The Regional Standards Agreement for Residential Furnaces, Air Conditioners, and Heat Pumps: Process, Results, and Implications

Karim Amrane, Air-Conditioning, Heating, and Refrigeration Institute
Harvey Sachs and Steven Nadel, American Council for an Energy-Efficient Economy

ABSTRACT

On October 13, 2009, HVAC equipment manufacturers and efficiency advocates signed an agreement on regional standards for residential furnaces, central air conditioners, and heat pumps. The agreement is without precedent. If accepted by Congress and the Department of Energy, it will profoundly change strategies for achieving greater energy efficiency. First, the agreement will avoid the long, expensive, and unpredictable process of a DOE rule-making, giving manufacturers predictable standards to meet with cost-effective, innovative, products. Second, the agreement will ultimately shift some enforcement responsibility from manufacturers to distributors, contractors, and local officials, because efficiency levels will vary regionally. In addition, the agreement reaches out to call for changes to building codes that will lead to more efficient structures by allowing states to increase the standards for reference buildings in new homes.

Work on the potential of regional standards began early in the decade, in a USDOE-NASEO State Technology Advancement Collaborative (STAC)-funded project sponsored by California, New York, Wisconsin, and Florida. Its results, guided by an advisory panel, led to language in the Energy Independence and Security Act (EISA) 2007 requiring DOE to evaluate the potential of regional HVAC standards. Frank, intensive, negotiations among all stakeholders accelerated in early 2009. Assuming legislative acceptance and/or a DOE implementation of the agreement in a direct final rule, the new furnace standards will take effect in 2013 and air conditioner-heat pump standards in 2015. We estimate that the proposed standards would save 3 quads of primary energy by 2030, with another 0.7 quad from the building code provisions.

Introduction

Minimum energy efficiency standards and manufacturer investments to meet and exceed them have led to enormous efficiency improvements since they were first implemented about two decades ago. For example, the lab-rated efficiency of central air conditioners has improved by more than 60%, from roughly 8 SEER (pre-1992) to 13 (effective January 23, 2006). All together, national standards on appliances and equipment have saved an estimated 2.7 quads of electricity source energy by 2010.[1] However, meeting national goals with higher performance equipment (and systems) requires standards that go beyond the "one-size-fits-all" national approach in some cases. Working together, the manufacturers of residential space-conditioning equipment and efficiency advocates reached a consensus on an alternative approach in 2009. This agreement recognizes that optimum solutions vary with climate. It also reaches beyond federal standards to propose other measures, notably building code provisions that will save additional energy.

[1] Computed from Neubauer et al. (2009), page iii.

This paper reviews the processes that led to the October 13, 2009 agreement on saving energy with standards and other measures, outlines the agreement itself, and discusses its ramifications. We emphasize that this agreement is a consensus, which is defined as a solution that all parties can accept. At the intersection of technology, market needs, and public policy, this means that no party involved got everything it wanted.

A Brief Introduction to Appliance Efficiency Standards

Standards have a long history, because they benefit both manufacturer and customer. By defining the "terms of reference" (rating methods) by which manufacturers describe performance, they establish a neutral way for manufacturers to establish value, and for their customers to judge products. Indeed, coins are an early example of standards: a defined weight of a defined purity of gold, giving both parties assurance of fair value. Today, effective standards are backed by well-defined rating methods, and by verification and enforcement mechanisms to assure that all manufacturers are presenting "honest coin" and avoiding false claims by unscrupulous competitors.

