January 23, 2014

Ms. Brenda Edwards  
U.S. Department of Energy  
Building Technologies Program  
Mailstop EE-2J  
1000 Independence Avenue, SW  
Washington, DC 20585-0121


Dear Ms. Edwards:

These comments are submitted by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) in response to the U.S. Department of Energy’s (DOE) notice of proposed rulemaking (NOPR) appearing in the Federal Register on October 25, 2013. The document pertains to the energy conservation standards for residential furnace fans.

AHRI is the trade association representing manufacturers of heating, cooling, water heating, and commercial refrigeration equipment. More than 300 members strong, AHRI is an internationally recognized advocate for the industry, and develops standards for and certifies the performance of many of the products manufactured by our members. In North America, the annual output of the HVACR industry is worth more than $20 billion. In the United States alone, our members employ approximately 130,000 people, and support some 800,000 dealers, contractors and technicians.

This rulemaking is of great importance to AHRI members. In general, we believe that several issues exist within the NOPR and significant changes are necessary in order to ensure that appropriate energy conservation standards are developed. We consider the adverse impacts of the proposed fan energy rating (FER) levels to be significant to the manufacturing industry. Additionally, we have reasons to believe that the proposed FER levels would not be economically feasible for consumers.

We have the following specific comments:

**Section 1 – Modular Blowers and DOE Interpretation of 42 USC § 6295**

We continue to maintain that modular blowers are not currently a federally regulated product and should be excluded from the scope of this rulemaking. If 42 USC § 6295(f)(4)(D) was intended to cover this equipment, then there would have been a corresponding change to the definition of furnace or the addition of this product class along with a direction to develop a corresponding test procedure. The absence of any such legislative change is contradictory to DOE’s proposed coverage of modular blowers. The heading of 42 USC § 6295(f) is “Standards for furnaces and boilers” and subsections 1 through 4 under that section apply to only residential furnaces and boilers, as defined by EPCA. This clear, consistent format combined with the fact that the requirement for a standard covering electricity used to circulate air through
duct work was inserted as 4(D) under 42 USC § 6295(f), strongly indicates that the scope of this requirement is only motor and blower combinations provided on residential warm air furnaces, otherwise referred to as furnace fans. There is nothing within section 42 USC § 6295(f) that suggests that the provisions of that section apply to any other products that may be used to heat a residence.

Additionally, the proposed test procedures in DOE’s April 2, 2013, supplemental notice of proposed rulemaking (SNOPR) are insufficient for modular blowers. The SNOPR fails to account for the fact that some modular blowers in today’s marketplace are not even designed to operate with electric heat resistance kits.

**Section 2 – Compliance Date and Implementation Period**

We agree with DOE’s proposal of a five-year compliance date on page 64103 of the NOPR and strongly recommend DOE against considering a compliance date sooner than five years. As stated by DOE in the NOPR, it was evident during the manufacturer interview process that the standards for furnace fans would result in manufacturers’ extending research & development (R&D) beyond the furnace fan assembly to understand the impacts on the design and performance of the furnace or modular blower in which the furnace fan is integrated. To comply with the proposed standard, manufacturers would not only have to alter the designs and fabrication processes for the furnace fan assembly, but also modify the furnace and/or modular blower designs which accommodate furnace fans. Additionally, similar products that require similar actions for compliance typically have lead times of five years.

**Section 3 – Issues Related to Residential Furnace Fan Test Procedures**

DOE’s last public notice on the residential furnace fan test procedures was issued in the Federal Register on April 2, 2013, with a comment period deadline of May 2, 2013. This essentially means that DOE had nearly six months to publish a final rule on the test procedures prior to the publication of the energy conservation standards NOPR. During the DOE public meeting on December 3, 2013, several stakeholders stated that the release of the October 25, 2013, NOPR prior to the issuance of a final rule on test procedures for residential fans was untimely; this approach did not provide stakeholders with sufficient opportunity to evaluate the proposed FER levels in the October 25, 2013, NOPR against the final residential furnace fan test procedures, and confirm whether or not DOE’s proposed energy conservation standards are technologically feasible and economically justified. Although we understand that DOE has a statutory requirement to consider and prescribe energy conservation standards for furnace fans by December 31, 2013, we believe that DOE could have timed the release of the documents related to the furnace fan test procedures and energy conservation standards in a manner that would have given stakeholders sufficient time to provide substantive comments on the proposed FER levels. The simultaneity of the test procedure and energy conservation standards rulemakings creates a moving target factor that undoubtedly will subject us and all others involved to iterative analyses and comments. The final test procedure rule on residential furnace fans was issued on January 3, 2014, and provided manufacturers with an insufficient amount of time (barely 20 calendar days) to assess the energy conservation standards NOPR based on the provisions within the test procedure. Moreover, manufacturers had to spend additional resources to simultaneously analyze the impact of the test procedure final rule while developing substantive comments on the energy conservation standards NOPR. Section 4 of this letter provides additional details on one of the effects of the final test procedure on the analyses within
the Technical Support Document (TSD) associated with the energy conservation standards NOPR. There may be additional issues that have not yet been identified since the industry received only 20 calendar days to review the final test procedure and submit comments on the energy conservation standards NOPR. This is an unnecessary regulatory burden and conflicts with the guidelines set forth in Appendix A to Subpart C of 10 CFR Part 430.

The appendix establishes procedures, interpretations and policies to guide the DOE in the consideration and promulgation of new or revised appliance efficiency standards under the Energy Policy and Conservation Act (EPCA). Section 7(c) within this appendix states the following:

“Issuing final test procedure modification. Final, modified test procedures will be issued prior to the NOPR on proposed standards.”

The test procedure was modified during the NOPR and SNOPR phases within the last two years. Hence, a final rule on furnace fan test procedures rule would qualify as being final, modified test procedures. Per Section 7(c) of Appendix A to Subpart C of 10 CFR Part 430, DOE was obligated to issue the NOPR on the proposed energy conservation standards after the issuance of the final rule on the furnace fan test procedures.

We are also strongly opposed to DOE’s proposed elimination of the heat capacity ratio from the denominator FER equation in the January 3 test procedure final rule. DOE did not provide a sound technical justification for such a modification and unnecessarily penalized the FER values associated with multi-stage and modulating units. We continue to maintain that the FER equation should be:

\[
FER = \frac{(CH \times E_{Max}) + (HH \times E_{Heat}) + (CCH \times E_{Circ})}{(CH + HH + CCH) \times Q_{Max}} \times 1000
\]

**Section 4 – Proposed Energy Conservation Standard FER Levels**

AHRI believes that the proposed energy conservation standards are very stringent and must be reevaluated. This reevaluation should be completed after allowing stakeholders sufficient time to test products per the final test procedure, thus providing stakeholders with an opportunity to address various impacts of the final test procedure and the proposed energy conservation standards.

The correlation between the efficiency levels and the design options are not in alignment in Table IV.7 on page 64091 of the energy conservation standards NOPR. Although DOE states that Trial Standard Level (TSL) 4 is the proposed target, there are existing products that use the design options specified within TSL 5 that will not even meet the proposed energy conservation standards. The linear function associated with the proposed FER levels should be replaced by a non-linear equation to account for the quadratic relationship between airflow and power.

In the final test procedure that was published on January 3, 2014, DOE introduced a change within the test procedure that increases the measured FER. In this test procedure, DOE decided not to implement AHRI’s recommendation that a furnace be fired at the maximum airflow rate to calculate the maximum airflow. Instead, the final rule specifies that the maximum airflow is determined by applying the airflow equation for a heating setting and adjusting to the maximum setting based on pressure measurements. This approach results in an increase of the measured FER and was not accounted within the analyses associated with the energy conservation
standards NOPR TSD that was issued on October 25, 2013. DOE needs to reevaluate the analyses within the entire TSD due to this single change.

Manufacturers are also concerned about the weatherized non-condensing gas furnace and manufactured housing furnace product classes. For weatherized non-condensing gas furnaces, the furnace fan energy conservation standard should be the same as non-weatherized condensing gas furnaces since the test procedure is the same for both products, except for the 0.15 in. H₂O external static pressure (ESP). The ESP accounts for the cooling coil within weatherized non-condensing gas furnaces. In effect, the furnace fan assemblies for weatherized and non-weatherized gas furnaces are subject to the same ESP, and therefore should have the same FERs. In the case of manufactured housing furnaces, there are furnaces that could belong to non-weatherized and manufactured housing product classes and would be required to display separate FER values for the same furnace fan.

Section 5 – National Energy Savings

Table V.28 on page 64127 of the NOPR states that the estimated full-fuel-cycle energy savings at TSLs 3 and 4 are 2.332 quads and 4.576 quads respectively. Based on the following reasons, we believe that the substantial increase in energy savings from TSL 3 to TSL 4 is erroneous, completely unjustified and that DOE needs to revisit its analysis:

- At TSL 4, DOE selected efficiency level (EL) 1 for the following three out of eight product classes: non-weatherized, non-condensing oil furnace fan; manufactured home non-weatherized, non-condensing gas furnace fan; and manufactured home non-weatherized, condensing gas furnace fan. EL 1 corresponds to the improved permanent-split capacitor (PSC) motor design option. At TSL 3, DOE selected EL 3 for the same three product classes, which coincides with the constant-torque brushless permanent magnet (BPM) design option. At TSL 3, DOE selected EL 3 for the same three product classes, which coincides with the constant-torque brushless permanent magnet (BPM) design option.

- In the case of the remaining five product classes, DOE selected EL 3 at TSL 3 and EL 4 (constant-torque BPM + multi-staging) at TSL 4. Per Table IV.7 of the NOPR, the percent reductions in FER from the baseline are 42% at EL 3 and 50% at EL 4. We fail to understand how an incremental efficiency level improvement of 8% (multi-staging being the only difference) across five product classes could result in the doubling of full-fuel-cycle energy savings from TSL 3 to TSL 4.

- As an example, Table 10.3.1 within chapter 10 of the NOPR TSD states that for non-weatherized, non-condensing gas furnace fans, the average annual electrical use values for TSLs 2, 3 and 4 are 720 kWh, 602 kWh and 539 kWh respectively. TSL 3 has an incremental average annual electrical use savings of 118 kWh compared to TSL 2. However, according to Table 10.6.2, the full-fuel-cycle national energy savings for both TSLs 2 and 3 is 1.02 quads, possibly due to the fact that the incremental electrical saving for TSL 3 may have been offset by the additional furnace fuel use. (Per Table 10.3.1, additional fuel use values at TSLs 2 and 3 are 0.334 MMBtu and 0.561 MMBtu respectively.) In comparison, TSL 4 has a much lower incremental average annual electrical use savings of 63 kWh over TSL 3. Additionally, TSL 4 has a higher additional fuel use than TSL 3. We fail to understand how DOE the full-fuel-cycle national energy savings increased significantly from 1.02 quads at TSL 3 to 1.86 quads at TSL 4 (an 82% increase).
As an example, Table 10.3.2 within chapter 10 of the NOPR TSD states that for non-weatherized, condensing gas furnace fans, the average annual electrical use values for TSLs 2, 3 and 4 are 704 kWh, 565 kWh and 479 kWh respectively. TSL 3 has an incremental average annual electrical use savings of 139 kWh compared to TSL 2. However, according to Table 10.6.2, the full-fuel-cycle national energy savings for both TSLs 2 and 3 is 0.87 quads, possibly due to the fact that the incremental electrical saving for TSL 3 may have been offset by the additional furnace fuel use. (Per Table 10.3.2, additional fuel use values at TSLs 2 and 3 are 0.215 MMBtu and 0.446 MMBtu respectively.) In comparison, TSL 4 has a much lower incremental average annual electrical use savings of 84 kWh over TSL 3. Additionally, TSL 4 has a higher additional fuel use than TSL 3. We fail to understand how DOE the full-fuel-cycle national energy savings increased significantly from 0.87 quads at TSL 3 to 2.00 quads at TSL 4 (a 130% increase).

