Transforming Markets by Combining Federal Tax Credits with Complementary Initiatives

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Executive Summary

Introduction

The Energy Policy Act of 2005 contains a variety of tax incentives for energy-saving equipment and practices. Incentives are provided for efficient new homes; residential air conditioning, heating, and water heating equipment; residential appliances; commercial buildings (new construction and lighting retrofits); building fuel cells and microturbines; light-duty vehicles; heavy-duty vehicles, and envelope improvements to existing homes.

The intent of the tax incentives was to spur increases in measure availability and sales so that ultimately these technologies and practices can thrive in the market without federal tax incentives. In other words, these tax incentives were designed to work in tandem with other initiatives in order to transform markets so that these products and practices become business as usual in the long term.

This Report

This report was prepared by the Tax Incentives Assistance Project (run by a consortium of non-profit organizations and government agencies) to provide a market transformation plan for each of the areas covered by the tax incentives. For each product and service covered, this report discusses short- and long-term objectives, market barriers, and actions needed to address barriers so that markets can be transformed. Actions include refinements to the tax incentives as well as complementary initiatives. This report contains a section for each major product and service, and then ends with a section discussing commonalities across measures.

Findings

Among the key commonalities across tax incentive areas, we found the following needs:

- Clarification of IRS rules
- Increased outreach, training, and technical support
- Complementary state and utility programs
- Extension of most of the tax incentives and refinement of some of them
- Work on test procedures in several cases
- Continued research, development, and deployment on specific items
- Work to bring specifications, codes and standards into alignment with the tax incentives

Conclusion

The federal tax incentives are designed to be a key element in a long-term market transformation strategy to make these products and practices "business as usual." But in all cases, tax incentives alone will not transform markets. The tax incentives need to be complemented with outreach, training, and technical support for them to have significant impact. A variety of other actions will be needed as well, including extension of most of the credits for at least another three years. If all of these tax incentives are successful in transforming markets, U.S. energy use will be

reduced by roughly 5%, reducing consumer and business energy bills by billions of dollars annually. In order to achieve these worthwhile objectives, states, utilities, manufacturers, federal agencies, Congress, and efficiency organizations will each need to undertake significant actions outlined in this report. While there is significant work involved, the benefits are large and the costs of inaction substantial.

Introduction

Tax Incentives in the Energy Policy Act of 2005

In August 2005, the Energy Policy Act of 2005 was signed into law (this is frequently abbreviated as EPAct). Approximately five years in the making, this law included more than a hundred provisions. This report addresses several provisions that provide federal tax incentives for advanced energy-saving technologies and practices. Specifically, the new law provides tax incentives for the following products that meet specified energy efficiency criteria:

- New homes
- Envelope improvements to existing homes
- Residential air conditioning, heating, and water heating equipment
- Residential appliances
- Commercial buildings (new construction and lighting retrofits)
- Building fuel cells and microturbines
- Light-duty vehicles
- Heavy-duty vehicles

The intent of the tax incentives was to spur increases in measure availability and sales so that ultimately these technologies and practices can thrive in the market without federal tax incentives. In other words, these tax incentives were designed to work in tandem with other initiatives in order to transform markets so that these products and practices become business as usual in the long term.

The Tax Incentives Assistance Project

The Tax Incentives Assistance Project (TIAP) is a cooperative effort by many organizations to assist with implementation of the federal tax incentives so that they achieve their market transformation objectives. TIAP includes public interest nonprofit groups, government agencies, trade associations, energy efficiency program administrators, and other organizations in the energy efficiency field. TIAP activities include the following:

- A Web site to provide information to consumers, businesses, and energy efficiency firms (http://www.energytaxincentives.org).
- Work with the U.S. Department of Treasury, Department of Energy (DOE), and other agencies on rules to implement the tax incentives.
- Provide information, presentations, and technical assistance to state and utility program implementers who want to use the federal tax incentives to complement their local programs.
- Networking with professional associations, trade associations, and firms that provide products and services eligible for the tax incentives.

Organizations active in TIAP include the following (listed alphabetically):

- Alliance to Save Energy
- American Council for an Energy-Efficient Economy
- California Energy Commission
- Energy Foundation
- Florida Solar Energy Center
- National Association of State Energy Offices
- National Electrical Manufacturers Association
- Natural Resources Defense Council
- New Buildings Institute
- New York State Energy Research and Development Authority
- North American Insulation Manufacturers Association
- Northwest Energy Efficiency Alliance
- Residential Energy Services Network
- Solar Energy Industries Association
- U.S. Department of Energy
- U.S. Environmental Protection Agency
- Vermont Energy Investment Corporation

This Report

This report was written by many people involved in TIAP to provide a vision of how to achieve market transformation objectives for the goods and services covered by the EPAct tax incentives. For each product and service covered, this report discusses short- and long-term objectives, market barriers, and actions needed to address barriers so that markets can be transformed. Actions include refinements to the tax incentives as well as complementary initiatives. This report contains a section for each major product and service, and then ends with a section discussing commonalities across measures.

Energy-Efficient Homes

Tax Code Provision

The Energy Policy Act of 2005 includes a provision (Section 1332) that provides tax credits for home builders and manufacturers to construct energy-efficient homes. The tax credits cover homes whose construction is substantially built after August 8, 2005 and sold between January 1, 2006 and December 31, 2007.

For site-built homes, there is a credit of $2,000 per home that exceeds the 2004 version of the International Conservation Code (IECC) by 50%. The Internal Revenue Service has determined the homes need to be verified by a certifier that has been accredited or otherwise authorized by the Residential Energy Services Network (RESNET) or an equivalent rating network. The homes performance must be calculated to comply with the threshold using a software tool that has been verified through the process developed by RESNET.

For manufactured homes, there is a credit of $1,000 per home that either exceeds the 2004 version of the IECC by 30% or complies with the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® for Homes guidelines. For manufacturers that choose the IECC compliance threshold, the homes need to be verified by a certifier that has been accredited or otherwise authorized by RESNET or an equivalent rating network. The homes' performance must be calculated to comply with the threshold using a software tool that has been verified through the process developed by RESNET. Manufactured homes that choose the ENERGY STAR compliance threshold must be verified through the process adopted by EPA.

When the legislation passed, EPA was in the process of modifying its ENERGY STAR guidelines for site-built homes. The most significant changes EPA made were to shift the basis of the guidelines from the Model Energy Code to the IECC and require a 13 SEER air conditioner as the basis of the analysis of a home's energy performance. EPA did not apply these changes to manufactured homes. This action causes manufactured homes complying for the tax credit through ENERGY STAR to have a less stringent energy performance than manufactured homes complying with the 30% over IECC option. If the tax credit is extended beyond 2007, the $1,000 credit for manufactured homes should only apply to manufactured homes that exceed the IECC by 30%.

Goals and Objectives

The long-term goal of this tax credit is to have the new homes built and sold in the future be as efficient as homes now eligible for the tax credit. This is a very ambitious goal, particularly for homes that are manufactured under the HUD standards. A tax-credit-compliant non-manufactured home is approximately 35% more efficient than the current guidelines for ENERGY STAR. EPA reports that in 2005 over 160,000 (approximately 10% of homes built in the United States) complied with the ENERGY STAR guidelines (Lee 2006).

Shorter-term objectives that should be considered are as follows:

1. The threshold of 50% efficiency above the IECC should become a new milestone for state and utility energy efficiency market transformation programs. ENERGY STAR would serve as the floor level with the incentives aimed at the higher threshold.

2. There should be an increase in the market share for energy-efficient homes that meet the tax credit threshold to equate to the current market penetration of ENERGY STAR homes by 2015.

3. If the market continues to develop at current trends, EPA should consider modifying its guidelines for ENERGY STAR Homes to meet the threshold of the tax credits, effective by approximately 2010.

4. Incentives should be put in place for homes meeting the tax credit threshold after 2008. While it is not certain what the market share for tax-qualifying homes will be at the end of 2007 when the credit is currently scheduled to expire, it appears that the credits for 50% savings for site-built homes should be extended. Further analysis will be needed on

whether to extend the 30% savings credit for manufactured homes or whether to serve manufactured homes strictly under the same 50% credit applied to site-built homes.

5. The credit for manufactured homes for meeting the current ENERGY STAR specification should expire in 2007. The current ENERGY STAR specification for manufactured homes is weak (weaker than the ENERGY STAR specification for site-built homes) and the savings are not large enough to justify federal investment. If ENERGY STAR revises its manufactured homes specification to align the ENERGY STAR site-built home specification or with 30% savings, then continuation of this provision should be analyzed further.

6. There should be an increase in the infrastructure of individuals trained and certified to perform the inspections and testing for the labeling of high energy performance homes.

7. A builder education effort should be implemented to transform the knowledge gained in meeting the tax credit's performance goals to the entire housing industry through the DOE's Building America Program.