History of Appliance Efficiency Standards

The energy crisis of 1973 and the desire to reduce the energy intensity of buildings prompted the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) to launch the development of ASHRAE standard 90 (ASHRAE 1975). Through the efforts of the ASHRAE 90 committee, the first energy efficiency standards for residential and commercial heating, ventilating and air conditioning (HVAC) products were introduced in the U.S. in 1975. These standards were voluntary and covered unitary air conditioners, chillers, packaged terminal equipment, and water-source heat pumps. In 1976, the state of California prescribed the first mandatory minimum efficiency standards. These standards applied to residential appliances such as refrigerators, freezers, room air conditioners, and central air conditioners. Meanwhile, at the federal level, the U.S. Congress enacted the Energy Policy Conservation Act (EPCA) of 1975 that directed the Federal Energy Administration to establish test procedures and voluntary energy efficiency improvement targets for certain home appliances (U.S. Congress 1975). In 1978, the National Energy Conservation Policy Act (NECPA) amended EPCA and directed the U.S. Department of Energy (DOE) to establish energy efficiency standards to replace EPCA voluntary targets (U.S. Congress 1978). NECPA also preempted all state energy efficiency standards prescribed after January 1, 1978. However, it is under the National Appliance Energy Conservation Act (NAECA) of 1987 and its amendments of 1988 that minimum federal energy efficiency standards were established for several categories of residential appliances (U.S. Congress 1987). The legislation also established schedules for DOE to review these standards.

Federal Minimum Energy Efficiency Standards

EPCA, as amended by NAECA, established energy efficiency standards for 12 types of "consumer products" including residential furnaces, central air conditioners, and heat pumps. In 1987, NAECA prescribed the first federal minimum energy conservation standards as shown in Table 1. Depending on the product class, these standards became effective between January 1, 1990 and January 1, 1993.

NAECA also required DOE to update the standards and publish final rules by various dates to determine whether the standards should be amended. The dates by which DOE was required to publish final rules were January 1, 1994 and 2001 for central air conditioners and heat pumps; and January 1, 1994 and 2007 for residential furnaces. However, DOE missed most of the deadlines. In 2005, 14 states and various other entities brought suit alleging that DOE had failed to comply with statutory deadlines and other requirements. In 2006, DOE entered into a consent decree under which it agreed to publish final rules for 22 product categories by specific deadlines (U.S. District Court 2006).

Table 1: Minimum Federal Energy Efficiency Standards Enacted by the National Appliance Energy Conservation Act (NAECA) of 1987

Product Class	Efficiency		Effective Date
Residential central air conditioners and heat pumps < 65,000 Btu/h (19 kW)	Seasonal Energy Efficiency Ratio (SEER)	Heating Performance Seasonal Factor (HSPF)	
Split systems	10	6.8	1/1/1992
Single package systems	9.7	6.6	1/1/1993
Residential furnaces < 225,000 Btu/h (66 kW)	Annual Fuel Utilization Efficiency (AFUE)		
Furnaces (excluding classes noted below)	78%		1/1/1992
Mobile Home Furnaces	75%		9/1/1990
Small furnaces < 45,000 Btu/h (13.2 kW)			
(A) Weatherized	78%		1/1/1992
(B) Non-weatherized	78%		1/1/1992

The minimum federal energy conservation standards were revised in 2001 for air conditioners and heat pumps and 2007 for furnaces, as shown in Table 2. According to EPCA, any new or amended standard must be designed so as to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. In order to determine economic justification, DOE must demonstrate that the benefits of the proposed standard exceed its burdens by weighing several factors including (1) the economic impact of the standard on manufacturers and consumers; (2) the savings in operating costs throughout the estimated average life of the covered product; (3) the total projected amount of energy savings likely to result directly from the imposition of the standard; (4) any lessening of the utility or the performance of the covered products likely to result from the imposition of the standard; (5) the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard; (6) the need for national energy and water conservation; and (7) other factors the Secretary of Energy considers relevant.