Based on the reasons stated within section 9 of this letter, we believe that DOE’s shipment projections are inaccurate and the projected numbers significantly skew the full-fuel-cycle national energy savings estimates.

If the effect of multi-staging was indeed prominent enough to nearly double the estimated full-fuel-cycle energy savings between TSLs 3 and 4, DOE should have evaluated this effect for PSC motors as well. Two out of the six efficiency levels that were evaluated by DOE fell under the “prototype” technology status, so it would have been perfectly reasonable for DOE to evaluate the potential energy savings of a PSC + multi-staging prototype as well.

The energy conservation standards for central air conditioners and heat pumps that went into effect on January 23, 2006, estimated an approximate savings of 4.2 quads of energy over 25 years (0.17 quads/year between the years 2006 and 2030). DOE’s June 27, 2011, direct final rule on residential furnaces, residential central air conditioners and heat pumps indicated that the energy conservation standards would save a significant amount of energy – an estimated 3.20 to 4.22 quads (excluding the 0.16 quads associated with standby mode and off mode power) of cumulative energy in 2013–2045 for furnaces and in 2015-2045 for central air conditioners and heat pumps (0.11 to 0.14 quads/year). Per this NOPR, the proposed FER levels save 4.576 quads over 30 years (0.15 quads/year). DOE’s proposed FER equation accounts for the furnace electrical consumption during the annual cooling operating hours. DOE states the following on page 64081 of the October 25, 2013 NOPR:

“In short, SEER and HSPF based standards do not directly regulate the efficiency of furnace fans, as required by 42 U.S.C. 6295(f)(4)(D). DOE recognizes that the energy savings in cooling mode from higher-efficiency furnace fans used in some higher efficiency CAC and heat pumps is already accounted for in the analysis of energy conservation standards for those products. As a result, DOE conducted its analysis in this current rulemaking in such a way as to avoid double-counting these benefits by excluding furnace fan electricity savings that were already included in DOE’s analyses for CAC and heat pump products. Chapter 7 of the NOPR TSD provides a more detailed discussion of this issue.”

Although the NOPR suggests that DOE avoided double-counting the benefits achieved within the June 27, 2011 final rule and the October 25, 2013 NOPR, our review of chapter 7 of the NOPR TSD and DOE’s national impact analysis (NIA) spreadsheet model suggests that DOE may have double-counted the benefits. For example, Table 7.8.1 within chapter 7 of the NOPR TSD suggests that the average annual electricity use for EL 4 is 475 kWh for non-weatherized, non-condensing gas furnaces. However, the NIA spreadsheet model estimates that the annual
electricity use for replacement units in the U.S. North within that product class is 488 kWh and 573 kWh for new units. The NIA spreadsheet model does not indicate how DOE used the average annual electricity use values in Tables 7.8.1, 7.8.2, 7.8.3 and 7.8.4 within chapter 7 to determine the national energy savings. As this NOPR indicates, the furnace fan electricity savings that were already included in DOE’s analyses for central air conditioner and heat pump products are excluded from the scope of the energy savings associated with this NOPR; however, section 7.5.2 within chapter 7 of the NOPR TSD suggests that DOE failed to exclude the furnace fan electricity savings that were achieved via DOE’s previous analyses on central air conditioner and heat pump products. DOE double-counted the energy savings benefits across various rulemakings by accounting for the default central air conditioner blower output used for calculating SEER. DOE even provides a reference to the central air conditioner test procedure by stating the following on page 7-16:

“The house cooling load (HCL) assumes that the household has a default furnace fan motor power output of 365 watts per 1000 cfm (used in the central air conditioner (CAC) test procedure).”

Given the fact that the energy used in cooling mode is greater than the other modes (heating or continuous circulation), it does not seem plausible that the energy savings within this NOPR can save as much or more energy than the standards that went into effect in 2006 and the June 27, 2011 direct final rule; we believe that the savings within this NOPR were made possible through DOE’s unintended double-counting of the energy savings benefits across various rulemakings. We recommend that DOE reevaluate its calculations with respect to this NOPR’s national fuel-fuel-cycle energy savings (in quads) and ensure that the estimated energy savings for this NOPR are not double-counted with the savings that were achieved via the previous rulemakings on central air conditioners, heat pumps and furnaces. As stated on page 64081 of the NOPR, DOE must ensure that its analysis is consistent with DOE’s intent to avoid double-counting of energy savings benefits.

On page 64083 of the NOPR, DOE states that standby mode and off mode energy consumption are already fully accounted for in the June 27, 2011 direct final rule. However, chapter 7 of the NOPR TSD states that for the efficiency levels that are greater than the baseline, the estimated electricity savings account for the furnace standby energy use. Furnace fans are integrated in the electrical systems of the HVAC products in which they are used and controlled by the main control board. Therefore, there is no standby mode and off mode energy use associated with furnace fans used in these products that would not already be measured by the established test procedures. DOE needs to ensure that it avoids double-counting the energy consumption associated with standby mode. Furthermore, DOE should reevaluate its estimated difference in standby power consumption of 3 watts for EL 3 and beyond; we believe that this estimate is extremely aggressive, given that the June 27, 2011 direct final rule set standby mode levels between 10 and 11 watts.

**Section 6 – Repair Cost Determination for Furnace Fans**

Although Appendix 8-D of the NOPR TSD accounts for installation, maintenance and repair costs for furnace fans, the appendix should have also accounted for costs associated with the replacement of furnace fans. Section 8-D.4 defines repair cost as “the cost to the consumer for replacing or repairing components in the furnace fan that have failed.” We do not completely agree with this definition since in many instances, the repair of a furnace system entails a complete replacement of an irreparable furnace fan. We believe that the cost that is passed on
to the consumer to replace a defunct furnace fan with a similar aftermarket furnace fan is about 2-3 times higher than DOE’s estimated manufacturer production costs for low-volume product classes. Exhibit 1 provides an example of motor prices from Grainger’s website and corroborates our assertion. Hence, we completely disagree with DOE’s material cost estimates of $0.00 in Tables 8-D.4.3 and 8-D.4.4, and recommend that DOE fully account for this cost as it has implications on the life-cycle cost (LCC) analysis.

The failure rate for a high efficiency motor is typically higher than a failure rate of a PSC motor since the electronics added to a high efficiency motor introduce additional failure modes associated with the life of electronic controls in damp, very cold and very hot conditions. Figures 8-D.4.1 and 8-D.4.2 confirm that PSC motors have a more robust average lifetime; the Weibull distribution in Figure 8-D.4.1 indicates 30,000 hours as the mean operating hours for furnace fan motors whereas the Weibull distribution in Figure 8-D.4.2 clearly indicates a mean capacitor lifetime of 60,000 hours.

In the TSD, DOE considered a single failure rate for motors in all equipment classes. AHRI has collected data from manufacturers and industry data shows that the failure rates associated with constant-torque BPM and constant-airflow BPM technologies are higher than PSC motors over an extended time period. The replacement rate associated with BPM (constant-torque and constant-airflow) motors is much higher than the rate associated with PSC motors; the following figure clearly illustrates this assertion and proves that the assumptions within the TSD are inaccurate:

![Motor Replacement: % Increase in BPM Failure Rates Over PSC Failure Rates](image)

**Figure 1: Percentage Increase in BPM failure rates over PSC Failure Rates.**

DOE states the following in section 8-D.4, thereby confirming the possibility of increased motor failure rates within the lifetime of the furnace for a majority of the design options (constant-torque BPM + multi-staging) associated with TSL 4:
“Although DOE used the same motor lifetime for each fan efficiency level in terms of total operating hours, the lifetime in terms of years is lower for equipment with multi-stage controls (most commonly applied in higher efficiency furnace fan designs) due to increased operating hours.”

It is also important to note that DOE’s LCC analysis spreadsheet tool fails to account for repair costs and repair year associated with the following product classes and design options:

<table>
<thead>
<tr>
<th>Product Class</th>
<th>Design Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-weatherized, non-condensing gas furnace fan</td>
<td>Constant-torque BPM, constant-torque BPM + multi-staging, constant-airflow BPM + multi-staging, and premium constant-airflow BPM + multi-staging + backward-curved impeller</td>
</tr>
<tr>
<td>Weatherized non-condensing gas furnace fan</td>
<td>Constant-torque BPM</td>
</tr>
<tr>
<td>Non-weatherized electric furnace / modular blower fan</td>
<td>All design options (including baseline)</td>
</tr>
<tr>
<td>Manufactured home non-weatherized, condensing gas furnace fan</td>
<td>Constant-torque BPM, constant-torque BPM + multi-staging, constant-airflow BPM + multi-staging, and premium constant-airflow BPM + multi-staging + backward-curved impeller</td>
</tr>
</tbody>
</table>

Section 7 – Manufacturer Impact Analysis

Government Regulatory Impact Model (GRIM)

The current NOPR states that the GRIM was used to determine the Industry Net Present Value (INPV) using various inputs for a period ranging from 2019 to 2048. Given that the GRIM predicts the INPV across an extended period, the model should have accounted for impacts on manufacturers due to subsequent revisions to the DOE energy conservation standards.

Based on DOE’s current rulemaking cycle, DOE could end up issuing up to five revisions to the residential furnace fan energy conservation standards by 2048. Hence, we believe that DOE has drastically underestimated the INPV range at TSL 4. (DOE has estimated that the INPV in 2012 dollars at TSL 4 is between -$54.4 million and 33.8 million.)

It is also important to note that while considering the benefits and burdens of all TSLs, DOE concluded that the reduction in INPV at TSL 5 (-$55.5 million) is substantial for manufacturers. The predicted INPV reduction at TSL 4 is only marginally better than the INPV at TSL 5. While providing the rationale for the selection of TSL 4 on page 64130 of the October 25, 2013 NOPR, DOE should have continued to maintain that the INPV reduction at TSL 4 is substantial for manufacturers and that such a selection could potentially have an adverse impact on the manufacturing industry.

Cumulative Regulatory Burden

While evaluating the combined effects of recent or impending regulations on manufacturers, DOE accounted for the adoption of the minimum efficiency levels for commercial equipment
specified within ASHRAE Standard 90.1-2010. However, DOE failed to account for the impact that the following recent rulemaking activities would have on furnace fan manufacturers:

<table>
<thead>
<tr>
<th>Rulemaking Description</th>
<th>Issue Date</th>
<th>Summary of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request for Information (RFI) on test procedures for residential furnaces and boilers</td>
<td>January 4, 2013</td>
<td>AFUE metric</td>
</tr>
<tr>
<td>Commercial and industrial fans and blowers framework document</td>
<td>February 1, 2013</td>
<td>Potentially two different efficiency metrics for a fan that could be installed in residential and commercial furnaces</td>
</tr>
<tr>
<td>RFI regarding commercial package air conditioning and heating equipment energy conservation standards</td>
<td>February 1, 2013</td>
<td>Several furnace fan manufacturers also make this product</td>
</tr>
<tr>
<td>Test Procedures for Two-stage and Modulating Condensing Furnaces and Boilers (NOPR)</td>
<td>February 4, 2013</td>
<td>AFUE metric</td>
</tr>
<tr>
<td>RFI on commercial warm air furnace energy conservation standards</td>
<td>May 2, 2013</td>
<td>Several furnace fan manufacturers also make this product</td>
</tr>
</tbody>
</table>

DOE states in Chapter 12 of the October 25, 2013 NOPR’s TSD that a proposed standard is not economically justified if it contributes to an unacceptable level of cumulative regulatory burden. Although DOE does provide a summary of various regulations in its cumulative regulatory burden analysis, DOE fails to quantify the incremental burden of each rulemaking on the industry in terms of a monetary value. Hence, there is no way of determining whether the cumulative regulatory burden imposed by various rulemakings is unacceptable since the monetary impact of these rulemakings was not adequately captured within the GRIM. The only monetary estimate that has been provided by DOE is $3.1 million, which is the estimated total industry investment to meet the proposed FER levels, and has been significantly underestimated in our opinion.