Barriers

There are a number of barriers that serve to hinder the market share of tax-credit-eligible homes that exceed the IECC by 50%. These are:

- *Market resistance to added first up-front cost to achieve a high energy performance home*—All too often private investment decisions concerning the energy performance of the building stock do not reflect the cradle-to-grave value of potential building energy-saving investments. The vast majority of owner-occupied buildings undergo multiple changes in ownership during their lifetimes and thus each individual owner has a limited financial interest in undertaking investments to minimize the building's long-term energy costs.

- *Builders not knowing what it takes to achieve the 50% savings*—ENERGY STAR was able to achieve its market share because builders had years to learn what it took to achieve the program's energy performance thresholds. The DOE's Building America early research focused on showing builders how to cost-effectively meet the ENERGY STAR guidelines. Because a lack of awareness of the new systems engineering for building highly energy-efficient homes, many builders perceive that it is too difficult and expensive to meet the 50% threshold. A main reason for this is that there has only been a limited amount of training on how to cost-effectively build a home that is 50% more efficient than code.

- *Lack of homebuyer awareness of the benefits of owning a home whose energy performance is 50% above code*—There has been little promotion of the 50% savings threshold to homebuyers, so few buyers are aware this is an option or familiar with the costs and benefits of these high levels of efficiency. Furthermore, because the tax credit

goes to the builder, there is no certainty the homebuyer will be aware of the benefits of the high energy performance of the home being purchased.

- *The need to bring ducts into conditioned space*—Research by the Florida Solar Energy Center indicates that outside of California, meeting the 50% tax credit threshold will require that the builder place the duct work inside the home's conditioned space (Fairey 2006). Such construction practice is not common and is seen by builders as a barrier to meeting the tax credit.

- *The short duration of the tax credit*—It takes time for builders, particularly production builders, to change. Homes are planned to be constructed several years before the foundation is laid. Two years is unrealistic to expect a production builder to change their homes' plans and construction specifications. The IRS did not release the tax credit rules for the energy-efficient homes credit until late in February 2006. Most of the homes being built this year were already designed and specified by the release of the tax credit's rules. Production builders also need a longer time commitment to make the significant changes called for by the tax credit to their line of homes.

- *The 50% threshold is considered to be too high by many builders*—Many builders who have not constructed very efficient homes consider the 50% savings target to be out of reach. Furthermore, the ease of meeting the 50% tax credit is governed by the region the home will be built in. It is more difficult to meet the tax credit threshold in Miami than in California. In climates such as Miami, some builders advocate that a more realistic target would be 30%. On the other hand, reducing the threshold to 30% nationwide would probably be more costly than Congress is likely to pass and developing a regional approach would require significant analysis and the complication would make it more difficult to get through Congress. This issue needs to be studied further by advocacy groups and policymakers.

Actions Needed

There are actions that would be helpful in addressing the barriers identified above and assist in achieving the market transformation goals that served as the basis for the energy efficiency tax credit. These are:

- *Extension of the tax credits for the 50% thresholds to December 31, 2010*—By extending the tax credits to December 31, 2010, Congress would allow builders an opportunity to learn about the tax credit, and change their designs and production specifications to begin building homes performing at the thresholds set by Congress. Already legislation in the Senate has been proposed by the ranking members of the Senate Finance Committee (S.2401) to extend the 50% credit to December 31, 2010.

- *Conducting additional research on the manufactured housing market to determine whether the 30% credit should be extended or whether the 50% credit can adequately address the manufactured home market.*

- *The U.S. Department of Energy should focus the Building America Program on research regarding how to achieve the 50% energy performance threshold*—The Building America research was very effective in showing builders how to meet the ENERGY STAR energy performance thresholds with little or no incremental cost. This research eased the transition to ENERGY STAR, particularly with production builders. Such an effort should be made by the DOE for meeting the performance threshold of the tax credit. Of particular value would be showing builders practical and cost-effective methods for addressing duct performance. Once the research is completed, DOE should work with other market transformation programs in educating builders on how to cost-effectively build homes that are 50% more efficient than code. In addition, an effort should be made to educate consumers of the benefits of such home performance.

- *Utility and state energy efficiency programs should promote the 50% savings threshold target and provide assistance and incentives to builders to achieve the target*—States and utilities can play a major role in meeting the market transformation envisioned by Congress in establishing the tax credit. Utility and state energy office programs should consider offering financial incentives and marketing support for homes whose energy performance exceeds the IECC by 50% in 2008 and beyond if the federal tax credit is not extended. These follow-up incentives can be offered for an additional transition period and then phased out as the market share grows. In addition, these programs should considered a tiered effort where ENERGY STAR serves as the base of support and builders are encouraged to achieve the more ambitious performance goal set by the federal tax credit. A particular focus of these efforts should be on training and education to consumers on the benefits of homes whose energy performance is 50% more efficient than code.

- *Commitment of the federally sponsored secondary mortgage market to energy efficiency mortgages*—Energy efficiency mortgages are offered by the entire government-sponsored secondary mortgage market. Energy efficiency mortgages increases the appraised value of energy-efficient homes and the buying power of consumers buying an energy-efficient home. Such mortgage products offers ongoing financial incentives for consumers to buy the high performing homes encouraged by the tax credit after the tax credits expire. While all of the secondary mortgage markets offer energy efficiency mortgages, they are not actively promoted. A follow-up activity for Congress to consider is to set a goal for the federally sponsored mortgage markets of achieving a 50% market share of homes that are 50% more efficient than the IECC by 2020 and annually reporting to Congress on its success in meeting the goal.

- *The Environmental Protection Agency should consider increasing its threshold by the end of the decade*—EPA reports that over 160,000 homes were built to the ENERGY STAR Homes guidelines in 2005. In terms of market transformation, this is fast approaching the critical mass threshold in the marketplace. As construction practice meets ENERGY STAR guidelines, EPA should consider ramping up its guidelines to the 50% savings threshold.

Tracking

Since the underlining purpose of the tax credit is market transformation, a key metric is to track the number of homes that achieve the energy performance threshold set by Congress. This should be a fairly straightforward process. The energy performance of the home's design must be calculated by a software program. The IRS has mandated that the software tools used to calculate compliance to the tax credit must be certified by RESNET. RESNET is working with the accredited software tool developers to track the number of tax verification reports produced for the IRS in the tool. When this is accomplished, it will allow RESNET to report in real time the number of homes that qualified to receive the $2,000 tax credit.

The tracking of manufactured homes should be easy also. EPA tracks on a quarterly basis the number of manufactured HUD code homes that were labeled as ENERGY STAR. Since all manufactured homes that meet the ENERGY STAR guidelines qualify for the $1,000 credit, it should be fairly simple to report on the number of manufactured homes that were eligible for the credit.

EPA and RESNET will be coordinating their efforts on tracking the number of homes that would be eligible for the tax credit.

Recommendations

Specific recommendations are provided in prior sections. To summarize, we recommend:

Congress: Extend the $2,000 tax credit. Pending the results of research, possibly extend the $1,000 credit for manufactured homes that exceed the IECC by 30%. In addition, consider adopting a performance target of 50% of homes exceeding the 50% performance threshold over the IECC by 2020 and a requirement that the markets report to Congress on progress achieved in meeting the goal annually.

U.S. Department of Energy: Make meeting performance levels called for in the tax credits a research priority for Building America. Undertake research and education to builders on cost-effectively addressing duct leakage to meet the tax credit performance called for in the tax credit. Develop and post a publication on the results of the research on the Building America Web site, as was done on research on meeting the ENERGY STAR guidelines.

U.S. Environmental Protection Agency: Assuming the market for ENERGY STAR-labeled homes continues to develop at the current trend, EPA should consider setting the energy performance guidelines for ENERGY STAR Homes to the tax credit level by 2010.

National energy laboratory: A national energy laboratory needs to be tasked to conduct research and make a recommendation whether there is justification for extending the 30% credit for manufactured HUD code homes.

Fannie Mae, Federal Housing Administration, Freddie Mac, and the Veterans Administration: Set a goal of 50% of homes exceeding the 50% performance threshold over the

IECC by 2020. Actively promote energy efficiency mortgages as an effective method of financing high energy performance homes after the tax credits expire.

Utility and state energy efficiency programs—Incorporate tax-compliant homes as part of their energy efficiency construction programs. Provide financial assistance, builder training and technical assistance and marketing support for such homes.

Efficiency advocates: Urge Congress to extend the tax credits until December 31, 2010.

TIAP: Encourage other players to undertake recommended actions.

Residential Retrofits

Tax Code Provision

The Energy Policy Act of 2005 (Section 1333) provides tax credits for individual taxpayers making certain energy efficiency improvements. There are two types of "Nonbusiness Energy Property" tax credits included in the statute and clarified in IRS Guidance Notice 2006-26. These are:

- "Qualified Energy Efficiency Improvements," including building envelope improvements such as insulation and energy-efficient fenestration products (windows, glazed doors, and skylights), and
- "Residential Energy Property," including residential heating and cooling (or HVAC) equipment.