Table 2: Revised Minimum Federal Energy Efficiency Standards

Product Class	Efficiency		Effective Date
Residential central air conditioners and heat pumps < 65,000 Btu/h (19 kW)	Seasonal Energy Efficiency Ratio (SEER)	Heating Performance Seasonal Factor (HSPF)	
Split systems			
Single package systems	13	7.7	1/23/2006
Through-the-wall split systems	10.9	7.1	1/23/2006
Through-the-wall split systems*	12.0	7.4	1/23/2010
Through-the-wall single package	10.6	7.0	1/23/2006
Through-the-wall single package*	12.0	7.4	1/23/2010
Space constrained products	12	7.4	1/23/2010
Residential furnaces < 225,000 Btu/h (66 kW)	Annual Fuel Utilization Efficiency (AFUE)		
Weatherized gas furnaces			11/19/2015
Non-weatherized gas furnaces	81%		11/19/2015
Mobile Home gas furnaces	80%		11/19/2015
Oil-fired furnace	80%		11/19/2015
	82%		

* Applies to products with a cooling capacity less than 30,000 Btu/h manufactured prior to January 23, 2010. Through-the-wall products manufactured after January 23, 2010 must meet the requirements for space constrained products.

However, these revisions were not completed without controversy. For residential central air conditioners and heat pumps, the final rule published during the last days of the Clinton Administration was withdrawn by the Bush Administration on the basis that the standards were not economically justified. A new rule was published a year later setting the federal standard at a lower level (i.e., 12 SEER/7.4 HSPF instead of 13 SEER/7.7 HSPF). However, the final rule was challenged in court by the National Resources Defense Council (NRDC), nine states, and several other entities, and the 13 SEER/7.7 HSPF standard was reinstated by the U.S. Court of Appeals.[2] Although the standard has been in effect for just about four years, a new rulemaking was started in 2008 and, according to the schedule laid out by DOE, will be completed in June 2011. Those new standards will become effective in 2016.

The final rule updating the minimum federal energy conservation standards for residential furnaces was published in November 2007 and was immediately challenged in court by NRDC and several states claiming that the standards were not stringent enough. In 2009, DOE filed a motion for voluntary reconsideration of the furnace finale rule. The motion was granted by the court and DOE has announced that a new final rule will be published in May 2011 (U.S. Department of Energy 2010).

Limitations of Standards

Efficiency standards are models of how a product will perform when tested under prescribed lab conditions that are chosen to indicate how the product is likely to perform in a field application. For example, the seasonal energy efficiency ratio of central air conditioners is

[2] The history is summarized in U.S. Department of Energy (2006).

deemed to be a suitable measure for comparing the relative performance of covered products under a wide variety of typical operating conditions.

Models simplify reality. Because efficiency ratings and standards require guarantees of performance, adding tested parameters increases the burden for certification — and can increase the number of ways that a product can fail to comply. So, there is pressure to keep testing simple. On the other hand, there is pressure for more rating points and more sophisticated testing, to better describe performance expectations over a range of operating conditions.

In the United States, standards set under NAECA and the Energy Policy Acts of 1992 and 2005 govern the minimum efficiency levels of covered products sold in the United States. But, increasing stringency is not the only way to save energy. Other routes include voluntary programs (such as ENERGY STAR), building codes, and better equipment installation. The expected life of a building is many times the service life of equipment, so many jurisdictions want "green" standards that go beyond the national minima.

The process for setting appliance standards has inherent stress. The law requires that standards be set at the level that achieves the maximum improvement in energy efficiency that is technologically feasible and economically justified. For many products, there are absolute ceilings for performance as measured; a condensing furnace cannot achieve AFUE $\geq$ 100%, but efficiency is a large part of the value proposition for marketing furnaces. As the federal standards become more stringent, there is less headroom to differentiate premium products on the basis of efficiency. Anticipated lower returns on investment would discourage research and development of more efficient products and affect profitability. Finally, as equipment performance improves, it is increasingly difficult to optimize equipment for the broad range of climates in the United States.

Historically, the standards-setting process has been expensive, drawn-out, and unpredictable. Over the years, ever more elaborate and detailed analyses have been added to justify decisions that were strongly influenced by political positions of successive Administrations. For example, in 2002 the Bush Administration attempted to replace the last-minute Clinton 13 SEER rule with a 12 SEER rule. As noted above, this was rejected by a federal court, leading to a revised 2004 rule setting 13 SEER.