Exhibit 2 provides a report on a study that was recently conducted to determine the costs of federal regulations for the industry. The study states that between 2006 and the beginning of 2013, manufacturers of residential furnaces, air conditioners, heat pumps and commercial unitary air conditioners have incurred $250 million in costs above those associated with the normal course of doing business as a result of energy and environmental regulations. (Residential furnace manufacturers alone have incurred a cost of over $50 million within this time period.) The study also states that for the period from 2013 through 2015, these manufacturers will incur costs of $50-55 million:

- $20 million for monitoring and participating in the regulatory process
- $10 million for duplicate reporting requirements
• $10-15 million for commercial products testing and compliance procedures
• $10 million in association costs for regulatory participation

Conversion Costs

DOE breaks down conversion costs into two categories – capital conversion costs and product conversion costs. As far as capital conversion costs are concerned, we do not agree with DOE’s assessment that manufacturers would not incur substantial costs since manufacturers would be able to use a different motor type without making significant changes to their production processes. We believe that the proposed FER levels in the October 25, 2013 NOPR would require that manufacturers make significant changes to their production processes; the design option associated with TSL 4 would necessitate changes in manufacturers’ assembly and subassembly production lines, including the modification and/or elimination of current fan housings, heat exchanger types and furnace cabinet sizes. This would effectively lead manufacturers to incur capital expenditures for new tooling and equipment. DOE has also grossly underestimated the R&D time and cost for the industry during the product conversion process. We believe that the industry cumulative capital and product conversion costs at TSL 4 are $103 million and $6.2 million respectively. Hence, the total industry investment to meet the proposed FER levels is approximately $109.2 million.

Markups Analysis and Employment Impacts

The manufacturer non-production cost markup values in Table IV.9 of the NOPR are impractical based on the preservation of gross margin percentage scenario, which implies that as production costs increase with efficiency, the absolute dollar markup will increase as well. It is unreasonable for DOE to assume that, as manufacturer production costs increase in response to an energy conservation standard, manufacturers would be able to maintain the same gross margin percentage markup as the base case. We believe that manufacturer markups will decrease as a result of new furnace fan energy conservation standards. Higher production costs would end up harming profitability. In order to maintain the same profit margins, manufacturers would most likely have to lay off employees and consolidate certain job positions within their companies. The restructuring within the industry would have an adverse impact on the U.S. employment numbers.

In our opinion, the preservation of operating profit scenario is also inaccurate since it implies that manufacturer markups are set so that operating profit one year after the compliance date of the new energy conservation standards is the same as in the base case. We believe that the one year time period is an extremely optimistic assumption; a five-year time period is a more realistic average for the industry.

There are some significant flaws in DOE’s assumptions with respect to employment impacts in subsection 12.7.1 of the NOPR TSD’s chapter 12:

• DOE assumes that the labor costs at each efficiency level will vary depending on the design options selected. However, Table 12.7.1 seems to suggest that the range of potential changes in domestic production workers will remain the same from TSL 1 to TSL 5. We fail to understand how this is possible, given that the labor costs will increase with higher design options and manufacturers will try to compensate the increased costs via reduced labor. Based on the reasons provided within the “conversion costs” subsection of this letter, we believe that higher efficiency levels cannot simply be achieved by substituting a higher-efficiency component for an existing component.
- Although subsection 12.7.1 accounts for line-supervisors as production workers who contribute towards the manufacture of furnace fans, the section fails to account for engineers and managers in supervisory roles who may not be involved in the day-to-day assembly line operations, but are essential to the production unit.

Section 8 – Utility Impacts Analysis and Power Quality

Although DOE used the NEMS-BT model to evaluate the impact of the proposed FER levels on utilities, we believe that the model did not account for issues related to power quality. DOE’s proposed standard levels would result in a significant increase of non-linear loads without power factor correction on the grid. The non-linear loads produced by constant-torque and constant-airflow BPMs tend to cause harmonic distortions in both voltage and current, and could potentially cause voltage control problems within a power grid system.

Our preliminary discussions with the Electric Power Research Institute (EPRI) suggests that while harmonic emissions from a single system may not have a major impact on the grid, the cumulative impact of millions of furnaces could be significant on the grid systems within the U.S. Harmonic emissions are capable of having adverse effects on transformer efficiency within an electric grid system. Although there are some mitigation options available with respect to harmonic emissions, the manufacturing costs associated with such options are significant (additional components, system redesign R&D, etc.) and would eventually be passed onto consumers. DOE should further investigate the power quality issues that would arise due to the proposed TSL 4 efficiency levels and account for the mitigation costs within the INPV, net present value (NPV), payback periods and LCC analyses. Additionally, the energy losses associated with harmonic emissions mitigation techniques would need to be accounted within DOE’s national energy savings analysis. DOE should also reevaluate its utility impact analysis based on the issues raised within this section.

Section 9 – Shipments Analysis

The shipment projections for furnaces shown on slide 77 of DOE’s December 3, 2013 public meeting presentation are very optimistic. Sales of furnaces are closely related to new homes sales. During the years prior to 2006, the demand for large homes with multiple furnace systems was more common than it is today. It is not clear that the demand for homes with multiple furnace systems can be projected into the future. The projected shipments also do not show an echo effect loss in replacement sales for the furnaces that were not sold in the years 2008-2012. DOE should account for this echo effect in its projected shipments. Page 64098 of the NOPR does state that the projected shipments show a lower level of replacement shipments between the years 2025 and 2030, which is a consequence (i.e., an echo) of the decline in historical shipments in 2007–2009. However, it is evident from slide 77 and Figure 9.4.1 (chapter 9 of the NOPR TSD) that the projected shipments increase for all product classes between the years 2025 and 2030. We believe that this is an inaccurate projection and significantly skews the full-fuel-cycle national energy savings estimates. Figures 2 and 3 provide the historical shipments of the industry’s gas warm air furnaces and oil warm air furnaces between 1993 and 2012. These figures are available on AHRI’s website.1

It is clearly evident from the above figures that the historical trend lines for gas and oil warm air furnaces are very different. However, Figure 9.4.1 of the NOPR TSD’s chapter 9 is inaccurate since it shows the trend lines for gas and oil warm air furnaces as being virtually the same. It should be noted that the slight improvement in shipments during the year 2010 was due to the federal energy efficiency tax credit (25C) of $1,500 associated with high-efficiency residential gas and oil furnaces (with minimum efficiencies of 95% AFUE). The maximum allowable tax credit for the same products has significantly reduced to $150 and the shipment trends over the past few years have been much lower in comparison to the 2010 shipments. DOE needs to extensively revisit this portion of the analysis as it has serious implications on the national energy savings and the NPV analyses.

There are three major issues with DOE’s relative price elasticity of demand analysis in Appendix 9-A of the NOPR TSD that could have led to erroneous results within the NIA spreadsheet tool:
• The relative price elasticities are based on appliance shipments and household economic data from 1980-2002. It is important to note that inflation adjusted wages have shrunk over the last decade whereas inflation adjusted wages gradually increased in the 1980s and 1990s. The historical household income data issued by the U.S. Census Bureau suggests that from 1980-2002, the growth in median income (in 2012 inflation adjusted dollars) was 15.2% whereas the median income (in 2012 inflation adjusted dollars) within the 2002-2012 time period was reduced by 5.7%. (See Table H-6 at http://www.census.gov/hhes/www/income/data/historical/household/ for full details.)

• Table 9-A.2.1 provides price elasticity, income elasticity and brand price elasticity figures based on data collected in the 1940s, 1950s, 1960s, and 1970s. The studies are outdated and should not have been used by DOE to evaluate the implicit discount rate.

• The relative price elasticity analysis was limited to household appliances such as refrigerators, clothes washers and dishwashers. Although the data for such appliances is readily available, it was inappropriate for DOE to use these appliances to predict the relative price elasticities for this particular rulemaking. DOE should have accounted for the fact that HVAC systems with furnace fans are typically applied products that are installed and decommissioned by licensed contractors. The typical distribution chain for such products is also vastly different from “plug-in” type appliances that are readily available in retail stores.

Section 10 – Alternative Efficiency Determination Method

We believe that in order to implement the new requirements on a timely basis while minimizing the burden on furnace manufacturers, the option of employing an alternative efficiency determination method (AEDM) to determine FER must be made available instead of mandating that a minimum of two samples be tested in order to achieve DOE certification.

The January 3 final rule stated that the added cost of testing according to DOE’s test procedure would be less than one percent of the manufacturer selling price (and lower than 0.1 percent in some cases). We believe that DOE has grossly underestimated the added cost of testing to the manufacturers. We believe that the overall number of basic models for furnace manufacturers could increase significantly. The number of furnace fan basic models will be greater than the number of furnace basic models. The test procedure defines external static pressure as the difference between static pressures measured in the outlet duct and the return air opening or duct. The pressure drop due to the gas heat exchanger will require that each furnace basic model also be considered as a furnace fan basic model. Additional furnace fan basic models would be created in order to account for the type of installation. DOE should also note that many of these manufacturers also produce several other DOE regulated products. Rather than requiring manufacturers to spend valuable resources on conducting several tests, DOE should recognize that those resources could be better spent on innovating more efficient products.

Section 11 – Social Cost of Carbon (SCC)

A review of page 64130 of the NOPR suggests that the CO₂ emissions reduction figures were used by DOE to facilitate comparisons between various TSLs. The monetary value of the CO₂ emissions reduction figures played a significant role in DOE’s justification to set the TSL 4 levels
as the national standards. Due to the uncertainties associated with the SCC values in Tables IV.10 and IV.11 on page 64108 of the NOPR, DOE should not use those SCC values to establish monetary figures for emissions reductions. DOE should instead maintain its focus on the core aspects of its analyses in appliance and equipment standards rulemakings, i.e. consumer payback and life cycle cost analysis.

AHRI believes that DOE should withdraw the 2010 and 2013 SCC values used within this NOPR, and refrain from using the SCC in any other rulemaking or policymaking until the SCC undergoes a more rigorous notice, review, and comment process. While the DOE may rely upon the SCC in determining the CO₂ emissions reductions in this NOPR, that does not change the fact that the SCC has not been adequately reviewed before being used in this NOPR or any other rulemaking. Pursuant to the Information Quality Act, a petition for correction was submitted by various associations stating that the 2010 and 2013 SCC estimates should be withdrawn and not used in any rulemaking and policymaking for the following reasons:

- The SCC estimates fail in terms of process and transparency. The SCC estimates fail to comply with the Office of Management and Budget (OMB) guidance for developing influential policy-relevant information under the Information Quality Act. The SCC estimates are the product of an opaque process and any pretensions to their supposed accuracy (and therefore usefulness in policymaking) are unsupportable.

