THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine
Board on Energy and Environmental Systems

May 15, 2009

Dr. John Mizroch
Acting Assistant Secretary
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
1000 Independence Avenue SW
Washington, DC 20585

Dear Dr. Mizroch:

In response to a request from the Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), the National Research Council (NRC) appointed the Committee on Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards to conduct a study called for in Section 1802 of the Energy Policy Act of 2005 (Public Law 109-58).

As specified in Attachment A of this letter report, the fundamental task before the committee was to evaluate the methodology used for setting energy efficiency standards and to comment on whether site (point-of-use) or source (full-fuel-cycle) measures of energy efficiency better support rulemaking to achieve energy conservation goals. As suggested by Senator Gordon H. Smith (see Attachment B), the committee adopted a broad view of its mandate, taking into account concerns about energy consumption's impact on national security, the environment, and climate change. Currently DOE rulemaking for appliance energy efficiency is based on site measurement of energy consumption to set efficiency standards and extended site measures of energy consumption to assess national energy consumption and environmental impact. However, full-fuel-cycle measurement of energy consumption is not employed in DOE analyses.

The committee met three times and heard presentations from representatives of the electric and natural gas utilities, appliance manufacturers, and the government agencies participating in the various aspects of the appliance standards program. In addition, the committee examined the data and analysis presented in various technical support documents and studies of energy efficiency and measurement of energy use.

The committee's primary general recommendation is that DOE/EERE consider moving over time to the use of a full-fuel-cycle measure of energy consumption for assessment of national and environmental impacts. Using that metric would provide the public with more comprehensive information about the impacts of energy consumption on the environment, the economy, and other national concerns, through the use of labels and other means such as an enhanced website. The current use by DOE/EERE of site energy consumption is effective for setting standards for the operational efficiency of single-fueled appliances within the same class and should be continued without change. However, DOE/EERE's current use of site energy consumption does not account for the total consumption of energy when more than one fuel is used in an appliance or when more than one fuel can be used for the same application. For these appliances, measuring full-fuel-cycle energy consumption would provide a more complete picture of energy used, allowing comparison across many different appliances as well as an improved assessment of impacts such as effects on energy security and the environment. The attached letter report discusses these matters and offers several related findings and recommendations together with supporting information.

Despite its best efforts to come to a full consensus, the committee was unable to achieve unanimous agreement on some of its majority views. The perspectives of committee members David H. Archer and Ellen Berman are presented in Attachments H and I and are referred to at points in the text of the committee's report.

The National Research Council was pleased to have this opportunity to serve DOE/EERE. If you have questions, please contact James Zucchetto, director of the Board on Energy and Environmental Systems, at (202) 334-3222 or Duncan Brown, senior program officer, at (202) 334-1202.

Sincerely,

James W. Dally, *Chair*
Committee on Point-of-Use and Full-Fuel-Cycle
Measurement Approaches to Energy Efficiency
Standards

Review of Site (Point-of-Use) and Full-Fuel-Cycle Measurement Approaches to DOE/EERE Building Appliance Energy-Efficiency Standards

COMMITTEE TASK AND APPROACH

In response to a request from the Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), the National Research Council's (NRC's) Committee on Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards examined the DOE's appliance standards program to assess whether the goals of energy efficiency standards are better served by measurements of energy consumed, and improvements in energy efficiency, at the actual site (point of use) of energy consumption or throughout the full fuel cycle, beginning at the source of energy production. The full statement of task is given in Attachment A, and a related request encouraging a broad approach to consideration of these issues is reproduced in Attachment B.

The committee gathered information during presentations at its three meetings (see Attachment C) and from a variety of published documents. These included a report by the Rand Corporation that investigated, at the request of the Office of Science and Technology Policy and EERE, the impacts of measuring energy consumption at the site of use versus the source (Ortiz and Bernstein, 1999) and a report by GARD Analytics (2005) commissioned by the American Gas Foundation. The key points of these two studies are summarized in Attachment D. The committee also considered DOE test procedures codified in the Code of Federal Regulations at 10 CFR Part 430; technical support documents developed for recent rulemakings for such products as distribution transformers and residential furnaces and boilers; and written material provided directly to the committee (see Attachment E).

DISCUSSION AND ANALYSIS

DOE/EERE Standards Setting for Appliances

The DOE/EERE appliance standards program is intended to reduce energy consumption in U.S. residential and commercial buildings (which account for 40 percent of the nation's primary energy use and 70 percent of its electric power use [DOE/EIA, 2008, Table 2-1a]). It does so by setting efficiency standards for appliances that perform specific functions (such as space cooling, water heating, or dishwashing), dividing the appliances into classes differentiated by their energy source (natural gas, oil, or electric power), technology, and capacity. Most of the energy consumed in a building passes through these appliances, and their efficiency is therefore highly important. Even seemingly small differences in energy efficiency can become significant when considered on a national scale.

Since Congress passed the Energy Policy Conservation Act of 1975, DOE has established several standards that have led to improved energy efficiency for light bulbs; appliances such as refrigerators, washing machines, air conditioners, storage water heaters, and furnaces; and motors and other devices. As a result, consumption of electricity, natural gas, heating oil, and other forms of energy has been reduced for each unit of service an appliance provides (NRC, 2001; Meyers et al., 2003). For example, according to the Association of Home Appliance Manufacturers, large reductions in energy consumption (47 to 69 percent) have been realized since 1980 for clothes washers, refrigerator-freezers, and dishwashers (see Attachment E). The appliance standards program has thus achieved significant benefits in reducing the energy required by appliances in U.S. buildings (NRC, 2001).

The appliance standards program is not meant to favor one energy source or technology over another (and the committee saw no evidence that it has done so) but instead to leave decisions about such matters to government policy and/or the market. For that reason, and for the benefit of the consumer purchasing an appliance, the results of the DOE/EERE'S appliance testing and standards setting are expressed in terms of estimated annual operating costs, annual energy usage, and the cost range of similar models.

Current DOE standards for the energy consumed by operating individual appliances call for measurement at the site (point of use) of the appliance. For example, the energy efficiency of a storage water heater is defined as a measure of the energy contained in a specified amount of hot water produced per unit of energy consumed at the site of the water heater over a typical day. Some analysts, however, question whether site measurements of energy consumption give a complete picture of overall energy use (see, for example, GARD Analytics, 2005).

Using appliance-testing procedures prescribed by DOE with input from the National Institute of Standards and Technology, appliance manufacturers measure site energy consumption. The accuracy of the data on site energy consumption is dependent on whether laboratory-defined operating conditions sufficiently reflect actual energy consumption by a particular appliance in a home or commercial building. Actual energy use differs from the standard according to differences in operating conditions. For a standard to be robust, it should reflect relative energy use. While it is plausible to believe that this is the case for many appliances, confirming empirical studies are lacking. Nevertheless, site energy consumption is the best constrained of the different measures of energy use that are considered in the rulemaking process. Site energy use is also the most appropriate measure for setting operational efficiency requirements for single-fueled appliances within the same class, because it can be controlled by the manufacturer in designing and constructing the appliance.

DOE/EERE also estimates extended site energy consumption, which is then used in preparing national impact and environmental impact analyses (Meyers et al., 2003). As a measure of energy consumption, extended site energy endeavors to capture energy losses that occur in the supply chains (generation, transmission, and distribution) for generated electricity and fuels such as natural gas.

DOE/EERE also defines for energy sources heat rates that do not involve conversion of heat to work such that hydro, wind, and solar power are made equal to the fossil heat rate. Instead, the heat rates of fossil, nuclear, hydro, wind, and solar energy are weighted according to their generation share, as supplied to the electrical grid.[1] In 2005, estimating losses of 9.5 percent due to transmission and distribution, the net conversion factor for site electricity to extended site energy was 3.75, a conversion factor determined from data supplied by the Energy

[1] The electricity grid is modeled as a national aggregate. The aggregation of electricity supply into a national grid is an essential element in estimates of extended site energy consumed. There is a concern that the regional variation in electricity grids implies that extended site energy does not accurately reflect energy losses when an appliance is connected to the electricity grid in a specific locale. However, one can also argue that electricity is fungible and that a kilowatt-hour of supply saved by a more efficient appliance could travel well beyond local consumers.

Information Administration. The committee did not explore in depth the methodology employed by EERE for the determination of this conversion factor.

In examining the DOE/EERE approach to setting standards, the committee found that the agency uses several different models developed by the Energy Information Administration, such as the National Energy Modeling System (NEMS), and conducts several analyses. Each standard is justified by DOE/EERE in terms of technical feasibility, reduction of energy use by the subject appliance, and reduced capital and operating costs for consumers. The agency estimates the effects on appliance manufacturers and calculates the net present value of the energy savings. Although the committee was briefed on the NEMS model, time was not sufficient to examine the capability of such models in depth.

In exploring measures of energy consumption and how they serve the goals of energy conservation standards central to DOE/EERE's appliance standards program, the committee examined all the criteria DOE/EERE considers in setting energy-efficiency standards. These criteria, together with the analyses conducted by DOE/EERE in the rulemaking process and the measure of energy consumption used, are listed in Table 1 and are described in some detail in Attachment F.

The committee believes that the seven criteria listed in Table 1 are appropriate and serve the well-being of the U.S. public, consumers, appliance manufactures, and the electric and gas utilities. In addition, it is the opinion of the committee that making the environmental impact of energy consumption an explicit factor in DOE/EERE rulemaking on standards for appliance efficiency, and not merely a consideration added at the discretion of the DOE secretary under the seventh criterion, would acknowledge the public's strong interest in environmental quality (Leiserowitz, 2006) and would help support related decision making.