This section of our report deals with the Qualified Energy Efficiency Improvements for building envelope efficiency measures. Residential Energy Property (HVAC equipment) is addressed in a subsequent chapter of the report.

Qualified Energy Efficiency Improvements for the building envelope must be installed in or on the taxpayer's principal residence in the United States. Home improvement tax credits apply for improvements made between January 1, 2006 and December 31, 2007. Specific eligibility levels and amounts are summarized in Table 1.

The total tax credit amount that can be claimed over 2006–2007 is $500, and there are caps on fenestration tax credits of $200 as shown in the table below. Also, only the cost of materials for these measures figure into the tax credit. Installation costs are not eligible.

Goals and Objectives

The clear goal of Section 1333 of the Energy Policy Act of 2005 is to encourage building envelope efficiency upgrades in the existing residential building stock. The longer-term goals are to bring the insulation levels of the existing housing stock up as close as possible to current model energy code requirements (e.g., also filling uninsulated cavities and stud spaces) and to encourage installation of energy-efficient products in the replacement fenestration market.

Establishing a duct sealing and air sealing (infiltration reduction) industry is also a goal, as a widely ignored part of current building codes is to properly seal against infiltration and duct leakage. Upgrading the energy efficiency of the existing housing stock has been a persistent challenge for advocates for decades, especially with building envelope improvements. Utility demand-side management programs and low-income housing programs have been the main vehicle for this, supplemented by ongoing insulation and windows marketing efforts in the private sector. In the energy-efficient windows market, gains have been made over the past decade to the point where about half of the window replacement market is for energy-efficient window products.

Table 1. Summary of Tax Credits for Building Envelope Qualified Energy Efficiency Improvements

Measure Type	Qualifying Efficiency	Credit Amount
Insulation, vapor retarder, infiltration seal	Must meet either 2001 Supplement to 2000 IECC or 2004 Supplement to 2003 IECC.	10% of material cost not to exceed $500 total
Exterior window, skylight, exterior door	Must meet either 2001 Supplement to 2000 IECC or 2004 Supplement to 2003 IECC. ENERGY STAR-rated exterior windows and skylights are deemed to qualify under the special rule in IRS Guidance Notice 2006-26.	10% of material cost not to exceed $200 total
Storm window and storm door	Must meet either 2001 Supplement to 2000 IECC or 2004 Supplement to 2003 IECC. Storm windows are eligible if the existing window plus the new storm window meet the window efficiency requirements in the IECC.	10% of material cost not to exceed $200 total
Metal roofs with reflective pigmented coatings	Must meet ENERGY STAR criteria.	10% of material cost not to exceed $500 total

Over the next five years, the energy efficiency community and other interested parties should work towards a number of market transformation goals related to the building envelope. These broad goals should include:

- Working towards a goal of achieving envelope retrofits at a rate of at least 5–10% of the existing housing stock annually. While some aggressive utility energy efficiency programs achieve this penetration rate, the national average is believed to be far below this level. This would include installation of insulation, efficient windows, duct sealing, and air infiltration sealing measures. Whole building retrofit approaches such as EPA's *Home Performance with ENERGY STAR* should be encouraged.

- Achieving a near-universal market penetration rate for energy-efficient windows in the replacement window market. The current tax credits for efficient fenestration products, while limited, offer an opportunity for all interested parties such as utilities, manufacturers, retailers, and installers to promote these incentives as part of promotion campaigns over the next few years (assuming an extension of the tax incentives by Congress).

Shorter-term and more immediate objectives for building envelope improvements related to the current tax incentives should include:

- *Extend the tax incentives effective period to at least 2010 or longer:* This will allow time to implement other strategies that could lead to increased retrofit activities through expanded utility demand-side management (DSM) programs and increased marketing activity by installers and industry trade allies.

- *Reform certain parts of the tax incentives:* As part of any move to extend the period for the tax incentives, include various reforms to encourage more retrofit activity. These reforms include: allowing the costs for building envelope retrofit installation (not just material costs) to figure into the tax credit; explicitly expanding the list of approved envelope measures to include air infiltration and infiltration air duct sealing (the current IRS guidance implies duct sealing is eligible but is not definitive); a performance-based option to encourage whole-building retrofits to meet achievable energy use reduction targets and an expanded network of home energy raters to provide the needed performance certifications.

- *Encourage more tax incentive promotion by industry trade allies and utilities:* While we have only anecdotal information available, it does not appear that natural trade allies such as insulation and window installers are engaged in significant promotion of the tax incentives. Local advertising for these products and services in different parts of the country generally has not prominently featured the available tax incentives. Also, while some utilities have begun to promote the tax credits to their customers, many have not. Discussions with utility trade associations indicate that many of their members don't have the expertise to properly inform their customers of the opportunity. Even utilities otherwise active in promoting energy efficiency programs have not fully embraced the tax incentives, citing the need to achieve some of the needed reforms mentioned above. Efficiency advocates should help to fill this information gap and work towards achieving the needed reforms.

Barriers

Barriers to accomplishing building energy retrofits have been described extensively in the energy efficiency literature and summarized most recently in the Western Governors' Association Energy Efficiency Task Force report (WGA 2005.) Some of the general market failures or barriers that inhibit greater investment in energy efficiency measures include:

- Consumers lacking or having incomplete information about energy efficiency options,
- Consumers lacking the capital to invest in energy efficiency measures,
- Fiscal or regulatory policies that discourage energy efficiency investments,
- Perceived risk associated with the performance of energy efficiency measures,
- Split incentives whereby the party designing, constructing, or purchasing a building or piece of equipment does not pay the operating costs, and
- Energy prices that do not reflect the full costs imposed on society by energy production and consumption (so-called externalities).

The tax credits address some of these barriers inasmuch as they provide financial incentives for efficiency measures and are available to both homeowners and tenants. However, some of the information barriers persist (i.e., performance risk and economic benefits) and must be overcome through outreach and education efforts to consumers. Proper messaging can be targeted to consumers through a coordinated program by efficiency advocates, utilities and their regulators, trade allies, and units of government.

The specific barriers to effective use of the EPAct 2005 tax credits include:

- *Installation costs for envelope measures are not included in the IRS interpretation of the statute in Guidance Notice 2006-26*—Only the cost of the materials currently counts towards the tax credit. However, the statute in Section 25c (a) (1) allows for "10 percent of the amount paid or incurred by the taxpayer for qualified energy efficiency improvements installed in such taxable year." It seems reasonable to interpret the statute language as including the amount paid for installation of envelope measures as well as materials. Windows and insulation are often purchased as part of a complete package including installation, and the invoice for the total installation may not include a breakout of just the material costs. Thus, taxpayers are in the uncomfortable position of having to make their own estimates of the material costs. **In addition, much of the cost for air infiltration sealing of the envelope and duct sealing is in labor costs. Modifying the IRS rules can mitigate this barrier.**

- *The tax credit level may be too low to attract significant public participation*—Installation of significant insulation upgrades and replacement windows in existing residences are expensive home improvement projects. The relatively low tax credit level for this type of work may be reflected in the lack of aggressive promotion by industry trade allies. A higher tax credit level should be considered, especially for performance-based approaches utilizing Home Performance with ENERGY STAR concepts, as has been proposed in recent legislative initiatives (Snowe and Feinstein 2006). This will provide additional quality assurance that the tax credits are delivering the required levels of energy efficiency improvements, but requires an expanded network of home energy raters.

- *Increased outreach efforts by industry trade allies and utilities are needed*—Additional effort needs to be made to encourage insulation and fenestration suppliers and installers to promote the tax incentives. TIAP and other interested parties such as utilities should reach out to recruit new trade ally members to its promotion efforts. TIAP and other parties (DOE, EPA, state energy offices, etc.) should seriously consider launching an outreach campaign to utilities as outlined below in conjunction with the various utility trade associations.

- *Market confusion related to IRS rules on eligible fenestration products*—IRS tax credit rules on storm doors and windows and glazed exterior doors need to be clarified to clear up potential market confusion and support proper messaging by trade allies. These rule clarifications are detailed below.

- *The tax credit level may be too low to attract significant public participation*—Installation of significant insulation upgrades and replacement windows in existing residences are expensive home improvement projects. The relatively low tax credit level for this type of work may be reflected in the lack of aggressive promotion by industry trade allies. A higher tax credit level should be considered, especially if installation costs are included for the tax credit. One option is to provide a higher tax credit level only if the insulation or fenestration products are professionally installed and certified by the installer to meet the IECC efficiency requirements. This provides some quality assurance that the materials have been correctly installed to the required levels.

