Baldor) report the dollar value of motor sales, disaggregated by 155 trading areas. Of these trading areas, one each is found in NH, RI, and VT; three are found in MA; three in CT; one in NYC and eight in the remainder of NY (excepting one in Long Island). Accordingly, were NEMA to provide unit sales by trading area, the sponsors would have highly detailed breakdowns.

<sup>24</sup> It is not unlikely that NEMA might also request some financial compensation to support the data collection, formatting, and reporting in such a way as to meet the needs of the sponsors. (This issue has not been discussed until now, since NEMA staff was reluctant to develop any cost estimates until their Board agreed in principle to work on a tracking system with the energy-efficiency industry.) To that extent, support for Baldor would not seem to pose the problem of differential treatment. As noted in the text, it appears that manufacturers are more interested in how program sponsors might help increase sales of NEMA-premium motors than in the short-term (and relatively small) benefits they might obtain from incentives for data-sharing.

**Table 2.1: Market Penetration Data Requirements for  
Premium Motors Program Tracking System**

Parameter	Minimally Acceptable Tracking System <sup>a</sup>	Ideal Tracking System	Additional Notes and Comments
Number of NEMA premium motors <sup>b</sup> sold in the sponsors' areas	Must be able to net out the number of qualifying motors going to OEMs	In addition, should be able to net out those motors going to applications running less than 2,000 hours per year	Manufacturer data on NEMA-premium motor shipments will net out motors sold directly for OEM use (approximately 90% of all motors going to OEMs). No technique seems available to strip out motors running fewer than 2,000 hours per year, except end-user data.
Number of (all) motors sold in the sponsors' areas	As above, must be able to net out the number of motors going to OEMs	As above, should also be able to net out the number of motors going to applications running less than 2,000 hours per year	Manufacturer data on non-NEMA-premium motor shipments has been requested; preliminary soundings were positive. As above, no likely technique to identify and net out low usage motors, short of end-user data.
Market penetration	Ratio of two preceding data points	Ratio of two preceding data points	
Disaggregation: Size	None	Into five bins: 1-5 hp; 6-20 hp; 21-50 hp; 51-100 hp; 101-200 hp	These data have been requested from NEMA; most manufacturers already track data using these categories. Shipment data for the 201-500 hp category have also been requested.
Disaggregation: RPM	None	Into three bins: 1200 rpm; 1800 rpm; 3600 rpm (as well as other—e.g., 900 rpm) <sup>c</sup>	RPM disaggregation (eliminate 900 rpm motor shipments; divide others into 1200 rpm, 1800 rpm, and 3600 rpm categories) is recommended, at least for future consideration, to help reduce uncertainties in savings estimates.

<sup>a</sup> If these requirements cannot be met, the system may not be worth the effort and expense involved.

<sup>b</sup> Throughout this table, “motors” refers to units that are:

- Integral horsepower, 3-phase
- 1 hp to 200 hp, except as noted
- ODP or TEFC design

<sup>c</sup> RPM disaggregation was recommended by the study; it was not part of the sponsors' original description of an ideal tracking system

**Table 2.1: Market Penetration Data Requirements for Premium Motors Program Tracking System (cont.)**

Parameter	Minimally Acceptable Tracking System <sup>a</sup>	Ideal Tracking System	Additional Notes and Comments
Disaggregation: Type	ODP vs. TEFC	ODP vs. TEFC	The research team recommends eliminating this requirement, lest its inclusion jeopardize development of an initial agreement with NEMA. These data may not be readily available from several manufacturers and requesting it could cause them to withhold their support. Moreover, this information would not help improve market penetration estimates; it would reduce uncertainty of savings estimates by a relatively small degree.
Disaggregation: Geography	New England vs. New York vs. New Jersey	By state and with Nassau/Suffolk counties removed from the New York data	NEMA may be able to provide state data. However, they cautioned that breaking out Long Island from the rest of New York State would not be feasible for many manufacturers. Association members are also considering the option of providing unit shipment data disaggregated by the 155 trading areas they use in tracking (dollar) sales volume. If this were done, LI would be readily netted out and some sub-state analysis would be possible (for NY, MA, and CT).
Type of data	Shipments	Distributor/dealer Sales	Manufacturer data requested through NEMA would be shipment data.
Frequency of reporting	Calendar year (reported no later than April of following year)	Semi-annually	Semi-annual reports may be helpful in program adaptation. While manufacturers generally track data monthly, only annual data were requested through NEMA to minimize initial reporting burdens. Based on NEMA's internal calendar, reports would be ready within the time window specified.
Comparative information	Comparable data at the national level	Comparable data at the national level, with data from other states/regions having strong programs (e.g., California) netted out	State data requested through NEMA would enable the sponsors to create a comparison area from national data stripped of states having strong programs. It would also support more sophisticated statistical analyses, such as regression models, to permit detailed attribution studies.

<sup>a</sup> If these requirements cannot be met, the system may not be worth the effort and expense involved.

<sup>b</sup> Throughout this table, "motors" refers to units that are:

- Integral horsepower, 3-phase
- 1 hp to 200 hp, except as noted
- ODP or TEFC design

## 2.3 Strengths and Weaknesses of Potential Approaches

The research team considered several data sources in recommending a tracking system that would meet almost all of the core requirements set forth by the sponsors as well as include some of the data ideally desired. The options considered, as listed in Table 2.2, include collecting data from individual manufacturers, working with a trade association to collect data, collecting data from individual distributors/dealers, and collecting data from end-users. Each has its own set of strengths and weaknesses.

### Manufacturer Data

*Advantages.* The primary strength of manufacturer data is its comparatively low cost and ease of collection. There are relatively few companies from which to collect data. Manufacturers are typically larger than distributors/dealers and are thus more likely to already track some of the desired data electronically for their own accounting, planning, and marketing purposes.

An added advantage to manufacturer data is that almost all domestic motor manufacturers belong to a relatively strong trade association, NEMA, which already collects a considerable amount of data from its members. NEMA collects data on monthly shipments, at a national level, disaggregated into NEMA-Premium, EPAct, and non-EPAct motors. NEMA also collects annual shipment data disaggregated into shipments to each of 155 Industrial Trade Areas. Finally, most manufacturers have some staff resources assigned to NEMA data reporting.

NEMA has a history of working with energy efficiency groups, notably CEE, to develop standards and share (some) data. Therefore, working through NEMA to obtain data not currently reported, netting out shipments of motors to OEMs, and disaggregating units shipped by horsepower range, NEMA-premium designation, and state, builds upon an established relationship.

*Disadvantages.* The data that may be obtained from NEMA would not be ideal. They would describe shipments, not final sales; while they would net out most sales to OEMs, they would not net out all such sales; they would not include sales of motors from offshore manufacturers; and they may not include geographically disaggregated sales from one domestic manufacturer with considerable market share in the Northeast.

The main disadvantage to manufacturer data is that they capture shipments, rather than sales to end-users. (Manufacturers do sell a small number of motors to end users, but these are likely to be custom motors, not part of the data sought or likely to be reported.) The reports identify the location to which motors are shipped; however, distributors and dealers may often ship motors across state lines—sometimes to entirely different regions of the country—to reach end users.<sup>25</sup>

<sup>25</sup> The volume of cross-border sales from any particular state or trading area is likely to be dependent on a number of factors, such as the size of the motor involved (which would correlate for the need of value-added services from particular types of distributors/dealers, and thus, the mix of those offering such services vs. those focused on commodity sales) and the purchasing policies of corporate customers in the area. Thus, it seems unlikely that a single adjustment factor could be developed and applied across states or trading areas.

It should also be noted that motors could remain in distributor/dealer inventories for an indefinite time.<sup>26</sup>

Manufacturer data can net out most, but not all, OEM sales. About 90 percent of OEM motors are estimated to be sold directly from the manufacturer to an OEM; these can be netted out of manufacturer data. However, about 10 percent of sales to OEMs (generally to smaller OEMs), are through distributors/dealers; these are not netted out of manufacturer data.

Another shortcoming of the manufacturer data that could be gathered through NEMA is the treatment of imports. NEMA is an association of North American manufacturers. Motors manufactured by its members in offshore facilities are included in the shipment data it collects; however, imports from nonmembers are not tracked. At present, imports are thought to constitute only a small part of sales in the U.S. (one manufacturer interviewee put the figure at 5 percent), but their share may be growing.<sup>27</sup>

Finally, some manufacturers may not cooperate fully with data requests from NEMA or another third party. This is the case with Baldor Motors and Drives: the company reports annual data on shipments of NEMA-premium motors, but not total sales or monthly, regionally disaggregated data. Since Baldor has a strong presence in the Northeast, the lack of availability of their data creates an important problem for hopes of a comprehensive tracking of NEMA-premium motor shipments. As indicated in the informal reply to the data request submitted by CEE, the industry association has some leverage with Baldor, in that the company is obligated to report on the sales of NEMA-premium motors as part of the agreement licensing Baldor's promotion of qualifying motors. It seems likely, therefore, that the extent of additional reporting would be a subject of future negotiations between NEMA and Baldor.

As discussed in the previous section of this report, a Baldor representative indicated that the problem lies in the lack of staff that would be needed to comply with the data requests. However, he also said the company would consider doing so were a third party willing to pay for the costs of data assembly. In considering this option, the program sponsors would have to weigh not only the costs involved, but also the issue of equitable relationships with all manufacturers. However, it would seem premature to reject consideration of making such an offer: NEMA may raise similar questions about the incremental costs or reporting the requested data on behalf of either the association or their members, once agreement in principle is reached. Moreover, insofar as the issue is cost recovery rather than a bounty for reporting, the equity issue may be moot.

### **Distributor/Dealer Data**

*Advantages.* The primary strength of distributor/dealer data is that it would cover final sales. Moreover, distributors/dealers are generally able to identify the location of the end-user and access to their records would avoid concerns about motors sitting in inventory (which shipment data do not, although all distributor/dealers are motivated to maximize turnover, so it may not be a major issue). Finally, distributor/dealer data may provide sponsors with the ability to eliminate

<sup>26</sup> The use of annual data would seem likely to minimize concern about this possibility. It seems unlikely that distributors/dealers would retain any substantial number of units in inventory for a year or more.

<sup>27</sup> The research team recommends that this issue be revisited in the next couple of years to determine whether a significant part of the market is being overlooked.

the small portion of OEM sales not netted out of manufacturer data, and allow sponsors to track the sales of imports not covered by NEMA.

*Disadvantages.* Tracking motor sales through distributor/dealer data, unfortunately, presents significant challenges, necessitating a relatively high level of effort and higher costs than tracking manufacturer shipments. Moreover, no guarantee is available that the additional effort and costs would yield the quality and representativeness of data required.

More than 300 distributors/dealers are currently participating in the MotorUp program and NYSEERDA's Premium Motor program. The sheer number of potential contributors to a tracking system make any effort at developing and maintaining a census approach quite expensive. Moreover, the interviews indicate that developing a standard reporting form or database would entail considerable effort in marketing the system and convincing or assisting distributors/dealers to provide the data in a usable form. Currently, distributors/dealers follow diverse record-keeping practices, with some having sophisticated database systems, but others continuing to rely on paper-and-pencil records and filing systems that are not consistent across the population. Even among those distributors/dealers that have computerized systems, moreover, a variety of software platforms are used, so that implementing a standard reporting system would require marketing, costs, and tradeoffs, with attendant time and cost implications.

Even if the sponsors were willing to invest in the development and marketing of a relatively simple reporting system, the problem of obtaining data from all or an unbiased sample of distributors/dealers participating in the programs remains. Distributors/dealers already complain about the time required to complete program-related paperwork. Their willingness to do so has not been enhanced by the termination of financial incentives in various states in the MotorUp program. Thus, the interviews indicate, any additional paperwork would be viewed as a highly unjustified burden. Moreover, when questioned about the possibility that feedback from the program regarding aggregate sales data for the state or region could be made available, none of the interviewees saw any value to their business from such information. Indeed, they could offer no suggestion as to what the sponsors might provide in return for relevant data reports that would be of value other than financial incentives.

However, even if the paperwork could be minimized and effective incentives provided, it would be necessary to overcome concerns about data confidentiality. At least some distributors/dealers believe that the disclosure of information about their total sales would compromise their competitive position. Although a portion of these participants would be likely to cooperate once appropriate agreements were negotiated, another group appears skeptical about the strength and enforceability of any such agreements and unlikely to cooperate under any conditions.