TABLE 1 Criteria Examined and Analyses Conducted by DOE/EERE in Its Standards-Setting and Rulemaking Process

Criteria Set by the Energy Policy and Conservation Act	DOE/EERE Analysis	Measure of Energy Efficiency Used
1. Economic impact on consumers and manufacturers	Life-cycle cost analysis Manufacturer impact analysis	Site Not applicable
2. Lifetime operating cost savings compared to increased cost of the product	Life-cycle cost analysis	Site
3. Total projected energy savings	National impact analysis	Extended site
4. Impact on utility or performance	Engineering analysis Screening analysis	Site Not applicable
5. Impact of any lessening of competition	Manufacturer impact analysis	Not applicable
6. Need for national energy conservation	National impact analysis	Extended site
7. Other factors the DOE secretary considers relevant	Environmental assessment Utility impact assessment Employment impact assessment	Extended site Not applicable Mixed

Defining and Evaluating Measures of Energy Consumption

The committee began by defining site and full-fuel-cycle measures of energy consumption as follows:

- *Site (point-of-use) measure of energy consumption* reflects the use of electricity, natural gas, propane, and/or fuel oil by an appliance at the site where the appliance is operated, based on specified test procedures.
- *Full-fuel-cycle measure of energy consumption* includes, in addition to site energy use, the energy consumed in the extraction, processing, and transport of primary fuels such as coal, oil, and natural gas; energy losses in thermal combustion in power-generation plants; and energy losses in transmission and distribution to homes and commercial buildings.[2]

The committee also noted that extended site energy consumption—which is used by DOE/EERE for assessing the impact of energy use on the economy, energy security, and environmental quality—includes the energy used in generating and distributing electricity, natural gas, or oil in addition to the energy used by the appliance at the site. But unlike the full-fuel-cycle measure, the extended site measure of energy consumption does not include the energy consumed in extracting, processing, and transporting primary fuels.

Although the site measure of energy consumption allows easy comparison of the operating efficiency of one appliance over another in isolation, it gives only a partial picture of total energy use because it omits the energy needed to mine, process, and transport the primary fuel to a generating plant; the energy used at the generating plant; and the energy used in delivering electricity or fuel to the site of operation of an appliance. For example, based on their site energy consumption, an electric storage water heater might operate with 90 percent efficiency and a natural gas water heater with 70 percent efficiency. But for the electric storage water heater, energy losses of about 70 to 75 percent occur in acquiring the primary fuel and in the generation, transmission, and distribution of the electricity, yielding an overall energy efficiency for the electric storage water heater of about 0.30 X 0.90, or 27 percent. This figure is much lower than the gas-fired storage water heater's overall energy efficiency of about 0.91 X 0.70, or 64 percent, when full-fuel-cycle energy consumption is the measure employed (Jaramillo et al., 2007, 2008).[3] In general, energy losses in heating applications with electric resistance heaters are greater than in heating applications with natural gas when the measure is full-fuel-cycle energy use.

[2] For an appliance powered by electricity, for example, full-fuel-cycle energy consumption includes all the energy consumed from the coal mine to the coal-fired power plant to the appliance at its site of operation. For a power plant fueled with natural gas or oil, full-fuel-cycle energy consumption includes all the energy used from the wellhead to the generating plant to the appliance, including transportation. For an appliance that directly uses natural gas (e.g., a storage water heater or stove), full-fuel-cycle energy consumption includes the energy consumed in extracting, processing, and transporting the natural gas, in addition to that used in distributing and ultimately using the gas.

[3] Jaramillo et al. (2007, 2008) estimated the efficiency for delivery of natural gas to the appliance site as 91.2 percent. For electricity generated from coal-fired power plants, full-fuel-cycle efficiency varied from 26.8 to 38.7 percent. For electricity generated from natural-gas-fired power plants the full-fuel-cycle efficiency ranged from 27.9 to 50.7 percent.

Given such observations, energy analysts have expressed interest in the use of full-fuel-cycle energy consumption as the measure of energy efficiency in DOE rulemaking because it provides more complete estimates of energy consumed and emissions produced (Matthews and Lave, 2000; Matthews et al., 2002).

The committee's examination of these concerns, and its subsequent deliberations, led 9 of 11 members to endorse the full-fuel-cycle measure of energy efficiency as integral to supporting more explicit consideration of the impacts of energy use on the nation and the environment. Two members of the committee, however, had other opinions that are expressed in Attachments H and I.

Full-Fuel-Cycle Approach

Full-fuel-cycle energy consumption is not currently estimated by DOE/EERE. Its estimates of extended site energy consumption, which are used, as noted above, in preparing national impact and environmental impact analyses (Meyers et al., 2003), understate the total energy consumed to make an appliance operational at a site. Likewise, environmental impact is also underestimated by the extended site measure. Actual energy consumption is estimated more completely by full-fuel-cycle measurements that extend the boundaries of energy consumption to incorporate the source of the fuel. More accurately capturing and understanding the impacts of even relatively small differences in estimated energy consumption have become important given the enormous amount of energy consumed in the United States today (DOE/EIA, 2008).

Conversion factors or other methods have not been established by DOE/EERE to convert site energy consumption to full-fuel-cycle energy consumption. The difficulty of this conversion was a matter of debate within the committee.

Although, as is pointed out in Attachment I, estimating full-fuel-cycle energy consumption is more involved and requires additional data and analysis for determining suitable methods for converting from a site to a full-fuel-cycle measure of energy consumption, the committee's majority view is that a methodology can be developed without undue strain on DOE/EERE's resources. This view is based on an extensive body of literature dealing with life-cycle analysis (Spath et al., 1999; Spath and Mann, 2000; Matthews and Lave, 2002; Matthews et al., 2000). Although life-cycle analysis is not directly comparable to full-fuel-cycle analysis (because its objective is to determine the impact of energy consumption on greenhouse gas emissions for specific applications), data presented in life-cycle analyses include data that trace energy consumption back to the source of the fuel used in powering the appliance.

In addition, a variety of methods, results, models, and databases are available to facilitate an estimate of full-fuel-cycle energy consumption. Two important resources affiliated with DOE are the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model[4] developed and maintained at Argonne National Laboratories and the U.S. Life Cycle Inventory Database[5] from the National Renewable Energy Laboratory. In addition, the sources and sinks of CO_2 and other greenhouse gases have been well-characterized, including those resulting from the use of energy (EPA, 2009, Chapter 3).

The committee's acknowledgment of the additional effort required to develop a full-fuel-cycle measure of energy consumption is reflected in its recommendation for a gradual transition

[4] Available at http://www.transportation.anl.gov/modeling_simulation/GREET/index.html.
[5] Available at http://www.nrel.gov/lci/.

to use of that measure for assessment of national and environmental impacts of energy consumption.

Appliance Issues and Product Classes

DOE/EERE does not combine product classes when setting efficiency standards for appliances in which fuel choice is an option. For example, because furnaces can be fueled with natural gas, propane, oil, or electricity, they are considered as separate appliances, even though they serve the same purpose.

Appliances that use different fuels—natural gas, propane, electricity, or oil—are rated within that specific fuel category. For example, ratings for all electrical appliances are based on site energy consumption so that the efficiencies of a specific family of electrical appliance can be compared and ranked. Appliances, such as storage water heaters, that use natural gas, propane, oil, or electricity are, as mentioned above, considered in different categories depending on the fuel used. Currently there are no plans by DOE/EERE to consider within a single category appliances that can use fuel alternatives.

In responses to committee queries, both the Edison Electric Institute and the American Gas Association indicated that using extended site energy consumption to establish a standard, without combining product classes of appliances to include both natural gas and electricity, would not change the outcome of the standard (see Attachment E). Customer choices among different appliances are based on many factors, including fuel availability and cost.

Storage water heaters, mentioned above, are the "poster child" for the site versus full-fuel-cycle debate. Under current efficiency requirements, the typical gas-fired storage water heater has an Energy Factor (EF) that is significantly lower than that of a typical electric water heater. When site energy consumption is measured, it appears that the electric storage water heater is more efficient than the gas-fired storage water heater. In terms of the appliance's operating efficiency, this is true. For gas-fired water heaters, full-fuel-cycle energy consumption and site energy consumption differ only by the relatively small losses in efficiency incurred in pipeline transmission and in the distribution of natural gas (about 10 percent). But for electric storage water heaters, the energy losses that occur in the generation, transmission, and distribution of electricity—losses that are not accounted for in site (point-of-use) measurements of energy consumption—are much larger (about 70 percent). For similar reasons, it is very difficult to compare furnace, boiler, and heat pump efficiency, each of which is rated with different metrics. Providing more comparable ratings would help toward making more complete information on energy consumption available to contractors, builders, and homeowners.

For storage water heaters, the metric for energy efficiency could still be called the Energy Factor but could be calculated using extended site energy consumption rather than site consumption until estimates of full-fuel-cycle energy consumption become available. For heating equipment, one option might be to rate all equipment on a percent efficiency basis, again using extended site energy until full-fuel-cycle energy estimates become available.

The key parameter in energy efficiency standards is the metric used to measure and regulate product efficiency. This metric varies from product to product, and currently it is based only on site energy use. For example, refrigerator efficiency is now measured in terms of annual consumption of electricity (kilowatt-hours), whereas clothes washer and dishwasher efficiency is measured in terms of water heating and motor energy use per load, with allowances made for appliance capacity. Furnace and storage water heater efficiency is measured in terms of heat

(British thermal units) provided per unit of primary fuel consumed on site. Some of these metrics can be improved to allow better comparisons between fuels, although such comparisons can be difficult to make and can sometimes be misleading.

Public Participation

Proposing the use of estimated full-fuel-cycle energy consumption to help determine impacts on greenhouse gas emissions or "carbon footprint" in setting appliance energy efficiency requirements or producing an index for use on appliance labels might have an impact on public participation in the appliance rulemaking process. While DOE/EERE and the Energy Information Administration already collect much of the data that would be used to construct a full-fuel-cycle energy consumption-based estimate, the construction of such an estimate would necessitate public scrutiny.

To participate effectively in a public debate, industry stakeholder groups, environmental organizations, and consumer advocates would have to allocate resources to understanding the details in a technically sophisticated proceeding. Resource-constrained stakeholders could find their participation and their effectiveness in advocating a position somewhat limited compared to less resource-constrained participants.

To some extent, this impact would be lessened by DOE/EERE's obligation to review and analyze any stakeholder input; nonetheless, it could still be incumbent on participants to review stakeholder filings in light of their constituents' perspectives and to raise concerns they might have.

The impact on participation by the public could be mitigated if DOE/EERE were to develop a suitable method for converting site energy measures of consumption to full-fuel-cycle measures of energy consumption, similar to the conversion factor currently used in calculating extended site energy from site energy.

Labeling Programs

The committee heard presentations from representatives of DOE/EERE, the Federal Trade Commission, the Environmental Protection Agency, and other organizations that relate to the content on and the format of labels affixed to appliances that give the consumer information on appliance efficiency and operating costs. The committee believes that such labels are of critical importance in conveying information to consumers about the energy consumption of an appliance. The current practice of showing the annual operating cost (see Figure F.1 in Attachment F) is an important element and is easily understood by the consumer. Equally important is the indicator of the range of annual operating costs that the customer can use in comparing a selection of products from different manufacturers. In considering additional information to include on the label, it is important to acknowledge increasing evidence that consumers are concerned about greenhouse gas emissions and ways to reduce them (e.g., Leiserowitz, 2006). A majority of the committee believes that information on the impacts of energy consumption on greenhouse gas emissions will be useful to the consumer and will positively affect consumers' purchasing behavior and their ability to participate in national energy conservation.