- The modeling systems used for the SCC estimates and the subsequent analyses were not subject to peer review as appropriate.

- Moreover, even if the SCC estimate development process was transparent, rigorous, and peer-reviewed, the modeling conducted in this effort does not offer a reasonably acceptable range of accuracy for use in policymaking.

- The federal Interagency Working Group (IWG) has failed to disclose and quantify key uncertainties to inform decision makers and the public about the effects and uncertainties of alternative regulatory actions as required by OMB.

- By presenting only global SCC estimates and downplaying domestic SCC estimates in 2013, the IWG has severely limited the utility of the SCC for use in benefit-cost analysis and policymaking.

An important principle of cost-benefit analysis is that costs and benefits must be compared over the same time frame and within the same scope. The cost-benefit analysis within this NOPR violates this principle. With respect to the time frame, DOE calculates the present value of the costs of the NOPR to consumers and manufacturers over a 30-year period. The SCC values, on the other hand, reflect the present value of future climate related impacts well beyond 2100. DOE’s comparison of 30 years of cost to hundreds of years of presumed, future benefits is inconsistent and improper. Although the national operating cost savings are domestic U.S. customer monetary savings that occur as a result of market transactions, the SCC values that are referenced within the NOPR are global and offer a worldwide perspective. DOE did not take any steps to modify those SCC values in a manner that is representative of domestic CO₂ emissions. Hence, DOE’s estimated CO₂ emissions reductions within the NOPR are unnecessarily inflated and not representative of the emissions within the U.S.

The SCC values in Table IV.11 of the NOPR only describe the SCC values for a particular year without accounting for any prior changes from baseline emissions trends in previous years. For example, the $66 SCC value at a 3% discount rate for the year 2045 is estimated based on the assumption that no policy changes or regulations impacting CO₂ emissions would occur until
2045. Therefore, the value of $66 in 2045 would not be appropriate if emissions reductions measures have occurred in each prior year since 2019, as is the case with the residential furnace fan rulemaking. This is yet another observation that leads us to believe that the claimed CO₂ emissions reductions benefits within the October 25, 2013 NOPR have been overestimated.

The NOPR also fails to take into account the U.S. Environmental Protection Agency’s (EPA) planned greenhouse gas (GHG) regulations for new and existing power plants. In the June 25, 2013 Climate Action Plan, the White House directed EPA to propose and issue regulations reducing GHG emissions from new and existing power plants. The Climate Action Plan and accompanying Presidential memorandum outlined detailed rulemaking schedules for both new and existing power plants. Specifically, EPA would propose regulations for GHG emissions from new power plants by September 20, 2013, and similar regulations for existing power plants by June 1, 2014. EPA has already fulfilled the first directive by releasing a proposed regulation for GHG emissions from new power plants on September 20, 2013. Given EPA’s simultaneous announcement that it would undertake a two-month outreach to stakeholders on the existing power plant rule, all indications are that EPA will fulfill the second directive, too. Despite the recent actions taken by EPA, DOE fails to consider the impact of EPA’s planned GHG power plant regulations on the residential furnace fan rulemaking. This is significant because the EPA’s planned GHG regulations likely will materially affect the projections of CO₂ emissions reductions on which the DOE’s SCC-derived benefit calculations are based. The DOE’s projections of baseline CO₂ emissions over the 2019-2048 timeframe assume the continuation of existing patterns of electricity generation by fuel types. It is well known, however, that EPA’s planned GHG regulations on power plants, as well as other existing and proposed regulations, can be reasonably expected to change the baseline pattern of energy generation, including the types of fuels used for electricity generation and the extent to which they are used. Consequently, in failing to consider EPA’s planned GHG regulations on power plants, DOE’s projections of CO₂ emissions reductions in this NOPR are likely invalid.

The EPA example highlights a significant problem with the application of SCC-derived benefit calculations by regulatory agencies. When different agencies are simultaneously pursuing regulatory agendas that address similar sources of CO₂ emissions, the likelihood of double-counting of the same presumed SCC benefits is high. The result may be to promote excessive and economically unjustified regulations because the actual benefits have been overestimated by duplicative emissions reduction claims. Both the DOE and EPA should not take credit for a reduction of the same amount of CO₂ emissions, and neither agency should claim benefits from the reduction in more than one of its own regulations. Indeed, the potential effects of EPA’s planned GHG regulations on power plants may very well overwhelm any emissions reduction claims that DOE may project for its energy conservation standards. Consequently, we believe that the analysis within this NOPR is severely flawed due to DOE’s failure to consider EPA’s planned GHG regulations on power plants, as well as other related EPA regulations that lead to a reduction in emissions.

DOE should note that on November 1, 2013, the Office of Management and Budget (OMB) issued technical corrections to the SCC values that were originally released in May 2013. In certain cases, the technical corrections led to a reduction in SCC values. In addition, OMB’s Office of Information and Regulatory Affairs (OIRA) is expected to provide a new opportunity for public comment on the latest amendments. Given the uncertainties associated with the SCC estimates, we reiterate that DOE should not use those SCC values to establish monetary figures for emissions reductions.
Concluding Remarks

AHRI appreciates the opportunity to provide these comments. Based on the several reasons outlined in this letter, we believe that significant changes are necessary to the October 25, 2013 NOPR in order to ensure that appropriate energy conservation standards are developed for residential furnace fans. If you have any questions regarding this submission, please do not hesitate to contact me.

Sincerely,

[Signature]

Aniruddh Roy
Regulatory Engineer
Air-Conditioning, Heating, and Refrigeration Institute
2111 Wilson Boulevard, Suite 500
Arlington, VA 22201-3001, USA
703-600-0383 Phone
703-562-1942 Fax
aroy@ahrinet.org

Exhibits:

1. Motor prices on Grainger’s website.
2. AHRI Project 5001 – Costs of Federal Regulations for Residential Heating and Air Conditioning Equipment Manufacturers
Exhibit 1 – Motor Prices on Grainger's Website

**Brushless DC Motor**

**GENTEQ**

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**Brushless Direct Drive Blower Motor**

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### Technical Specs

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AHRI Project 5001 – Costs of Federal Regulations for Residential Heating and Air Conditioning Equipment Manufacturers

Prepared for:
Air-Conditioning, Heating and Refrigeration Institute (AHRI)

May 2013

Everett Shorey
Richard F. Topping

RFTopping Consultants, LLC
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Executive Summary

The federal government issues a variety of regulations directly affecting the manufacturers of heating and air conditioning equipment (in addition to the wide range of health, safety, employment and other regulations that affect all businesses). In order to comply with these regulations, manufacturers divert effort and money from other activities that produce products with benefits to consumers. The more effectively the federal government manages its regulatory programs, the lower the cost burden for all stakeholders – manufacturers, environmental groups, the government itself and, ultimately, consumers. The purpose of this study is to document the costs to manufacturers of federal energy regulations and to understand some of the underlying causes for those costs. The study is based on a survey of air conditioner and furnace manufacturers to determine their activities and associated costs.

Between 2006 and the beginning of 2013, manufacturers of residential furnaces, air conditioners, heat pumps and commercial unitary air conditioners have incurred $250 million in costs above those associated with the normal course of doing business as a result of energy and environmental regulations:

- Residential air conditioners and heat pumps: $140+ million
- Residential furnaces: $50+ million
- Commercial unitary air conditioners: $35 million
- Association costs for regulatory participation: $23 million

For the period from 2013 through 2015, these manufacturers will incur costs of $50-55 million:

- $20 million for monitoring and participating in the regulatory process
- $10 million for duplicate reporting requirements
- $10-15 million for commercial products testing and compliance procedures
- $10 million in association costs for regulatory participation

These costs are related to the sheer number of filings and rulemakings from the Department of Energy and other agencies, lack of coordination between agencies and policy decisions. The largest portion of the costs is due to a lack of coordination leading to more rapid design cycles and differing reporting requirements. This amounts to waste where manufacturers bear costs for no environmental or energy conservation gains.
Costs of Federal Regulations for Residential Heating and Air Conditioning Equipment Manufacturers

Situation

The federal government issues a variety of regulations directly affecting the manufacturers of heating and air conditioning equipment (in addition to the wide range of health, safety, employment and other regulations that affect all businesses). How the federal government manages the regulatory process has a significant effect on the costs and activities required from heating and air conditioning equipment manufacturers as well as causing costs and other requirements to ripple through the distribution and supplier channels.

Ineffective management of these programs by the Federal government (DOE, EPA, FTC, etc.) not only increases the costs of the regulatory process but also diverts engineering and other management resources away from new product development and other activities. Effective management allows the federal government to achieve its policy objectives without excessive burden. The purpose of this paper is to indicate where and how ineffective actions have increased the regulatory burden and to suggest some of the possible causes of excess costs.

Summary Conclusions

Between 2006 and the beginning of 2013, manufacturers of residential furnaces, air conditioners, heat pumps and commercial unitary air conditioners have incurred $250 million in costs above those associated with the normal course of doing business as a result of energy and environmental regulations:

- Residential air conditioners and heat pumps: $140+ million
- Residential furnaces: $50+ million
- Commercial unitary air conditioners: $35 million
- Association costs for regulatory participation: $23 million

For the period from 2013 through 2015, it is expected that residential and commercial HVAC equipment manufacturers will have industry-wide additional total costs of:

- $20 million for monitoring and participating in the regulatory process
- $10 million for duplicate reporting requirements
- $10 million in association costs for regulatory participation

Reporting and compliance could be $10-15 million per year higher industry-wide if the current DOE proposals for commercial equipment remain in place.

The single greatest factor in these costs was the requirement to redesign air conditioners and heat pumps twice in a four year period, once to meet 2006 minimum efficiency standards (the “13 SEER Standard”) and then once again to
eliminate the use of HCFC R-22 in 2010. The change of refrigerant or the 13 SEER requirement led to larger indoor coils and forced some manufacturers to redesign furnaces and other indoor air handling units to make them shorter. Combined, the total cost of the extra redesign was $140+ million for both design and initial compliance testing, excluding any capital investments in tooling or plant capacity.

Because of the major impact energy and environmental regulations have on their businesses, manufacturers must spend considerable time and effort to monitor and participate in the regulatory process. The total of these costs directly to manufacturers from 2006 through early 2013 have been approximately $36 million. In addition, the Air-Conditioning, Heating and Refrigeration Institute (AHRI), the industry trade association, spends approximately $3.3 million per year on regulatory monitoring and participation, for an additional $23 million that manufacturers must support through dues, leading to a grand total of $59 million.

The cost of participating in the regulatory process varies by the amount of time and effort required by manufacturers. The total cost to all manufacturers is approximately $300 thousand whenever DOE or another agency issues a notice or other action requiring consideration and interpretation, $500 thousand for each request for information and $175 thousand to monitor and interpret rules when they are issued in draft or final form.

Based on announced and anticipated DOE activities from the second quarter of 2013 through 2015, the cost of monitoring and participating in the standards processes will be nearly $30 million for manufacturers, or approximately $10 million per year. This compares with $36 million for 2006 through early 2013, or just over $5 million per year. The cost of monitoring and participating in the regulatory process accelerated in 2010 and remains high.