For all these reasons, it appears that collecting the relevant data from all participating distributors/dealers would be an unattainable goal. Moreover, establishing an unbiased sample of participants and establishing a system with their cooperation may also be extremely difficult. Information obtained from the implementation contractor, along with that from the interviews, suggests that many smaller distributors/dealers lack the reporting systems needed and many larger ones are particularly suspicious of possible agreements. Taken together, the challenges to creating an unbiased sample of participants are considerable. It follows that the development of a

sample of non-participating distributors/dealers is likely to be even more costly and unrepresentative. Thus, even if the sponsors could develop a data reporting system for the program area, it is almost certain that no comparable data from non-program areas would be available.

In discussions with the implementation contractor, it was learned that a relatively effective system had been implemented in work for a California utility. In that effort, the participating distributors/dealers faxed a copy of each invoice to the program staff as soon as a sale was made, in return for a nominal incentive. The participation in this system was excellent, and the data were extremely useful both in documenting program effects and providing feedback on implementation activities. However, it is likely that the cooperation of distributors/dealers depended to a large extent on the fact that the overall program was one involving quotas for sales of qualifying motors, an approach that is not considered applicable by some of the Northeast sponsors. It should also be noted that collection and processing of information from such a system would require year-round administrative activity. Finally, the interviews indicated that at least some distributors/dealers do not record model number information on their invoices (for competitive reasons) and not all indicate on the invoice whether the motor sold is NEMA-premium or not.<sup>28</sup>

### **End User Data**

*Advantages.* Collection of end-user data would allow any degree of regional disaggregation desired, as well as disaggregation by size, efficiency level, or other useful variables. End-user data would also permit netting out all OEM motors with certainty. Moreover, the only effective avenue to netting out motors that run fewer than 2,000 hours per year would be through the collection of end-user data, including the “Out-of-the-box” approach described in Chapter 4.

*Disadvantages.* A key disadvantage to the collection of end-user data is the cost of such a system. Locating recent motor purchasers to track market penetration of NEMA-premium motors would be time-consuming and quite costly. As problematic as it appears to be to convince distributors/dealers to provide aggregate sales data, attempting to obtain information about their customers would be several orders of magnitude more difficult. They consider such information the most valuable competitive information they possess. Even when recent buyers are identified, problems would remain in achieving acceptable response rates to surveys and ensuring that knowledgeable people are answering the questions regarding nominal efficiency, horsepower, hours of operation, or even manufacturer and model number. Site visits would ensure more accurate data collection, but at an even higher cost. Moreover, unlike a data tracking system, which should operate fairly economically once established, little cost advantage<sup>29</sup> would be found in repeating telephone surveys or on-site visits over time. For these reasons, it was agreed this option would not be further explored as part of this project.

These considerations are summarized in Table 2.2, below.

<sup>28</sup> If the system were developed, it is likely that these latter objections could be overcome with modest effort.

<sup>29</sup> Other than development of the survey instrument and the analytic protocols (which are relatively minor components of the overall survey cost).

**Table 2.2: Possible Sources of Tracking Data—Motors**

Market Actor Source	Approach	Selected Advantages	Selected Disadvantages	Status
Individual manufacturers	Shipment data from individual mfrs	<ul style="list-style-type: none"> <li>• Relatively few companies to be approached and monitored</li> <li>• Development of relationships may offer opportunities for collaboration on program design, incentives, etc.</li> <li>• Most OEM motors can be netted out</li> </ul>	<ul style="list-style-type: none"> <li>• Disaggregation of sales by state (and possibly by region) impossible, given only shipment points</li> <li>• Uncertain timing; not sure whether a motor shipped is operational or part of a dealer’s inventory</li> <li>• Spotty coverage if varying degrees of cooperation</li> <li>• Imports, currently a small portion of the market, may be more difficult to track</li> <li>• Manufacturer reluctance to release data to a third party with which they have no working relationship</li> </ul>	Not recommended
Manufacturer association (NEMA)	Association-aggregated reports of shipment data	<ul style="list-style-type: none"> <li>• Single point of contact.</li> <li>• Easier to build a partnership and negotiate an agreement for mutual benefit than with multiple companies</li> <li>• Manufacturers already supplying NEMA with a considerable amount of data</li> </ul>	<ul style="list-style-type: none"> <li>• Major domestic manufacturer (Baldor) not included in NEMA</li> <li>• Disadvantages regarding disaggregation of sales by state, timing, and imports</li> </ul>	Recommended

**Table 2.2: Possible Sources of Tracking Data—Motors (cont.)**

Market Actor Source	Approach	Selected Advantages	Selected Disadvantages	Status
Distribution centers	Shipments data and turnover	<ul style="list-style-type: none"> <li>• Relatively few companies</li> <li>• (Some) regional geographic disaggregation of shipments</li> </ul>	<ul style="list-style-type: none"> <li>• Spotty coverage; pure distribution centers not the norm for all manufacturers or dealers</li> <li>• Shipment rather than sales data; no state-by-state disaggregation of sales</li> <li>• Sales to a small number of OEMs not addressed</li> <li>• Varying degrees of cooperation likely</li> </ul>	No further consideration
Dealers/ Distributors	Regular collection of sales data from census of dealers	<ul style="list-style-type: none"> <li>• Sales rather than shipment data</li> <li>• Easier to estimate state-by-state disaggregation</li> <li>• May break out the small portion of OEM motors not netted out of manufacturer data</li> <li>• Can track sales of imports</li> <li>• Many dealers participate in program and are thus potential allies</li> </ul>	<ul style="list-style-type: none"> <li>• Many companies; likely to require multiple types of agreements and considerable development time</li> <li>• Some companies unwilling to rely on confidentiality agreements</li> <li>• Varying degrees of cooperation</li> <li>• Records may be difficult to aggregate</li> <li>• Company software systems likely to vary</li> <li>• Recruitment time and expenses; incentive costs</li> <li>• Lack of leverage with non-participating dealers; no reason for them to cooperate, either in states with programs or in states chosen for comparison</li> <li>• Companies that cooperate and have needed data likely to constitute a biased sample</li> </ul>	Not recommended

**Table 2.2: Possible Sources of Tracking Data—Motors (cont.)**

Market Actor Source	Approach	Selected Advantages	Selected Disadvantages	Status
Dealers/ Distributors	Regular collection of sales data from stratified sample of dealers	<ul style="list-style-type: none"> <li>• Advantages listed above</li> <li>• Reduced cost, compared to attempts to obtain records from all distributors/dealers</li> </ul>	<ul style="list-style-type: none"> <li>• Critical dimensions for stratification not known</li> <li>• May still not be able to avoid sample biases</li> <li>• Easier and less expensive to develop ongoing relationships and incentive packages, but little other leverage for recruiting</li> <li>• Lack of leverage with non-participants, as above</li> <li>• Software systems and aggregation issues, as above</li> <li>• Problem of negotiating agreements, as above</li> </ul>	Recommended for consideration as fallback option
Dealers/ Distributors	Regular collection of individual invoices via fax	<ul style="list-style-type: none"> <li>• Advantages of distributor/dealer data listed earlier</li> <li>• Contemporaneous</li> <li>• Most dealers provide necessary information on each motor on the invoice</li> <li>• Simplifies reporting for dealers/distributors and offers immediate incentive to them</li> </ul>	<ul style="list-style-type: none"> <li>• May still not be able to avoid sample biases</li> <li>• Costs of aggregating the data would now fall directly on the program sponsors</li> </ul>	Recommended for consideration as fallback option
Dealers/ Distributors	Collection of sales data as part of quota-based program design	<ul style="list-style-type: none"> <li>• Advantages listed above</li> <li>• Incentives for participation in tracking system could be built into program (a la “Next Step”)</li> </ul>	<ul style="list-style-type: none"> <li>• Requires that program design be modified, with accompanying uncertainties over participation and effectiveness</li> <li>• Contrary to policy of some sponsors and regulators</li> </ul>	No further consideration

**Table 2.2: Possible Sources of Tracking Data—Motors (cont.)**

Market Actor Source	Approach	Selected Advantages	Selected Disadvantages	Status
End Users	Telephone/ mail surveys	<ul style="list-style-type: none"> <li>• State-by-state disaggregation inherent in design</li> <li>• Ability to net out OEM sales</li> <li>• Direct opportunity to probe users about operating hours and strip out motors used less than 2,000 hours per year</li> </ul>	<ul style="list-style-type: none"> <li>• Cost of identifying recent purchasers (dealers unlikely to provide lists; selection through RDD or postcards quite expensive; sample of those who do cooperate likely to be biased)</li> <li>• Information unreliable as respondents may not understand efficiency level designations or be able to find model numbers</li> <li>• No cost savings for repeated (annual or semi-annual) waves</li> </ul>	No further consideration
End Users	On-site surveys	<ul style="list-style-type: none"> <li>• End-user data advantages above</li> <li>• In addition, issue of reliable model data resolved (except insofar as model numbers difficult to observe)</li> <li>• Could add run-time and loading data collection (but at considerable incremental cost)</li> </ul>	<ul style="list-style-type: none"> <li>• As above, with exception of reliability issue (for telephone or mail surveys with end-users)</li> <li>• Far greater cost (even without collection of run-time and loading data)</li> </ul>	No further consideration

**Table 2.2: Possible Sources of Tracking Data—Motors (cont.)**

Market Actor Source	Approach	Advantages	Disadvantages	Status
Hybrid	National data on shipments from mfr association, plus sample data on sales from distributors/dealers	<ul style="list-style-type: none"> <li>• Opportunity to leverage shipments data with limited amount of sales data, as replacement for state-specific shipment breakdowns</li> <li>• Overcomes problem of sales that leave state to which shipped</li> </ul>	<ul style="list-style-type: none"> <li>• No readily available method to test assumptions</li> <li>• No reduction of problems or uncertainties associated with either collection of shipment data from NEMA or collection of sales data from distributors/dealers</li> <li>• No reduction of costs from other data collection methods</li> </ul>	Not recommended
“Out-of-Box” (See Chapter 4)		<ul style="list-style-type: none"> <li>• Chips themselves likely to be quite cheap</li> <li>• May be expanded to collect data on run-time and loadings, as well as location</li> <li>• Additional data collection options may entice other utilities as funders</li> <li>• Additional sales opportunities (to other utilities) may appeal to other investors</li> </ul>	<ul style="list-style-type: none"> <li>• Developing initial test will require time and effort identifying and romancing a cooperative manufacturer or developing an attractive RFP</li> <li>• Initial investment and time will be required to spec out, develop, and bench-test the hardware and software</li> <li>• May be necessary to partner with a funder interested in the technology (e.g., EPRI, NYSERDA)</li> <li>• Likely to require considerable legal work to design confidentiality and competitive information protections</li> <li>• If initial tests successful, will still require time and effort to enroll other upstream actors (e.g., recruiting motors mfrs to install the chips)</li> </ul>	Recommended for further consideration as possible long-term strategy

## 2.4 Comparison of Data Sources

Table 2.3 presents features of the two key options discussed above: NEMA shipment data and distributor/dealer sales data collection options, in the format requested by the sponsors. A crucial advantage of the NEMA option is that the association is willing to consider a data request encompassing almost all of the data elements the sponsors are seeking. The main disadvantage of the NEMA option is that it consists of shipment rather than sales to end users; even when manufacturers are willing to disaggregate their data by state, a portion of motors may end up crossing state boundaries when going from their shipping points to end-users. Conversely, the advantage of distributor/dealer option is that it would capture sales to end users. The disadvantages of collecting distributor/dealer data are that it would be very expensive, it is hard to predict ahead of time what level of coverage could be achieved through recruitment efforts and there is little chance of recruiting a representative sample of distributors in a non-program area.

**Table 2.3: Features of NEMA and Distributor/Dealer Data Collection Approaches**

Feature	Key Data Collection Option	
	Collaboration with NEMA	Collection of distributor/dealer reports
Data source	Manufacturers' reports, aggregated by NEMA	Distributor/dealer reports or copies of invoices—most likely representing a sample
Organization responsible for aggregating data	NEMA	Could be implementers (APT); sponsors (utilities participating in MotorUp, individually or through NEEP, and NYSERDA); or a separate contractor
Data availability		
By equipment category	Some (Yes, for horsepower; no, for motor type)	Yes
By qualifying level	Yes	Yes
Netting out OEMs	Yes	Yes
By region	Likely	Yes
By state	Likely (but without breaking LIPA territory from NYSERDA territory, unless at trading area level)	Yes
Past data available	May be possible at limited level	Extremely unlikely
Baseline data available for comparison area	Likely to be able to track along with program area	Extremely unlikely
Data frequency	Annual (could become more frequent if relationship proves fruitful)	Quarterly or more to retain participating distributors/dealers
Cost to develop	Minimal; but likely to include some support for data processing and some reimbursements to major manufacturer that is not a member of NEMA	Considerable, including time and effort to contact decision-makers, develop confidentiality agreements, and secure cooperation
Ongoing cost	May be some continuing costs to offset processing costs of contributors	Likely to require continuing incentives as well as processing costs

## 2.5. Sources of Uncertainty in the Data as Applied to Energy Savings Estimates

Regardless of the source of the data and regardless of how well the sampling design or reporting methods can be designed and implemented to minimize reporting biases, the data for sales of NEMA-premium motors will not provide absolutely precise information regarding the savings achieved through the program. In other words, a well-developed tracking system can be used to estimate changes in market penetration of the NEMA-premium efficient motors being promoted. However, considerable caution should be exercised in using those data to estimate the energy savings being achieved. Moreover, given the uncertainties relating to the savings associated with changes in market penetration, care should be taken in determining what data should be sought from potential providers. If those data do not contribute to increased understanding of sales, the gain in precision of savings estimates may not be justified by the cost in additional burden and processing.