A majority of the committee believes that additional information on the Energy Guide label is the most effective means for conveying the environmental impact of energy consumption to the public. The DOE/EERE could also consider using an enhanced website for this purpose.

FINDINGS AND RECOMMENDATIONS

The committee's primary general recommendation is that DOE/EERE consider moving over time to use of a full-fuel-cycle measure of energy consumption for assessment of national and environmental impacts, especially levels of greenhouse gas emissions, and to providing more comprehensive information to the public through labels and other means, such as an enhanced website.

The current use by DOE/EERE of site energy consumption is effective for setting standards for the operational efficiency of single-fueled appliances within the same class and should be continued without change. However, DOE/EERE's current use of site energy consumption does not account for the total consumption of energy when more than one fuel is used in an appliance (e.g., a heating system with a gas furnace and an electric fan) or when more than one fuel can be used for the same application. For these appliances, measuring full-fuel-cycle energy consumption would provide a more complete picture of energy used, allowing comparison across many different appliances as well as an improved assessment of impacts such as effects on energy security and the environment.

Acknowledging the complexities inherent in developing a full-fuel-cycle measure of energy use—a concern expressed in Attachment I—a majority of the committee recommends a gradual transition to that expanded measure and eventual replacement of the currently used extended site measure. To improve consumers' understanding, DOE/EERE and the Federal Trade Commission could evaluate potential indices of energy use and its impacts and could explore various options for label design and content using established consumer research methods.

In considering the questions posed in its statement of task (Attachment A), the committee developed the findings and recommendations presented below.

Findings

Question 1: Are the data available for site and full-fuel-cycle energy consumption by appliances and commercial equipment appropriate for the studies undertaken?

Finding 1: The data on site energy consumption that are generated in and available to the DOE/EERE appliance standards program are sufficiently accurate for the purpose of setting appliance operational efficiency requirements. However, environmental concerns, particularly with respect to climate change, are playing an increasing role in national discussions of energy use, and broad national impacts of energy consumption should be a specific criterion in DOE/EERE rulemaking. Accurate estimates of full-fuel-cycle energy consumption that will more completely capture the environmental and other national impacts of energy consumption will require the collection and analysis of additional data.

Question 2: Are there uncertainties with the data?

Finding 2: There are uncertainties in all data, but the data used currently to estimate site energy consumption by appliances operating in the prescribed manner are sufficiently accurate for the DOE/EERE standards program to use in setting energy efficiency requirements for appliances. However, data on and measures of site energy consumption and extended site energy consumption are insufficient for estimating the overall national and environmental impacts of appliance use. Somewhat greater uncertainties exist in the data currently available to estimate full-fuel-cycle energy consumption as opposed to extended site energy consumption.

Question 3: Are the models and analyses used appropriate for the studies undertaken?

Finding 3: The models used by DOE/EERE to estimate the energy used by single-fuel appliances and to develop associated standards appear to be adequate for setting efficiency requirements in the appliance standards program. The current practice of establishing energy efficiency requirements for appliances based on fuel type appropriately recognizes the need to allow for differences in fuel availability and consumer choice.

Finding 4: Using current efficiency ratings to compare appliances that have the same purpose but use different fuels (such as water heaters fired by gas or electricity) can be misleading in some cases, and difficult to accomplish in other cases.

Question 4: Does the measure of energy efficiency and/or energy use (site or full-fuel-cycle) impact the ability of the public to participate in the appliance standards rulemaking process?

Finding 5: Using full-fuel-cycle energy consumption as the measure of appliance performance could hamper the public's ability to participate effectively in appliance standards rulemaking, because use of that measure depends on analysis of a larger range of variables plus the collection of more data, both of which are efforts that could require additional resources.

Question 5: Does the measure of energy efficiency and/or use affect the studies undertaken by DOE/EERE?

Finding 6: Most of the DOE/EERE analyses and studies of single-fuel appliances are not affected by the particular measure of energy consumption used. However, for categories of appliances that can use more than one type of fuel, additional studies are needed to establish the performance standard. If DOE/EERE were to adopt the full-fuel-cycle measure of energy consumption, studies on the energy used in the extraction and transport of fuels would be needed.

Finding 7: Access to information on how levels of greenhouse gas emissions are affected by operating an appliance could have an impact on consumers' purchasing decisions and on national energy conservation.

Recommendations

Recommendation 1: DOE/EERE should consider moving over time to use of the full-fuel-cycle measure of energy consumption for assessment of national and environmental impacts, especially levels of greenhouse gas emissions, and to providing more comprehensive information to the public through labels and other means including an enhanced website. DOE/EERE efforts should address the data collection and analysis needed to accurately estimate full-fuel-cycle energy consumption as well as to assess and improve consumer understanding and use of information on full-fuel-cycle energy consumption.[6]

Recommendation 2: For single-fuel appliances, DOE/EERE should retain the current practice of basing energy efficiency requirements on the site measure of energy consumption and should also continue to keep product classes separate when setting efficiency standards for appliances for which fuel choice is an option.

Recommendation 3: For appliances for which there is a choice of fuel, such as storage water heaters and heating equipment, efficiency ratings should be calculated using the extended site measure of energy consumption until DOE/EERE can consider and complete a transition to the use of the full-fuel-cycle measure of energy consumption.[7]

Recommendation 4: DOE/EERE should make available and easily accessible all data used in developing energy efficiency standards for appliances. These data, which include results of analyses, assumptions used as input, performance requirements, and other information used in developing efficiency standards, should be available in an open-standard, machine-readable format.

Recommendation 5: DOE/EERE and the Federal Trade Commission should initiate a project to consider the merits of adding to the Energy Guide label an indicator of how an appliance's total energy consumption might affect levels of greenhouse gas emissions. Such a project would include development of specific data on greenhouse gas emissions associated with the appliance's operation, formulation of pertinent information for addition to the appliance's energy efficiency label, and research with a sample of consumers to test various options for encouraging consumers' understanding and use of information on full-fuel-cycle energy consumption and its impacts.[8]

[6] For differing views, see Attachments H and I.
[7] See Attachment I for another view.
[8] See Attachment I for another view.

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NOTE

This letter report was reviewed in draft form by the following individuals, chosen for their diverse perspectives and technical expertise in accordance with procedures approved by the National Research Council's Report Review Committee: Dell K. Allen (NAE), consultant; J. Michael Davis, Pacific Northwest National Laboratory; Tom Eckman, Northwest Power and Conservation Council; Jeremy T. Fox, University of Chicago; Robert W. Fri, consultant; David B. Goldstein, Natural Resources Defense Council; Eckhard Groll, Purdue University; James E. Hill, consultant; Alexander MacLachlan (NAE), E.I. du Pont de Nemours & Co. (retired); John P. Rust, University of Maryland; Charles A. Samuels, Mintz Levin; Kenneth Shiver, Southern Company; Frank A. Stanonik, Air-Conditioning, Heating and Refrigeration Institute; and W. Michael Griffin, Carnegie Mellon University. The review was overseen by Elisabeth M. Drake, Massachusetts Institute of Technology (NAE), and Robert A. Frosch, John F. Kennedy School of Government (NAE). Although the individuals listed above provided many constructive comments and suggestions, they were not asked to endorse the report's conclusions or recommendations, nor did they see the final draft of the report before its release. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

List of Attachments

Attachment A: Statement of Task
Attachment B: Letter from Senator Gordon H. Smith
Attachment C: Committee Meetings and Presentations Received
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Attachment A
Statement of Task

The National Research Council will appoint a committee to conduct a review of the U.S. Department of Energy's appliance standards program. The committee's task is to evaluate or critique the methodology used for setting energy conservation standards for the purpose of determining whether site (point of use) or source (full fuel cycle) energy efficiency measures best serve the goals of energy conservation standards.

The committee may seek to answer questions such as the following:

- Are available data on appliance and commercial equipment on both point-of-use and/or full fuel-cycle energy use appropriate for the studies undertaken? Are there uncertainties with the data?
- Are the models and analyses used appropriate for the studies undertaken?
- Does the measure of energy efficiency and/or energy use (point-of-use or full fuel-cycle) impact the ability of the public to participate in the appliance standards rulemaking process?
- Does the measure of energy efficiency and/or use affect the studies undertaken by DOE?

The committee will not address whether energy conservation standards are appropriate government policy or what levels may or may not be appropriate. The committee will consider the technical support documents (TSDs) that have been developed for recent rulemakings (distribution transformers and residential furnaces and boilers), the report by Rand, *Measures of Residential Energy Consumption and Their Relationships to DOE Policy*, the GARD Analytics report, *Public Policy and Real Energy Efficiency*, and the DOE test procedures codified in the Code of Federal Regulations at 10 CFR Part 430, as well as any other relevant literature. The review will comment on whether one measure of energy efficiency or another (point-of-use or full fuel-cycle) improves the efficacy of the rulemaking process over the other.
The committee will write a letter report on its review and conclusions.

Attachment B
Letter from Senator Gordon H. Smith

GORDON H. SMITH
OREGON

COMMITTEES:
FINANCE
COMMERCE, SCIENCE, AND TRANSPORTATION
ENERGY AND NATURAL RESOURCES
INDIAN AFFAIRS

RANKING MEMBER, SPECIAL COMMITTEE ON AGING

United States Senate
WASHINGTON, DC 20510–3704

February 19, 2008

Mr. Ralph J. Cicerone
President
National Academy of Sciences
500 Fifth Street, NW
Washington, DC 20001

RE: Section 1802 of the Energy Policy Act
Study of Energy Efficiency Standards.

Dear Mr. Cicerone:

I believe that improving energy efficiency is one of the key elements to reducing American's dependence on foreign energy, reducing overall energy consumption and reducing unwanted emissions.

Based on these concerns, I supported the targeted study of the Energy Policy Act of 2005 (Section 1802) that calls upon the Department of Energy to have the National Academy of Sciences conduct a study of our energy efficiency standards, particularly whether measurement should be done at the site of the energy consumption or on the full-fuel cycle, beginning at the source of energy production. I am pleased to be informed that this study is now underway, and that the first committee meeting is being held this week.

In light of the fact that climate change legislation may be considered by the Senate in 2008, this study has taken on greater importance and could make a very valuable contribution to the debate. I encourage you to conduct this study with a broad view of its mandate and include an analysis of the impact of a full fuel cycle standard on greenhouse gas emissions.