Lack of coordination in reporting standards and testing requirements between various government agencies creates a need for additional tests and for separate record keeping and reporting systems. The annual costs for these additional reporting requirements were $3-4 million per year, or a total of approximately $25 million during the period from 2006 through early 2013. These costs will continue at these levels through 2015 for a total additional cost of $10 million.

The principal direct cause of these regulatory-related costs is a lack of coordination of regulations and reporting requirements between government agencies. It has not been within the scope of this study to understand why this lack of coordination occurred or whether it is avoidable. Whatever the underlying causes, the results have been an increased burden to manufacturers of $250 million. As documented in manufacturer interviews, these costs displace resources for additional research and development.
Regulatory Framework and Cost Elements

Manufacturers of heating and air conditioning equipment are subject to energy and environmental regulations that are distinct from and in addition to the regulations affecting the normal course of all manufacturing businesses. The principal energy and environmental regulation families include:

- Minimum appliance efficiency standards and related testing and enforcement procedures, administered by the US Department of Energy (DOE)
- Energy Star ratings and associated testing and enforcement procedures, administered by the US Environmental Protection Agency (EPA)
- EnergyGuide energy use labels administered by the US Federal Trade Commission (FTC)
- Refrigerant controls administered by the EPA

The costs to manufacturers of these regulations include:

- Monitoring the regulatory process
- Participating in the development of regulations
- Designing products to meet any new regulatory requirements (including product design-related testing, plant conversion, market introduction and other costs related to a new product)
- Testing, labeling and reporting to assure compliance with regulations

Some of these are real incremental cash costs, some involve diversion of staff time to regulatory matters and some are part of the normal course of business in new product development cycles.¹

Some of the costs arise from real policy differences. For example, the cost of designing a new product can be driven by the engineering difficulty in meeting a new standard level. Or the cost of testing and compliance can reflect different visions on how much verification is necessary. Other costs are related to how each of the energy and environmental programs is managed. Again, overlapping standards and programs between government agencies can force more frequent product redesigns or duplicative reporting processes. While some of the costs based on policy differences are unavoidable, the costs from program management can, in principle, be controlled.

How the federal government manages these energy and environmental programs has a significant bearing on the total costs to the manufacturers of heating and air conditioning equipment. It is in the interest of all parties (the federal government, consumers, energy advocates, consumer protection groups, manufacturers, distributors, contractors, etc.) to minimize the costs of the programs for each party.

¹ In measuring the effects of DOE and related regulatory actions on the heating and air conditioning industry, this analysis counts all costs related to energy and environmental regulation as incremental. Other operating costs, such as normal product design cycles or non-energy and environmental regulations, are considered normal costs of doing business.
There is no benefit to anyone for any other party to have unnecessary costs. This simply produces waste that is, ultimately, born by consumers, taxpayers and funders of environmental advocacy groups. Operating the regulatory programs efficiently will save money for each group. In order to do this, it is necessary to understand how the programs create costs for each group. The purpose of this paper is to define how the regulatory process creates costs for heating and air conditioning equipment manufacturers.

Structure of the Analysis

Regulations generally take place with regard to types of products and so a product-by-product analysis is a simple way to understand the costs borne by manufacturers. Individual firms have different portfolios of products, so each individual firm participates in some combination of each product type. Thus, this analysis looks at the costs to a sub-industry as a whole rather than at the costs for any one individual company. The process included surveying manufacturers to understand the activities they undertake in the regulatory process, what those activities cost and whether the manufacturers use internal or external resources. Some, but few, of the activities scale with volume (for example, larger manufacturers tend to have broader product lines, increasing product development and testing costs but all manufacturers regardless of size have to meet standards as well as labeling, compliance and reporting requirements). So most regulatory activities do not have substantial scale effects. This can put extra burden on smaller companies.

The product types include:
- Residential central air conditioners and heat pumps
- Residential furnaces
- Commercial unitary air conditioners and related equipment

A wide variety of other products are covered by similar sets of regulations and the manufacturers face similar costs. This study is limited to heating and air conditioning equipment.

Residential Central Air Conditioners and Heat Pumps

Since 2006, the effective date of the last set of minimum efficiency standards for residential central air conditioners and heat pumps, central air conditioners and heat pumps have undergone a series of regulatory and enforcement-related proceedings including:
- Phase out of HCFC refrigerants (R22) in 2010, requiring a complete redesign of air conditioners and heat pumps

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2 The survey document is in Appendix A. Actual responses by companies and the number and identities of companies responding are confidential for competitive reasons.
• Allowance by EPA of an HCFC R-22 loophole, which permitted the continuance of the production of “dry” or nitrogen-charged condensing units, thus creating a situation where manufacturers carried duplicative inventories of both the new R-410a product, as well as the old designs, which use R-22 refrigerant.

• Multiple requests for comment by DOE on rating dry R-22 units

• Modification of test procedures effective in 2008 with modifications for off-mode and regional conditions initiated in 2010 and still under development

• Request for comment by DOE on regulating residential air conditioning systems at the component level

• Development of new energy efficiency standards defined in 2011 and effective in 2015 to increase efficiency, set regional variations and include off-mode considerations

• Modification of new EnergyGuide labels to support regional efficiency standards introduced in 2011 and effective in 2015

• Changes in compliance and verification testing procedures including testing standards and the use of models as a substitute for testing discussed and developed from 2011 through into 2013. This has included federal retesting to check on industry verification programs and expanded enforcement.

In total, the costs to the manufacturers of residential air conditioners and heat pumps in order to monitor and comply with these regulations and standards has been $140 million over and above the normal product design cycle costs and the general costs of doing business (Table 1).

Table 1: Costs of Regulations for Residential Air Conditioner and Heat Pump Manufacturers (2006 – Q1 2013)

<table>
<thead>
<tr>
<th></th>
<th>Monitoring &amp; Participating</th>
<th>Designing</th>
<th>Complying</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFC Phase Out</td>
<td>$2.8 Million</td>
<td>$100+ Million</td>
<td></td>
<td>$100+ Million</td>
</tr>
<tr>
<td>Test Procedures</td>
<td>$3.8 Million</td>
<td></td>
<td>$20 Million</td>
<td>$23.8 Million</td>
</tr>
<tr>
<td>Standards</td>
<td>$3.7 Million</td>
<td>TBD for 2015</td>
<td></td>
<td>$3.7 Million</td>
</tr>
<tr>
<td>Labels</td>
<td>$2.1 Million</td>
<td></td>
<td></td>
<td>$2.1 Million</td>
</tr>
<tr>
<td>Compliance Procedures</td>
<td>$3.0 Million</td>
<td></td>
<td>$6 Million</td>
<td>$9.0 Million</td>
</tr>
<tr>
<td>Total</td>
<td>$15.4 Million</td>
<td>$100+ Million</td>
<td>$26 Million</td>
<td>$140+ Million</td>
</tr>
</tbody>
</table>
Monitoring and Participating

The costs of monitoring and participating in the regulatory process for air conditioning and heat pump products has tended to average approximately $1 million per year for the manufacturers of residential air conditioners and heat pumps from 2006 through 2009. This cost increased dramatically to over $5 million in 2011 because of the number of regulatory actions and initiatives compressed into the 2009-2012 time period (Figure 1).3

![Figure 1: Costs to Monitor and Participate in Regulatory Processes](image)

Residential Air Conditioner and Heat Pump Manufacturers

In addition to the financial costs, participating in and responding to multiple regulatory topics diverts staff to focus on regulatory activities and away from normal job functions. This is particularly true of more senior personnel with the experience to understand the implications of regulatory proposals. For example, one manufacturer reports that responding to regulatory filings involves a “combined effort from our staff in industry relations, engineering, marketing and legal. There can be multiple individuals from each function involved depending on the specific issue involved.” As a result “engineering and marketing resources are diverted from new product development activities. This resource reallocation slows the introduction of products targeted at delivering more value to customers.” Another reports that, in response to a new regulatory filing “the following group is typically notified and

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3 These are the costs reported by a sample of manufacturers for monitoring and participation activities allocated to air conditioner and heat pump regulations. The total cost to companies would include similar costs for other products. This also excludes the costs incurred by the Air Conditioning Heating and Refrigeration Institute (AHRI) on behalf of its members, costs that are passed onto the member in dues.
reviews the issues, the amount of time and effort spent depends on the extent of the regulation:

1. CEO
2. CFO
3. Sr. VP Marketing
4. Sr. VP, Secretary & General Counsel
5. Sr. VP Engineering
6. Sr. VP Operations/Global Supply Chain
7. Director of Regulatory Affairs
8. Managers/Directors of Engineering
9. Marketing Product Managers

As a result the following activities may typically be affected by the time put into monitoring and analyzing:

1. New product development plans
2. Business growth plans
3. Business improvement plans"

Other responses from manufacturers were similar.

Manufacturers estimate that the costs to them of participating in the regulatory process are essentially the same either if the process involves a standard approach to rule making or a negotiation between parties. While there are many advantages to the negotiated approach, the time and effort faced by manufacturers are not substantially different. In either case, there are significant demands on the time of both senior management and technical staff.

The regulatory burst in 2010-2012 put a significant burden on the residential air conditioner and heat pump manufacturers to divert cash and human resources to regulatory matters. A smoother pattern of regulations and a more coordinated approach between and within agencies would allow for more efficient and effective use of economic and human resources.

Designing

Product design is one of the most critical activities undertaken by air conditioner and heat pump manufacturers. It sets the product configuration, the material and labor costs and the performance characteristics (energy and other) for the manufacturer’s new product offerings. In addition, any significant changes in product design almost always entail changes in parts supply and in manufacturing plant layout and tooling. The implications on investment in engineering time, testing, marketing support and plant investment are substantial. It is critical to manufacturers that they only have to undergo product design programs on a well-planned and coordinated basis. Manufacturers go through a product cycle in a 5-7 year time period absent any standards or other factors, so accelerating that cycle creates additional cost for the manufacturers. Working with that cycle may create additional product design costs if the standards or other regulations force major
technology change (such as a change in refrigerant), but the net incremental cost beyond the normal cost of doing business is much smaller.

The cost of product design in response to a major change in product configuration or technology, such as the switch to 13 SEER products in 2006 or the switch of refrigerants in 2009, is substantial. Each manufacturer that does its own significant product development incurs design and development costs (excluding associated testing and plant investment) of several million dollars. The exact amount of investment by any particular manufacturer depends on its individual product development strategy and the size and breadth of its product lines. Estimates of the total costs to all manufacturers of such a change are more than $100 million, although the precise levels of cost by manufacturer are highly proprietary and cannot be published.

Manufacturers report that they incurred costs at this level for each of the 2006 standard and 2009 refrigerant redesigns. Absence of coordination between these two regulatory requirements, therefore, cost the air conditioner and heat pump manufacturers an incremental $100 million beyond what would have been incurred as part of the normal course of business.

In addition to these 2006 and 2009 standards, there are now new standards that will go into effect in 2015 necessitating additional investments of $100 million or more between now and 2015. The 2015 standards were originally set in 2006, providing a long lead time for the design effort and to recover the embedded design and tooling costs for the 2006 and 2009 standards. However, these were modified in 2011 to raise the heat pump efficiencies, add a regional standard and measure “off-mode” performance (for which the test procedures still have not been determined). Further, DOE has announced the intention to consider separate standards for “outdoor” units of air conditioners and heat pumps in addition to the standard for the total combination of outdoor and indoor portions. These proposals could, if not coordinated in a timely manner, create an additional round of design and design investment, yielding yet another incremental cost level of $100 million plus.