Some sources of uncertainty are already addressed in the discussion of what the sponsors are seeking; other sources of uncertainty may not have been considered in that review, but will be recognized once they are made explicit. For completeness, this section lists key sources of uncertainty in both of these categories.

- **Operating hours**

The sponsors are seeking sales information for units that will be used 2,000 hours per year or more. The research team does not believe this is feasible without on-site data collection or the development of the out-of-the box technology. Even if such information were available, it must be recognized that the energy savings for each premium motor could vary by more than a factor of four, depending upon whether a particular motor is used for that minimum (2,000 hrs/y) or is run three shifts per day (8,760 hr/y less maintenance time).

- **Loading**

The efficiency of a motor varies considerably as a function of the degree to which it is loaded. Actual savings cannot be calculated without on-site studies, although it is possible to substitute deemed levels based on motor function and the industry in which it is being used, to reduce this uncertainty, if such information is available.

- **Manufacturers and models**

Even within a particular category (motor type, size, speed), nominal motor efficiencies vary considerably, whether at the NEMA-premium level or not. In a report prepared for the California Public Utilities Commission in 2000, researchers who examined nominal efficiencies of motors sold by a wide variety of manufacturers found relatively little consistency within a category. For example, ODP motors (rated at 1200 rpm, at 75% of full load) meeting the CEE premium standard at that time varied between 0.6 percentage points and 2.8 percentage points within a particular horsepower range. (For example, the most efficient motor in the 2 horsepower category had a nominal efficiency of 88.3; the least efficient, a nominal efficiency of 85.8.) Similarly, motors meeting only EPA standards varied between 0.9 percentage points and 2.9

percentage points. (In the 2 horsepower category, the most efficient motor was 84.8 percent efficient; the least, 83.4 percent efficient.)

- **Motor type**

In two-thirds of the cases examined (27 of 38 cases), the California research team found no difference in the nominal efficiency of the median ODP motor meeting premium efficiency standards and the TEFC motor meeting those standards.<sup>30</sup> In eight cases, the TEFC motor was more efficient than the ODP motor (by up to 2.0 percentage points); in the remaining three cases, the ODP motor was the more efficient one (by up to 0.6 percentage points). Thus, there is some increase in uncertainty around the savings estimate if the type of motor purchased is not reported. However, this added uncertainty is quite small in absolute terms. It is also quite small relative to other sources of uncertainty discussed here, as well as in the uncertainty of savings resulting from the lack of information about the efficiency of the motor that is being replaced or the variations in efficiency among motors that meet only EPA standards for which the NEMA-premium motor is being substituted.<sup>31</sup>

- **Speed**

The efficiency of a qualifying motor is quite likely to vary as a function of its rated speed, regardless of the motor type. This is particularly true for smaller motors. The California team's analysis found that the median qualifying motor rated at 1800 rpm tended to be more efficient than those rated at 1200 rpm or 3600 rpm—often by about 0.5 percentage points, but by as much as 5.0 percentage points for ODP motors. Indeed, it appears that variations in motor speed are more consistent and greater contributors to differences in efficiency than is the difference between ODP and TEFC motors.

These factors have been considered in the NMR team's recommendations regarding requests for shipment disaggregation information. Specifically, they motivate the suggestion that sponsors forego the request for disaggregation by motor type (particularly given the concern that this request may impede the development of an agreement for data-sharing with NEMA) and the recommendation that disaggregation by motor speed be placed on the agenda.

<sup>30</sup> The data were developed in 2000, and relied on CEE standards for premium motors. Agreements on NEMA-premium motors had not yet been concluded. We are unaware of any intervening factors that would have increased the disparity in efficiency levels as a function of motor type, however.

<sup>31</sup> A parallel analysis of the median motor meeting only the EPA standards shows that the efficiency levels are the same in 23 of 38 cases; the TEFC motor is more efficient in twelve cases; and the ODP motor is more efficient in three cases.

### 3. Market Penetration Tracking of Energy-Efficient Packaged HVAC

Background research for this project included review of existing utility-sponsored studies of the HVAC market and discussions with experts in the energy efficiency industry who are familiar with the HVAC market. We had extensive discussion with staff from CEE and also spoke with American Council for an Energy Efficient Economy (ACEEE), which has worked with ARI in the past to get access to ARI shipment data by equipment type, efficiency and size for a project on federal tax credits. We also spoke with the Energy Center of Wisconsin, which currently collects residential HVAC data from distributors in the state of Wisconsin. We also had discussions with contacts at MaGrann Associates and Kema-Xenergy, who serve as implementation contractors for the HVAC programs for Cool Choice and NYSERDA's New York Energy Smart<sup>SM</sup> programs, respectively.

Our research also included telephone discussions and e-mail communications with a senior staff person at the Air-Conditioning and Refrigeration Institute (ARI)—the national trade association representing manufacturers of North American produced central air-conditioning and commercial refrigeration equipment—who is involved with facilitating their data exchange with manufacturers.

Our original plan for this research included interviews with each of the four major HVAC manufacturers. However, this strategy changed after contact with one of the manufacturers who made it very clear that sponsors should pursue discussions about obtaining market share data with ARI—the industry association—not the individual manufacturers. After consulting with NEEP, our efforts shifted to identifying a strategy for facilitating future discussions through ARI. Our recommendations are discussed in this report.

We also conducted an in-depth telephone interview with a key staff member at Heating, Air-Conditioning, and Refrigeration Distributors International (HARDI)—the trade organization for HVAC/R distributors. In addition, we conducted in-depth telephone interviews with seven HVAC distributors who represent each of the major manufacturers—Lennox, Trane, Carrier, and York. The sample was developed to include a mix of manufacturer-owned and independent distributors, which as a group serviced the entire geographic area covered by sponsors' programs. We developed contacts for the sample through a variety of sources, including references from our discussions with implementation contractors and the HVAC contractors themselves and member listings published on the HARDI web site ([www.hardinet.org](http://www.hardinet.org)).

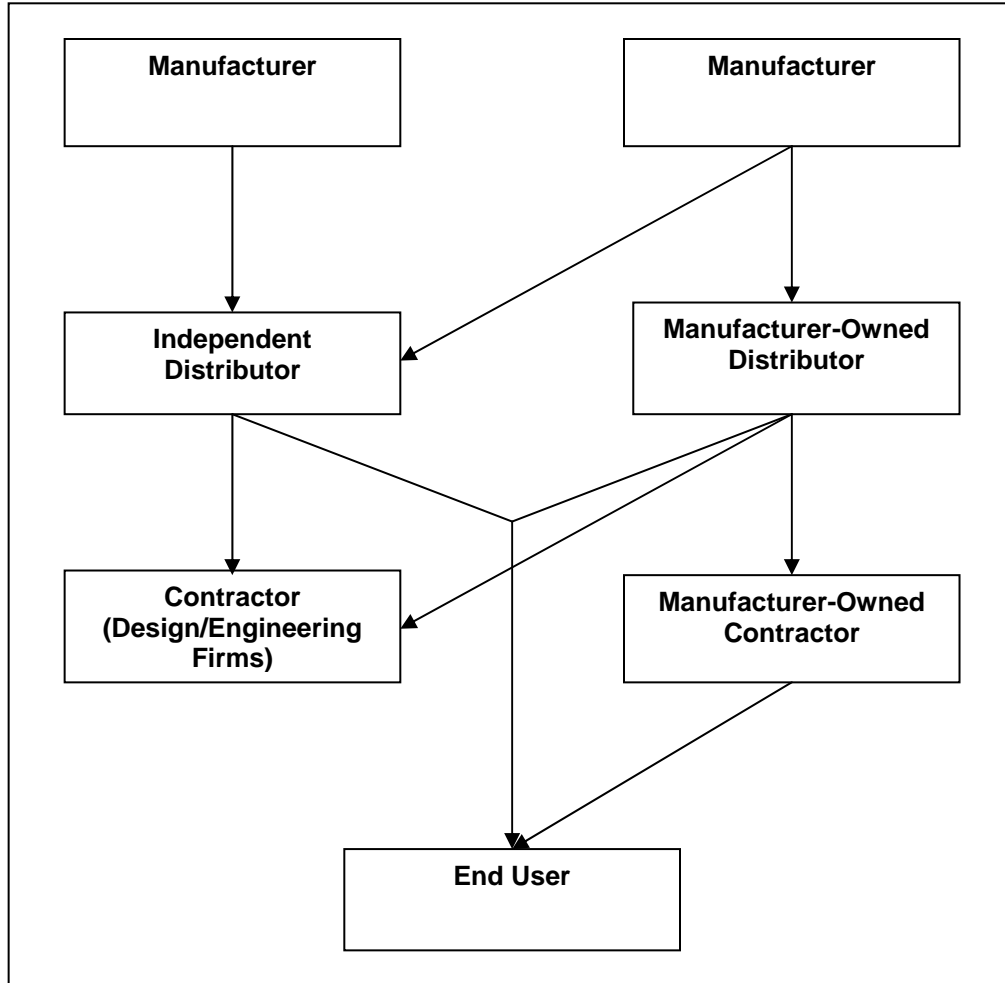
#### 3.1 The Commercial Packaged HVAC Market

To better understand possible data collection strategies, we asked respondents to describe the market structure for HVAC equipment in this market—that is, tracing the path from manufacturer to end-user.

Typically, equipment in this market follows the route from Manufacturer to Distributor (manufacturer-owned or independent) to Contractor to End-User. A small percentage of the market is covered by sales representatives who typically serve as brokers on bid jobs and may or may not represent any single manufacturer. Sometimes they work for a distributor, and other

times fill in the gaps where no distributorship exists. Figure 3.1 illustrates the path of product as it typically passes from manufacturer to end-user.

**Figure 3.1: Product Flow for C/I HVAC Units**



**Manufacturers**

The commercial and light industrial HVAC market is dominated by four manufacturers: Carrier, Lennox, Trane, and York. Estimates of the combined market share for the “Big Four” ranges from 50% to 85%, according to distributors interviewed. Distributors identified other manufacturers in the market as Rheem-Ruud (probably fifth biggest), Bryant (a Carrier brand), Comfort Maker (a Carrier brand), Heil, Command Aire, Samsung, and Goodman (probably very little in this market).

Currently there are seven manufacturers signed on as ENERGY STAR® partners and producing ENERGY STAR-qualifying products in the Light Commercial Heating and Cooling category. (Table 3.1) The Consortium for Energy Efficiency currently lists 86 brands of Tier 1- and Tier 2-qualifying HVAC equipment (68 brands of Tier 2 equipment) on its website.

**Table 3.1: ENERGY STAR Partner Manufacturers  
(Light Commercial Heating and Cooling)**

Manufacturer	Products
Carrier Corporation	Boilers, Central ACs and Air-Source Heat Pumps, Furnaces, Light Commercial HVAC, Programmable Thermostats, Room Air Conditioners
Global Energy Group Inc.	Light Commercial HVAC
Goodman Manufacturing	Central ACs and Air-Source Heat Pumps, Furnaces, Light Commercial HVAC
Lennox Industries Incorporated	Central ACs and Air-Source Heat Pumps, Furnaces, Light Commercial HVAC, Programmable Thermostats
Munters Corporation	Light Commercial HVAC
The Trane Company	Central ACs and Air-Source Heat Pumps, Furnaces, Geothermal Heat Pumps, Light Commercial HVAC
York International Corp. UPG	Central ACs and Air-Source Heat Pumps, Furnaces, Light Commercial HVAC

Source: ENERGY STAR website [www.energystar.gov](http://www.energystar.gov)

Manufacturers in this market often sell products under more than one brand name. Table 3.2 lists some of the brand names.