- *Possible market confusion on Storm Door Qualification*—Under the IRS Guidance Notice, a storm door will qualify for the credit if the storm door "…in combination with a wood door assigned a default U-factor by the IECC, does not exceed the default U-factor requirement assigned to such combination by the IECC." [Notice, Section 4(.01)(3)-(4)]. However, the IECC does not clearly specify default U-factors for wood doors, and thus potential users of this provision may be confused whether they qualify or not.

- *Possible market confusion on exterior doors*—The Special Rule for ENERGY STAR windows qualifying for the tax credits does not explicitly address whether glazed exterior doors carrying the ENERGY STAR label also qualify under the Special Rule which can lead to market confusion on whether specific ENERGY STAR doors qualify or not.

- *Utility programs related to the tax credits*—Electric and gas utilities are significant players in making the tax credit program a success. They have unparalleled reach to their customer base and are considered to be a source of accurate, reliable information by consumers. However, utilities as a whole have not significantly engaged in the mass marketing of tax credit opportunities to their customers. In discussions with utility trade associations we have been advised that there is a lack of expertise and specific tax incentive knowledge at many individual utilities to launch such a campaign.

Actions Needed

There are several actions that can be taken to address the barriers identified above and assist in achieving the market transformation goals related to energy-efficient building envelope improvements These are:

- *Extend and reform the tax incentives:* Extend the effective period for the tax credits as outlined above and include the recommended reforms in the extension legislation. These reforms include: allowing the costs for building envelope retrofit installation (not just material costs) to figure into the tax credit; explicitly expanding the list of approved envelope measures to include infiltration air as well as duct sealing; and including a performance-based option to encourage whole-building retrofits to meet achievable energy use reduction targets. In addition, the whole building performance approach will require an expanded cadre of home energy raters nationwide. Legislative proposals to encourage an increase in the number of home energy raters should be supported by all

interested parties. Also consider raising the amount of the tax credit to encourage professional installations.

- *Encourage increased outreach efforts to industry trade allies and utilities:* Additional effort needs to be made to encourage insulation and fenestration suppliers and installers to promote the tax incentives. This might involve TIAP reaching out to recruit new trade ally members to its residential subcommittee. TIAP should seriously consider launching an outreach campaign to utilities as outlined above in conjunction with the various utility trade associations.

- *Utility programs related to the tax credits:* As noted above, electric and gas utilities are significant players in making the tax credit program a success. They have unparalleled reach to their customer base and are considered to be a source of accurate, reliable information by consumers. However, utilities as a whole have not significantly engaged in the mass marketing of tax credit opportunities to their customers. In discussions with utility trade associations we have been advised that there is a lack of expertise and specific tax incentive knowledge at many individual utilities to launch such a campaign. However, there is significant interest in providing this information if only as a customer service. The trade associations were receptive to receiving information support from national advocacy organizations and DOE. Of immediate use would be a resource and information kit consisting of: standardized TIAP-based web content to be used on utility web sites; fact sheets and scripts for utility customer call centers; templates for tax incentive promotion bill stuffers; and generic PowerPoint presentations suitable for group presentations by marketing representatives. An additional approach is to provide simple DSM or energy efficiency program designs that can be implemented by smaller utilities or those less experienced with DSM programs. These simplified programs would rely on the IRS-specified tax credit certification process to assure that products have been installed at the required efficiency levels. Reliance on IRS-specified documentation for their own supplemental incentive processing, for example, would allow utilities to avoid having to set up their own infrastructure for inspection and verification. Utilities could value the kWh and kW impacts of the measures and provide appropriate rebates or other incentives in addition to the tax credit claimed by the customer.

- *Clear up possible fenestration market confusion:* IRS should clarify its rules on exterior doors and storm doors and windows as detailed below. The ENERGY STAR label will assist in promotion of efficient exterior doors, and clarification of IECC requirements will allow straightforward marketing of the storm door and window measures.
    - *Clarification of Storm Door Qualification*: As noted above, under the IRS Guidance Notice, a storm door will qualify for the credit if the storm door "…in combination with a wood door assigned a default U-factor by the IECC, does not exceed the default U-factor requirement assigned to such combination by the IECC." Further clarification of this approach would be helpful. The 2004 Supplement to the 2003 IECC does not list the default U-factors for a combination of storm doors and wood doors; as a result, it does not appear applicable here. The 2001 Supplement to the 2000 IECC specifies default values for four different types of wood doors with storm doors. To simplify the

procedure, IRS should determine one type of wood door to use to make the determination, or otherwise clarify how this approach is intended to work.

- *Clarification of exterior door requirements:* The Special Rule for ENERGY STAR windows qualifying for the tax credits does not explicitly address whether glazed exterior doors carrying the ENERGY STAR label also qualify under the Special Rule. However, the underlying reasons for establishing the Special Rule for windows and skylights apply equally to glazed exterior doors (like swinging and sliding patio doors). Both the IECC and the ENERGY STAR program establish exactly the same requirements for these doors as they do for windows. As a result, this ENERGY STAR qualification/certification path should be equally valid for these doors as it is for windows or skylights. The IRS should clarify its guidance to include ENERGY STAR doors in the Special Rule

Tracking

The primary tracking method of tax credit participation will likely be the summary statistics and aggregate data available from the IRS based on analysis of tax returns. Such data is often made publicly available and reported in the press (e.g., mortgage deductions, charitable contributions, etc.) TIAP should engage with the IRS and Treasury Department to possibly design a tax form that produces the best tracking data available consistent with minimizing taxpayer reporting burden and complexity. For Qualified Energy Efficiency Improvements (i.e., building envelope), progress could be tracked by knowing the number of taxpayers claiming separate credits for insulation, fenestration products and reflective roofs in addition to the aggregate amount spent on each. A similar approach could be followed for Residential Energy Property (i.e., HVAC equipment).

Recommendations

Specific recommendations are provided in prior sections. To summarize, we recommend:

Congress: Extend the tax incentives to 2010 and perhaps beyond and legislate the recommended reforms, including: allowing the costs for building envelope retrofit installation (not just material costs) to figure into the tax credit; explicitly expanding the list of approved envelope measures to include infiltration air as well as duct sealing; including a performance-based option to encourage whole-building retrofits to meet achievable energy use reduction targets; and providing incentives to expand the network of home energy raters nationwide.

IRS/Treasury Department: Clarify rules on fenestration products as recommended and extend ENERGY STAR Special Rule to exterior doors. Revisit rules on allowing installation costs to count towards tax credits. Work with advocacy organizations to develop tax forms for tracking participation in the tax credit program.

Utility DSM and efficiency programs: Commence an outreach and education program as outlined above to involve utility customers with tax credit opportunities. Incorporate tax credit opportunities into existing DSM and efficiency programs or implement simplified tax credit incentive programs based on IRS compliance and certification procedures.

Industry trade allies: Reinvigorate efforts to spotlight tax credit benefits in marketing insulation and fenestration products. Look for ties to utility programs. Support a whole-building performance-based retrofit program and an expanded network of home energy raters.

Efficiency advocates: Urge Congress to reform the tax credits and extend them until December 31, 2010 if not further.

TIAP: Encourage other players to undertake recommended actions. Initiate a special utility outreach program as described above. Work with IRS and Treasury to develop effective market tracking data using aggregate taxpayer data.

Residential Appliances

Tax Code Provision

The Energy Policy Act of 2005 includes a provision (Section 1334) that provides tax credits to appliance manufacturers for sales of very efficient refrigerators, clothes washers, and dishwashers. The incentives are generally for products sold in 2006 and 2007, relative to sales of efficient qualifying models by each manufacturer in the previous three years (i.e., if a manufacturer sold an average of 50,000 eligible clothes washers in the preceding three years, then only sales beyond 50,000 earn an incentive).

For refrigerators, there are three efficiency tiers—a $75 credit (2006 only) for refrigerators that use 15–19.9% less energy than a unit just meeting the 2001 federal minimum-efficiency standard (15% savings is the current ENERGY STAR level), a $125 credit for units saving 20–24.9%, and a $175 credit for units saving 25% or more.[1] For clothes washers, there is only one efficiency tier—a $100 credit for units meeting the 2007 ENERGY STAR level. DOE has recently determined that this level means a Modified Energy Factor (MEF) of 1.72 or more and a Water Factor (WF) of 8.0 or less (DOE 2005a). For dishwashers, there is also one efficiency tier based on the 2007 ENERGY STAR level, which DOE just set at an Energy Factor (EF) of 0.65 (DOE 2006a). Given the 0.65 ENERGY STAR requirement, the credit per unit is $32.31 (this is determined by a formula in the legislation).

All of the appliance credits only apply to products produced in the United States, which could affect the foreign production plans of U.S. manufacturers and also mean that imported products are not eligible. There is also a total cap per manufacturer of $75 million, a figure some of the larger manufacturers may reach but smaller manufacturers will not.