Beyond the issue of costs, time is a significant factor in the product design process. It takes 2-4 years to design, test and introduce a new product. The more significant the change, the longer the time cycle not only for product design reasons but also to perform all other aspects of product introduction as well as to stock the distribution channel and train distributor/wholesalers and installing contractors. One manufacturer describes its own work beyond engineering and also the requirements on suppliers and distribution partners as:

- **Impact on Internal Departments**
  - **Marketing**
    - Resources are reallocated and stretched thin, when unplanned activities occur,
    - New product brochures and marketing collateral must be printed,
- New promotions are developed
- Advertising (print and web) must be adjusted.
  - Technical Services Department
    - New training materials must be developed, printed and distributed.
    - New catalog numbers must be created, which increases the chance of dead or slow moving inventory.
  - Training Department
    - Must change training materials and ensure customers and sales representatives understand the changes to products and regulations.
  - Sourcing Department
    - Must react to new product specifications with new specifications for new subcomponents.
  - Parts Department
    - Must order and stock new parts.
    - Part numbers must be created, new part catalogs must be printed and online catalogs must be updated.
- Impact on Wholesalers/Distributors and Contractors
  - Printing
    - New product catalogs
    - New catalog numbers
  - Administrative
    - Must become familiarized with new listings in AHRI
    - New part numbers
    - Stock new (and old) parts for installation and repair
  - Training
    - Contractors must train technicians and sales associates on new equipment specifications and features
    - Contractors must train sales associates on any rebates (Federal, State and Local) that may be available to pass along to consumers
- Impact on Suppliers
  - Downstream suppliers must create new product components, assemblies, sub-assemblies and parts.
  - These first-level suppliers need to work with their own suppliers for any materials, parts or sub-components, which often need to be tested and certified.

It is difficult for manufacturers to shorten this lead-time in any significant manner. To the extent it is possible to shorten the development cycle, doing so increases costs because the manufacturer must choose to pursue multiple development options in parallel rather than working on the most promising options and then trying others as necessary. Compressed time does not permit experimenting. If it is
possible to shorten the development time, this comes at a cost increase of approximately 10% per month.

*Complying*

Any set of standards or regulations needs some form of compliance mechanism. For residential air conditioners and heat pumps, this consists of testing and other protocols to demonstrate initial compliance with standards, reporting and monitoring of continuing compliance with the protocols and follow-up testing for enforcement. The manufacturers themselves recognized the need for such a system and created one through their trade association (AHRI and its predecessors) long before there were federal efficiency or other standards. The AHRI system, thus, became the base-line cost of doing business for the manufacturers. Any additional procedures and activities beyond the AHRI program represent added costs brought on as a result of regulatory and other programs. These costs may meet some public need, but they remain an incremental cost of doing business driven by regulations.

The basic set of processes in assuring compliance is:

1. Testing equipment during the design process to be sure that it will meet standards. Typically this testing process covers some combination of products and is augmented by computer models for other combinations.
2. Periodic testing of production products by independent laboratories to assure continued compliance
3. Reporting of testing results and continued compliance to various organizations
4. Responding to challenges of compliance

Under the traditional AHRI certification process, manufacturers must have third-party tests of 20% of their basic models\(^4\) (similar product designs) prior to listing or selling the product accompanied by annual testing of 20% of the basic model combinations. This amounts to 75-100 units for many manufacturers in the initial certification process and 50-75 units per year. In addition, the manufacturer itself must either test all of its units or have a certified engineering program to determine expected operating results. If all combinations of indoor and outdoor units required physical testing, the number of combinations for residential products easily reaches into the tens thousands for most manufacturers.

In addition to testing for certification under the AHRI program, manufacturers must also perform testing to assure compliance with other regulations. One manufacturer reports:

> *In order to sell throughout North America, our residential products must comply with multiple standards. These standards include Federal energy and*

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\(^4\) A “basic model” is a product family with essentially the same energy characteristics but with some different features. For example, a company can have from five to eighty individual products for a single “basic model” residential air conditioner or heat pump.
related standards (from DOE, EPA and FTC), the National Electric Code (NEC), UL1995 safety standards, AHRI standards, California Title 24 standards as well as numerous state and local standards and building codes. These multiple standards do increase the amount of testing required on a regular basis even when one of them changes. For example, product changes required to meet changes in DOE standards require additional testing to demonstrate that products continue to be in compliance to UL1995.

Following the testing process, manufacturers must submit reports or other documentation to various regulatory or other bodies including AHRI for its certification program, DOE for standards certification, EPA for Energy Star qualified products, FTC for labels, among others. As of now, these reports or submittals are not coordinated so that each manufacturer must make separate submissions to each body.

The total cost of testing and submittals for residential air conditioners and heat pumps is approximately $20 million for initial testing of a new product design to demonstrate initial compliance. The annual cost of testing to demonstrate continuing compliance is $7-10 million per year including internal costs and fees to AHRI for its certification program. The cost of recordkeeping and managing submittals is $2-3 million per year. Thus the total continuing costs under the current approaches are approximately $9-13 million per year. Of this, approximately $1-2 million annually is due to overlapping or uncoordinated programs requiring different tests or submittals. Given that there was an extra round of product designs in the period from 2006-2015 due to the HCFC R-22 phase-out, the manufacturers incurred an addition cost of $20 million for that additional initial product certification and testing.

The DOE has recently changed some of its practices in dealing with certification and enforcement questions. Instead of initiating informal inquiries if there seems to be a problem with a product or a set of data, DOE has begun to send formal subpoena notices to answer otherwise routine questions. This has led to situations where manufacturers have needed to respond to DOE enforcement actions to prove that models are within compliance. The cost for such actions, often requiring manufacturers to retain outside legal counsel given the heavy DOE legal approach, has been on the order of $15,000 to $35,000 per manufacturer for any individual residential product.

In addition, DOE is proposing to change the testing and other approaches for certifying compliance with its regulations. These changes could increase the testing burden by increasing the number of units that need to be tested for each “basic model” and by restricting the ability to use computer simulations rather than testing to establish compliance. The exact nature of these potential changes is still under discussion.
Furnaces

Residential furnaces have been the subject of efficiency rulemakings by DOE as well as changes in test procedures, compliance requirements, and Energy Star classification changes. In addition, the 13 SEER air conditioner standard and the phase out of HCFC R-22 had a ripple effect causing some manufacturers to redesign their furnaces. The total costs of these regulatory actions, over the normal costs of doing business, have been over $50 million since 2006 (Table 2).

Table 2: Costs of Regulations for Residential Furnace Manufacturers (2006 – Q1 2013)

<table>
<thead>
<tr>
<th></th>
<th>Monitoring &amp; Participating</th>
<th>Designing</th>
<th>Complying</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFC Phase Out</td>
<td>$25+ Million</td>
<td></td>
<td></td>
<td>$25+ Million</td>
</tr>
<tr>
<td>Test Procedures</td>
<td>$3.1 Million</td>
<td>$8.0 Million</td>
<td></td>
<td>$11.1 Million</td>
</tr>
<tr>
<td>Standards</td>
<td>$3.6 Million</td>
<td></td>
<td></td>
<td>$3.6 Million</td>
</tr>
<tr>
<td>Labels</td>
<td>$2.1 Million</td>
<td></td>
<td></td>
<td>$2.1 Million</td>
</tr>
<tr>
<td>Compliance Procedures</td>
<td>$1.0 Million</td>
<td>$6.0 Million</td>
<td></td>
<td>$7.0 Million</td>
</tr>
<tr>
<td>Total</td>
<td>$9.8 Million</td>
<td>$25+ Million</td>
<td>$14.0 Million</td>
<td>$50+ Million</td>
</tr>
</tbody>
</table>

The largest portion of this cost was due to the product redesign costs as a secondary consequence of air conditioner standards. At the current time, regional efficiency standards adopted by DOE as part of a consensus process are open for re-analysis. A change in these standard levels could cause an additional furnace product redesign, increasing the cumulative costs associated with regulatory actions.

Monitoring and Participating

The DOE agenda for furnaces since 2006 has included efficiency requirements and testing procedures for furnaces as well as for furnace components:

- DOE set minimum efficiency standards for furnaces with regional and with off-mode/standby requirements, initiated as two rulemakings in 2008 and 2009 and with effective dates in 2013. The regional standard consensus agreement has now been withdrawn by DOE due to a lawsuit and is under reconsideration.
- DOE revised test procedures to include off-mode and standby power consumption, initiated in 2009 and effective in 2010.
- DOE initiated a rulemaking process for test procedures and standards for furnace fans (essentially the electricity consumptions of all air handling equipment with heating capability and including furnaces) in 2012 with no effective date yet.
- EPA phased out the use of HCFC R-22 and DOE set a 13 SEER standard for air conditioners with the effect that some furnaces needed to be redesigned to a
lower height in order to accommodate larger air conditioner evaporator coils.

- EPA updated Energy Star requirements, effective in 2012, to include regional efficiency levels and fan energy maximums.
- The FTC modified its labeling for furnaces to include the regional efficiency levels but held implementation until the DOE regional standards are resolved.
- DOE changed its testing and compliance procedures for all residential products in 2012.

The cost to furnace manufacturers of monitoring and participating in these activities has been just under $10 million from 2006 through the beginning of 2013.

Because of the concentration of activities in the 2010-2012 period, the costs to manufacturers spiked during those years (Figure 2):

![Figure 2: Costs to Monitor and Participate in Regulatory Processes](image)

The process leading to the regional minimum efficiency standards was based upon consensus negotiations between manufacturers and other interested parties. While this approach did not have a material effect on the cost to manufacturers, it is generally a preferable one. However, the process was overturned by a lawsuit. As a result, the costs to manufacturers will increase as the regional efficiency standard process is re-initiated in 2013.
Designing

The only actual DOE standards that have come into effect for furnaces in the period since 2006 are for standby mode electric power consumption, due to come into effect in May 2013 and a minor increase in efficiency from 78 to 80%. These requirements, for most manufacturers, do not require a major redesign of furnaces. Many, but not all, furnace manufacturers have had to redesign their furnaces as a consequence of air conditioner standards, redesigns that had no effect on furnace efficiency and were extraneous to the normal furnace design cycle. Meeting the 13 SEER air conditioner standard typically required larger coils for both the indoor and the outdoor units in an air conditioner. Depending on the original cabinet and other characteristic for a furnace, the need for larger coils forced some manufacturers to redesign their furnaces into smaller units so that the combination of the furnace, the indoor air conditioner coil and the associated duct work would fit into a typical indoor utility space. Changing from R-22 to R-410A refrigerant involves operations at higher pressures that also caused some manufacturers to redesign furnace units to accommodate different coils and other components. Redesigns for either or both of these air conditioner related factors were incremental actions unrelated to normal product development and to furnace efficiency. The total engineering cost to the industry for this redesign process was approximately $25 million, excluding any related capital expenditures.

Complying

The situation for furnaces is virtually identical to that for residential air conditioners and heat pumps. AHRI and its predecessors have maintained a testing and certification program for years. Recently DOE is proposing to change the number of required tests and various other aspects of the certification process. There are also disconnects in reporting between AHRI, DOE, EPA and FTC for their various certification programs. Finally, any extra product redesign that occurred as a result of air conditioner changes added an additional round of initial compliance testing.