**Table 3.2: Manufacturers (and Brand Names) in the Unitary HVAC Equipment Market**

Manufacturer	Brand/s
American Standard	Trane
Electrolux	
Fedders	Emerson Quiet Kool Fedders Hampton Bay
Friedrich	
Goodman	Amana Goodman
Haier	
Lennox	Armstrong Lennox Ducane
LG Electronics	Goldstar
Matsushita	Panasonic Quasar
Nortek	Nordyne
Rheem/Paloma Industries	Rheem Ruud
Samsung	
Sharp	
United Technologies	Carrier Bryant Payne  Through International Comfort Products (ICP): Airquest Arcoaire ComfortMaker Heil Tempstar
Whirlpool	
York	

Source: Adapted from Unitary HVAC Market Assessment. For NYSERDA by Xenergy, June 26, 2002.

While it was reported that most of the major manufacturers have factories in Mexico, respondents say imports from foreign firms do not play a significant role in this market. Exceptions exist mainly in niche applications, such as the ductless systems from Mitsubishi and Sanyo, which represent an estimated 5% to 10% of the market.

**Distributors**

As shown in Figure 3.1, equipment typically flows from the manufacturer to a local or regional distributor/wholesaler. Distributors usually represent just one manufacturer per line. Types of distributors include manufacturer-owned, franchises, and independent wholesale distributors. Of the four major manufacturers, Lennox is the only one that is completely vertically integrated across the supply chain—that is, it owns all of its distribution centers and has its own Lennox contractors for installation and service. Respondents estimate that among distributors of the other three major manufacturers there is a 50%/50% split between company-owned and

independent distributors. Among the lesser known brands, almost all distribution is through independents.

Identifying the population of distributors is very important in helping us to determine sampling expectations as a possible means for tracking market share. Much of the literature we reviewed on HVAC market characterization covers the wider market—including residential, commercial, and industrial products. It becomes very difficult to single out only the parts of the supply chain that deal specifically with packaged HVAC systems and air- and water-source heat pumps for commercial and light industrial use. For example, a Xenergy study for NYSERDA estimated that 580 HVAC distributors exist in New York alone<sup>32</sup>. A study for PG&E in California estimated the number of HVAC distributors in PG&E's territory alone at 48 firms.<sup>33</sup> However, our discussions with distributors for this study reveal that when distinctions are made between *equipment* distributors who provide packaged HVAC systems and air- and water-source heat pumps to the commercial and light industrial markets on one hand, and those who are *supplier* distributors to the HVAC industry or serving other markets on the other hand, the number of distributors of interest to the sponsors is much smaller.

Distributors in our discussions were able to identify, with varying levels of detail, which distributors serve the New England, New York and New Jersey markets. Using the example of Trane, one distributor estimated that approximately 20 Trane distributors serve the New England/New York/New Jersey market (Table 3.3). The majority in the sponsors' territory are Trane company (-owned or -franchised); of these about 60% are Trane-owned and 40% are franchises. A handful of distributors in the sponsors' territories are independently owned Trane distributors.

**Table 3.3: Distribution Network for Trane in Sponsor Region\***

	Trane Owned	Trane Franchises	Independently Owned
New England	N.E. Trane (4 offices Woburn, Providence, Portland, Springfield covering MA/RI/ME; headquarters Woburn)		Star Supply (CT) Air Purchases (NH, MA, ME, VT)
	CT (2 offices Hartford, Shelton)		
	VT (1 office)		
NY	NY Trane (5 offices—Long Island, NYC, Albany, Syracuse, Buffalo)	Gerster Trane** (Buffalo)	Gerster Trane** (Buffalo) Ward Supply (Syracuse, Rochester, Canandaigua) Wallwark Group (multiple offices, including NJ)
NJ	NJ Trane (2 Offices)	1 franchise	

\*Intended to demonstrate sample distribution coverage for one manufacturer. Based on depth interview with one distributor.

\*\*Unique company structure, both franchise & independent.

<sup>32</sup> Unitary HVAC Market Assessment. For NYSERDA by Xenergy, June 26, 2002.

<sup>33</sup> Commercial/Industrial Market Effects Baseline Study. Final. Study ID3306 for Pacific Gas & Electric by Quantum Consulting in association with Shel Feldman Management Consulting and KVDR, Inc. July 30, 1998.

If we assume that the number of Trane distributors is representative of the coverage by the other major manufacturers, there are perhaps 80 to 100 distributors in sponsors' territory for this market.

Across all brands of equipment, manufacturers try to maximize their market coverage by assigning geographic territories to distributors, with very little overlap. Where overlap exists, distributors commonly focus on different markets, with one specializing in residential and another in commercial equipment. Most distributors of the major brands operate from multiple offices, servicing multiple metropolitan areas and/or states.

Very rarely is product exchanged between distributors. Sales from distributors typically pass through the installation trades (contractors, builders, etc.), who are doing the marketing and sales to the end-users.

### **Industry Associations**

#### *ARI*

The Air-Conditioning and Refrigeration Institute (ARI), located in Arlington, Virginia, is the national trade association representing manufacturers of North American-produced central air-conditioning and commercial refrigeration equipment. ARI was formed in 1953. Since then, several related trade associations have merged into ARI, and today ARI is seen as the major voice for the air conditioning and refrigeration industry.

One of ARI's most important functions is developing and publishing technical standards for industry products. ARI also certifies manufacturers' performance ratings of industry products. Their certification programs include extensive laboratory testing, are voluntary, and are open to non-ARI members.

ARI claims their membership represents manufacturers of more than 90% of North American produced central air-conditioning and commercial refrigeration equipment. As listed on their Website ([ari.org](http://ari.org)) the benefits of ARI membership include:

- A forum to solve common problems
- Development of product performance standards
- Development of voluntary performance certification programs
- Liaison with Federal, State and local government entities
- Assistance with international trade activities
- Statistical reports detailing product shipments and inventories

Members meet twice a year - typically in November and March. Any request from the sponsors for access to currently proprietary data would have to be voted on at a member meeting. Emergencies or specific issues needing immediate attention are sometimes addressed outside of the standard member meetings via conference calls, etc.

### *Heating, Air Conditioning, and Refrigeration Distributors International (HARDI)*

HARDI is a non-profit trade organization “dedicated to advancing the science of wholesale distribution in the HVACR industry.” It was formed from the consolidation of two distributor organizations—North American Heating, Refrigeration & Air Conditioning Wholesalers (NHRAW) and Air-conditioning & Refrigeration Wholesalers International (ARWI). HARDI membership consists of about 500 wholesale distributors, with about 2800 branches and about \$16 billion/year in sales, or about 85% of the market. HARDI estimates there may be as many as 1000 additional distributors, but these are mainly small; most of major distributors belong to HARDI. One exception is Lennox—they are a big player in market, but due to their structure do not participate. With the exception of one, the distributors we spoke with are familiar with HARDI.

HARDI does not collect data on its own and reports that it has never really had a request for it from members. HARDI advises that data would be very hard to collect from distributors because they will be reluctant to reveal any information that might be considered proprietary. HARDI believes that the most consistent data collection would be done at the manufacturer level, because manufacturers know what they ship and to which distributors; most manufacturers produce sales reports for their distributors already.

HARDI considers ARI to be a sister organization. HARDI named ARI as the likely avenue for the best source of sales data since it already collects manufacturer data. HARDI would welcome a continued dialog about this issue should the sponsors wish.

## **3.2 Interview Findings**

### **Current Data Tracking by ARI**

ARI currently collects monthly data on US factory shipments by size, efficiency and equipment category and can separate single-phase from three-phase equipment. An exception is water-source heat pumps, which are not tracked by efficiency level. ARI does not currently collect any state- or regional-level data for commercial equipment, but this does not mean it could not be done in the future. They do not track dual enthalpy control economizers because these are not an ARI-certified product. At this time all but total shipments of unitary equipment by size for commercial equipment is proprietary. The published data include air-to-air heat pumps, but not water-source heat pumps.

More detailed information is available for residential equipment. ARI reports residential data on shipments (sales to distributors) by state. They also provide a statistical profile. They do not publicly report shipments by efficiency level but do calculate an overall total shipment-rated EER for residential equipment, which can be purchased on the Internet for \$70.

### *Ability To Track Unitary Versus Split Systems*

ARI can separate unitary from split systems. (They use the terms “single package” versus “split” systems.) Currently both are included in their published unitary shipment data. They indicated

that split systems are typically matched components. In replacement situations a customer may want to replace only one piece, but the industry recommendation is to replace both components: if only the condensing unit is replaced it won't match the indoor coil and the efficiency of the overall system will drop.

#### *Ability To Track Water Source Heat Pump Systems*

Water source heat pumps are an applied product and are not included in the published unitary shipment data. They do track water-source heat pump shipments, but not by efficiency level and the reports are proprietary at this point.

#### *Ability to Track Dual Enthalpy Control Economizers*

ARI does not track economizers, nor does it certify economizer equipment. Economizers are an add-on feature supplied by manufactures on their own and are typically installed in the field as an option.

#### **ARI Willingness to Provide Data**

The key to gaining access to ARI data is getting a majority vote of the membership to approve a data-sharing proposal. This will not be an easy task. Based on the interview with ARI, members would probably reject a simple request to gain access to their data. Efforts to approach ARI about sharing currently proprietary data and collecting additional information will need to be handled with great care and patience. The sense among ARI members is that energy efficiency groups have different agendas: agendas that do not always make sense and are not consistent with the industry. When asked what the sponsors could do to overcome ARI member concerns related to sharing information, the ARI response was to work on building trust first and worry about the data later.

**Distributor Interviews**

We conducted interviews with seven distributors, including a mix of manufacturer-owned and independent distributors and at least one distributor representing each of the four major manufacturers: Lennox, Trane, York and Carrier. The following two tables provide a summary of the distributors interviewed, the brands and sales areas covered and willingness to provide data. The sections following the tables present what we learned from the interviews about what data distributors track, how they track it, their willingness to provide data and their interest in getting data on sales in their territories.

**Table 3.4: Summary of HVAC Distributor Interviews**

Category	Brands Sold	Sales Area	Willingness to Provide Data
Owned by Trane	Trane	Western Massachusetts	Decisions would take place at Trane headquarters in LaCrosse, WI
Independent	Mostly Samsung, Command Aire and Heil.	Rhode Island Connecticut Massachusetts	Yes
Owned by Lennox	Lennox	Delaware Pennsylvania New Jersey New York Connecticut Rhode Island Massachusetts Vermont Maine	Not sure: Willing to discuss further.
Owned by Carrier	Carrier	Connecticut Western Massachusetts New Jersey New York: Syracuse to Buffalo and New York City north through Westchester	Yes: If confidentially, timing and resource issues could be adequately addressed.
Independently Owned	Carrier	Territory in: Maine New Hampshire Rhode Island Eastern Massachusetts	Probably not. It would not be worth the effort.
Independently Owned	York	Maine Massachusetts Connecticut Rhode Island New Hampshire Vermont Eastern border of NY State	Yes
Independently Owned	Trane and American Standard	3 locations in NY state (Trane in 22 counties in central, western NY State)	Willing to consider the possibility of providing data on his end

**Table 3.5: HVAC Distributor Interview State/Brand Coverage**  
(Number of interviews covering each brand in each state)

Brand→ State ↓	Trane	Lennox	Carrier	York	Other Brands
Massachusetts	1	1	2	1	Samsung, Command Aire and Heil
Connecticut		1	1	1	Samsung, Command Aire and Heil
Rhode Island		1	1	1	Samsung, Command Aire and Heil
New Hampshire			1	1	
Vermont		1		1	
New York	1	1	2	1	American Standard
New Jersey		1	1		

### Current Data Tracking by Distributors

Most but not all distributors have the capability to track sales data. Virtually all sales and inventory data are recorded electronically, whether by the distributor or further up the supply chain. Systems used include Legacy and other off-the-shelf software programs.

Current distributor data collection and analysis practices vary widely. Distributors typically record a sales tracking number, model number, and/or serial number for each sale. Some distributors report that they track all their sales and can narrow in on just about any detail with relative ease; others say the data tracking according to sponsors' interests would require significant effort, possibly involving multiple data sources.

Distributor sales include both units shipped through the warehouse and units shipped directly from the manufacturer to the job site; some distributors maintain separate tracking systems for each sales channel.

However, not all distributors have systems that are capable of doing the level of breakdown that the sponsors desire. Some distributors have rigid, automated data collection procedures that are dictated and manipulated further up the supply chain, at either a regional distribution sales office or at the manufacturer. Two distributors, each representing a major manufacturer, say they record only a sales code for products sold. This information is not used directly by either of these distributors, and one felt that he could not extract breakdowns of his own sales activity, even if he wanted to. Both rely on feedback from manufacturers about their sales.