Goals and Objectives

A reasonable long-term goal for appliances is to make all products sold as efficient as units now eligible for the tax credits. This is a long-term goal, however, as except for refrigerators that save 15%, tax credit-eligible units account for less than 20% of models now on the market,

[1] For refrigerators, there is one additional quirk—baseline sales are increased by 10% each year before determining the number of units that earn an incentive (e.g., 50,000 in the example above becomes 55,000 in the first year and 60,500 in the second year).

meaning that substantial market growth is needed to achieve this goal. Specifically, recent data indicate that tax credit-eligible units accounted for about 18% of clothes washer models on the market (DOE 2006b), 15% of dishwashers (Karney 2005,) and approximately 60%, 8%, and 1% of refrigerators[2] (the three numbers for refrigerators apply to units saving 15%, 20%, and 25% respectively).

Shorter-term objectives might be as follows:

1. Increase model availability so qualifying models account for at least 25–30% of models on the market (for refrigerators, this applies to units with savings of 20% or more as units with 15% savings already meet this threshold). Qualifying models should be available in a wide range of sizes and styles so as to have units that meet the preferences of most consumers.

2. Increase market share for qualifying units to at least 25% (again, for refrigerators, this applies to units saving 20%). Data are not available on the current market share of clothes washers and dishwashers meeting the 2007 ENERGY STAR spec or for refrigerators saving 20% and 25% so it is unclear how far from this target we are. However, a 25% market share has been achieved by ENERGY STAR for prior qualification levels,[3] implying that such an objective is feasible.

3. Raise the ENERGY STAR qualification level for refrigerators to 20% savings from the present 15%, ideally for 2007 but definitely by 2008. Raising the ENERGY STAR specification would align the tax incentives with ENERGY STAR in 2007 and would leverage the ENERGY STAR network to promote tax credit-eligible units in 2007 and beyond.

4. DOE rulemaking for new dishwasher efficiency standard on track for 2009 completion (per current DOE schedule) and refrigerator standard rulemaking begun. (The clothes washer standard will change in 2007 and thus a new rulemaking is still a few years off.)

5. Incentives in place for qualifying products after 2008 where the 2007 market share is still modest. Incentives could be new federal tax incentives and/or utility and state energy efficiency program incentives. While it is unclear what market shares will be in 2007, based on current trends, it appears that the credit for refrigerators saving 25% should definitely be extended, the credit for refrigerators saving 15% should not be extended (in fact this expires Dec. 31, 2006), and the other incentives should probably be extended, although some could maybe be at a reduced amount per unit sold.

[2] From an ACEEE analysis on refrigerators in the FTC Directory (FTC 2005) and the ENERGY STAR Web site (DOE 2006e). These figures are approximate since they use two different lists that do not fully align with each other.

[3] Specifically, in the last quarter of 2004, ENERGY STAR dishwashers accounted for 86% of total sales, ENERGY STAR clothes washers for 27% of sales, and ENERGY STAR refrigerators for 37% of sales (DOE 2005a).

Barriers

Several key barriers contribute to the current low market share of tax credit-eligible products.

First, as noted above, only a limited number of qualifying models are on the market today. However, with new ENERGY STAR specifications for clothes washers and dishwashers taking effect in January 2007 and the tax incentive for refrigerators that save 15% ending then as well, manufacturers are planning many model introductions, so we expect fairly good availability in 2007 for all but refrigerators saving 25%.

Second, some of the very high efficiency products on the market sell at a substantial price premium. In part this is due to increased costs for higher efficiency levels, but in part this is due to a variety of other factors including lack of economies of scale, packaging of extra "bells and whistles" in efficient units (e.g., in a multi-element "value-added package"), and higher profit margins on value-added models.

Third, where high-efficiency models are available, they are more likely to be available in regions where utilities and states are promoting the ENERGY STAR program. In other regions of the country, these units appear to be less widely available.

Fourth, manufacturers are reluctant to keep pushing efficiency higher and sometimes they resist efforts to promote the highest-efficiency products. For example, manufacturers have so far resisted efforts to increase the ENERGY STAR specification for refrigerators to 20% savings and have actively opposed efforts to have DOE start a new refrigerator standard rulemaking.

Actions Needed

Several actions would be helpful in the next couple of years to complement the appliance tax credit.

First, utilities and states should plan on increasing their efforts to promote high-efficiency appliances in 2007, to coincide with new ENERGY STAR specifications for clothes washers and dishwashers. Likewise, these programs should promote refrigerators saving 20% and 25%. For example, programs in the Northwest and New York State are discussing promoting the very best appliances as part of a "Best of the Best" promotion campaign. In addition to utilities and states already promoting ENERGY STAR, efforts should be made to expand promotions and programs to other regions of the country, particularly such regions as the Southeast, Southwest, and mountain states. These promotion efforts should increase sales, raising market share and contributing to lower product prices.

Second, DOE should start the process to revise the ENERGY STAR refrigerator specification. Data from the end of 2004 indicate that ENERGY STAR refrigerators had a 37% market share (DOE 2005b), and informal reports since then indicate that this share is now above 40%. Under DOE and EPA guidelines, ENERGY STAR generally represents the top 15–25% of the market, and when market share exceeds 40%, the ENERGY STAR label no longer differentiates the best products. An update of this specification is overdue.

Third, now is the time to begin discussions on possible federal tax incentives for 2008 and beyond. It seems reasonable to include refrigerators, clothes washers, and dishwashers, but eligibility levels probably need to be adjusted. In the case of clothes washers and dishwashers, eligibility could start with the new ENERGY STAR specifications, but it might be useful to add a new higher tier, with higher incentive levels. In the case of refrigerators, a 30% savings level could be added to the 20% and 25% levels that will be in place in 2007, with the present incentives for 20% and 25% units adjusted downward to make room for a new 30% tier.

Fourth, utility and state energy efficiency programs should consider offering incentives for qualifying equipment in 2008 and beyond if the federal tax incentives are not renewed. Utility and state support is particularly needed for refrigerators saving 25%, in order to reassure manufacturers that efforts to develop such units will not be left stranded. These incentives can be offered for several years, and then phased out as market share grows and free riders start to become an issue.

Fifth, DOE should continue efforts to set new efficiency standards for these products. The dishwasher rulemaking began in April 2006 and is scheduled to be completed in March 2009. DOE began preparatory work for a new refrigerator standard rulemaking in 2005, but then put this work on hold, announcing that a formal rulemaking would begin no earlier than late 2011. DOE should revisit this issue and include refrigerators in a second appliance rulemaking now scheduled to begin in 2008 and end in 2011 (DOE 2006c). A clothes washer rulemaking will likely wait until the subsequent appliance proceeding.

Tracking

Two of our key objectives are for increased model availability and market share. Model availability can be monitored through the ENERGY STAR lists of qualifying equipment, as these lists provide information to identify both ENERGY STAR products and products that meet higher efficiency tiers. Market share for the ENERGY STAR specification is also collected by ENERGY STAR and can be monitored through its data. However, the ENERGY STAR data cannot be used to track tax credit-eligible clothes washer and dishwasher sales in 2006 (since the ENERGY STAR spec is lower in 2006) nor to track eligible refrigerator sales in 2007 (since the tax credit criteria is stronger than ENERGY STAR). To address this problem, we recommend that AHAM, DOE, or the IRS compile this data and make it publicly available in aggregate form (i.e., combining all manufacturers so that data from individual manufacturers remains private).

Recommendations

Specific recommendations are provided in prior sections. To summarize, we recommend:

Appliance manufacturers: Continue efforts to expand offerings and sales of tax credit-eligible appliances. Support raising the ENERGY STAR specification for refrigerators to 20% in order to coincide with the tax incentive criteria in 2007. Compile data on sales of qualifying models and report on aggregate numbers. Work with efficiency advocates to develop consensus recommendations to Congress on tax incentives for 2008 and beyond.

Utility and state energy efficiency programs: Expand efforts to promote high-efficiency appliances in 2007 to coincide with new ENERGY STAR specifications for clothes washers and dishwashers and to promote refrigerators saving 20% and 25%. Consider providing incentives for this equipment in 2008 and beyond if the tax incentives are not extended. Encourage DOE to update the ENERGY STAR specification for refrigerators.

DOE: Update ENERGY STAR spec for refrigerators. Keep dishwasher standard rulemaking on schedule and add refrigerators to the list of products included in the second appliance rulemaking. Collect data on tax credit eligible sales if manufacturers or IRS do not publicly report this data.

Efficiency advocates: Urge DOE to update the ENERGY STAR refrigerator spec. Work with manufacturers to develop and promote consensus recommendations to Congress on new tax incentives. Encourage DOE to keep the dishwasher standard rulemaking on schedule and to add refrigerators to the 2008–2011 appliance rulemaking.

TIAP: Encourage other players to undertake their recommended actions. Filling data-tracking needs might be a special focus that other groups are unlikely to lead on.