Thank you for your attention to this important matter.

Sincerely,

Gordon H. Smith
United States Senate

www.gsmith.senate.gov
PRINTED ON RECYCLED PAPER

Attachment C
Committee Meetings and Presentations Received

FIRST COMMITTEE MEETING, FEBRUARY 19-20, 2008

Building Technologies Program—Michael McCabe, Buildings Technology Program, DOE/EERE
Appliance Efficiency Strategies—Ronald Lewis, Office of Building Research and Standards, DOE/EERE
Energy STAR and Measuring Energy Efficiency—Kathleen Hogan, Director, EPA Climate Protection Partnership
NIST's Role in Appliance Testing, Hunter Fanney, Building and Fire Research Laboratory, National Institute of Standards and Technology
FTC's Appliance Labeling Role, Hampton Newsome
Review of Measures of Residential Energy Consumption Study, David Ortiz, RAND (co-author of study)
Site/Source Methodology, Eric Hsieh, National Electrical Manufacturers Association
Source-Based Methodology: A Critical Tool in Today's Environment, Bruce McDowell, American Gas Association
Energy Efficiency Standards: Approaches to Measurement, Steve Rosenstock, Manager, Energy Solutions, Edison Electric Institute
Site v. Source Impacts on Appliance Standards, Donald Brundage, Principal Engineer, Southern Company Services
Engineering Analyses Performed for Standards Rule Making, Michael McCabe, Buildings Technology Program, DOE/EERE
Impact of Standards on Appliance Manufacturers, Frank Stanonik, Gas Appliance Manufacturers Association

SECOND COMMITTEE MEETING, MAY 1-2, 2008

Appliance Standards and EIA's NEMS Residential Module, John Cymbalsky, Energy Information Administration
Effective Energy Labeling for Appliances, Jennifer Thorne Amann and Steven Nadel, American Council for an Energy Efficient Economy
Technical Considerations for Alternative Energy Efficiency Measurement Methods, Neil P. Leslie, Gas Technology Institute
Question and Answers, Michael McCabe, Buildings Technology Program, DOE/EERE

THIRD COMMITTEE MEETING, AUGUST 5-6, 2008

This was a closed meeting in which the committee worked on the draft of the letter report.

Attachment D
Key Findings of 1999 RAND Study and 2005 Gard Analytics Study

In 1999, the Rand Corporation conducted a study of the DOE's appliance program at the request of the Office of Science and Technology Policy and the Department's Office of Energy Efficiency and Renewable Energy. The study resulted in a report (Ortiz and Bernstein, 1999) that investigated certain consequences of measuring energy use at either the site or the source. The results of Rand's comparison of site versus source energy consumption are as follows:

1. Analysis does not support the claim that site-based measurement used to promulgate minimum efficiency standards for water heaters favors electric units over natural gas units.
2. There is no statistical difference in the market share of electricity between states with source-based residential energy codes or codes that are fuel specific as a group and states with site-based residential energy codes as a group. The claim that the measurements of energy used to comply with residential energy codes adversely influences the broader market for natural gas and electricity is unsupported.
3. There is preliminary evidence that states that use source-based energy codes or codes that are fuel specific, as a group, are more efficient with respect to energy use per capita than other states.

Another study, commissioned by the American Gas Foundation, resulted in a report by GARD Analytics (2005). That report had four major findings:

1. Real Energy[1] analysis is the best method for measuring energy efficiency and the impact of energy consumption on the environment. While Energy Cost analysis at times can be an acceptable alternative, regional pricing variations and non-cost based utility pricing structure impair the accuracy of this approach.
2. Most federal energy efficiency policies use Site Energy as their criteria. As a result, many federal energy efficiency policies actually encourage the use of less efficient appliances. Not only does this result in higher total energy consumption, it increases total pollution. The activities associated with providing energy to the customer, particularly electricity generation and transportation, often emit substantial amounts of CO_2 and other gasses associated with global warming.
3. Modifying a number of current and proposed efficiency policies that utilize Site Energy criteria to incorporate Real Energy efficiency approach could cause market shift away from less overall efficient technologies. This is particularly true if policies promoted more efficient electric and gas technologies compared to electric resistance applications. At a minimum, these energy policies could utilize a combination of approaches, similar to the Federal Energy Management Program (FEMP) policy for analyzing government energy efficiency projects. FEMP requires government agencies to choose the lowest life cycle cost option while reducing Site Energy use per square foot, and any increases in Site Energy can be offset by decreases in Real Energy.
4. Numerous barriers impede federal policy use of Real Energy efficiency standards. Political and legal barriers pose the greatest challenges to changing policies. Market and technical barriers could be more easily overcome with sufficient education and resources.

[1] The AGA reference defined "real energy" as site energy plus all upstream energy consumption. This definition corresponds closely to the committee's definition of full-fuel-cycle energy.

REFERENCES

GARD Analytics. 2005. Public Policy and Real Energy Efficiency: Assessing the effects of federal policy on energy consumption and the environment. Prepared for the American Gas Foundation.

Ortiz, D.S., and M.A. Bernstein. 1999. Measures of Residential Energy Consumption and Their Relationships to DOE Policy. Report No. MR 1105.0-DOE. Rand Science and Technology Policy Institute, Santa Monica, Calif. November.

Attachment E
Written Material Provided Directly to the Committee

EDISON ELECTRIC INSTITUTE RESPONSE TO COMMITTEE QUERIES

April 9, 2008

EDISON ELECTRIC INSTITUTE
701 Pennsylvania Avenue, N.W
Washington D.C. 20004-2119
202-508-5010

Mr. Duncan Brown
Senior Program Officer
Board on Energy and Environmental Systems
National Academies of Sciences
500 Fifth Street NW
Room Keck 908
Washington, DC 20001

RE: Query from Committee on Point of Use and Full Fuel Cycle Measurement

Dear Mr. Brown:

The Edison Electric Institute (EEI), as an interested participant in the setting of standards and in this case appliance efficiency standards, appreciates the opportunity to submit answers to your questions that were sent via e-mail on March 28, 2008.

> ***1) (a) If source energy as opposed to site energy was used by DOE when efficiency standards were set for appliances, might the efficiency standard set for electric and gas water heaters - assuming as now the standards are set separately - change and be higher? (b) If yes, why might the standard change? (c) If it does change, what might the change be in the appliance that was manufactured (e.g., more insulation or what?)***

The efficiency standards set for the separate classes of electric and gas water heaters would be no different under a source-based metric than it is under the current site based metric. DOE currently uses a mix of site and source energy metrics when setting appliance energy efficiency standards. If source energy as opposed to site energy was used when setting efficiency standards for electric and gas water heaters, the standards values derived from the rigorous DOE process would not change based on the use of site or source energy. They could change only if DOE abandoned its required use of economic analysis (consumer cost effectiveness) in the process.

The current procedure sets standards based on (1) the level of efficiency that is technically achievable, and (2) the level of efficiency that is cost effective from the manufacturers' and consumers' point of view. When performing its economic analysis, DOE uses the cost impacts of efficiency measures at the retail price (or "site" price, as it were), rather than the wholesale manufacturing cost (a "source" cost, in a way). The efficiency levels set are not based on the metric used or the perception that it is too high or too low. They are set based on the level that is most cost-effective for consumers based on life-cycle costs.

For instance, the efficiency of an electric resistance water heater is 90+ percent today, and there is very little opportunity for improvement in this class of water heater. If the metric used today for electric resistance units assigned a value of "1" to the efficiency of an electric water heater, are manufacturers going to suddenly discover a way to improve the efficiency of their products in order to raise the rating? Will they find a way to achieve efficiency levels greater than 100 percent in resistance water heaters? Of course not. Whether the value of the metric is 1 or 99, the ability of resistance water heater manufacturers to improve their efficiency does not change. Therefore changing the measurement metric of a standard by itself will make no difference in the efficiency of the water heater.

Similarly, changing the efficiency metric with gas (or oil-fired) water heaters will make no difference in the manufactured efficiency levels. With gas equipment, the efficiency ceiling for non-condensing units has been the cost effectiveness of the units. While improvements are technically achievable, it has not been deemed cost effective to do so. Changing the metric assigned to the efficiency rating does not change that fact. Gas water heater manufacturers are still faced with the same economic hurdles.

DOE has enough information available now to require higher levels of efficiency where possible and cost effective. Manufacturers are continually looking to improve their product, and with the higher energy costs higher efficiency becomes a greater competitive advantage. Changing the efficiency metric does not change any of that ability or incentive.

If the standard were to change, the other required decision factors would still have to be considered, regardless of using site or source energy. In the case of water heaters, there are significant additional costs for raising the standard higher, such as difficulty fitting water heaters through doorways and other clearances due to increased insulation levels. Insulation materials are also more costly, because of the elimination of low cost, high performance materials that contained ozone- depleting chemicals. If the standard did change slightly, electric water heaters could potentially use better, more costly insulation materials, while gas water heaters could do the same.

However, if the standard changed significantly, such that there would be elimination of entire classes of products (e.g., non-condensing gas water heaters). It is likely that the DOE manufacturer impact analysis would detail the negative effects on manufacturers, and the US Justice Department would be obligated to detail the negative impact on competition, such that the standard would likely not be implemented.

> ***2) (a) If no change in the efficiency standard would be made by changing from site to source energy when standards are established, what are the two most important results of the change from the perspective of the consumer? What would the consumer see that is different? (Different labels?) (b) From society's perspective, how would things be different if no change would be made in the efficiency standard using source instead of site energy?***

It is difficult to provide a succinct answer without seeing a final version of the following: the source energy metric; the label provided by the appliance manufacturer; and the FTC Energy Guide label.

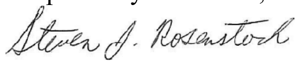
The most important result of the change from the consumer's perspective would be the difficulty in comparing the efficiency of the current water heater using site energy to a new water heater based on source energy. At present, when consumers shop for water heaters, they can compare various models using metrics that they are familiar with, such as kWh's of electricity used per year, therms or cubic feet of gas used per year, gallons of oil consumed per year, and annual operating costs. Consumers are familiar with these terms because these terms are the basis of consumer utility bills as well as other guides that consumers use. Changing the label to a metric based on a new unfamiliar term and concept will not result in increased energy efficiency, but rather in consumer confusion. The result will be a loss in consumer credibility in the standards process and a loss in the "societal" investment made by the Department of Energy and the Federal Trade Commission over the last 20 years in educating consumers about smart energy choices.