It seems that most major manufacturers track distributor sales and provide feedback to them in the form of sales goals and an analysis of distributor achievement of those goals. These reports tell the distributor that the marketplace sold xx# of units, last year you sold xx#; we want you to sell xx# next year. Trane offers its distributors on-line access to sales information so distributors can see how their sales of selected products compare to their overall sales. Carrier also gives its distributors feedback through sales reports. Some of the sales reports appear to be based on national industry data, presumably from ARI. However, because manufacturers typically set the

sales goals for the distributors and track it for them, the *distributors never really know whether these data are correct.*

### *Product Type*

Most distributors say that even if their sales data are not currently broken out into the categories of interest by the sponsors, tracking and model numbers can be used to extract breakdowns by product type: unitary, split, air-to-air and water-source heat pumps. Exceptions exist; one distributor who relies on the manufacturer to supply him with sales breakdowns says he can get sales of unitary products compared to his overall sales, but he cannot get information about water-source heat pumps.

### *Size and Efficiency*

Size breakdowns by efficiency level seem to be possible for most distributors. However, at least one distributor said that tracking by Tier 2 standards would be quite tedious because it would require pulling data from different sources.

### *Dual Enthalpy Economizers*

Some distributors indicated that tracking of factory-installed dual enthalpy economizers would be possible. Tracking of field-installed units is more problematic. While distributors may be able to provide the numbers of controls sold individually, they could not track the ultimate installation points; thus it would not be feasible for sponsors to determine if the economizers were being installed in program-qualifying units. Furthermore, third-party manufacturers or distributors, such as Honeywell, may serve this market, further obscuring an accounting of the field-installed controls.

### *Timing of Tracking Reports*

Distributors who generate their own tracking reports do so with schedules ranging from daily to weekly to monthly to bi-annually. Because sales tracking is done electronically, there is virtually no lag time from sales to report production. However, customization of reporting according to sponsors' interests would require more effort; in some cases in which multiple data sources must be cross-referenced, it would require significant effort.

Obtaining data from distributors who do not produce their own tracking reports would require considerable additional effort, working through a regional sales office or the manufacturer.

### *Geographic Breakdowns*

Distributors have well-defined service territories, often served through multiple satellite offices, designated by state or major metropolitan area. Most distributors can identify the office generating sales and some can track to the contractor making the purchase, so it is theoretically possible for sales to be tracked to a state or contractor location. However, distributors do not necessarily know where the end-user is located.

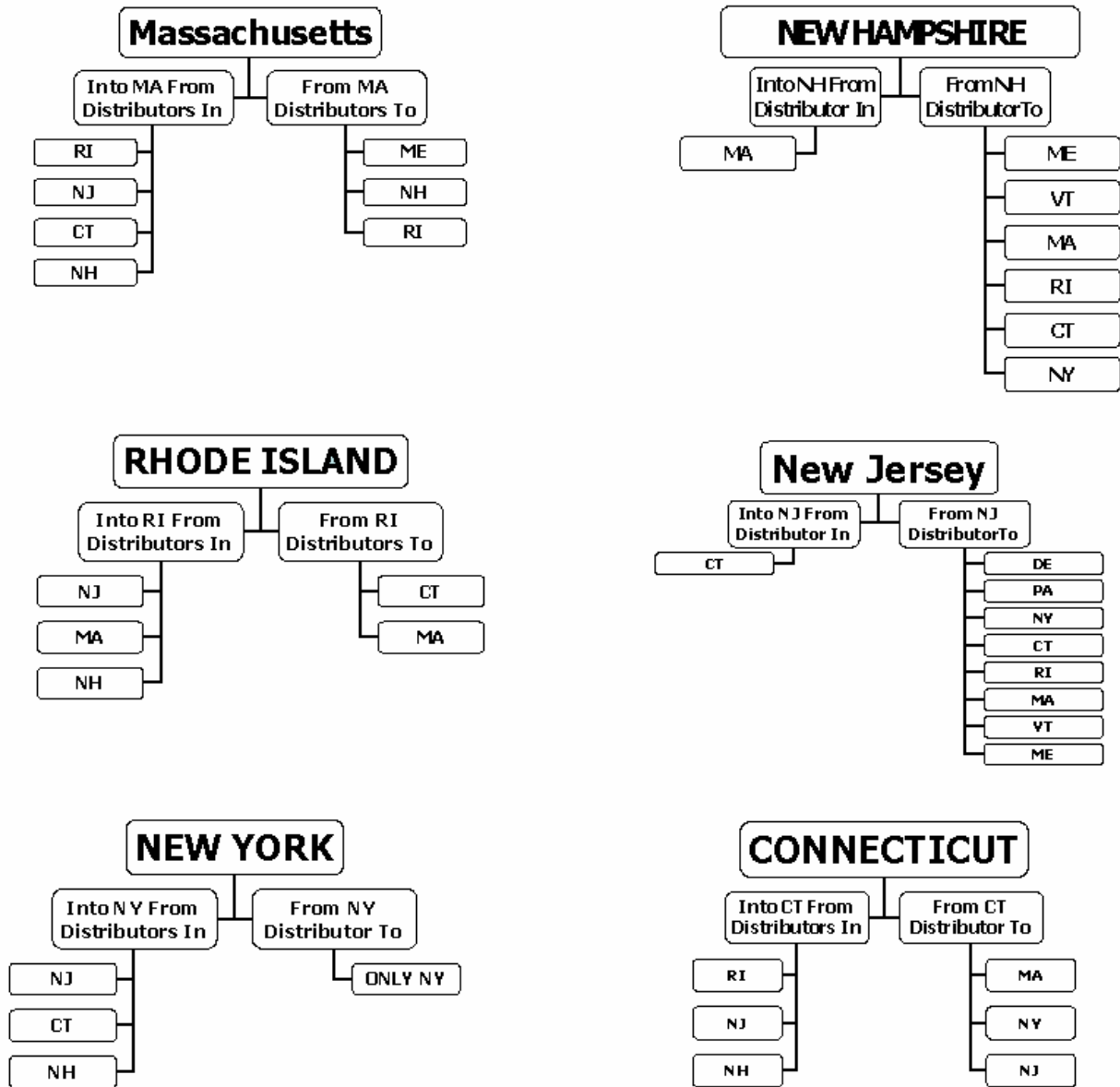
Assumptions can be made that sales from a distributor office or to a particular contractor will be installed in that state. One distributor described his operations as focused in New York State (not including Long Island), so he could assume that most of his products are installed in Central New York. Another explained that because sales are tracked by satellite office, he currently does not separate sales on a state-by-state basis. He may not be able to separate sales in Western Massachusetts from those in Connecticut, but could separate sales in Connecticut and New York. It is possible that with additional time, distributors could break sales out by state based on location of the contractors.

One distributor says he does not do breakdowns by state because he is more interested in how his numbers look for the region—his total service territory. He believes that even if state data could be extracted—say from sales to contractors—because the contractor information is generated to the nearest city, Boston data, for example, may contain information about other areas of New England.

A major limitation to using distributor data to estimate state sales is the fact that distributors often serve contractors in multiple states. The concern is two-fold. First, some distributors may not be able to net out sales to contractors in non-sponsor areas. Secondly, and perhaps the greater concern would be identifying distributors in non-sponsor areas who serve contractors in sponsor areas. Accounting for cross-border sales and the timing of sales are significant sources of uncertainty. Figure 3.2 illustrates the complexity of the issue. It is based on service territories as identified by the seven interviewed distributors and shows for each state the distributors serving that state and other states served by in-state distributors.

**Figure 3.2: Example of State-to-State Distributor Sales**

(Based on reported sales from Distributor interviews)



### **Distributor Willingness to Provide Data**

Distributors are not accustomed to sharing sales data with each other or with parties other than the manufacturers they represent. Even distributors representing a single manufacturer do not share data directly with each other. If data are shared, the manufacturer currently serves as a buffer. Despite this, most distributors seemed open to continuing discussions to explore the possibility of sharing their sales data with the sponsors, under carefully controlled conditions.

Of the two distributors unwilling even to consider providing data, a lack of interest in the results is an underlying factor. One distributor simply does not collect data with any level of sophistication and relies on his regional sales office and the manufacturer he represents to provide him with recaps of sales activity; the other believes there is no incentive for him to provide data. He is not interested in the information and feels the utilities would be unlikely to pay him enough to persuade him to do so.

Serious consideration of any sponsor request would likely require legal representation from each of the distributors. Distributors closely guard their sales information and would object to the release of proprietary information. A primary consideration is an assurance of confidentiality, so that their name, the name of the manufacturer they represent, and customer names not be disclosed in association with the data.

Distributors are also concerned about the resource commitment required of them for reporting purposes, both in terms of time and effort. Being able to accommodate distributors' normal reporting schedules—and they vary by distributor—would be important. One distributor noted that providing data on a quarterly basis would be acceptable; anything more often would be burdensome, particularly if the effort involved more than a few hours of his time. Monetary compensation for the additional effort to produce reports for the sponsors would be an important consideration for many.

### **Distributor Interest in Data**

Besides addressing confidentiality and compensation issues, one of the best ways for a tracking system to work is understanding the motivating interests of all parties. The basic motivating factor for distributors to consider providing the sponsors with sales tracking data is that they have a stake in the continued existence of efficiency programs. Interest in high-efficiency systems mainly takes the form of what it means to them in terms of sales—can they make more money by selling them? If yes, they are interested. One distributor explained that talk of programs going away gets people thinking about the role played by these programs now and what would happen if they go away. They plan their inventory, as well as their sales strategy, based on the availability of rebates.

Depending on how strong of a focus efficient equipment is in a distributor's business, it will dictate their interest in looking at the data. A distributor can gain little from looking at competitive data in a market in which they do not participate. For the simple reason that there would be no incentive for them to do so, distributors say it is unlikely that distributors who are not participating in utility programs for high-efficiency HVAC equipment would be willing to

provide data to the program sponsors. One distributor explained that while climate-wise it is not logical, efficiency is much less a driver for sales in other areas of the country than in the Northeast, California, and the Northwest—areas with strong utility and regional program support.

One distributor reports that knowing how he stands in the marketplace does not empower him to make more sales of standard or high-efficiency equipment. He basically sells to two types of situations:

- Design and build—Here he works with the contractor and is not particularly concerned with what competitors have to offer. He may recommend efficiency upgrades or more options depending on the contractor's preferences and the end-user's needs.
- Plan and spec jobs—Here he is basically working with a specific checklist of equipment specifications that have already been determined. He is basically competing on price and so will not offer options for efficiency upgrades.

Either way, he says knowing how he stands in the marketplace does not help.

However, most distributors see value in understanding their market share of units sold compared to the share sold by other distributors in their area. State or regional comparisons are most useful—basically the smaller the area, the better. For many, there is value in knowing how they fare against their competitors; this information does not currently exist in any detailed way. However, being able to sell more equipment is really a much greater concern.

The argument that the less the sponsors have to spend on a data-tracking system, the more funding will be available for program incentives is a persuasive one for many distributors.

### **Repository for Distributor Data**

Distributors agree that having an independent organization serve as the collector and repository for data—so that program sponsors would only see it in summary form and the identity of individual manufacturers would be concealed—is an important aspect of their willingness to consider releasing any sales data. Distributors say ARI and HARDI would be the most likely candidates to serve this role.

### **3.3 Tracking System Data Requirements**

The sponsors' minimal and ideal market penetration data requirements are addressed in the following updated version of a table originally submitted in the first status report. It has been updated to incorporate information from the interviews.