Residential Air Conditioners, Heat Pumps, Furnaces, and Water Heaters

Tax Code Provision

The Energy Policy Act of 2005 provides tax credits for very efficient new central air conditioners, heat pumps, furnaces, and water heaters used in non-business applications. The credits apply to equipment placed in service in 2006 and 2007. Specific eligibility levels and amounts are summarized in Table 2.

Table 2. Summary of HVAC Tax Credits

Equipment Type	Qualifying Efficiency	Credit Amount
Central air conditioners	15 SEER and 12.5 EER for split systems* 14 SEER & 12.0 EER for single-package systems*	$300/unit
Central air-source heat pumps	15 SEER, 9 HSPF, and 13 EER	$300
Ground-source heat pumps	All systems must provide water heating	
Closed loop	14.1 EER and 3.3 COP**	$300
Open loop	16.2 EER and 3.6 COP**	$300
Direct expansion (DX)	15.0 EER and 3.5 COP**	$300
Gas, oil, or propane furnace or boiler	95% AFUE	$150
Furnace blower	Electricity use <2% of total furnace site energy use***	$50
Electric heat pump water heater	2.0 EF	$300
Natural gas, propane, or oil water heater	0.80 EF	$300

* For central air conditioning, the bill refers to the highest efficiency tier of CEE, in effect as of Jan. 1, 2006. The levels shown here correspond to this tier.
** These are the same as the ENERGY STAR specification.
*** This is the CEE/GAMA specification.
Note: There is a $500 lifetime cap per taxpayer for the HVAC and existing home credits combined. Lifetime means in 2006 *plus* subsequent years.

Goals and Objectives

Goals for residential HVAC equipment vary with the type of equipment. Proposed *long-term* goals for each type of equipment are discussed below. These are long-term goals, since for all of these products the current market share is less than 10%.

Central air conditioners and heat pumps: Units meeting the EPAct requirements, *or their energy saving equivalents,* fully saturate the U.S. market (e.g., 100% market share). This means about 13% energy savings relative to the current federal standard. However, to achieve these savings will require broadening the current SEER (seasonal energy efficiency ratio) metric to better reflect equipment performance in the field, and ways to improve this performance such as proper air flow and refrigerant charge, improved air circulation efficiency, and improving performance at operating conditions besides the current primary test point.

Furnaces, boilers and water heaters: 50% market share for units meeting the tax incentive specifications. This goal is 50% and not 100% because absent major cost reductions, these high efficiency levels are not feasible for all applications. For example, furnaces and boilers at these efficiency levels are only cost-effective in cold regions and these highly efficient water heaters are only cost-effective in homes with average to above-average hot water needs (e.g., most one- and two-person households do not use enough hot water to justify investments in these water heaters).

Furnace blowers: 100% market share. Efficient blowers provide savings during both the heating and cooling seasons and also provide other benefits such as quieter operation and less fluctuation in indoor temperatures.

Shorter-term objectives might be as follows:

1. Increase model availability three-fold. Currently, complying units account for only about 3% of the water heaters on the market, 1% of gas furnaces on the market, less than 1% of boilers and oil furnaces on the market, 5% of central air-conditioners and heat pumps, and 9% of furnace blowers on the market.[4] Qualifying models should be available in a wide range of sizes and configurations so as to have units that meet the needs of most consumers.

2. Increase market share for qualifying units to at least 15% for gas furnaces, furnace blowers, and central air conditioners/heat pumps and to 3% for water heaters, boilers, and oil furnaces. Data are not available on the current market share of this equipment, but for most of this equipment, the current market share is likely less than 5%, and less than 1% for water heaters, boilers, and oil furnaces. Thus, these targets are approximately three times the current market share.

[4] Figures based on ACEEE May 2006 analysis of units in GAMA (http://www.gamanet.org/gama/inforesources.nsf/vContentEntries/Product+Directories?OpenDocument) and CEE/ARI databases (http://www.ceehvacdirectory.org).

3. Develop and adopt an improved test procedure for central air conditioners and heat pumps that better approximates performance in the field by using more realistic assumptions. A new test procedure will allow use of techniques to reduce energy use by 13% or more that are lower cost than raising SEER to 15 as SEER is now measured.

4. Keep process to revise minimum-efficiency standards for these products on track. In the short term, new furnace and boiler standards should be finalized (currently scheduled by DOE for September 2007) and rulemakings for water heaters, central air conditioners and heat pumps, and furnace blowers should be started (all but the latter are now on DOE's schedule) (DOE 2006c).

5. Incentives in place for qualifying products after 2008 where the 2007 market share is still modest. Incentives could be new federal tax incentives and/or utility and state energy efficiency program incentives. While it is unclear what market shares will be in 2007, given the very low current market shares, it is likely that all of these equipment credits should be extended for another 2–3 years.

Barriers

Several key barriers contribute to the current low market share of tax credit-eligible products.

First, as noted above, only a limited number of qualifying models are on the market today. This is particularly a problem for water heaters, boilers, oil furnaces, and central heat pumps. In the case of boilers and oil furnaces, it is technically very difficult to design products with 95% AFUE and therefore we recommend reducing these criteria to 90% AFUE. A similar situation applies to central heat pumps and we recommend that this criterion be revised to reference the highest CEE efficiency tier (the same as is referenced by the legislation for central air conditioners).

Second, some of the very high efficiency products on the market sell at a substantial price premium. In part this is due to increased costs for higher-efficiency levels, but in part this is due to a variety of other factors including lack of economies of scale, packaging of extra "bells and whistles" in efficient units (e.g., in a multi-element "value-added package"), and higher profit margins on value-added models.

Third, where high-efficiency models are available, they are more likely to be available in regions where utilities and states are promoting high-efficiency products. In other regions of the country, these units appear to be less widely available.

Fourth, in the case of central air conditioners and heat pumps, the current test procedure does a poor job of approximating field performance and as a result some equipment efficiency improvements that could improve field performance are not adequately rewarded.

Actions Needed

Several actions would be helpful in the next couple of years to complement the residential HVAC equipment tax credit.

First, utilities and states should plan on increasing their efforts to promote these products. Equipment at these efficiency levels has rarely been promoted in the past. Most recent promotions have emphasized lower efficiency levels such as ENERGY STAR performance levels for furnaces and central air conditioners. There is a need to reach out to supply houses, contractors, and consumers to explain the advantages of these higher-efficiency levels as well the availability of tax incentives to help cover a portion of the extra costs involved.

In addition to utilities and states already promoting efficient residential HVAC equipment, efforts should be made to expand promotions and programs to other regions of the country, particularly such regions as the Southeast, Southwest, and mountain states. These promotion efforts should increase sales, raising market share and contributing to lower product prices.

Second, the efficiency criteria for boilers and oil furnaces should be reduced to 90% AFUE from 95% AFUE. There are presently no 95% efficient models oil furnaces or boilers on the U.S. market and only three gas boilers (GAMA 2006). 95% efficiency is difficult to reach for this equipment due to the corrosive qualities of oil and due to common boiler distribution system temperatures that makes it difficult to reach very high efficiency levels. We recommend reducing this qualifying level to 90% to modestly increase model availability but to also make it easier for manufacturers to develop new products. 90% AFUE is enough of a challenge. In addition, in line with their current very low market share, the tax credit for these units should be raised to $300. A higher incentive will spur additional sales, and due to the very low current market share, have only a modest cost to the U.S. Treasury.[5]

Third, DOE should start the process to revise the central air conditioner and heat pump test procedure. To provide just a few examples, the current procedure underestimates pressure losses in ducts (causing it to undervalue measures that improve blower efficiency) and overly emphasizes a single outdoor temperature (causing manufacturers to optimize products for that single temperature point and not the range of temperatures over which the product will operate). An improved test procedure will reward designs that operate better under field conditions and provide more ways for manufacturers to reach efficiency targets (Sachs et al. 2006).

Fourth, now is the time to begin discussions on possible federal tax incentives for 2008 and beyond. Due to the very low market shares for complying equipment, it is reasonable to allow several more years for the market to develop before the tax credits sunset. Continuation is particularly needed for water heaters, boilers, and oil furnaces, as very few products currently qualify for the incentives and extending the credits will encourage manufacturers to introduce additional complying products.

[5] In contrast, the incentive for gas furnaces should remain at $150 as they have enough sales that raising the incentive would have a significant cost to the Treasury.

Fifth, utility and state energy efficiency programs should consider offering incentives for qualifying equipment in 2008 and beyond if the federal tax incentives are not renewed. These incentives can be offered for several years and then phased out as market share grows and free riders start to become an issue.

Sixth, DOE should continue efforts to set new efficiency standards for these products. DOE is scheduled to finalize new furnace and boiler standards in September 2007, new water heater standards in March 2010, and new air conditioner and heat pump standards in June 2011 (DOE 2006c). A rulemaking on furnace blowers should be added to this schedule.