The Residential Regional HVAC Standards

Getting to Yes

Climate varies enormously in the United States, from frigid Minneapolis to almost tropical Mobile, and from arid Arizona to the humid Southeast. National efficiency standards are important, but regional approaches that increase stringency only where seasonal climate is severe might offer greater savings yet. Work on the potential of regional standards began early in the decade, in a USDOE-NASEO State Technology Advancement Collaborative (STAC)-funded project sponsored by California, New York, Wisconsin, and Florida. Its results, guided by an advisory panel, led to papers and presentations on the potential for regional air conditioner standards (Henderson and Sachs 2006; Sachs et al. 2007). Language in the Energy Independence and Security Act (EISA) 2007 required DOE to evaluate the potential of regional HVAC standards.

In addition, the concurrent rulemaking for furnaces had considered whether a condensing standard (AFUE 90) would be cost-effective for gas-fired furnaces nationally. Furnace standard

discussions between manufacturers and energy efficiency groups began in the spring of 2008, but they did not reach a consensus. In 2008 the Gas Appliance Manufacturers Association (GAMA) merged with the Air-conditioning and Refrigeration Institute (ARI) to form the Air-conditioning, Heating, and Refrigeration Institute (AHRI), a single trade association representing both product classes (which were largely produced by the same manufacturers). This facilitated expanding the conversation to include central air conditioners in the fall of 2008. The American Council for an Energy-Efficient Economy (ACEEE) was the lead group for states and advocates. Almost a year later, following very challenging negotiations, compromises by all participants resulted in an overall agreement. The consensus was reached in July 2009 and announced at a public event on October 13, 2009.

The discussions focused on empirically-based proposals that relied on industry shipment data and models listed in the AHRI directory of certified equipment. Shared spreadsheet models allowed the parties to estimate changes in energy savings with various alternatives built on these data. This allowed advocates to focus on cumulative energy savings and gave industry flexibility in seeking standards that met its needs. Importantly, this approach helps demonstrate that the agreement is technologically feasible and economically justified, applying the relevant criteria in EPCA.

The interested parties shared several hopes for the process: First, we thought that a successful negotiation would allow DOE to proceed to a proposed and final rule more quickly than through the normal, more adversarial procedures. Second, informal discussions allow stakeholders to develop creative approaches, both regulatory and non-regulatory, which are more difficult to develop and discuss in normal notice and comment rulemaking. Third, DOE encouraged stakeholders in the past to consider informal discussions that could result in a consensus agreement. Furthermore, in 2007, Congress amended EPCA to expedite the rulemaking process by authorizing DOE to issue direct final rules establishing new energy conservation standards upon receipt of joint stakeholders' proposals.

The Regional Agreement Provisions

The agreement divides the U.S. into three regions: (1) the North, comprising states with population-weighted heating degree days (HDD) equal to or greater than 5,000; (2) the South, comprising states with population-weighted HDD less than 5,000; and the Southwest (see Figure 1). Table 3 depicts the proposed consensus federal minimum energy efficiency standards. In the North, most furnaces will be required to have an efficiency of 90%, vs. 78% today. In the South, central air conditioners will be required to have a minimum SEER of 14, vs. 13 SEER today. Heat pump and oil furnace standards will rise nationwide, for reasons explained later. The standards apply to residential single-phase air conditioners and heat pumps less than 65,000 Btu/h of cooling capacity,[3] and single-phase weatherized and non-weatherized forced-air furnaces (including mobile home furnaces) below 225,000 Btu/h heat input. For split air conditioners, minimum EER values also are specified for the states of Arizona, California, Nevada, and New Mexico, making a third region for these products.

[3] Except through-the-wall and small duct high velocity products, which are not included in this agreement.