**Table 3.6: Market Penetration Data Requirements for HVAC Tracking System**

	<b>Minimally Acceptable Tracking Data</b>	<b>Ideal Tracking Data</b>	<b>Additional Notes and Comments</b>
<b>Total Market</b>	Total units packaged HVAC	Same	<ul style="list-style-type: none"> <li>• ARI national shipment data for combined single and three phase units available for all but water source heat pumps</li> </ul>
<b>Market Share</b>	Tier 2 qualifying and not qualifying	Same	<ul style="list-style-type: none"> <li>• ARI tracks national shipments by efficiency level</li> <li>• Most distributors could supply</li> </ul>
<b>Comparison</b>	National data less units sold in NEEP program area	National data less units sold in all areas with active programs,	<ul style="list-style-type: none"> <li>• Easily addressed if ARI agrees to collect and supply shipment data by state.</li> <li>• State/regional data needed to address program attribution</li> </ul>
<b>HVAC Type Segmentation</b>	Packaged systems in the following categories: Unitary and split combined, Air to air heat pumps, and Water source heat pumps. Dual enthalpy economizer controls: Number factory installed by category Estimate field installations based on number of add-on kits sold by size category.	Packaged systems in the following categories; Unitary, Split, Air to air heat pumps, and Water source heat pumps. Dual enthalpy economizer controls: Number of factory and field installed by category	<ul style="list-style-type: none"> <li>• Both ARI and distributors can track equipment by the desired system categories</li> <li>• ARI does not collect any information on controls</li> <li>• Most distributors can supply data on factory installed controls</li> <li>• Field installed controls may not be traceable to specific installations</li> </ul>
<b>Size Segmentation</b>	4 size categories by ton for Unitary and Split (may be combined) and Air to Air HP: <5.4 ≥5.4 to <11.2 ≥11.25 to <20 ≥20 to ≤30 tons; ≤30 tons for Water HP; All Dual Enthalpy Economizers—factory installed for units ≤30 tons	By ton, up to 30 tons for each of following: Unitary, Split, Air to Air HP, and Water HP; All Dual Enthalpy Economizers	<ul style="list-style-type: none"> <li>• ARI national data publicly available in the minimally acceptable size segments for all but water source heat pumps</li> <li>• Most distributors could provide data in any requested segments.</li> <li>• Most distributors could provide factory installed dual enthalpy control economizer data and some data on field installed controls</li> </ul>
<b>Geographic Segmentation</b>	National and Regional—NEEP program area of New England states, minus ME; plus NY and NJ	National and by state; New York broken down into Nassau & Suffolk counties and remainder of state	<ul style="list-style-type: none"> <li>• Not currently available</li> <li>• State shipment data potentially available through ARI</li> <li>• Distributors could provide for areas they serve.</li> </ul>
<b>Type of Data</b>	Shipments	Sales	<ul style="list-style-type: none"> <li>• ARI - shipments.</li> <li>• Distributors - sales.</li> </ul>
<b>Frequency</b>	Annual	Annual, max 4 month lag with quarterly, mid-year updates.	<ul style="list-style-type: none"> <li>• Frequency does not appear to be a problem.</li> </ul>

**Total Market:** National total market shipment data covering the size units addressed in the sponsors' programs are currently publicly available through ARI, with the exception of water-source heat pumps. The one drawback is that the published ARI data include both single- and three-phase units.

**Market Share:** ARI tracks shipment data by efficiency level at the national level, except for water source heat pumps, which are considered an applied product and are not tracked by efficiency level. These data are currently available only to ARI members. National distributor sales data by efficiency level is not available.

**Comparison:** Getting ARI to report shipment data by state would allow the sponsors to address program attribution by comparing the market penetration of high-efficiency equipment between states with and without HVAC programs, as well as comparing states with programs. Currently, ARI does not collect commercial equipment shipments by state. However, it does collect state level-data for residential equipment, which means it would likely be a relatively easy addition for manufacturers to report commercial shipments by state. Without ARI cooperation, comparisons would have to be based on information from distributors, and the likelihood of getting data from non-program area distributors is extremely low.

**HVAC Type Segmentation:** Both ARI and distributors are able to track equipment shipments or sales in the ideal tracking categories, except for dual enthalpy economizer controls. ARI tracks no data on controls because they are not an ARI-certified product and are considered an add-on option supplied by individual manufacturers. Most distributors indicated that they could supply data on factory-installed controls. However, they might not be able to trace field-installed controls to specific installations. Also, controls can be installed by a separate control contractor and distributors would have no information on these installations. It may be possible to estimate the penetration of field-installed dual enthalpy controls by looking at the percentages of rebated units in each size, equipment type and efficiency level category that have factory-installed and field-installed dual enthalpy controls; this information could come from the rebate form. These percentages could be applied to total distributor sales in comparable categories to estimate the market penetration of factory- and field-installed dual enthalpy economizer controls.

**Size Segmentation:** ARI national data are publicly available in the minimally acceptable size segments for all equipment categories except water source heat pumps; the water source heat pump data are currently proprietary. Distributor sales data are not currently available, but could be collected in whatever segments the sponsors specify if they pursue collecting data directly from distributors. Data on dual enthalpy control economizers are more elusive. ARI does not track any information on controls because they are not an ARI-certified product. Most of the distributors we talked to said they could provide factory-installed dual enthalpy control economizer data and at least some information on field-installed controls. However, it is unlikely they could trace the field-installed controls to specific unitary equipment.

**Geographic Segmentation:** As mentioned earlier, ARI currently tracks residential equipment by state, but not commercial equipment. The distributors we talked with could supply sales to contractors by state. Some contractors may install equipment in more than one state, but distributors indicated that such situations are not common. As previously described, information on dual enthalpy controls is more elusive.

**Type of Data:** There is no source of national sales data. All ARI data are based on shipments. Sales data would have to come from distributors.

**Frequency:** Reporting frequency is not a problem for either ARI or distributor data. ARI currently collects monthly shipment data and the distributors we talked to who showed a willingness to consider sharing data have computerized tracking systems that can provide information quickly. The least frequent reporting mentioned by distributors was once every six months.

### **Ability to Meet Standard Measurement Requirements**

A viable data collection process must provide the sponsors with information that is comparable from one report to the next. Readers or policy analysts should be required to make only minimal interpretative adjustments when examining the data from different quarters, years, or regions. In addition, the data should meet other standard measurement requirements, including:

- **Repeatable**—The technique(s) selected should allow for regular tracking of sales and market progress.
- **Meaningful and theoretically defensible**—Results are readily recognized as demonstrating market changes and as representative of the specific equipment types involved.
- **Representative**—If the data are not obtained from a census of all sales outlets they must nonetheless provide information that is generalizable and characteristic of the entire population.
- **Sensitive**—Results should change with market movements, with little if any lag time.
- **Reliable**—Comparable results will be obtained with different samples
- **Minimally intrusive**—Data collection should not interfere with the normal business practices or activities of those supplying the data, unless adequate compensation is provided for their cooperation.
- **Inexpensive**—The costs of obtaining the data must be kept in proportion to the costs of the program itself and to the savings anticipated.
- **Verifiable**—Alternative techniques should provide convergent results

Table 3.7 shows how manufacturer shipment data collected through ARI compares to sales data collected from distributors with respect to the measurement requirements described above. Manufacturer shipment data collected through ARI fares better than distributor sales data because the information represents over 90 percent of HVAC manufactures producing the targeted equipment in North America and because the information would likely be consistent and accurate as it comes from reports that the manufacturers have been submitting for some time. It is impossible to predict how well distributor sales data would meet many of the various data requirements without knowing how representative a sample of distributors could be recruited to supply data.

**Table 3.7: Comparison of ARI and Distributor Data Collection Options**

<b><i>Approach</i></b> → <b><i>Measurement Requirements</i></b> ↓	<b><i>Manufacturer Data From ARI</i></b>	<b><i>Distributor Data</i></b>
<b>Repeatable</b>	Yes	Unknown—would depend on getting consistent information from participating distributors
<b>Meaningful and theoretically defensible</b>	Yes	Depends on Coverage and Consistency
<b>Representative</b>	Yes	Depends on Coverage
<b>Sensitive</b>	Yes	Depends on Coverage
<b>Reliable</b>	Yes	Depends on how representative the sample is
<b>Minimally intrusive</b>	Yes	Will Vary by Distributor
<b>Verifiable</b>	Close to Consensus	Unknown—difficult to predict

### 3.4 Strengths and Weaknesses of Potential Approaches

Table 3.8, on the following pages, summarizes the advantages and disadvantages of various options for collecting the HVAC market data the sponsors are seeking. This table was originally submitted in the first status report and has been updated to incorporate the results of interviews. There are advantages and disadvantages to both ARI and distributor based data collection options.

At the project outset, several data collection options were discussed with study sponsors. These included:

- Collecting shipment data directly from individual manufacturers
- Collecting sales data by tracking information on warranty cards
- Gaining access to data currently collected by ARI but available only to ARI members
- Collecting sales data from individual distributors, both independent and manufacturer-owned
- Developing a hybrid approach that uses data from more than one source to estimate market penetrations
- Collecting sales data through telephone surveys of dealers and contractors

- Collecting sales data from dealers and contractors by changing the program to require supplying sales data a requirement for participating in the sponsors' program
- Collecting data through telephone surveys of end users.
- Collecting data through on-site surveys of end users.

At the kick-off meeting, the sponsors agreed to eliminate from further consideration options involving getting data from end users and the option of changing the program to require dealers and contractors to provide data as a condition for getting rebates.

Later in the study, two additional options were rejected:

- The option involving collecting data through telephone surveys of dealers and contractors was rejected because of cost. Options involving end users or dealers and contractors are very expensive because of the large number of sample points that need to be individually recruited, and because many dealers and contractors would need to be financially compensated to supply data they do not track as part of their normal business operations. In addition, response bias could easily produce results that do not accurately represent the market and are, therefore, not defensible.
- The warranty card option was rejected as a viable option during the course of the study because the consensus from discussions with implementation contractors, ARI and distributors is that most contractors do not give the warranty card to the end user. The contractors want their customers to call them with any problems, not go to the manufacturer.

For these reasons the study focused on the following options involving getting data from manufacturers, distributors and ARI as well as the longer-term potential for implementing an “out of box” approach:

- Collecting Data Directly From Individual Manufacturers
- Getting Access to Data Through ARI
- Collecting Data From Distributors
- Using A Hybrid Data Collection That Draws From More Than One Source.

**Table 3.8: Strengths and Weaknesses of Potential Approaches**

Market Actor Source	Approach	Advantages	Disadvantages	Status
Manufacturers	Shipment data from individual manufacturers	<ul style="list-style-type: none"> <li>• Relatively few companies to be approached and monitored if the focus is on the major manufacturers</li> <li>• Development of relationships may offer opportunities for collaboration on program design, incentives, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Accurate disaggregation by state (and possibly by region) difficult to impossible, given only shipment points.</li> <li>• Spotty coverage if all major manufacturers do not supply data: some manufactures not willing to provide data except through ARI.</li> <li>• Based on the ARI interview, there remains an air of distrust with respect to utilities. This will need to be addressed before, or along with, any request for data.</li> </ul>	Explored
Manufacturers	Warrantee Warranty cards	<ul style="list-style-type: none"> <li>• Provides sales data</li> <li>• May be modified to get additional data, breakdowns</li> <li>• Provides geographic breakdowns by end-user</li> </ul>	<ul style="list-style-type: none"> <li>• Consensus from implementation contractor, ARI and distributor interviews is that most contractors do not give the warranty card to the end user: contractors want customers to call them with any problems, not go to the manufacturer.</li> </ul>	Rejected

**Table 3.8: Strengths and Weaknesses of Potential Approaches (cont.)**

Market Actor	Approach	Advantages	Disadvantages	Status
Manufacturer or dealer associations (ARI)	<ul style="list-style-type: none"> <li>• Work through ARI to get proposal for sharing data with program sponsors on the agenda for ARI’s next member meeting.</li> <li>• Offer something of value to ARI members to encourage their support of any proposal</li> <li>• Proposal would include:                             <ul style="list-style-type: none"> <li>✓ Why sponsors need the data</li> <li>✓ Willingness to sign confidentiality agreement</li> <li>✓ Need to add shipments by state</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Single point of contact.</li> <li>• Most cost effective to deal with one data source.</li> <li>• Likely to be relatively inexpensive.</li> <li>• Highest likelihood of consistent data across manufacturers.</li> <li>• Greatest coverage: ARI claims to represent 90% of US produced central a/c and commercial refrigeration equipment..</li> <li>• Access to data from areas without utility programs.</li> <li>• Manufacturers prefer to work through ARI rather than deal with utilities one to one.</li> <li>• Easier to build a partnership and negotiate one legal confidentiality agreement for mutual benefit with one central organization than with multiple companies</li> <li>• Easier to build on an existing tracking system than develop one from scratch..</li> <li>• ARI releases shipment data monthly (free on Internet) and in timely fashion (1-2 month lag)</li> <li>• Published ARI data includes U.S. factory unitary shipments (central a/c and air-source heat pumps), with breakdowns by size (Btuh). Also publishes factory stocks (Distributor inventories, %of distributor shipments)</li> </ul>	<ul style="list-style-type: none"> <li>• All but national shipment data are proprietary – would need majority of membership to approve providing data to the sponsors.</li> <li>• Getting members to approve sharing data could take some time.</li> <li>• Only national level data currently tracked</li> <li>• Would need to ask members to report data on shipments by state, something they do not now track for commercial equipment:                             <ul style="list-style-type: none"> <li>✓ All ARI data are based on shipments, not sales</li> <li>✓ Do not track water source heat pumps by efficiency level</li> <li>✓ Do not track economizers.</li> </ul> </li> <li>• ARI data may be limited to unitary equipment and air-source heat pumps</li> <li>• If collected, shipment data would be to distributors, not the end user, so accurate state level installation data would not be available.</li> </ul>	Explored