Changing from "all-site" efficiency measures to "all-source" efficiency measures on consumer labeling such as the FTC Appliance Guide would mean that all information would be communicated based on societal impacts, without easy linkage to consumer behavior, local energy use, or local energy costs. If the perceived performance doesn't match the perception of what the label tells the consumer, the credibility of the label will rapidly decline, making the label less valuable and moving the consumer to some other source that they trust. This would result in (1) less useful information for comparing their actual energy usage to the information on the label, and (2) a focus on societal benefits rather than individual consumer benefits which are typically the key driver of choice in buying the new appliance.

From a societal perspective, it would reduce the usefulness of the label, by rendering the information in a form less usable to consumers. It could also lead to increased overall energy usage if the result was for more consumers to delay purchases, make the less efficient selection based on confusion over source estimates or retain equipment by repairing rather than replacing older and less efficient appliances.

EEI sincerely appreciates the opportunity to submit these comments. It remains our recommendation that DOE retain the current system to set appliance energy efficiency standards which uses a mix of site measurements and source estimates.

Respectfully submitted,



Steve Rosenstock, P.E.
Manager, Energy Solutions Edison Electric Institute
701 Pennsylvania Avenue N.W. Washington, D.C. 20004-2696

cc: Rick Tempchin, EE1
Donald Brundage, Southern Company Services
Steve Kennedy, Georgia Power Company
Charles Foster, Esq.

AMERICAN GAS ASSOCIATION RESPONSE TO COMMITTEE QUESTIONS

AGA responses to questions from the National Academies Committee on Point of Use and Full Fuel Cycle Measurement sent on March 28th, 2008:

1) (a) If source energy as opposed to site energy was used by DOE when efficiency standards were set for appliances, might the efficiency standard set for electric and gas water heaters - assuming as now the standards are set separately - change and be higher? (b) If yes, why might the standard change? (c) If it does change, what might the change be in the appliance that was manufactured (e.g. more insulation or what?)

AGA Response:

If source energy as opposed to site energy was used by DOE when efficiency standards are set for appliances, the measurements of energy efficiency would change but the actual energy efficiency of those appliances would most likely not change. DOE’s test procedures and energy descriptors would remain the same, but a new descriptor would be added to allow source calculation methods. Additions of source energy descriptors to current descriptors and DOE test methods will not alter the standards. However, with a clearer understanding of full fuel cycle efficiency opportunities provided by this additional information, together with energy savings remaining the primary consideration of the standards process, these additions are likely to change and improve energy efficiency outcomes within the DOE appliance program.

Consumer education would be enhanced if source procedures were employed. This new calculation method would more accurately reflect the amount of overall energy consumed by the appliance and thus allows consumers to compare appliances on a common basis. In addition, source methodology provides information that can be used to identify the carbon footprint and other environmental impacts associated with each appliance.

2) (a) If no change in the efficiency standard would be made by changing from site to source energy when standards are established, what are the two most important results of the change from the perspective of the consumer? What would the consumer see that is different? (different labels?) (b) From society's perspective, how would things be different if no change would be made in the efficiency standard using source instead of site energy?

AGA Response

Changing from site to source energy methodologies when standards are established can yield important benefits to consumers. These include:

1. Providing a more accurate determination of overall energy use by appliances that will allow true comparisons between fuels and equipment types. If the DOE results are made available to the public (e.g., appliance labels), consumers will be able to make an "apples to apples" comparison when a common energy unit measurement (Btu) is used, as opposed to the confusing fuel-specific measurements (cubic feet, kilowatts, etc.) now in use. Thus the consumer will be better able to choose an appliance if overall energy efficiency is important to them. It should be noted that changes to the Federal Trade Commission (FTC) Energy Guide Labeling program were proposed by AGA. FTC in its final rulemaking called for under EPACT 2005 admitted that it currently had the authority to implement consumer information on source energy and emission but pointed to the lack of DOE calculation methodologies as the basis for making this change to the Energy Guide labels.[1] DOE can provide an immediate remedy to this lack of calculation methodologies by either documenting and recommending procedures it currently uses within the Energy Information Administration for source energy calculations, coupled with existing DOE test procedures, or recommending to FTC use of the EPA ENERGY STAR Portfolio Manager calculations for source energy and carbon dioxide emissions:

    http://www.energystar.gov/index.cfm?c=evaluate_performance.pt_neprs_learn

2. Making DOE test results available, which could aid consumers to make a "green" choice when purchasing appliances. Using DOE results that employ source methods, organizations and individuals will be better able to determine the environmental impacts of their purchase options. Having DOE test results in used to determine a typical carbon footprint that appears on the appliance label will aid the consumer in making an informed choice, particularly if carbon reduction goals become law. DOE test procedures represent the only reliable and consistent means of comparing appliances and energy efficiency. While questions about specific test procedures persist, the current DOE rulemaking

[1] Office of the Federal Register, National Archives and Records Administration, "Federal Trade Commission: Rule Concerning Disclosures Regarding Energy Consumption and Water Use of Certain Home Appliances and other Products Required Under the Energy Policy and Conservation Act ("Appliance Labeling Rule")," Federal Register, Volume 72, Issue 167, August 29, 2007, pp. 49948-49997.

process for addressing test procedures represents a reasonable opportunity to make changes where needed.

From society's perspective, changing from site to source calculations, even with no change in the efficiency standards, would provide much needed guidance for other groups to employ this measurement technique. The use of source methodology by DOE would set a precedent that should encourage other organizations (International Code Council, the American Society of Heating, Refrigeration, and Air Conditioning Engineers, Federal Trade Commission, etc.) to incorporate source methodologies into their codes, standards, and consumer education activities.

If current voluntary efforts to reduce carbon become mandatory through future government actions, source methodologies will be the only way to accurately depict environmental impacts of energy use. Even if appliance efficiency standards do not change, the use by DOE of source methods will allow consumers to make a more educated decision when purchasing appliances and will also pave the way for other organizations to employ source methods in their energy/environmental activities.

LETTER FROM THE ASSOCIATION OF HOME APPLIANCE MANUFACTURERS

Dr. James W. Dally, Chair and Council Members
Committee on Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards
National Academy of Sciences
500 5th Street NW
Washington, DC 20001

RE: AHAM Comments on National Academy of Sciences Project on Energy Efficiency Standards: Alternative Approaches to Measurement

Dear Dr. Dally and NAS Council Members:

On behalf of the Association of Home Appliance Manufacturers (AHAM), I would like to provide written comments on the National Academy of Sciences project titled "Energy Efficiency Standards: Alternative Approaches to Measurement". AHAM is a not-for-profit trade association representing manufacturers of major, portable and floor care home appliances, and suppliers to the industry.

In 1975, the Energy Policy and Conservation Act (EPCA) established test procedures, targets and labeling requirements for household appliances. This was followed by the National Energy Conservation and Policy Act (NECPA) in 1978, which provided DOE with authorization to set standards for 13 of these household appliances. Standards were set using point-of-use energy measurement, or the energy used by the appliance at the electrical outlet. Over the past 30 years, the household appliance industry has risen to the challenge of producing products that consume less energy and provide equal or better performance for the consumer. For example, since 1980 when these regulations became effective:

- Clothes washer energy use per cycle has decreased 69%, while tub capacity has increased 20%;
- Refrigerator-freezer energy use per year has decreased 61%, although volumes have increased nearly 12%;
- Dishwasher energy use per cycle has decreased 47%.

These significant improvements in energy use by appliances are achievable because household appliance manufacturers have a clearly defined energy goal for product design and a representative test procedure for product evaluation. Designing to a point-of-use energy requirement allows the manufacturer to wholly manage the energy use of their product and provides incentive for research and development that go above and beyond current regulations.

Furthermore, appliance energy information has become an important factor in purchasing decisions for consumers in the past five years. Through a combination of appliance efficiency standards, Energy Guide labels, Energy Star and other market awareness efforts, including tax incentives to manufacturers to deliver energy savings beyond that required by regulation, consumers are taking steps to further reduce energy consumption of appliances. The product specific information addressed by the abovementioned information programs is critical to this progress and should be maintained.

AHAM requests that the Committee maintain the current DOE procedure for defining appliance energy standards using point-of-use energy as the basis. As noted above, this approach has incentivized manufacturers and results in substantial improvements in product energy efficiency. As mentioned earlier, AHAM believes that consumers are also motivated by point-of-use energy values, as these are values they can control.

AHAM acknowledges that addressing inefficiencies in the fuel cycle, for all fuels, is paramount to further reducing energy inefficiencies and greenhouse gas emissions; however, home appliance manufacturers are not responsible for fuel cycle efficiencies and therefore cannot directly address energy use at this level. Only the utilities can be held accountable for the fuel source in their generating plants. Again, DOE's current approach, where point-of-use energy values are used to set regulations and full fuel cycle energy use is estimated through impact analysis, provides a realistic foundation for addressing both concerns.

We thank you for the opportunity to provide these comments. Please feel free to contact me with any comments or questions that you may have.

Sincerely,
Debra K. Brunk, Ph.D.
Director, Technical Services
Cc: Joe McGuire, AHAM President
David Calabrese, AHAM Vice President, Government Relations
Charles Samuels, AHAM Legal Counsel

Attachment F
Setting Energy Conservation Standards

DOE/EERE APPLIANCE STANDARDS PROGRAM AND RULEMAKING PROCESS

DOE/EERE Appliance Standards Program

To comply with the Energy Policy and Conservation Act (EPCA) of 1975, DOE/EERE established energy-efficiency standards for many appliances used in residential and commercial buildings and powered by oil, natural gas, propane, or electricity. The standards specify tests for measuring energy consumption and the manner in which the appliance is operated. The results are summarized, expressed as a comparative measure of energy efficiency or effectiveness such as the Annual Fuel Utilization Efficiency (AFUE), Seasonal Energy Efficiency Ratio (SEER), or annual energy consumption. The standards prescribe a minimal level of energy efficiency that each appliance must meet to be manufactured in the United States.

Each of these standards is justified by the DOE/EERE in terms of technical feasibility, reduction of energy consumption by the appliance, and cost-benefits to consumers in terms of capital and operating costs. The DOE/EERE estimates the national economic and environmental benefits of each standard including the overall reductions in energy consumption and reductions in emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulfur oxides (SO_x). The agency also estimates the standards' economic impacts on the appliance manufacturers and calculates an estimate of the industry net present value (INPV). For purposes of setting appliance efficiency standards, the minimum levels of energy consumption are based on site (point-of-use) measures, while the determination of economic and environmental justification is currently based on extended site energy estimates (from generation plant to appliance for those using electrical power).