Figure 1: Regional Efficiency Map

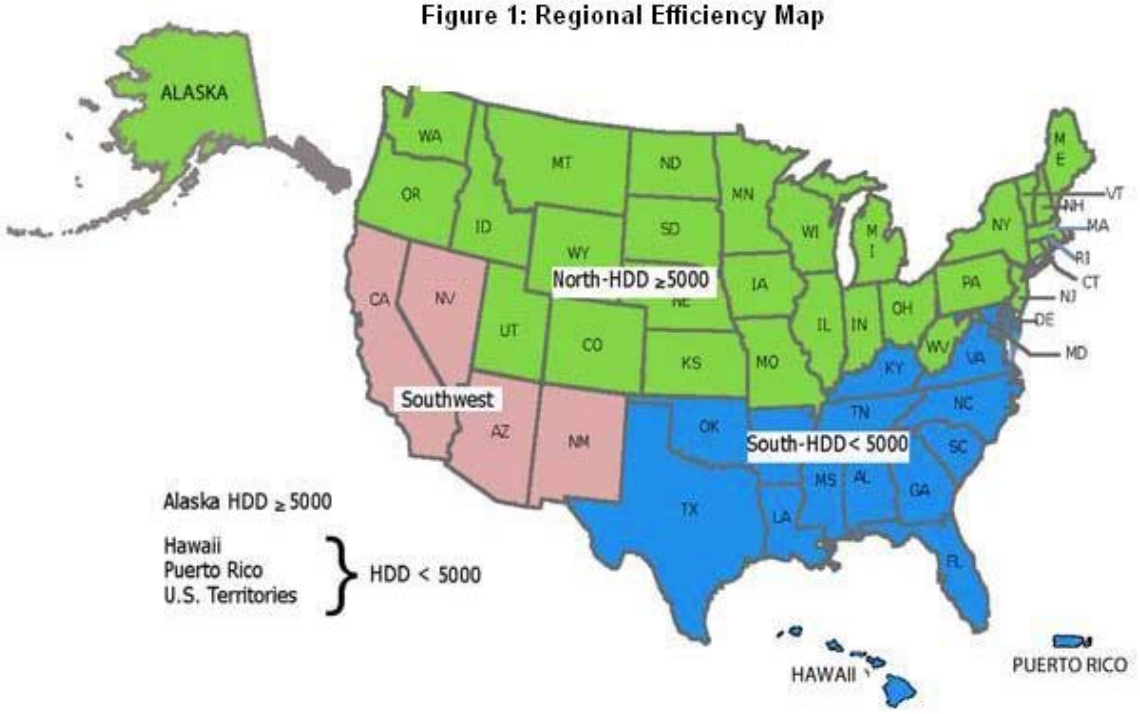

Table 3: Proposed Minimum Federal Standards

System Type	≥ 5,000 HDD	< 5,000 HDD	CA/AZ/NM/NV
Split A/C	13 SEER	14 SEER	14 SEER /12.2 EER <45,000 Btu/h 14 SEER /11.7 EER ≥45,000 Btu/h
Split HP	14 SEER /8.2 HSPF	14 SEER /8.2 HSPF	14 SEER /8.2 HSPF
Package A/C	14 SEER	14 SEER	14 SEER/11.0 EER
Package HP	14 SEER/8.0 HSPF	14 SEER/8.0 HSPF	14 SEER/8.0 HSPF
Gas-Pack (weatherized)	14 SEER/81% AFUE	14 SEER/81% AFUE	14 SEER/81% AFUE
Gas Furnaces (non-weatherized)	90% AFUE	80% AFUE	80% AFUE
Oil Furnaces (non-weatherized)	83% AFUE	83% AFUE	83% AFUE

Note: SEER = seasonal energy efficiency ratio; EER = energy efficiency ratio; HSPF = heating seasonal performance factor; and AFUE = annual fuel utilization efficiency.