Tracking

Two of our key objectives are for increased model availability and market share. Model availability for water heaters, furnaces, and boilers can be monitored through the GAMA Directory, which lists efficiency levels. Model availability for central air conditioners can be monitored through the ARI Directory, which lists models by CEE tier. However, since the eligibility for central heat pumps does not align with the CEE tiers, it is currently not possible to monitor model availability for central heat pumps. As noted above, we recommend that the criteria for heat pumps be modified to reference the highest CEE tier, which would solve this problem. But until Congress makes this change, we recommend that ARI modify its Directory to specifically note which heat pumps are eligible for the tax incentives.

GAMA and ARI also compile market share data at different efficiency levels for this equipment but currently the tax credit eligibility levels are not tracked as a separate category. We recommend that the trade associations begin to track and report this information. If the trade associations do not do this, then either DOE or the IRS should.

Recommendations

Specific recommendations are provided in prior sections. To summarize, we recommend:

Equipment manufacturers: Continue efforts to expand offerings and sales of tax credit-eligible equipment. Support revisions to the central air conditioner and heat pump test procedure so the procedure better reflects field conditions. Compile data on sales of qualifying models and report on aggregate numbers. For central heat pumps, prepare a directory of models eligible for the tax incentives. Work with efficiency advocates to promote extension of the tax incentives.

Utility and state energy efficiency programs: Expand efforts to promote high-efficiency products eligible for the tax credits. Consider providing incentives for this equipment in 2008 and beyond if the tax incentives are not extended. Encourage DOE to update the test procedure for central air conditioners and heat pumps.

DOE: Update test procedure for central air conditioners and heat pumps. Keep furnace/boiler, water heater, and central air conditioner/heat pump standard rulemaking on schedule and add furnace blowers to the list of products included in the next heating equipment rulemaking. Collect data on tax credit eligible sales if manufacturers or IRS do not publicly report this data.

Efficiency advocates: Urge DOE to update the central air conditioner and heat pump test procedure. Work with manufacturers to promote extension of the tax incentives. Encourage DOE to keep the furnace/boiler, water heater, and air conditioner/heat pump standard rulemakings on schedule and to add furnace blowers to the next heating equipment rulemaking.

TIAP: Encourage other players to undertake their recommended actions. Filling data-tracking needs might be a special focus that other groups are unlikely to lead on.

Commercial Buildings

Description of Incentive

The Energy Policy Act of 2005 provides tax incentives for buildings whose energy performance reaches or exceeds 50% savings compared to ASHRAE 90.1-2001. Commercial buildings entering service between January 1, 2006 and December 31, 2007 can realize a tax deduction of $1.80 per square foot by using 50% less energy with respect to lighting, HVAC, and envelope systems. A tax deduction of $0.60 per square foot is available for buildings using 50% less energy for any of the three individual systems, with some additional specific considerations for lighting, covered in a separate section of this report.

Commercial buildings consume 17% of total energy in the United States. Aggressive performance improvements in the commercial building sector are necessary to impact overall energy use. About 2% of the commercial building stock is newly constructed in any given year and a similar amount is renovated, so energy use reduction in the overall commercial stock requires significant improvements in the performance of new and renovated commercial construction. Capital assets in the building sector have a very long lifespan, so individual building energy performance characteristics may remain in place for decades.

Goals and Objectives

Research completed by the New Buildings Institute has identified approximately 100 newly constructed buildings in this country claiming to be at least 50% more efficient than the ASHRAE 90.1 baseline. This represents approximately one-tenth of 1% of annual new commercial construction. While there are undoubtedly buildings that meet the goal but are not on the NBI list, it is evident that complying buildings are rare. A market transformation program should try to facilitate the construction of as many commercial buildings that are 50% more efficient than the ASHRAE 90.1 baseline as are possible during the lifespan of the deduction.

An initial near-term goal is to design and construct 1,000 new commercial buildings meeting the 50% savings target as rapidly as possible. A key purpose of this goal is to demonstrate that this standard can be routinely met for a wide variety of buildings types in all climate zones. Achieving this goal would also indicate that the design knowledge and technologies needed to achieve this level of performance are widely available at reasonable costs.

The long-term goal is to make all new commercial construction at least 50% less energy intensive than the ASHRAE 90.1 baseline by 2020.

The following objectives identify areas of the commercial construction sector in which progress would support improvements in building energy performance.

1. "50% lower energy than ASHRAE 90.1" established as a milestone for commercial buildings performance for a variety of national, state, and local programs that influence commercial new construction. To the extent that EPACT energy performance guidelines align with existing market efforts, all parties will have greater success in encouraging and implementing 50% improvements in commercial building performance.

2. DOE establishes a major effort to develop and demonstrate techniques for reaching the 50% savings level. Such a program can be loosely modeled after the Building America program, which has a similar objective for new homes.

3. Additional financial incentives are available to reach the 50% performance level. This action would include extending and enhancing the current EPACT deductions as well as aligning utility incentives with the 50% performance level. Such incentives could vary by state or by utility and could be adjusted up or down to respond to market conditions.

4. Strong educational and technical resources are developed for the design community. Case studies, guidelines, in-depth training, and tools are needed across the commercial building industry to support design teams in developing high performance buildings. ASHRAE, AIA, and the New Buildings Institute have each recently initiated processes to develop improved technical materials supporting high performance buildings.

5. Owners, developers, and financial institutions are reached with convincing messages about building human, environmental, and financial performance. Owners are a critical link in the decision-making chain related to new commercial construction, and their direction and support are needed for better design practices to impact new commercial construction.

Barriers

The vast majority of commercial buildings implement energy performance characteristics that align closely with code requirements, at best. Only a small number of projects take steps to exceed energy code requirements, and an even smaller subset of projects exceed these requirements by a significant margin. There are several key barriers to improved building performance that can reduce the effectiveness of EPACT in improving commercial building performance:

- The design and technology decisions that can result in a 50% performance improvement in buildings are not well understood. With only 100 buildings currently documented as to how they were constructed to meet these levels, clearly knowledge of building energy performance is only in the hands of a limited number of design teams and experts, and no information infrastructure is currently in place to correct this information imbalance.

- Investment in building technology research is very low compared to other industries. The goal of EPACT is to spur significant technological changes in the building industry. However, the rate of investment, industry-wide, in building technologies is extremely low compared to other industries. Some studies suggest that research and development investment in the design and construction industry may be as low as one-half of 1%. This is a tiny fraction of the level of investment that is typical for industries undergoing major innovation, as is anticipated in the goals.

- There are significant limitations on project financing that can reduce the ability of owners to invest in efficiency. Many organizations that set out to design and build new facilities find themselves extremely constrained by building first cost issues. Even though there is a widespread recognition that better buildings save energy and money in the long term, it is often very difficult to allocate additional funding to the project at the front end to cover the incremental cost for improved performance measures. While this is certainly an issue in the commercial real estate market (build to lease), this can also be true for public sector buildings where the building owner organizations themselves (such as school districts) would be the prime beneficiaries of additional investment in building performance. Although the EPACT program is designed to help with financial incentives, this money is not available until the completion of construction. For many projects and organization types, this disbursement is too late in the process to support increased design and construction costs.

- The lack of feedback on the success of building energy technologies is a critical weakness in the state of knowledge about commercial building energy performance. This lack of feedback cripples the ability of the design community to learn from innovations about what building performance strategies actually work well. Significant meaningful improvements in building energy performance will require a much closer linkage between design concepts and actual building energy use data.

- The application/implementation process is not defined. There is as yet no firm definition of how projects can qualify for EPACT tax deductions. The information published by the IRS on June 2, 2006 has problems of ambiguity that are unlikely to be resolved until software vendors submit their products for DOE approval. So the only area where it is clear to the real estate and design industries about how to comply is lighting. This uncertainty over what it takes to comply for the rest of the building significantly limits the effectiveness of the EPACT program for commercial construction.

- The duration of the EPACT program does not align with the delivery timetable for new construction. To be meaningful in the context of commercial building design and construction, any energy incentive program must have a lifespan of at least five years. From the time of project inception to building occupancy, commercial projects can take from two to five years, with three years being typical. Incentives need to be in place at the beginning of this process to garner the attention of the owners and affect the design of the building and must remain in place until project completion so that the project can demonstrate achievement. As currently adopted, the EPACT program lasts for only two

years. Neither owners nor project design teams are likely to adopt design strategies to capture incentives that may not be in place when the project is completed.

Actions Needed

- Improve the coordination among building performance organizations and programs. A number of existing programs and organizations support reductions in commercial building energy use. Some, notably the U.S. Green Building Council's LEED program, have made significant strides in initiating market transformation in the commercial building industry. Other organizations like AIA, ASHRAE, and EPA have also developed or adopted significant programs and policies to improve building energy performance. Various utilities and the New Buildings Institute provide program offerings supporting change in new commercial construction from a demand-side management perspective. For the most part, each of these organizations approaches the definition and encouragement of energy performance differently. The strength of these efforts would be enhanced significantly if EPACT were leveraged to increase coordination among these organizations in defining and implementing advanced building performance programs.