DOE/EERE Rulemaking Process

The DOE/EERE carries out a four-step process to establish the minimum efficiency standard for an appliance. When the minimum efficiency standard is established and becomes effective, all of those appliances manufactured in the United States must meet at least that minimum standard. Each stage of the process entails several analyses and assessments. (Attachment B gives details of the analyses.) The stages include:

- A framework workshop to describe the rulemaking process and analyses to be conducted and to receive initial input on some analysis issues.
- A workshop to review initial analyses, such as engineering analysis and life cycle cost and payback analysis.[1]
- Notice of Proposed Rulemaking (NOPR).
- The final rule, including the effective date of the rule.

[1] This workshop, authorized by the Energy Independence and Security Act of 2007 (Pub. L. 110-140), replaces the Advance Notice of Proposed Rulemaking.

For the analyses, the products are divided into different functional categories (e.g., water heating, space cooling, or dishwashing) and into different classes according to their energy source (such as natural gas, propane, oil or electric power) and other performance features such as capacity of the appliance. A separate efficiency requirement is established for each class.

Pursuant to section 325 of the Energy Conservation and Policy Act (ECPA) (42 U.S.C. 6295), the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy (DOE/EERE) considers seven factors when setting energy conservation standards, which include the following:

To establish the data required in assessing the various impacts and determining the cost and fuel savings, the Office of Energy and Renewable Energy (EERE) conducts several analyses that evolve during the four-step rulemaking process.

Seven criteria are used in every rulemaking of this kind:

1. Economic impact on consumers and manufacturers;
2. Lifetime operating cost savings compared to increased cost for the product;
3. Total projected energy savings;
4. Impact on utility and performance
5. Impact of any lessening of competition
6. Need for national energy conservation
7. Other factors the Secretary considers important.

Step 1: Advance Notice of Proposed Rule Making (ANOPR)

The analyses conducted for the ANOPR[2] include:

- Market and technology assessment
- Screening analysis
- Engineering analysis
- Preliminary manufacturer impact analysis
- Product price determination
- Life cycle cost and payback period analyses
- Shipment analysis
- National impact analysis

Key input information used in these analyses includes: national energy use, product process and shipment data.

Key output information includes: product classes, technology options, design options, product designs, life cycle costs, payback periods, national energy savings, net present values, conversion capital expenses and direct employment impacts.

[2] The Energy Independence and Security Act of 2007 replaces ANOPR with a workshop.

Step 2: Notice of Proposed Rulemaking (NOPR)

The analyses conducted for the NOPR include:

- Revision of ANOPR analyses
- Life-cycle cost subgroup analysis
- Manufacturer impact analysis
- Utility impact analysis
- Employment impact analysis
- Environmental assessment
- Regulatory impact analysis

Key inputs for these analyses include: stakeholder comments, demographics, manufacturer prices, manufacturers financial data, utility load factors, national energy savings, national product costs, national operating costs, emission rates and non-regulatory alternatives. Key output data include: Life cycle costs, payback periods, industry cash flow, sub-group cash flow, direct employment impacts, competitive impacts, cumulative regulatory burden, utility impacts, national employment impacts, emission estimates, national energy savings and net present values.

Based on DOE/EERE management's consideration of the outputs, management decides on the "proposed rule," (i.e., proposed standard level and effective date).

Step 3: Final Rule

In preparing the Final Rule, the Department considers stakeholder comments on the proposed rule, particularly the comments of the Attorney General with regard to the impacts of the proposed rule on competition, and updates the analysis to accommodate stakeholders' concerns and comments. The final rule sets the standard level and effective date of the standard.

Step 4: Effective Date

The effective date of the final rule may be established based on:

- The date set by legislation authorizing the development of a standard.
- An alternative date established by consensus of the stakeholders.
- A date timed to match the requirements of another agency that is related to the standard.

Lawsuits filed by individuals or affected parties can delay or advance the process. A stakeholder has in one case obtained an injunction delaying the effective date after the announcement of the Final Rule. In another case, a group of concerned parties sued because of a failure of DOE/EERE to issue a Final Rule.

DOE/EERE Practices

DOE/EERE establishes separate energy conservation standards for each product class. For instance, gas-fired water heaters have different standards than electric water heaters or oil-fired water heaters. The products are divided into different classes by the type of fuel/energy consumed and other performance related features such as capacity that affect consumer utility in accordance with the requirements of the EPCA.

In the rulemaking process, the DOE/EERE uses both site and source energy, but not full-fuel-cycle energy. For example, site energy is used in establishing the cost and energy consumption that is used in the engineering analysis. Cost and energy consumption are the pieces of information that the FTC places on its labels. However, the site energy used in the engineering analysis is converted to source energy that is subsequently used in the analysis of national impact, present value of the energy savings, utility impact analysis and the environmental impact analyses. Sufficient data on a regional level are available to use either source or site measurements in the labeling process; however, placement of the labels in factories precludes the possibility of using regional data on the labels.

Information Generated in the Rulemaking Process

In its rulemaking, DOE/EERE sets the minimum efficiency requirement for a class of appliances, generates a significant amount of information contained in its analyses, and disseminates some of this information in the labeling programs and in the Federal Register. DOE/EERE performs several analyses that benefit other government agencies, appliance manufacturers, consumers, and the national interest.

FEDERAL TRADE COMMISSION ENERGY GUIDE LABEL

The Federal Trade Commission (FTC) uses data generated by EERE and the compliance measurements provided by appliance manufacturers to develop Energy Guide labels that inform consumers about the relative performance of an appliance. The labels must be placed on appliances to inform consumers of the appliance's annual energy efficiency. The labels are for a specific class of appliances and indicate the range of the cost of energy consumed by the models in that class as well as the annual cost of the energy to operate that particular appliance, based on national average energy costs. In the labeling, the FTC uses energy consumption measured at the site. This label is the primary method of conveying information to the public about energy consumption.

The Federal Trade Commission is mandated by Section 324 of the Energy Policy and Conservation Act to implement an Energy Guide Rule (16 CFR Part 305), which requires that Energy Guide Labels be established for most appliances. The information on the appliance labels must be based on DOE/EERE test procedures. The statute requires disclosure of annual operating costs and energy consumption. The label must also include a range of comparability for the covered products listed below:

- Refrigerators and freezers
- Dishwashers
- Clothes washers
- Water heaters
- Furnaces and boilers
- Central air conditioners and central air conditioning heat pumps

- Room air conditioners
- Pool heaters

Manufacturers of appliances must submit data to the FTC pertaining to energy use or efficiency of their models annually. The FTC announced a new label designed in 2007 that shows a bar graph of the estimated operating costs and the estimated yearly energy use either in kilowatt-hours or British thermal units depending on the fuel. Site measurements of energy consumption are used on the labels. An example of a label for an electrical appliance is presented in Figure F-1.

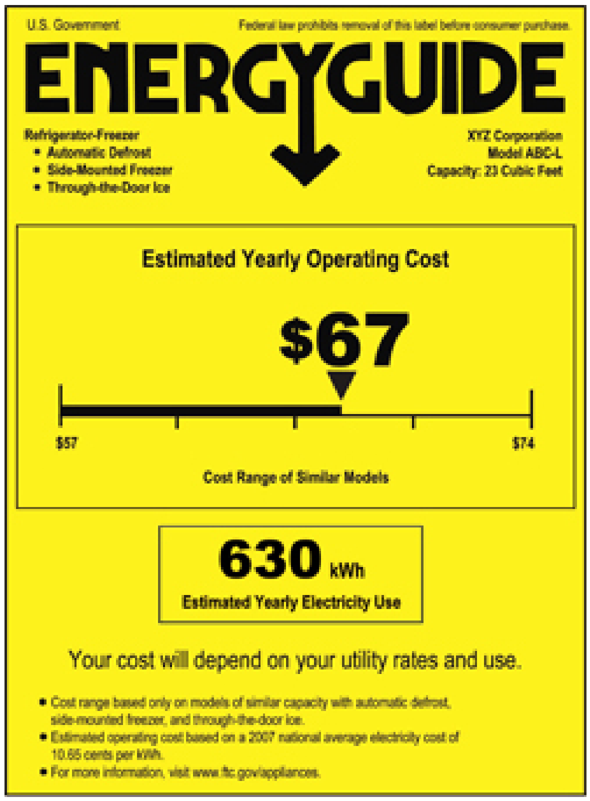


FIGURE F-1 Sample EnergyGUIDE label from U.S. Federal Trade Commission. Available at http://www.ftc.gov/opa/2007/08/energy.shtm. Accessed September 3, 2008.

EPA ROLE IN ENCOURAGING APPLIANCE EFFICIENCY

DOE and the U.S. Environmental Protection Agency (EPA) jointly administer the ENERGY STAR[3] program and data developed by EERE are used by EPA and DOE to rank appliances in a given class for efficiency. The program typically selects products in the top 25 percent efficiency for all the appliances in a category to display the ENERGY STAR label. The ENERGY STAR program includes more products than those covered under the appliance standards program. It is an effective informational program that aids the consumer in comparing

[3] Background information on Energy Star appliances is available at http://www.energystar.gov/index.cfm?c=appliances.pr_appliances. Accessed September 4, 2008.

efficiencies of appliances performing the same applications and identifying which are the most efficient ones.

The ENERGY STAR program entails defining and labeling cost-effective products that are more efficient than standard. It covers a wide range of products including home appliances, heating and cooling equipment, home electronics, office equipment commercial appliances, lighting, windows, etc. DOE/EERE is responsible for the ENERGY STAR labeling for most of the home appliances (e.g., refrigerators, clothes washers, dishwashers and room air conditioners), residential windows, compact fluorescent lamps and solid-state lamps. EPA is responsible for the ENERGY STAR labels for heating and cooling equipment, home electronics, office equipment commercial appliances, and certain types of lighting. In those cases where there is a choice of fuels, EPA addresses the issue using source energy measurements to define the more efficient products.

The ENERGY STAR program extends well beyond the DOE/EERE appliance standards program in that it evaluates more appliances and includes both residential and commercial construction.