The proposed standards will take effect in 2013 for non-weatherized furnaces, two and a half years ahead of the effective date of the 80% AFUE standard published by DOE in 2007 (U.S. Department of Energy 2007) and several years ahead of the new standards that DOE intends to promulgate by May 1, 2011.[4] For central air conditioners, heat pumps, and weatherized furnaces, the standards will take effect in 2015, a year ahead of the planned effective date under the current DOE rulemaking. As part of the agreement, we recommend that the effective date for the next DOE rulemaking iteration of the above standards will be January 1, 2019 for non-weatherized furnaces and January 1, 2022 for air conditioners/heat pumps and weatherized furnaces. This schedule represents a substantial acceleration of the next effective

[4] On April 15, 2009, DOE filed a motion with the Second Circuit Court of Appeals for voluntary remand of the final rule on residential furnaces indicating that it will publish a revised final rule no later than May 1, 2011.

dates relative to the dates by which DOE would be statutorily required to complete and implement the next final rule. These accelerated effective dates have the potential to result in considerable additional savings.

The consensus agreement also includes two additional features that increase energy savings. First, the consensus agreement sets new construction/major renovation standards for each region that states may incorporate into their building codes. These are summarized in Table 4. It also would seek amendments to EPCA to allow building codes to provide for building energy budgets and baseline building designs to include covered equipment having an efficiency greater than the federal minimum standard, up to specified levels, as long as at least one option is made available to meet the code through the use of covered equipment at the federally established minimum level. The building code provision alone is expected to save an additional 0.7 quads of primary energy by year 2030.

Second, the agreement calls on DOE, as part of the next rulemakings on central air conditioners and furnaces, to convene meetings of interested stakeholders to develop consensus regarding adding additional energy efficiency metrics for central air conditioners, heat pumps, and furnaces. In the event that consensus is not reached within one year, DOE will have the authority to consider additional efficiency metrics, provided that DOE concludes that the benefits of adding one or multiple metrics substantially exceed the burdens.

Table 4: Energy Efficiency Standards for Building Codes (for New Construction and Significant-Upsizing Only)

System Type	≥ 5,000 HDD	< 5,000 HDD	CA/AZ/NM/NV
A/C	14 SEER	15 SEER	15 SEER/12.5 EER <45,000 Btu/h 15 SEER/12.0 EER ≥45,000 Btu/h
HP	15 SEER/8.5 HSPF	15 SEER/8.5 HSPF	15 SEER/8.5 HSPF
Gas Furnaces	92% AFUE	90% AFUE	92% AFUE
Oil Furnaces (non-weatherized)	85% AFUE	85% AFUE	85% AFUE

These building code provisions require Congressional action and the signatories to the agreement have agreed to jointly advocate these legislative changes.

One other provision has attracted less attention, but has high potential. Under "Sensible Heat Ratio and Product Performance Data by Bin of the agreement," "…manufacturers agree to make the sensible heat ratio (SHR) at 82ºF (at the rated airflow) available in their technical literature and websites, so as to make these data more accessible to contractors and consumers. However, the SHR will not be verified or certified by AHRI. Manufacturers also agree to make available to contractors, program operators and software vendors estimated equipment performance data as a function of temperature bin, so that equipment performance can be modeled using local weather data." This provision is intended to help contractors to choose the most appropriate equipment for each customer, by facilitating energy modeling to complement load calculations. It should support their efforts to more accurately estimate energy costs for alternative solutions and to present "good-better-best" model presentations for their customers.

Discussion

What Are the Benefits?

There are several notable benefits and features of this agreement. By proposing standards for residential furnaces and central air conditioners with respective effective dates of 2013 and 2015, the proposed standards will start saving energy several years ahead of any standards established under the schedule that would apply if DOE adhered to the specific lead times in the statute.[5] In addition, the agreement strikes a balance between the desire for greater state and regional flexibility and the need for a uniform marketplace. Also, manufacturers will have at least three years to prepare for these major changes. A preparation period of this length is particularly important in light of the challenges many of these manufacturers are facing as they prepare for the phase out of R-22, the most common refrigerant in residential air conditioners and heat pumps, and for new standards on commercial air conditioners and heat pumps, both happening in 2010. With this timing, the significant investment and redesign can be addressed after the major 2010 changes are implemented, thus allowing time and resources for manufacturers to innovate and optimize products and processes to meet the standard. The levels of the proposed standard have been chosen in order to maintain the diversity of design approaches and engineering flexibility. The proposal is fully consistent with the requirements of EPCA and represents the maximum standards that are technological feasible and economically justified. For manufacturers, the consensus has an additional virtue: early agreement on standards that will be stable for about a decade yields predictability that helps justify investments in advanced technologies and manufacturing methods.