**Table 3.8: Strengths and Weaknesses of Potential Approaches (cont.)**

<b>Market Actor</b>	<b>Approach</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Status</b>
Distributors (Independent and Manufacturer-owned)	Regular collection of sales data	<ul style="list-style-type: none"> <li>• Relatively few companies, compared to contractors</li> <li>• Regional geographic disaggregation:</li> <li>• Data available by location of the installation contractor - though not exact in terms of final installation location, it is a close approximation.</li> <li>• Sales rather than shipment data</li> <li>• Most distributors track, or have access to, the data fields the sponsors want to track.</li> </ul>	<ul style="list-style-type: none"> <li>• Varying degrees of cooperation may not produce a representative sample.</li> <li>• Recruiting many companies will require multiple types of legal confidentiality agreements and, therefore, take considerable development time.</li> <li>• Must identify incentives to encourage participation: both monetary and report/data sharing.</li> <li>• Very expensive option</li> <li>• Must confirm minimal overlap of sales from manufacturer distributor sales to independent distributors.</li> </ul>	Explored
Dealers/ Contractors	Collection of sales data through telephone surveys.	<ul style="list-style-type: none"> <li>• Closer to end user</li> <li>• Sales rather than shipment data</li> <li>• Easier to estimate state-by-state disaggregation</li> </ul>	<ul style="list-style-type: none"> <li>• Relatively many companies compared to distributors</li> <li>• Complex sampling design</li> <li>• Varying degrees of cooperation may not produce a representative sample.</li> <li>• Reimbursement expenses</li> <li>• Unknown consistency in level of data tracked</li> <li>• Unknown and varying dealer/contractor interest in data</li> <li>• Previous studies show low response rates unless one to one contact is made by a professional interviewer who understands the HVAC market and equipment.</li> <li>• Unlikely that non-participating contractors will supply data, inside as well as outside the sponsors' service areas.</li> </ul>	Rejected

**Table 3.8: Strengths and Weaknesses of Potential Approaches (cont.)**

<b>Market Actor</b>	<b>Approach</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Status</b>
Dealers/ Contractors	Alternative collection of sales data as part of quota system design	<ul style="list-style-type: none"> <li>• Closer to end user</li> <li>• Sales rather than shipment data</li> <li>• Easier to estimate state-by-state disaggregation</li> <li>• Incentives for participation in tracking system built into program (a la “Next Step”)</li> </ul>	<ul style="list-style-type: none"> <li>• Relatively many companies compared to distributors</li> <li>• Varying degrees of cooperation and delays</li> <li>• Lack of coverage for non-qualifying products</li> <li>• Reimbursement expenses</li> <li>• Requires that program design be modified, with accompanying uncertainties over participation and effectiveness</li> </ul>	No further consideration
End Users	Telephone surveys	<ul style="list-style-type: none"> <li>• State-by-state disaggregation inherent in design</li> <li>• Direct opportunity to probe users about systems</li> <li>• Many dealers participate in program and are thus potential allies</li> </ul>	<ul style="list-style-type: none"> <li>• Cost of identifying recent purchasers (dealers unlikely to provide lists; selection through RDD or postcards quite high; likely to be biases among those who do cooperate)</li> <li>• Information unreliable as respondents may not understand efficiency levels or be able to find model numbers</li> <li>• No cost savings for repeated (annual or semi-annual) waves</li> </ul>	No further consideration
End Users	On-site surveys	<ul style="list-style-type: none"> <li>• End-user data advantages above</li> <li>• In addition, issue of reliable model data resolved</li> <li>• Could add run-time and loading data collection (at considerable cost)</li> </ul>	<ul style="list-style-type: none"> <li>• As above, plus smaller sample because of higher cost per site</li> </ul>	No further consideration

**Table 3.8: Strengths and Weaknesses of Potential Approaches (cont.)**

Market Actor	Approach	Advantages	Disadvantages	Status
Hybrid	<ul style="list-style-type: none"> <li>• Combine manufacturer shipment data and distributor sales data</li> </ul>	<ul style="list-style-type: none"> <li>• Opportunity to leverage shipments data with limited amount of sales data</li> </ul>	<ul style="list-style-type: none"> <li>• If ARI is willing to share their data, and provide state data, the incremental cost of also collecting distributor sales data would come at a high cost and provide marginal value</li> <li>• If ARI members refuse to share data, it is unlikely major manufactures would go against that industry opinion and agree to independently provide data to the sponsors.</li> <li>• Without access to shipment data from a representative sample of manufacturers, a hybrid approach offers no benefits over a distributor sales based tracking system.</li> <li>• Manufacturers refusing to supply shipment data would likely refuse to allow their company owned distributorships to provide sales data, greatly reducing the likelihood of being able to recruit a representative sample of distributors.</li> </ul>	Explored

### 3.5 Comparison of Data Sources

Table 3.9 presents features of the ARI shipment data and distributor sales data collection options in the format requested by the sponsors. The advantage of the ARI data is that most of the data the sponsors are seeking are currently collected by ARI. The disadvantage of the ARI data is that all but national shipments by size are currently proprietary – available only to ARI members. The advantage of distributor data is that it appears most distributors would be able to provide the data fields the sponsors are seeking, including sales by state and region, at least for current data. The disadvantages of collecting distributor data are that it would be very expensive, it is hard to predict ahead of time what level of coverage could be achieved through recruitment efforts and there is little chance of recruiting a representative sample of distributors in a non-program area.

**Table 3.9: Features of ARI and Distributor Data Collection Approaches**

Feature	ARI Shipment Data	Distributor Sales Data
Data Source	ARI Shipment Data	Distributor reports on sales to contractors
Data Collection Methodology	ARI collects data and supplies sponsors with aggregated report	Agreements with individual distributors to supply data. Independent organization compiles individual reports into one aggregated report for sponsors.
Organization Responsible for Aggregating Data	ARI	ARI or HARDI
<b>Data Availability:</b>		
<ul style="list-style-type: none"> <li>• By program equipment category</li> </ul>	Yes – currently proprietary	From most distributors
<ul style="list-style-type: none"> <li>• By program qualifying efficiency level</li> </ul>	Yes, except for water source heat pumps – currently proprietary	From most distributors
<ul style="list-style-type: none"> <li>• Factory installed dual enthalpy controls</li> </ul>	Not currently tracked	From most distributors
<ul style="list-style-type: none"> <li>• Field installed dual enthalpy controls</li> </ul>	Not currently tracked	Estimates available from some distributors but unlikely they could track them to qualifying units.
<ul style="list-style-type: none"> <li>• By Region</li> </ul>	Not currently tracked for commercial equipment	From most distributors
<ul style="list-style-type: none"> <li>• By State</li> </ul>	Not currently tracked for commercial equipment	From most distributors
<ul style="list-style-type: none"> <li>• Past data available</li> </ul>	Yes, by equipment category, size and efficiency except water-source heat pump data are not available by efficiency – currently proprietary	Will vary by distributor. Unlikely to get all the data fields the sponsors seek.
<ul style="list-style-type: none"> <li>• Baseline data available for comparison area</li> </ul>	Data not currently tracked by region or state, but could be – all but total shipment data currently proprietary	Would need to recruit representative sample of distributors in non-program states – probability of being able to do this is low
Data Frequency	Monthly	At least twice a year
Accuracy	Claim data covers 90% or more of equipment manufactured in North America. Accuracy is acceptable to industry members.	Unknown – probably varies by distributor
Cost to Develop	Relatively Low – dealing with only one data point	Very High – need to recruit and work with 80-100 distributors in the sponsors' service areas
Ongoing Cost	Lowest because you are dealing with one data source	High – each aggregated report would involve collecting combining data from up to 100 individual distributor reports.

### 3.6 Sources of Uncertainty in the Data as Applied to Energy Savings Estimates

While we feel obtaining data through ARI will provide the sponsors with the best source of HVAC tracking data, there are some inherent uncertainties in pursuing this avenue. Working with ARI will require delicate negotiations and patience. Relationship building with ARI and its members will be an important part of gaining access to any data. Because ARI operates largely by consensus, having even one major manufacturer decline to participate in data sharing will jeopardize the possibility of obtaining data from any of them.

Even if ARI and the manufacturers are able to provide shipment data by state, the sponsors will have to make assumptions about how those shipments translate to state-by-state sales; the place where equipment is shipped is not necessarily the place where it is installed.

Alternatively, should the sponsors pursue data tracking through distributors, there is also uncertainty about precise market size, actual willingness to cooperate, cross-border sales, the timing of sales, and ultimately the quality of the data.

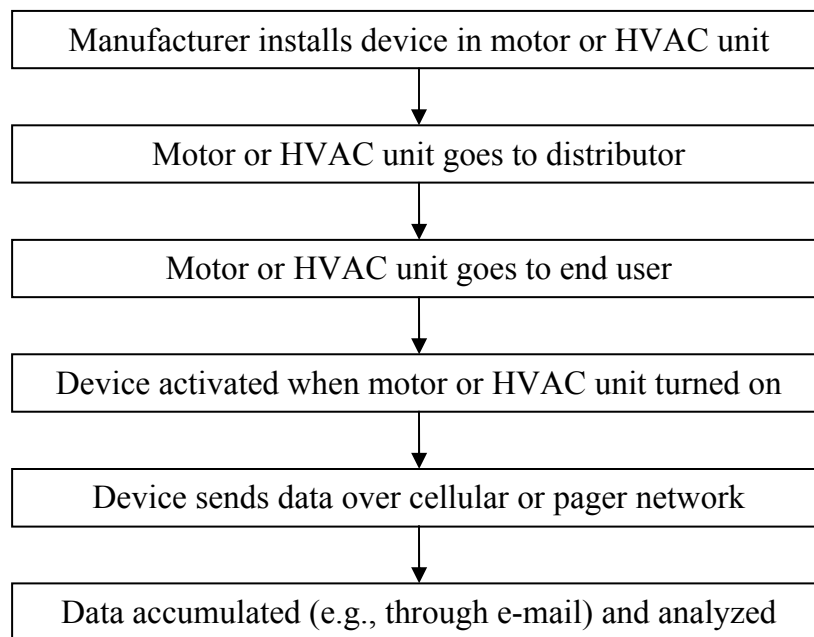
Relationship building again will be an important part of obtaining data from distributors. Each distributor must be recruited individually and consent must be obtained from a large number of distributors. If cooperation is not achieved with the major distributors from every sponsor area, significant portions of market data will be missing and the tracking system will not be useful—particularly for program attribution. This relationship building will continue to be a source of uncertainty for the duration of the data collection period—the sponsors will need to maintain distributor relationships on a constant basis to ensure that reporting takes place on a timely basis and to ensure that personnel or policy changes at each distributor do not jeopardize the data collection process. Furthermore, the success of the tracking system can not be assessed until significant time, effort, and money have been spent in establishing the system.

## 4. Out-of-the Box Approach for Market Penetration Tracking

### 4.1 Initial Product Concept

A big issue with market penetration tracking—especially for attribution of market effects—is knowing where the equipment ends up, not just how many units are produced or shipped. NMR performed Internet research and contacted manufacturers of devices that provide location data to assess the feasibility of a pilot project to integrate such devices into HVAC units and motors for the purpose of market penetration tracking. The idea was for a device that could communicate location and model numbers of all (or a sample of all) integral motors and unitary and split commercial HVAC systems, in order to allow the estimation of penetration of energy-efficient units within the sponsors' areas, as well as comparison areas. The concept is depicted in Figure 4.1.

**Figure 4.1: Out-of-the-Box Concept**



## 4.2 Candidate Companies and Products

Internet research turned up no company that makes a product immediately useable for the sponsors' application. There are, however, some products related to the sponsors' particular application, generally falling into four categories:

- **Equipment security:** For discretely tracking high-value items, generally communicating real-time location data.
- **Livestock/Wildlife tracking:** For tracking sheep, cows, or wildlife, communicating real-time and/or recent location data and/or other data such as health indicators (i.e., body temperature).
- **Surveillance:** For tracking articles, pets, people, or vehicles, generally communicating real-time and/or recent location data.
- **Marine rescue:** For locating lost marine craft, usually bundled with navigation equipment, communicating mostly real-time location data.