Attachment G
Biographical Sketches of Committee Members

James W. Dally (Chair), University of Maryland, College Park. James W. Dally (NAE) is professor emeritus, University of Maryland, College Park. Dr. Dally has had a distinguished career in industry, government, and academia and is the former dean of the College of Engineering at the University of Rhode Island. Dr. Dally is Glenn L. Martin Institute Professor of Engineering (emeritus) at the University of Maryland at College Park. His former positions include senior research engineer, Armour Research Foundation; assistant director research, Illinois Institute of Technology Research Institute; and senior engineer, International Business Machines Corporation. Currently, he is also an independent consultant. Dr. Dally is a mechanical engineer and the author or co-author of six books, including engineering textbooks on experimental stress analysis, engineering design, instrumentation, and the packaging of electronic systems, and has published approximately 200 research papers. He has served on a number of National Research Council (NRC) committees such as the Committee on Alternatives for Controlling the Release of Solid Materials from Nuclear Regulatory Commission-Licensed Facilities, the Panel on Prospective Benefits of DOE/EERE's Distributed Energy Resources R&D Program, and the Panel on Air and Ground Vehicle Technology for the Army Research Laboratory Technical Assessment Board. He has a B.S. and an M.S. from the Carnegie Institute of Technology and a Ph.D. from the Illinois Institute of Technology.

David H. Archer, Westinghouse Electric Corporation [retired]. David H. Archer (NAE) is an adjunct professor, Carnegie Mellon University. He has earned a B.S. in chemical engineering and mathematics from Carnegie Mellon University and a Ph.D. from the University of Delaware. He is a consulting engineer from the Westinghouse Corporation. He has extensive experience in the development, design, and evaluation of innovative fossil and nuclear-fueled power generation systems. His work has included basic studies of flame behavior and process equipment dynamics as well as the applications of high-temperature solid oxide fuels, coal gasifiers and fluidized bed combustors, hot gas cleaning units, and combustion turbines. He is currently involved at Carnegie Mellon in the development of advanced energy supply Committee for the Disposal of the Chemical Weapons Stock Pile, the Committee on R&D Opportunities for Advanced Fossil Fueled Energy Complexes, and the Committee Investigating Methods for the Evaluation of DOE/EERE Programs. He joined Westinghouse in 1960, retired, and joined Carnegie Mellon in 1990.

Ellen Berman, Consumer Energy Council of America. Ellen Berman has a 40-year career that spans the intersection of science and technology. She served as president of the Consumer Energy Council of America from its founding in 1973 until her retirement and the organization's closing in 2006. Under Ms. Berman's leadership, CECA was one of the leading public interest organizations in the United States focusing on the energy, telecommunications, and other industries providing essential services for consumers. Throughout her tenure as leader of CECA, Ms. Berman sought to advance the public's understanding of the interrelationship of energy policy and the environment, transportation, telecommunications, and other disciplines. She directed the publication and dissemination of nearly 500 reports; technical, economic, and policy analyses; public testimony; and brochures, pamphlets, articles, official documents, consumer guides, and op-ed pieces. Ms. Berman has served on numerous national energy policy committees. She continues to be an active member of the Aspen Institute Energy Policy Forum. She served on the Council on Competitiveness National Innovation Initiative. She serves on the Advisory Council of the Women's Council on Energy and the Environment. In 2004, Ms. Berman was awarded a Key Women in Energy in the Americas Pathfinder and Trailblazer Award. In the past she served on the Committee on Energy and Economic Development of the NAACP; the Magnetic Fusion Research and Development Advisory Committee and the Residential Energy Conservation Advisory Committee of the Office of Technology Assessment of the U.S. Congress; the American Council for an Energy Efficient Economy's Building Efficiency Program; and the Secretary of Energy's Fuel Oil Marketing Advisory Committee. She was invited by the White House and the Japanese Ministry of International Trade and Industry to participate in a month-long executive business study program in Japan. Ms. Berman served as 2008 chair and 2007 co-chair of the 2007 Sarasota International Design Summit, a sustainable design initiative sponsored by the Ringling College of Art and Design in Sarasota, Florida. Ms. Berman holds a B.A. in Russian language and literature from Barnard College of Columbia University.

Ramon L. Espino, University of Virginia. Ramon L. Espino is currently research professor, University of Virginia, Charlottesville; he has been on the faculty since 1999. Prior to joining the Department of Chemical Engineering, he was with ExxonMobil for 26 years. He held a number of research management positions in petroleum exploration and production, petroleum process and products, alternative fuels and petrochemicals. He has published about 20 technical articles and holds 9 patents. Dr. Espino's research interests focus on fuel cell technology, specifically in the development of processors that convert clean fuels into hydrogen and of fuel cell anodes that are resistant to carbon monoxide poisoning. Another area of interest is the conversion of methane to clean liquid fuels and specifically the development of catalysts for the selective partial oxidation of methane to synthesis gas. He served on the NRC Committee on R&D Opportunities for Advanced Fossil-Fueled Energy Complexes, the NRC Committee on Review of DOE/EERE's Vision 21 R&D Program, and the NRC Committee on Prospective Evaluation of Applied Energy Research and Development at DOE/EERE (Phase One and Two). He received a B.S. degree in chemical engineering from Louisiana State University, and an M.S. and a doctor of science in chemical engineering from the Massachusetts Institute of Technology.

David Hungerford, California Energy Commission. David Hungerford is the special advisor to Commissioner Arthur Rosenfeld at the California Energy Commission. He most recently served as the Energy Commission's lead staff on demand response policy development. He was the facilitator of a committee formed to oversee measurement and evaluation of Demand Response programs and rate designs approved by the California Public Utilities Commission, as well as the facilitator of a working group set up by the California Public Utilities Commission to develop programs and tariffs for large commercial and industrial customers. Dr. Hungerford's professional career has focused on conducting and overseeing evaluation research of energy efficiency and demand response programs and using those results to analyze the impacts of policy change for the purpose of developing and guiding policy initiatives. He has also served on numerous technical advisory committees for investor-owned utility programs and public interest energy research (PIER) projects. Since 2003, He has served on the advisory group overseeing PIER demand response research at the Demand Response Research Center at

Lawrence Berkeley National Laboratory and as a member of the technical advisory panel for the San Diego Gas & Electric Advanced Metering Infrastructure project. His professional focus is in energy policy analysis and his research interests are in technology/society issues, technology adoption, consumer behavior, and social change applied to the problem of energy consumption. He received his Ph.D. in human ecology from the University of California, Davis and holds a B.A. in English and in environmental studies from Baylor University.

Steven Nadel, American Council for an Energy-Efficient Economy. Steven Nadel is executive director of the American Council for an Energy-Efficient Economy (ACEEE), Washington, D.C., where he has worked since 1989. He is responsible for overall management of the organization including supervising program directors, fund-raising, overseeing administrative systems, and working with the board of directors. Prior to becoming the executive director, Mr. Nadel served at deputy director and also led ACEEE's Buildings and Equipment Program and Utilities Program for many years. With the ACEEE Buildings Program he has worked on appliance and equipment efficiency standards, building codes, and market transformation programs. He led successful efforts to incorporate lamp, motor and HVAC standards and luminaire and office equipment labeling in the federal Energy Policy Act of 1992 and to include standards on 15 new products in the Energy Policy Act of 2005. Both are now law. He continues to play a major role on U.S. efficiency standards and market transformation programs. With the ACEEE Utilities Program he helped plan, profile, and evaluate energy efficiency programs for many years, and remains active in the development of public benefit programs and policies in several states and in the development of programs to reduce peak electric demand in response to recent electric reliability problems. Mr. Nadel has led or assisted on numerous research projects, leading to over 100 published papers. In early 2006 he authored a report on energy efficiency resource standards (energy-savings targets for utilities) and since that time has provided assistance to several states and members of Congress working on legislative and regulatory proposals. He has an M.S. in energy management from the New York Institute of Technology and a B.A. in government and an M.A. in environmental studies from Wesleyan University in Connecticut.

Richard K. Newell, Duke University. Richard G. Newell is the Gendell Associate Professor of Energy and Environmental Economics at the Nicholas School of the Environment and Earth Sciences, Duke University. He is a University Fellow at Resources for the Future, Washington, D.C. He recently served as the senior economist for energy and environment on the President's Council of Economic Advisers, where he advised on policy issues ranging from automobile fuel economy and renewable fuels to management of the Strategic Petroleum Reserve. He is a member of the National Academy of Sciences (NAS) Committee on National Science Foundation Innovation Inducement Prizes, the NAS Committee on Energy R&D, the National Petroleum Council Global Oil and Gas Study Committee, the Advisory Board of the Automotive X-Prize, and the Editorial Board of the journal *Energy Economics*. He has served as an independent expert reviewer and advisor for governmental, non-governmental, international, and private institutions including the National Commission on Energy Policy, the U.S. Environmental Protection Agency, the U.S. Department of Energy, the U.S. Energy Information Administration, the U.S. National Science Foundation, the Intergovernmental Panel on Climate Change, the Pew Center on Global Climate Change, and others. He holds a Ph.D. from Harvard

University, a master in public affairs (M.P.A.) from Princeton University's Woodrow Wilson School of Public and International Affairs, and a B.S. and a B.A. from Rutgers University.

Reinhard Radermacher, University of Maryland, College Park. Reinhard Radermacher is a professor in the Department of Mechanical Engineering at the University of Maryland. He has 30 years of experience in research and development of energy conversion systems in general and CHP (Cooling Heating and Power) Systems and air-conditioning/heat pumping devices in particular. He is an internationally recognized expert in the use of working fluid mixtures. Dr. Radermacher founded the Energy Laboratory in 1983 and is the director and co-founder of the Center for Environmental Energy Engineering (CEEE) at the University of Maryland. The center is taking the lead in developing energy conversion systems that meet environmental and economic concerns. Dr. Radermacher's service includes international activities such as being the U.S. representative of the International Energy Agency Annexes 13 and 34, past vice president of Commission B1, and president of Commission B2 of the International Institute of Refrigeration (IIR). He is an honorary member of the IIR and has been invited for lecture tours to Europe, China, Japan, Korea, and South America. He also serves as the coordinator of the Student Exchange Program for the University of Maryland, College of Engineering. Nationally, he is an active fellow of the American Society of Heating Refrigeration and Air-conditioning Engineers (ASHRAE) and a member of the American Society of Mechanical Engineers (ASME). His work has resulted in more than 150 publications, as well as numerous invention records and 10 patents, and he co-authored three books. He serves as the editor ASHRAE's *HVAC&R Research* journal starting in July 2002. He holds an M.S. and a Ph.D. in physics from the Munich Institute of Technology and was a visiting scientist and NATO scholar at the National Institute of Standards and Technology.