According to our analysis, the proposed standards would save approximately 3 quads of primary energy by 2030 equivalent to all the energy consumed by approximately 18 million households in a single year, or enough to meet the annual energy needs of either Georgia, Massachusetts, Michigan, Missouri, North Carolina, or Virginia.

These energy savings will result in annual greenhouse gas emission reductions of about 18 million metric tons of carbon dioxide in 2030, an amount equal to that produced by approximately 3.3 million cars every year. Under the agreement, the new standards would raise the minimum efficiency of residential central air conditioning systems in the South by about 8 percent and furnaces in the North by about 13 percent, and would result in a 5 percent reduction of the total heating energy consumption and a 6 percent reduction of the total cooling energy consumption in 2030. The benefits of the proposed standards through energy savings and reduced operating costs over the average estimated life of the covered product exceed the burdens of increase in price to the greatest extent practicable. The new standards are projected to save U.S. consumers about $13 billion in today's dollars between 2013, when the new standards begin to take effect, and 2030 — taking into account the incremental cost of the more efficient equipment.

We are also pleased that this consensus extends the discussion of energy savings from equipment standards to venues such as building codes. These codes, unlike equipment standards, can incorporate features such as installation quality. Just eliminating duct leakage and properly

[5] By law, this iteration of furnace standards "shall apply to products manufactured on or after January 1, 2002" and this iteration of the air conditioner standard "shall apply to products manufactured on or after January 1, 2006." DOE has in the past sought to maintain the lead time between final rule and compliance date, even when final rules are late. We believe, in this instance, that the statute permits the lead time we recommend.

insulating ducts may decrease energy use by at least 20 (ASHRAE 2004), and this is within the realm of Code authority (CEC 2005).

Finally, this agreement will reduce the burden on the Department of Energy's standards group, which is under court order to catch up with respect to an enormous backlog of overdue rulemakings.

What Are the Adoption Risks?

This consensus agreement is likely to be adopted, but the Department has legal authority to reject it. Although the signers represent a diverse array of interests who have pledged to support it at DOE and in Congress, there is a possibility that non-signatories could delay or prevent adoption.

We also believe that Congress will adopt the enabling legislation for the building code provisions, because they comport well with the intentions of the code authorities to adopt energy-saving provisions. However, the code authorities, with the exception of the California Energy Commission, were not involved in the agreement. We do not expect that this will ignite a "turf war" that would distract Congress from the importance of the opportunity.

Are There Implementation Risks?

The regional residential HVAC agreement embodies a huge conceptual shift for equipment efficiency standards. Uniform national standards make it illegal to sell non-complying equipment, whether imported or manufactured domestically. Regional standards cannot be enforced at the manufacturer level: for example, a non-condensing 80% AFUE furnace that is legal in the South is not legal in the North, under this agreement. Manufacturers do not sell to consumers, but (generally) sell to distributors who sell to contractors who sell to end-users and install the equipment. The manufacturer only knows where the unit is installed if the warranty is registered.

Thus, responsibility for enforcing the regional codes will fall to state and local government, particularly to code officials. Under the "stimulus" bill of 2009, efforts are being made to help states with compliance and enforcement. Licensing of HVAC contractors is not universal, so there remains some risk that some units will be installed "off the books" by unlicensed contractors buying from unscrupulous distributors or manufacturers. DOE is to carry out a separate proceeding on enforcement that will address these issues.

Although manufacturers fully support this agreement, they remain concerned about another issue: will increasing efficiency lead to higher costs that lead more customers, particularly landlords, to elect equipment repair instead of replacement with new, much higher efficiency units that are properly installed? Appropriate financing programs will help address this potential problem, and it is recognized as a transient issue (even repaired units are eventually replaced), but answers are not yet clear.