There are, in total, approximately 75% as many basic furnace models as there are residential air conditioner and heat pump models. Therefore, the total industry-wide cost of testing and submittals for furnaces is somewhat lower than for air conditioners and heat pumps, approximately $8 million for initial testing of a new product design to demonstrate initial compliance. The annual industry-wide cost of testing to demonstrate continuing compliance is $6-8 million per year including internal costs and fees to AHRI for its certification program. The industry-wide cost of recordkeeping and managing submittals is similar to air conditioners and heat pumps as these activities are not related to the number of models or units – $2-3 million per year. Thus the total continuing costs for all manufacturers under the current approaches are approximately $8-11 million per year. Of this, approximately $1-2 million annually is due to overlapping or uncoordinated programs requiring different tests or submittals. Given that there was an extra
round of product designs for some manufacturers in the period from 2006-2013 due to air conditioner standards, the manufacturers incurred an addition cost of $8 million for that additional initial product certification and testing.

Commercial Unitary Air Conditioners & Related Equipment

The regulatory process for commercial unitary air conditioners and related equipment covers multiple equipment capacities and equipment types. Some of the products are, essentially, extensions of residential air conditioners and heat pumps. Some are similar technologies but in different configurations and larger capacities (so called small, large and very large packaged units). In addition, there are technology variations in how heat is dissipated in the cooling process (air, water or evaporative cooling) and there is a range of specialty products. The complexity of product configurations, sizes and technologies has led to a different regulatory structure than for home appliances, residential air conditioners and heat pumps and furnaces.

Commercial heating and cooling equipment has been covered by a set of consensus-based standards produced by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) as Standard 90.1 and its predecessor Standard 90. These have set minimum heating and cooling equipment standards since the initial adoption of ASHRAE 90 in 1975. The DOE standard setting process is designed to use the ASHRAE standards as the model and to adjust the federal standards congruently with changes in those from ASHRAE. The intention is to base the federal standard on the ASHRAE efficiency levels and testing approaches under most circumstances. The most recent updates of the AHSRAE 90.1 standards came in 2004, 2007 and 2010 and these have been the foundation for the DOE regulatory process in subsequent years.

The total cost to manufacturers of monitoring and participating, designing and complying with these regulations as well as EPA requirements for HCFC R-22 phase out and Energy Star labeling has been $34 million from 2006 to the first quarter of 2013 (Table 3).

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5 Most residential air conditioners and heat pumps are “split systems”, the compressor unit is outside the house and the fan is inside. For regulatory purposes, commercial equipment is “packaged”; all of the components are in one box.
Table 3: Costs of Regulations for Commercial Air Conditioner and Related Equipment Manufacturers (2006 – Q1 2013)

<table>
<thead>
<tr>
<th></th>
<th>Monitoring &amp; Participating</th>
<th>Designing</th>
<th>Complying</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFC Phase Out</td>
<td>$2.1 Million</td>
<td></td>
<td></td>
<td>$2.1 Million</td>
</tr>
<tr>
<td>Test Procedures</td>
<td>$2.1 Million</td>
<td>$10 Million</td>
<td></td>
<td>$12.1 Million</td>
</tr>
<tr>
<td>Standards</td>
<td>$1.6 Million</td>
<td></td>
<td>$10 Million</td>
<td>$11.6 Million</td>
</tr>
<tr>
<td>Labels</td>
<td>$2.1 Million</td>
<td></td>
<td></td>
<td>$2.1 Million</td>
</tr>
<tr>
<td>Compliance Procedures</td>
<td>$3.5 Million</td>
<td>$2.5 Million</td>
<td></td>
<td>$6.0 Million</td>
</tr>
<tr>
<td>Total</td>
<td>$11.4 Million</td>
<td>$10 Million</td>
<td>$12.5 Million</td>
<td>$33.9 Million</td>
</tr>
</tbody>
</table>

Monitoring and Participating

The DOE agenda since 2006 for commercial equipment has been driven largely by statutory requirements and by the need to conform the federal regulations to the ASHRAE standards. The EPA phase-out of HCFC R-22 and the prohibition of manufacturing pre-charged products containing HCFC R-22 in 2010 have affected the commercial air conditioning and heat pump manufacturers as they have the manufacturers of residential equipment. In addition, DOE has proposed new testing and certification requirements that will substantially change the current testing and certification process.

In total, these actions have cost commercial air conditioner and related equipment manufacturers approximately $11 million in order to monitor and participate in the process. This is slightly lower than for residential air conditioners and heat pumps because the standard setting process draws more directly on ASHRAE efforts. These costs do not include the costs of participating in the ASHRAE consensus process, which largely occurred prior to 2006. However, the broader range of specialty products increases the number of manufacturers and their costs while the smaller revenue levels for most products means that the costs are a larger percentage of total revenues.

Regulatory activity was relatively high in 2006 due to initial activities on standards, testing, compliance and HCFC phase out. Activity declined from 2007 through 2010 and then increased with standards efforts to incorporate changes from ASHRAE 90.1 in 2007 and 2010. In addition, there was a significant increase in activity on testing and certification, which continues and is likely to increase above first quarter 2013 levels through an additional consensus process recently started by DOE (Figure 3):

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6 Commercial unitary air conditioner revenues are approximately 40% of residential air conditioner and heat pump revenues (Source: Current Industrial Report MA333M - Refrigeration, Air Conditioning, and Warm Air Heating Equipment)
The commercial air conditioning sector contains many manufacturers of specialty products who have limited revenues in this arena (some may be portions of larger companies but the resources available for participating in regulatory activities remain limited). As such, these companies have both constrained budgets and small technical staffs who have little time available for participation in regulatory activities.

**Designing**

The cost of designing equipment to meet DOE, EPA and other energy and environmental standards has not been a significant incremental burden on commercial air conditioner and related equipment manufacturers in the period from 2006 through 2012. Coincidentally the normal product cycles, ASHRAE/DOE regulatory cycles and the HCFC phase out have been in synchronicity with each other during this period. The HCFC phase out in 2010 came at the same time as the effective date of several ASHRAE standard levels and preceded others by a year. While the cost of redesigning equipment for HCFC phase out approached $100 million for the industry as a whole, this generally could be incorporated within the normal design cycle. There is some fall-out of the regulatory process that causes redesign of products not covered by DOE standards that, for commercial reasons, need to be coordinated with the covered products. This added design cost was approximately $10 million.

While it is not possible to quantify, the more significant issue in the design process for commercial unitary and related air conditioning equipment is the diversion of engineering resources from product features to energy efficiency and HCFC phase
out. This effect is true across all types of equipment, and is particularly noticeable in commercial equipment because of the inability to afford design time given the more limited revenue levels. In addition, the commercial sector has a wider range of customization in the products sold, with more actual options for product features (many of which would save energy).

Additionally, DOE has announced potential rulemakings on both commercial cooling and commercial heating products – if these are not coordinated well, design changes required by one mode could affect the performance of the other mode, causing either two rounds of design changes or not correctly analyzing the cost of the product changes for compliance.

**Complying**

The major issue during the period from 2016 through 2013 for manufacturers of commercial air conditioners and related equipment has been the process (and, thus, the cost) of demonstrating compliance with energy and environmental regulations. Traditionally, commercial air conditioning equipment was tested and certified through the industry-sponsored program operated by AHRI. This set testing levels for basic equipment configurations and included a range of product customization without the need for additional testing. Since most commercial air conditioning equipment is specified for a specific project and includes an individualized set of options, this testing and certification program accommodated the realities of production.

DOE is proposing to substitute a new set of testing and compliance procedures for the traditional AHRI program. In the proposals adopted to date (but currently with implementation on hold), the definition of a basic model is tightened in such a way that the number of basic models produced by a manufacturer will increase exponentially. For example, one manufacturer estimates that the number of basic models of commercial air conditioners and heat pumps it produces will expand from under one hundred to, theoretically, millions or more. Potentially, each equipment order will be an individual model (or several) and will require individual testing. In some cases, a requirement to test two units would exceed the number ordered and produced. The total costs of such a requirement would be $10-15 million per year and, moreover, would place significant delays on shipments of products while they await testing.

As a partial alternative to this testing regime, DOE is proposing that manufacturers could adopt Alternative Efficiency Determination Methods (AEDMs) in order to determine the energy consumption of commercial air conditioning equipment. While some manufacturers have AEDMs at the current time, most will need to develop them. The total cost for developing such AEDMs, including internal time and external software support will be $2-3 million.
Future Costs

Based on the statutory requirements and DOE's announced plans, the cost of monitoring and participating in the development of future regulations will total approximately $30 million from the second quarter of 2013 through 2015 (Table 4):

Table 4: Projected Future Costs for Monitoring and Participating in Standards Activities (Q2 2013 through 2015)

<table>
<thead>
<tr>
<th>Program</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Central Air Conditioners and Heat Pumps</td>
<td></td>
</tr>
<tr>
<td>Off-Mode Test Procedures</td>
<td>$2.4 million</td>
</tr>
<tr>
<td>Furnaces</td>
<td></td>
</tr>
<tr>
<td>Condensing AFUE Test Procedure</td>
<td>$2.4 million</td>
</tr>
<tr>
<td>Furnace Fan Test Procedure</td>
<td>$2.4 million</td>
</tr>
<tr>
<td>Regional Furnace Standards</td>
<td>$2.1 million</td>
</tr>
<tr>
<td>Furnace Fan Standards</td>
<td>$2.1 million</td>
</tr>
<tr>
<td>Furnace Labels</td>
<td>$1.5 million</td>
</tr>
<tr>
<td>Furnace Fan Labels</td>
<td>$1.5 million</td>
</tr>
<tr>
<td>Total</td>
<td>$12.0 million</td>
</tr>
<tr>
<td>Commercial Unitary Air Conditioners</td>
<td></td>
</tr>
<tr>
<td>IEER Test Procedure</td>
<td>$2.4 million</td>
</tr>
<tr>
<td>Commercial Furnace Test Procedure</td>
<td>$2.4 million</td>
</tr>
<tr>
<td>IEER Standards</td>
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</tr>
<tr>
<td>Commercial Furnace Standards</td>
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</tr>
<tr>
<td>ASHRAE 90.1-2013 Related Standards</td>
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</tr>
<tr>
<td>Compliance Process Review</td>
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</tr>
<tr>
<td>Commercial Product Labeling</td>
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</tr>
<tr>
<td>Total</td>
<td>$14.7 million</td>
</tr>
<tr>
<td>Grand Total</td>
<td>$29.1 million</td>
</tr>
</tbody>
</table>

This compares to approximately $36 million for the period from 2006 through the first quarter of 2013, for a total of $71 million over the ten-year period. The balance is shifting with commercial products and furnaces bearing greater costs in the future relative to residential air conditioners and heat pumps (Table 5):

7 Costs based on the average costs reported by manufacturers for notices, comments and rules and the average number of each type per rulemaking from 2006 through Q1 2013
Table 5: Past and Future Costs of Monitoring and Participating in Standards Activities

<table>
<thead>
<tr>
<th>Product</th>
<th>2006-Q1 2013</th>
<th>Q2 2013-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Central Air Conditioners and Heat Pumps</td>
<td>$15.4 million</td>
<td>$2.4 Million</td>
</tr>
<tr>
<td>Furnaces</td>
<td>$9.8 million</td>
<td>$12.0 million</td>
</tr>
<tr>
<td>Commercial Unitary Air Conditioners</td>
<td>$11.4 million</td>
<td>$14.7 million</td>
</tr>
<tr>
<td>Total</td>
<td>$36.6 million</td>
<td>$29.1 million</td>
</tr>
</tbody>
</table>

Part of the issue for furnaces is the redo of the regional standards as a result of the withdrawal of the consensus standard. The costs for commercial products reflect the greater number of products that are being considered by DOE.