Phyllis Reha, Minnesota Public Utilities Commission. Phyllis A. Reha was appointed to the Minnesota Public Utilities Commission (PUC) by Governor Jesse Ventura on May 16, 2001, and reappointed by Governor Tim Pawlenty on June 26, 2007, and serves as its vice chair. Commissioner Reha has been active in a number of utility and energy organizations during her tenure as a PUC commissioner. She is a member of the National Association of Regulatory Utility Commissioners (NARUC) and currently serves as the chair of the Committee on Energy Resources and the Environment. She is also a member of and past president of the Mid-America Regulatory Conference. Commissioner Reha also serves on the advisory councils of the Electric Power Research Institute; the New Mexico State University Center for Public Utilities; and the National Council on Electricity Policy. Recently she was selected as one of seven commissioners nationally to participate on a leadership group, sponsored by the U.S. Environmental Protection Agency and the U.S. Department of Energy, whose charge was to develop a National Energy Efficiency Action Plan. She is also co-chair of the Federal Energy Regulatory Commission/NARUC Demand Response Collaborative, which will explore how to coordinate federal and state approaches to electricity demand response policies and practices. Commissioner Reha has a B.A. degree from the University of Minnesota and a J.D. from the University of Minnesota Law School.

Eric Williams, Arizona State University. Eric Williams is assistant professor in civil and environmental engineering and in the School of Sustainability. As part of his responsibilities, he is also developing a program in Earth Systems Engineering and Management. Before joining

Arizona State University, he spent a year as visiting faculty at civil and environmental engineering at Carnegie Mellon University, preceded by eight years in Tokyo at United Nations University where he conducted research related to information technology and the environment. His research interests include industrial ecology, life cycle assessment, information technology (IT), and energy systems, with a focus on the environmental assessment and management of IT hardware. In addition to IT-related issues, Dr. Williams is also working on the effects of development and urbanization on energy demand in industrializing nations, including analysis of relationships between infrastructure provision and transport-related carbon dioxide emissions in Asia and projections of future energy demand of the Chinese iron/steel sector, hybrid life cycle assessment (which combines process and economic input-output techniques), uncertainty analysis in industrial ecology, and sector-level forecasting of technological change/growth. Dr. Williams earned degrees in physics at Macalester College, in St. Paul (B.A.) and the State University of New York, Stony Brook (Ph.D.).

James L. Wolf, Independent Consultant. James Wolf is an independent consultant working with private companies, governments, and foundations on energy and climate change issues. He was formerly vice president of energy and environmental markets for Honeywell, Inc. where he focused on business development opportunities to develop new products and services and market existing services to energy and environmental concerns. Previously, he was executive director at the Alliance to Save Energy, a nonprofit coalition whose board of directors is composed of U.S. senators, chief executive officers of major corporations, and environmental leaders. He also served as acting deputy assistant administrator for policy and planning with the U.S. Department of Commerce's National Oceanic and Atmospheric Administration, where he helped design and supervise policies and programs addressing marine pollution, global climate change, alternative energy resources, and international scientific research protocols. Mr. Wolf has a J.D. degree from Harvard Law School.

Attachment H
Minority Opinion of David H. Archer, Committee Member

I regret that I cannot concur with the draft transmittal letter and the final report of the committee.

First, they do not include [what I view as] the most important finding and recommendations that should result from the information presented to the committee:

- [Archer] Finding: The U. S. DOE/EERE Energy Conservation Program that establishes energy performance standards for residential and commercial building appliances is significant and effective in reducing the energy demand of the nation. It is well conceived and structured. It properly uses site energy to set the standards and source energy to estimate their energy, economic, and environmental cost/benefits to the nation. The Program is appreciated by appliance manufacturers and their customers, the public.

- [Archer] Recommendation 1: The scope of the program should be broadened to include a wider variety of residential and commercial building appliances and systems. These should be identified by DOE/EERE to cover a broader range of the energy consuming appliances in these buildings. (An illustrative, but not prescriptive, list of such appliances and systems is attached as . . . [Table H.1].)

- [Archer] Recommendation 2: The pace of the program should be accelerated to establish and also to revise appliance standards more rapidly.

Second, the report overemphasizes the concept of full fuel cycle energy to the point that it diverts attention from the purpose of the DOE/EERE program: to assure that the available building appliances for all the various functions, energy sources, and building applications are efficient; not to compare the energy use of appliances using different energy sources on the basis of full fuel cycle energy consumption.

Third, I am concerned that the length and complexity of the committee's "letter" report detracts from its impact.

TABLE H-1 Additions to the Department of Energy/Office of Energy Efficiency and Renewable Energy Appliance Energy Conservation Standards Program

Residential television sets
Lap and desk top computers
Solar photovoltaic power or solar thermal heating units
Commercial air circulation fans for variable and constant air flow
Cooling/heating and ventilation systems
Commercial ventilation air enthalpy recovery units.
Commercial desiccant based air dehumidification units
Commercial absorption chillers
Advanced thermostats, smart meters, and other instrumentation and control hardware to achieve energy reductions in the operation of appliances

Attachment I
Minority Opinion of Ellen Berman, Committee Member

The committee's primary recommendation (Recommendation 1) is that:

> DOE/EERE should consider moving over time to use of the full- fuel-cycle measure of energy consumption for assessment of national and environmental impacts, especially levels of greenhouse gas emissions, and to providing more comprehensive information to the public through labels and other means including an enhanced website. DOE/EERE efforts should address the data collection and analysis needed to accurately estimate full-fuel-cycle energy consumption as well as to assess and improve consumer understanding and use of information on full-fuel-cycle energy consumption.

As an advocate for energy policy in the best interest of the nation's consumers, I believe that consumers may unintentionally be adversely affected by the primary conclusion and related recommendations. In order to ensure that consumers are best served by the Appliance Efficiency Program, I present this dissent. My dissent addresses three key issues which could impact the usefulness of the program for consumers:

1. **The problem with the appropriateness and validity of a full-fuel-cycle energy measure.** The Committee's recommendation that DOE/EERE transition to a full-fuel-cycle energy measure is intended to provide a more complete picture of the energy consumed by an appliance. The full-fuel-cycle measurement would expand the energy calculations beyond the direct consumption of energy by the consumer's appliance and would include those upstream costs incurred from the point of extraction of the fuel to the point the energy made from that fuel enters the home. As laudable as this intent is meant to be, this approach would not benefit consumers. Developing a full-fuel-cycle cost methodology is fraught with complexity and controversy. A simple conversion factor from site energy to full fuel cycle is not adequate. There are myriad criteria for determining full-fuel-cycle analysis and reaching agreement on a satisfactory procedure would likely be beyond DOE/EERE's time and resources at a time when such resources are already strained. Some reputable economic models include not just costs of fuels but benefits as well, while others include societal costs and benefits, such as health impacts, environmental impacts, global warming, accidents, energy security, employment impacts, and depletion of non-renewable resources. In addition, both supply and demand of fuels should be considered. The impact of new technologies for carbon sequestration and clean coal, new generation of nuclear power, greater use of renewables, gas technologies should be factored into the model. Given the complexity of a proper full-fuel-cycle-cost model, the ability of the public to respond meaningfully in the rulemaking process would be limited and the Appliance Efficiency Program would not benefit. The current measurements best serve the goals of the Program.
2. **The problem with using full-fuel-cycle in setting a standard when a choice of fuels can be used.** Assuming an appropriate full-fuel-cycle methodology could be determined, using this measure when a choice of fuels can be used could have unintended consequences and harm consumers. As explained in this report, "the appliance standards program is not meant to identify or establish favored energy sources or technologies for building appliances. That is a matter of government policy and/or the free market." Notwithstanding this caveat, direct comparisons among fuels will inevitably favor one fuel over another in terms of the measures

used in the analysis—one fuel will be more environmentally sound, one will be more affordable, another might be more reliable or secure, yet another might be more available, and another might be determined to be safer. These preferences are beyond the intention of the Program and are a matter of national energy policy. Of particular significance is the fact that the consumer has no control over upstream costs of producing energy or the physical characteristics of fuels. They cannot control the transmission and distribution losses incurred in bringing electricity to the home. They cannot control the energy required to bring LNG into the country or pressurize it into the pipeline system. They cannot account for the cost of oil drilling or storing nuclear waste. They can only control the amount of energy used within their home—site energy. Factoring in the upstream costs would create a disservice to consumers and could thwart the intent of the Program. Were consumers to switch fuels based on incomplete analysis, costs of conversion could be very great and energy savings might not occur at all. In addition, supplies of the preferred fuel could become constrained, prices could soar, and industries could relocate abroad in order to stay competitive. The nation saw such an example of unintended consequences—constrained supply, sharply increased prices, chemical industries moving abroad—when natural gas, a clean-burning fuel, was popularly used in turbines to generate electricity. DOE/EERE should continue using site measurements to set appliance efficiency standards.

3. The problem with using the label as a vehicle for societal goals as measured by full-fuel-cycle energy analysis. Informing the public of environmental consequences of energy use is an important goal. The government has an obligation to conduct such educational campaigns. As worthy as this goal is, the appliance labeling program is not the appropriate vehicle. Over the past 30 years, energy efficiency standards have helped consumers in very important ways which can be negatively impacted by the recommendations. Adding information on environmental impacts would confuse the decision process. The existing site-based labels provide clear and understandable cost and consumption information that is relevant to consumers' purchases. Consumers can easily compare the annual operating costs of different appliances while they compare the purchase prices of the appliances. The cost and energy consumption information on the label equips the consumer to make an informed economic decision—a decision which is fully within the consumer's control. Importantly, a unit of energy saved by the purchase of an efficient appliance—regardless of the fuel used—means one less unit of energy that we need to produce from domestic sources or import from unstable foreign countries. That helps the environment through reduced air emissions and has important national security implications.

In 2006, the Consumer Energy Council of America convened leading energy experts to examine the costs and benefits of each fuel used for stationary energy needs. The consensus forum examined the characteristics of each fuel through the prism of national consumer priorities, including cost, environmental impacts, availability, national security, public health, safety, and other factors. The report of the forum, *Fueling the Future: Better Ways to Use America's Fuel Options,* determined that over the next 20 years we need to use every fuel in the nation's portfolio—but we need national policy and new technology to improve the characteristics of each fuel. The Appliance Efficiency Program is not the proper vehicle for setting national fuels policy—and fuels policy would be the unintended consequence. Site based standards are uncomplicated, non-political, provide valuable cost and consumption information for consumers, result in significant national energy and environmental savings, and best serve the goals of the Program.