It has long been recognized that poor installations can defeat the best efforts of manufacturers to design and produce more efficient equipment. All parties expect that this agreement will help strengthen the contracting industry. The agreement on engineering data will help contractors provide differentiated service to their customers, supporting quality installation

(Air Conditioning Contractors of America 2007). Also, devolution of enforcement to code officials may yield greater scrutiny of all installations, improving the quality of systems in the field.

Summary

In a profound departure from past practice in which an adversarial DOE process yielded unpredictable efficiency standards that did not satisfy participants on any side, manufacturers, state agencies, and environmental advocates succeeded in reaching a consensus on a suite of measures to improve the delivered efficiency of residential furnaces, air conditioners, and heat pumps. To the extent possible, the work was built on empirical data, including shipment data and spreadsheets estimating savings from alternative approaches. One novel and important element was the commitment to work together for additional savings through building code changes, savings that could not be accomplished through the DOE rulemaking process. In time, we believe that this agreement will help effective contractors differentiate their businesses, further increasing savings from quality installation and maintenance. We also believe that the advantages to all parties, including customers, will commend this model for consideration for standards for other products.

References

Air Conditioning Contractors of America. 2007. *ANSI/ACCA 5 QI-2007 HVAC Quality Installation Specification – Residential and Commercial Heating, Ventilation, and Air-Conditioning (HVAC) Applications.* Arlington, Va.: Air Conditioning Contractors of America.

American Society of Heating Refrigerating, and Air Conditioning Engineers (ASHRAE). 1975. *Standard 90, Energy Conservation in New Building Design.* Atlanta, Ga.: American Society of Heating Refrigerating, and Air Conditioning Engineers.

———.. 2004 ASHRAE Handbook – HVAC Systems and Equipment, page 9.3

California Energy Commission (CEC) 2005. "2005 HVAC Change-Out Information," http://www.energy.ca.gov/title24/changeout/ and "Letter to Homeowners," http://www.energy.ca.gov/title24/changeout/2005-08-02_NEW_DUCT_REQUIREMENTS.PDF.

Henderson, H.I. and H. Sachs. 2006. "The Efficacy of SEER as a Performance Measure for Humid Climates." 15th Symposium on Improving Building Systems in Hot and Humid Climates, Orlando, Fl.: July 24–26.

Neubauer, Max, Andrew deLaski, Marianne DiMascio, and Steven Nadel. 2009. *Ka-BOOM! The Power of Appliance Standards: Opportunities for New Federal Appliance and Equipment Standards.* ACEEE Report A091. Washington, D.C.: American Council for an Energy-Efficient Economy.

Sachs, H.M, H. Henderson, D. Shirey, III, and S. Nadel. 2007. *Improving Central Air Conditioner Performance Ratings: A Review of Seasonal Energy Efficiency Ratings (SEER).* ACEEE Report A071. Washington, D.C.: American Council for an Energy-Efficient Economy.

U.S. Congress. 1975. *Energy Policy and Conservation Act, Public Law 94-163.* Washington, D.C.: U.S. Government Printing Office.

———. 1978. *National Energy Conservation Policy Act, Public Law 95-619.* Washington, D.C.: U.S. Government Printing Office.

———. 1987. *National Appliance Energy Conservation Act, Public Law 100-12.* Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Energy. 2004. "Energy Conservation Program for Consumer Products: Central Air Conditioners and Heat Pumps Energy Conservation Standards." *Federal Register* 69 (158), August 17, Rules and Regulations 50997 – 51001.

———. 2007. *Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers.* 72FR65136. November 19.

———. 2010. *Energy Conservation Standards for Residential Furnaces Rulemaking Analysis Plan RIN: 1904-AC06.* http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/furnaces_framework_rap.pdf.

U.S. District Court. 2006. *Consent Decree. Consolidated Civil Actions No. 05 Civ 7807 (JES) and No. 05 Civ. 7808 (JES).* April 6. Southern District of New York.