NMR interviewed five manufacturers identified through the Internet research, to inquire as to the feasibility of the sponsors' potential project, gauge their level of interest in participating in the product development process, and obtain ideas for how to implement such a project. These companies are as follows:

- **LoJack Corporation**, Westwood, MA ([www.lojack.com](http://www.lojack.com)): LoJack's core business is in stolen vehicle recovery but it also has an application for tractor trailers (18-wheelers); unlike the vehicle recovery system, this application for untethered equipment does not rely on the car's battery. As the website says, "The LoJack for Trailers contains a small transmitter, randomly hidden and activated by a routine stolen vehicle police report. The LoJack signal leads police directly to your trailer within the LoJack network." Activation of the trailer's tracking system is made through police radio-frequency transmitters, and location information is then transmitted and tracked through the LoJack network. Because LoJack relies on cellular towers for much of its services, some areas, however, are not within the LoJack network. Other technologies are designed to provide information "on demand," or provide early warning notification for owners via phone, cell phone, email, text messaging or alpha pager.
- **Digital Angel Corporation**, St. Paul, MN ([www.digitalangel.net](http://www.digitalangel.net)): Digital Angel mostly pursues a retail strategy, offering products and data services for consumers including pet or person location devices, emergency notification (seniors), and wander alerts. Limited commercial applications include fleet management, equipment theft reporting and recovery, high value product tracking, law enforcement monitoring of parolees, livestock and endangered species monitoring, and nuclear waste transport monitoring.
- **Laipac Technology, Inc.**, Toronto, Canada ([www.laipac.com](http://www.laipac.com)): Laipac makes some finished products that are relevant to the project, and some intermediate products that might be useful to manufacturers willing to partner in the effort. Laipac's Automatic Vehicle Location (AVL) products are relevant for this application, offering a variety of technology solutions including radio frequency, GPS, cellular network technologies, or some combination thereof, to transmit location information.

- **Telonics, Inc.**, Mesa, AZ ([www.telonics.com](http://www.telonics.com)): From its web site, “Telonics is best known for its adaptation of aerospace technologies and reliability to the field of wildlife research. Thousands of the company's receiving systems and tens of thousands of its transmitters have been deployed in the field. Associated support systems are being used in aircraft, boats and land vehicles around the world.” Telonics also develops products for special commercial applications including search and rescue operations.
- **EM Microelectronics U.S., Inc.**, Colorado Springs, CO ([www.emmarin.com](http://www.emmarin.com)): E.M. Microelectronics makes many intermediate products such as microprocessors and GPS locators.

None of the companies interviewed is familiar with any application similar to the sponsors' proposed project. Two companies (LoJack and Laipac) make electronic products that transmit identification and some operational data to a central receiving source. For LoJack's automobile anti-theft device, the operation and identification data are already logged in the automobile's own computer and its product is designed to simply send the data; however, the sponsors' application would require a module not only to transmit the data, but also to hold identification data and log any operational data that may be of interest. Digital Angel and Telonics largely use electronic location devices to learn about the object, animal, or person being monitored after the product has been located, and data logging operations are dispersed.

Four types of location tracking devices were considered in this research: radio frequency identification (RFID), used for inventory tracking for distributors and easy check-out for customers at retailers; Woznet (developed by Apple co-founder Steve Wozniak), involving a wireless network using radio signals and global positioning satellite data to keep track of a cluster of tags; straight global positioning satellite (GPS) systems; and systems based on cellular technologies. The first two—RFID and Woznet—were rejected because they require custom base stations close to the products being tracked—a few feet away in the case of RFID, and within two or three miles in the case of Woznet. Regular GPS transmitters were rejected because their signals cannot be read by satellites through buildings. That left cellular technology, which appears to be technically viable for this purpose.

Of the five companies interviewed, four develop and market retail products that transmit both location and operational data. The fifth company is primarily a manufacturer of intermediate products and does not handle the product retailing or data management service (E.M. Microelectronics). Telonics and Digital Angel both use satellites, radio frequency transmitters, and other homing devices for their products, in which having the object's location data is a prerequisite for the application, or in which location-fixing equipment is transported to the object being tracked. LoJack uses radio frequency transmitters with local police radio towers as the collection points. LoJack, Laipac, and to a lesser extent Digital Angel use cellular phone and pager networks to get location data to transmit location and operation data.

All four companies that produce retail products work in partnership with other industries to manage some aspect of their service operations. Most companies subcontract data management operations to a third party. In particular, LoJack claims ownership of the data, subcontracts the data management service, and sends data to police agencies holding agreements with LoJack.

“Privacy and confidentiality are handled through data-safeguarding procedures required by federal law to protect consumers in relation to sharing of non-public information.”

The interviews suggest that the product we envision is not only feasible but also reasonably easy to develop given the current state of the technology. Of the five respondents, however, only two companies (LoJack and Laipac) actually develop and sell retail products for physical asset management—not including wildlife, livestock or human medical applications. Both express interest in learning more about the business opportunity. The remaining three respondents are more cautious, expressing a preference to remain within their companies’ product niches. Respondents believe the field of companies for developing a product that suits the sponsors’ application would specialize in physical asset management, and they say it is a competitive, and fairly low-margin field.

### 4.3 Key Product Attributes

Key product attributes related to the sponsors’ application include:

- **Data transmission and collection:** Location and other data can be transmitted by radio frequency transmitter, by global positioning system (GPS) transmitter, by cell-phone and pager networks, or some combination thereof. Radio frequency transmitters generally require more than one nearby cooperating radio tower to triangulate a position. The signals from GPS transmitters at unknown locations are usually lost once within buildings, where there is no “clear shot” to a satellite in the sky. Cellular phones and pagers already transmit general location data proximate to the nearest cellular tower; however, cellular technologies equipped with GPS chips are being used with increasing frequency for specialized uses by three of the manufacturers interviewed (Laipac, LoJack, and Digital Angel). According to all manufacturers interviewed, cell phone companies will begin introducing GPS technology into cellular phones by the third quarter of 2003. Two manufacturers claim that with this new GPS feature, location data transmitted from cell-phones will be accurate within 100 to 150 meters. Although the companies vary in the technologies for generating location data, all five companies agree that cellular phone and pager networks would be the most appropriate backbone for the sponsors’ application. Coverage is approximately the entire country (one manufacturer said 98 percent), consistent with cell phone or pager coverage for major carriers. Any holes in coverage are small, and they vary by cellular or pager network carrier, depending on where a specific carrier has coverage.
- **Data management:** Some companies provide their own data management services, while others work in partnership with data management companies and possibly a third party (e.g., medical rescue, security, police). There are various ways of managing the data. As one manufacturer said, “Information could be sent to an e-mail account.”
- **Power supply/longevity:** Many products have a battery (sometimes rechargeable), or connect to a power supply. The location device could use the power supply of the HVAC unit or motor itself. Only one company speculated on the energy requirements of a transmission and data-logging device, saying that since the device should be inactive the majority of the time, and when active should require very little electricity to operate, total power consumption should be small. Such a product would be energized through the

same power source used for the motor or HVAC unit itself, not requiring any battery power. “If the power is out, there would be no need to track the motor’s operation.” Energy requirements increase as the duty cycle increases.

- **Activation:** Products have a variety of activation modes based on movement (for security applications), sleep/wake mode (requiring a persistent electricity supply), or persistent mode (with limited longevity). The activation for the sponsors’ product could be triggered by the power going on.
- **Footprint (size/weight):** Products can be discrete (for security, surveillance, or some wildlife monitoring applications), or functional (marine rescue). Basically, the more the data requirements, the larger the product would have to be.
- **Cost:** The longer the longer battery life, the greater the number of anticipated activations, and the smaller the footprint, the more expensive the device is likely to be. Cost estimates varied among the three companies utilizing cellular and pager networks for their products. One company did not believe it would be cost-effective to install a locator product for a one-time location transmission, but did not offer specific cost information. Another company projects the cost of the sponsors’ concept product to be that of a cell phone, with little anticipated reduction in volume pricing since the business for cell-phone volume is already present, saying: “Unit cost production is about \$100 for 100,000, but for 1 million units, about \$90. The volume is already achieved through cell-phone devices—so I don’t know [about price breaks] for 100,000,000 units.” For data transmission costs, the respondent continued, “The cost difference between basic data versus operation data is basically the same once the link is established on a cell-phone network,” adding that ongoing data transmission is just a continued subscriber cost. Another manufacturer agrees that the price is a function of ongoing use, saying: “Cell phone prices are effectively subsidized. The same cell phone is priced very differently based on whether and which service plan you purchase.” Therefore, the cost-effective option would be to develop a product to transmit operational data over an extended period, since the cost of a device transmitting data one time would be substantially more than the price of a product designed for a long term commitment to reporting operational data. Moreover, the “account” would need to remain open until the product is activated for one-time usage and that time period could be indefinite. Only one company would speculate on R&D costs, saying: “R&D from concept to production, if we don’t take control center data responsibility, would be around \$32,000 to \$40,000.”

Most companies recognize the potential offered by such a product, mentioning appliance manufacturers’ concept of “smart” appliances, and remote control of energy-consuming equipment (HVAC systems) for peak-load management by electric utilities (which Laipac already manufactures). One company said, moving forward would require: “...first determining whether the product would work economically for [the sponsors], and then determining whether it would work for us.”

Table 4.1 below summarizes some of the major barriers associated with the Out-of-the-Box concept, as well as possible solutions and other advantages.

**Table 4.1: Issues with and Advantages of Out-of-the-Box Concept**

Barriers and Issues	Possible Solutions and Advantages
Application does not yet exist.	Technology is already developed; technical development costs would be relatively low.
End users may have privacy concerns.	Similar systems already use data-safeguarding procedures required by federal law; data could be reported or recorded at the zip code level.
Per-unit costs are high.	Adding load control capabilities—making the unit “load-control ready”—would add to the potential base of funders and facilitate cost recovery. Using the devices in other types of equipment—such as residential air conditioning—could lower the per-unit costs.
Participation by all major manufacturers required for system to be effective.	Market penetration data could attract them to the concept, as could the added capability of reporting key operating characteristics that would allow preventive maintenance.
Sales tracking application may be of limited value overall.	Census approach allows virtually unlimited capability for attribution of market effects by geography, time, and product characteristics.

**Appendix**  
**Sample Format for Annual Motors Shipment Data**  
*(Form submitted to NEMA by Consortium for Energy Efficiency,  
as part of data request)*

**Sample Format for Annual Motors Shipment Data  
Requested by Consortium for Energy Efficiency  
June 2003  
Sheet 1 of 2**

**Units of NEMA-Premium, Non-OEM, Integral Motors Shipped, by Horsepower<sup>1</sup>  
January 1, 2\_\_\_ to December 31, 2\_\_\_**

	Horsepower						<i>Total</i>
	1-5	6-20	21-50	51-100	101-200	200-500	
Alabama							
Alaska							
Arizona							
Arkansas							
California							
Colorado							
Connecticut							
Delaware							
District of Columbia							
Florida							
Georgia							
Hawaii							
Idaho							
Illinois							
Indiana							
Iowa							
Kansas							
Kentucky							
Louisiana							
Maine							
Maryland							
Massachusetts							
Michigan							
Minnesota							
Mississippi							
Missouri							
Montana							
Nebraska							
Nevada							
New Hampshire							
New Jersey							
New Mexico							
New York							
North Carolina							
North Dakota							
Ohio							
Oklahoma							
Oregon							
Pennsylvania							
Rhode Island							
South Carolina							
South Dakota							
Tennessee							
Texas							
Utah							
Vermont							
Virginia							
Washington							
West Virginia							
Wisconsin							
Wyoming							
U.S. Protectorates (Virgin Is., Guam, Marshall Is., etc.)							
<i>Total</i>							

<sup>1</sup> Low voltage, Design A and B motors only. Does not include custom or special purpose motors.

**Sample Format for Annual Motors Shipment Data  
Requested by Consortium for Energy Efficiency  
June 2003  
Sheet 2 of 2**

**Units of Non-NEMA-Premium, Non-OEM, Integral Motors Shipped, by Horsepower<sup>1</sup>  
January 1, 2\_\_\_ to December 31, 2\_\_\_**

	Horsepower					<i>Total</i>
	1-5	6-20	21-50	51-100	101-200	
Alabama						
Alaska						
Arizona						
Arkansas						
California						
Colorado						
Connecticut						
Delaware						
District of Columbia						
Florida						
Georgia						
Hawaii						
Idaho						
Illinois						
Indiana						
Iowa						
Kansas						
Kentucky						
Louisiana						
Maine						
Maryland						
Massachusetts						
Michigan						
Minnesota						
Mississippi						
Missouri						
Montana						
Nebraska						
Nevada						
New Hampshire						
New Jersey						
New Mexico						
New York						
North Carolina						
North Dakota						
Ohio						
Oklahoma						
Oregon						
Pennsylvania						
Rhode Island						
South Carolina						
South Dakota						
Tennessee						
Texas						
Utah						
Vermont						
Virginia						
Washington						
West Virginia						
Wisconsin						
Wyoming						
U.S Protectorates (Virgin Is., Guam, Marshall Is., etc.)						
<i>Total</i>						

<sup>1</sup> Low voltage, Design A and B motors only. Does not include custom or special purpose motors.