These costs exclude any redesign costs that might occur if any standards are out of sync with normal product lifecycles. The development of furnace fan and furnace standards creates the potential for such out of sync design requirements.

In addition to the monitoring and participation costs, there will continue to be incremental costs for monitoring and compliance activities. The current $3 million per year incremental monitoring and reporting costs incurred across all three product categories will continue until and unless reporting and testing requirements are coordinated between DOE, EPA and the FTC. These monitoring and reporting costs could escalate substantially to an additional $10-15 million per year if the current DOE proposals for commercial equipment go into effect.

Underlying Causes

The purpose of this analysis has been to identify the costs borne by manufacturers of energy and environmental regulations above and beyond the normal costs of doing business. This did not include a determination of the root causes for those costs, nor did it attempt to calculate the added costs to HVACR distributors, contractors or the impact to the end-consumer. However, it is possible to make some observations on several factors that have influence the creation of additional costs:

- Non-administrative directives: topics outside of the control of administrative agencies (DOE, EPA, etc.) such as legislative directives
- Administrative actions: actions by one administrative agency that led to additional costs
- Lack of coordination: absence off coordination between various administrative agencies
- Policy differences: policy choices by a regulator that created costs
There can be interactions between factors and more than one may be involved in any situation. Examples of each of these factors (or combinations of factors) underlie the costs identified in this paper.

Non-Administrative Directives

The spike in activities in the 2010-2012 time frame is largely due to mandates from the Energy Independence and Security Act of 2007 and the American Clean Energy Act of 2009 that contained requirements for new standards on a variety of residential and commercial products. The spike increased the costs of monitoring and participating in the regulatory process. In addition, given the broad involvement of senior management at the manufacturers, such a spike is much harder to accommodate than a steadier flow of activities.

Administrative Actions

In 2009, DOE used a consensus agreement reached by environmental groups, manufacturers and others as the basis for regional furnace standards. This consensus approach has been successful in the past as a way of developing standards. However, in this instance, DOE withdrew the consensus standard in the face of legal action, therefore initiating a new rulemaking process (one whose costs are after the timeframe of this paper). The costs of this second process will be additional ones for manufacturers and others.

Lack of Coordination

As discussed extensively in this paper, the lack of coordination between the DOE 13 SEER standard and the EPA HCFC R-22 phase out with the two requirements occurring within four years of each other, forced the manufacturers to redesign not only air conditioners and heat pumps but also furnaces within a compressed time frame and outside of the normal product design cycle. This created a significant cost for design and testing of $200+ million as well as additional capital expenditures to retool manufacturing capabilities.

Policy Differences

The decision by DOE to change its testing and certification programs has elements of administrative actions that may not be an efficient use of resources. However, the principal issue is an underlying difference on policy choices. DOE has determined that the traditional industry testing, certification and reporting practices are not acceptable and DOE has proposed alternatives. These alternatives may or may not be a useful use of DOE and manufacturer resources but the requirement to undertake the additional testing is a deliberate policy decision.
Appendix A - Cumulative Regulatory Burden - Data Collection

Purpose and Approach

The purpose of this data collection process is to develop quantitative and qualitative data on the burden caused by appliance efficiency and related regulations. We are seeking both a qualitative description of how your firm deals with the regulatory process and quantitative information on the costs of compliance. We have broken down the regulatory process into five parts:

- Monitoring and Analyzing
- Designing for Compliance
- Testing for Compliance
- Certifying and Enforcing
- Other

For each part, we would like to get a brief description of how your firm operates (dedicated staff, staff pulled in from other activities, consultants, outside testing firms, etc.) as well as how much these activities cost. Internal costs should include salaries, fringe benefits, any materials, in the case of engineering or other activities using large amounts of space, the cost of space plus any other costs your company deems relevant. External costs include all costs paid to third-parties. In all cases, we are looking for data that you have reasonably readily at hand and for reasonable estimates.

Confidentiality – all data we receive will be treated as highly confidential and will not be released except in aggregate form to anyone.

Monitoring and Analyzing

The activities in this part relate to dealing with DOE, EPA, FTC, states and other agencies’ announcements in terms of monitoring and deciding what to do. The next section on Designing for Compliance covers engineering and other activities to bring your products into compliance with any new standards. The idea is that every time one of the government agencies initiates anything (a NOPR, a revision to an NOPR, a request for data, etc.) it generates activities and costs for manufacturers. These costs could include analyzing the agency’s filing, determining its impact, preparing comments, etc.

Questions:

1. How does your firm manage this process?
   a. Who is involved?
   b. What outside resources are required?
   c. What other work is given up to respond?
2. How much does it cost you each time a governmental agency initiates a topic
   a. Where only comments are required?
   b. Where data is required?

Designing for Compliance

The activities in this part cover the actual engineering and new product introduction costs, etc., for designing products that meet any proposed testing requirements, standards, etc. It does not include the costs of testing for compliance, which is covered in the next section. We realize that the immediate answer to this question is “it depends” because the degree of product design effort can be quite variable. That said, it is important to set some parameters around the activities and costs. We also realize that the product complexity and volume differences for residential and commercial equipment may be cause significant differences in the costs. If so, please respond independently for residential and commercial products.

What we are trying to get to is that every time DOE, a state or another agency changes things, it creates a whole set of engineering and other new product introduction activities. Moreover, the closer to the start of the new product process is to the implementation date, the more this costs (expediting is inefficient and expensive). So, for example, if the EnergyStar program changes the level for EnergyStar qualification after the design process starts to meet a new DOE efficiency standard, a manufacturer might have multiple redesign efforts, at least one under a short time frame. We want to understand whether this (or similar) event has occurred and what the cost implications are.

Questions – Residential Equipment:

1. How does your firm manage this process?
   a. Who is involved?
   b. What outside resources are required?
   c. What other work is given up to respond?
2. What does it cost you for a new product design/introduction?
   a. What is the unit of measure that drives the cost (e.g. a product line, a specific model, a family of models, etc.)?
   b. Approximately how much does it cost for the product design through introduction for each unit of measure (i.e. how much does it cost for each product line that you must adapt)?
   c. What is the desired time frame for the product design/introduction process?
   d. How much does the cost change if that process is compressed? Is there some function of time that changes the cost (e.g. for each month the process is compressed, the cost increases by x%)?

Questions – Commercial Equipment:
1. How does your firm manage this process?
   a. Who is involved?
   b. What outside resources are required?
   c. What other work is given up to respond?

2. What does it cost you for a new product design/introduction?
   a. What is the unit of measure that drives the cost (e.g. a product line, a specific model, a family of models, etc.)?
   b. Approximately how much does it cost for the product design through introduction for each unit of measure (i.e. how much does it cost for each product line that you must adapt)?
   c. What is the desired time frame for the product design/introduction process?
   d. How much does the cost change if that process is compressed? Is there some function of time that changes the cost (e.g. for each month the process is compressed, the cost increases by x%)?

Testing for Compliance

The activities in this part cover the testing and other activities necessary to substantiate product performance and demonstrate compliance with DOE or other standards. This area has become more complicated, particularly for commercial equipment, with questions about the definitions of “basic models” and the availability of non-testing approaches (AEDMs and ARMs) as a means of establishing efficiency and performance. This part does not cover the costs related to enforcement after products are manufactured and put into commerce. It does include the costs of maintaining certification data systems and directories.

We recognize that the activities and costs here may be quite different for commercial and for residential equipment. Therefore, we will separate the questions into two groups, one for each type of equipment, in order to focus the discussions.

Questions – Residential Equipment:

1. How does your firm manage this process?
   a. Who is involved?
   b. Is there a dedicated group that focuses on testing for compliance or are these activities part of a more general engineering or other group?
   c. What other work is given up to respond?
   d. Do you use an Alternative Rating Method (ARM) or and Alternative Efficiency Determination Mechanism (AEDM)? Did you develop this?
   e. What outside resources are required for engineering, testing or other activities?

2. What is the magnitude of the testing and compliance process?
Questions – Residential Equipment:

1. How many basic models of residential equipment do you produce?
   a. How many distinct products are there in total that are covered by these basic models?
   b. How many times in the past five years have you had to retest or recertify any or all of your basic models? Why?
   c. Are your products covered by multiple standards requiring multiple testing on the same product? How often does this occur?

2. What does it cost you for testing and demonstrating compliance?
   a. What are your internal costs for testing and demonstrating compliance whenever such testing or other methods are required? What do those costs cover?
   b. What are your external costs? What do those costs cover?

3. What does it cost you for testing and demonstrating compliance?
   a. What are your internal costs for testing and demonstrating compliance whenever such testing or other methods are required? What do those costs cover?
   b. What are your external costs? What do those costs cover?
   c. Who is involved?

Questions – Commercial Equipment:

1. How does your firm manage this process?
   a. Who is involved?
   b. Is there a dedicated group that focuses on testing for compliance or are these activities part of a more general engineering or other group?
   c. What other work is given up to respond?
   d. Do you use an Alternative Rating Method (ARM) or and Alternative Efficiency Determination Mechanism (AEDM)? Did you develop this?
   e. What outside resources are required for engineering, testing or other activities?

2. What is the magnitude of the testing and compliance process?
   a. How many core product platforms (or AHRI basic models) of commercial equipment do you produce?
   b. How many distinct products are there in total that are covered by these basic models (essentially the DOE definition of basic model)?
   c. How many times in the past five years have you had to retest or recertify any or all of your core product platforms? Why?
   d. Are your products covered by multiple standards requiring multiple testing on the same product? How often does this occur?

3. What does it cost you for testing and demonstrating compliance?
   a. What are your internal costs for testing and demonstrating compliance whenever such testing or other methods are required? What do those costs cover?
   b. What are your external costs? What do those costs cover?
   c. Who is involved?
Certifying and Enforcing

The activities in this part cover the post-production timeframe where manufacturers need to keep records certifying compliance with standards and conducting additional testing in the event of questions relative to actual performance versus a standard. We recognize that there is a change underway in this area with DOE substituting new procedures for traditional AHRI certification processes. We are seeking to understand the cost of complying with traditional approaches and also the cost of complying with newer DOE proposals. There seem to be some start-up issues with the DOE procedures where manufacturers have had difficulties with DOE’s testing, some of which may be start-up problems for DOE’s labs. There may still be additional on-going costs once DOE works out the bugs in its system. We want to understand all three of these sets of costs (traditional approach, DOE start-up issues and expected continuing costs from new DOE procedures).

Questions:

1. How have you conducted certification in the past?
   a. Have you participated in AHRI or other certification programs? Which ones?
   b. How have you managed these activities – who is involved and how much time does it take?
   c. How much does it cost you per certification program, per basic model or other means of measurement?
   d. How much doe it cost you in total?
2. Have you had to retest products for lack of compliance reasons under these traditional certification programs?
   a. How often over the past five years?
   b. How did you manage this?
   c. What did it cost?
3. Are you now covered by new DOE testing and compliance procedures?
   a. For how much of your product line?
   b. Have you had to change the way that you manage this process internally?
   c. Has this changed you internal costs and, if so, by how much?
4. Have you had any products selected for additional testing under the DOE process?
   a. How many instances and what products?
   b. What has been the outcome of this process?
   c. How much did it cost you for any actions that you took related to this review process?
   d. What was the outcome?
Other

Are there other aspects of efficiency related regulatory burden that are not covered here? What are those issues? What have you needed to do with relationship to them? How much has it cost you? Is this a one time or a recurring cost?