- Develop training, technical support, and information-sharing processes that can be used by building performance organizations and programs. Like any industry, performance improvements require the adoption of technological improvements into the product line. In the commercial building sector, the industry that delivers buildings is composed of thousands of small and medium-sized design firms with widely varying access to information about the latest performance technologies and widely ranging ability to understand and incorporate these technologies effectively. Strong education programs that highlight successful building energy performance strategies are critical to the successful transformation of this market. Technical support may also include the improvement or development of tools that support the implementation and documentation of energy performance strategies, such as energy modeling software that incorporates baseline and EPACT requirements. This technical and educational effort is likely to require larger commitments of personnel and resources than most of the efforts of the past. These efforts should piggyback on efforts within the real estate and financial communities to educate and interest its members in energy efficiency. Programs like this are being developed and enhanced by BOMA and CEE as well as others.

- Increase financial support for DOE's Building Technology efforts. New technologies need to be developed, tested, demonstrated, and deployed to achieve the long-term goal. While much can be accomplished with current design and technology development, there are critical barriers that only concerted long-term research and development efforts can impact.

- Additional financial mechanisms need to be developed to resolve short-term financial barriers. For example, utilities can provide financial support to design teams to assist the additional efforts needed to thoroughly review and develop improved designs. Additional state financing could be provided for schools and other public buildings,

possibly with revolving funds. Additional state tax credit/deduction programs could be implemented.

- More buildings should reconcile performance estimates with actual performance. ENERGY STAR Benchmarking is one option for this, although methods that consider occupant comfort, review design practice, or use detailed data to conduct more detailed reviews can provide additional information to the market.

- Extend the duration of the EPACT tax deductions to at least five years. The EPACT provisions will have very limited effect on commercial building performance if the duration of the program does not more closely align with the delivery schedule for new commercial construction.

- Clarify the application process. Without clear guidance on how to apply for the EPACT tax deductions, the program may have little effect on the industry outside of the lighting discipline. In the six months since EPACT took effect, tens of thousands of commercial buildings have been completed, or started their design process without EPACT. Each of these projects represents a lost opportunity to implement the energy performance improvements EPACT was designed to encourage.

Tracking

There is no current tracking of energy-efficient commercial buildings. Owners may elect to participate in USGBC efforts or in EPA ENERGY STAR for Commercial Buildings, but neither program reaches the entire marketplace. We strongly recommend that the IRS and DOE work together to compile summary information from tax deduction applications that will report on how many buildings, square footage, and energy savings have been achieved by buildings applying for the tax deduction. This can be done in an aggregate fashion without divulging confidential information on specific taxpayers. If DOE and the IRS do provide such tracking, a national information sharing process should be established that can serve the needs of the green buildings community, utilities, and government programs to share information on the advancement of buildings that meet the 50% performance threshold.

Recommendations

Congress: Extend the EPACT tax deductions to at least five years.

Congress and the Department of Energy*:* Increase investment in building technology research and development as well as training and technical assistance. There is a widespread need for significant investments in research, development, and deployment of new building technologies to support substantial increases in energy efficiency in commercial buildings.

U.S. Environmental Protection Agency: Enhance its ENERGY STAR efforts related to new commercial construction to focus on rating more high performance buildings. The tax deduction is based on calculated energy use, not actual use. The EPA offers an approach that projects an ENERGY STAR score based on design and then requires tracking of billing data. All parties

should encourage software vendors to include an option to enter into the ENERGY STAR program by generating automatically a projected score. Data on the actual level of performance achieved and an analysis of which systems and techniques perform well and which do not will assist the market in making energy technology and design decisions.

Utilities and other Demand-Side Management Program Administrators: Develop incentive structures for commercial new construction that support the 50% efficiency performance level. Specific options include:

a. Guarantee an incentive equal to the tax deduction for future years so that projects can be assured of equal or better financial incentives;
b. Provide a bonus incentive structure to reward commercial building clients who reach the 50% performance threshold;
c. Pay a portion of the incentive funding at the beginning of the project to encourage attention by the design team on building performance issues; and
d. Sponsor energy design centers—physical demonstration centers staffed by experts who can give hands-on demonstrations of equipment and design methods and can teach classes to design professionals and the real estate industry.

U.S. Green Building Council: Offer additional points to buildings that reach the 50% performance threshold. Getting to 50% better than ASHRAE 90.1 requires a significant and sustained effort on the part of owners and designers, and should receive additional recognition as a leading building. Furthermore, as significant numbers of buildings begin to hit the 50% level, LEED should offer additional points for savings beyond 50%.

AIA, ASHRAE, and NBI: Accelerate the completion of technical guidance and training, and develop cooperative partnerships to push towards common efficiency goals.

State Energy Programs: Review ways to resolve first cost financial barriers for public buildings.

Manufacturers: Coordinate research and development efforts with DOE. Assist marketing efforts to the owners, developers, and financial communities to recognize the value of energy efficiency.

Efficiency Advocates and TIAP: Encourage other players to take recommended actions.

Commercial Lighting

Tax Code Provision

The Commercial Buildings Tax Deduction provides for a tax deduction for efficient commercial buildings systems up to a maximum of $1.80 per square foot for buildings designed to use 50% less energy on an annual cost basis than a building built to ASHRAE standard 90.1-2001. Lighting-only systems solutions are eligible for a $0.60 per square foot deduction if they demonstrate by a whole building computer simulation a reduction of whole building annual

energy cost by16.67% from just lighting system improvements. In addition, the law provides an interim lighting deduction (interim until final IRS regulations are issued) of $0.30 or $0.60 per square foot for lighting power density reductions below 90.1-2001 of 25 or 40%, respectively (warehouses must reduce lighting power density by 50%). To be eligible for the interim lighting provision, the mandatory lighting controls from 90.1-2001 plus bi-level switching must also be included. The commercial buildings tax deduction is available for buildings or systems placed in service from January 1, 2006 to December 31, 2007, inclusive.

It is not anticipated that many lighting0only systems solutions would be justified on the basis of the whole building calculation approach. Such an analysis would likely show such whole buildings savings since the values were initially chosen to save more than 16.67%. However, the lighting contractors that previously had no need for whole building analysis capability, would not be likely to develop this analysis capability for such a small deduction. NEMA has requested that the interim rule remain effective for the duration of the tax deduction.

Goals and Objectives

A five-year goal of the National Electrical Manufacturer's Association (NEMA) is that all lighting designs including retrofits would utilize technology at or better than ASHRAE 90.1-2004 lighting power densities (which are specified in Watts of connected lighting per square foot of floor area). The average of the 2004 ASHRAE targets is 25% lower than the 2001 targets that form the foundation for the federal deduction (see Addendum G to 90.1-2004). This efficiency level, with the additional lighting controls, would be nearly sufficient to achieve the $0.30 interim deduction level for most spaces. For warehouses, NEMA's goal is a 50% reduction in lighting power density from ASHRAE 90.1-2001.

Following from this, a second goal is that ASHRAE 90.1-2004 will be adopted in an increasing number of jurisdictions as time goes by. Based on adoption of ASHRAE 90.1-2001, a reasonable goal is the half the states adopt 90.1-2004 by 2010.

The lighting power densities required for the commercial building tax deduction 25% interim savings targets are a little lower (i.e., more stringent) than 90.1-2004 for most buildings and they are a lot lower for the maximum deduction.

A near-term objective for the tax deduction efficiency levels follows from the assumptions in the analyses presented to the U.S. Congress' Joint Committee on Taxation in support of the tax provision. These assumptions were that the fraction of new buildings and lighting systems retrofits meeting the energy savings targets would be doubled over then-current U.S. installations. The doubling numbers assumed were that 2.4% of the new whole commercial buildings would be upgraded to satisfy the whole building 50% savings criteria and 6% of lighting retrofits would be upgraded to satisfy the 25% below 90.1-2001 Lighting Power Densities (LPDs). It was assumed that no lighting retrofits would be beyond 25% reduction because of sharply increasing cost beyond a 25% reduction. The total annual square feet for new commercial buildings and lighting retrofits, after analysis, turns out to be about the same number, 2 billion square feet for each. The 2.4% and 6% assumptions would be multiplied by 2 billion square feet, each to estimate energy savings based on the tax deduction, alone.

A long-term goal would be to eventually increase the 2.4% and 6% assumptions to values approaching 100%, perhaps by around 2020. This market transformation goal is for much higher market penetration than the near-term goal and will require much more time and effort than can likely be achieved with the tax deduction alone. Products to achieve these goals are readily available. However, as discussed in the next section, many barriers stand in the way. To address these barriers, some additional nearer-term objectives might be as follows:

- Lighting designers and contractors are familiar with ways to meet the 25% existing buildings savings targets.
- Manufacturers increase promotions of the highest efficiency products, which are key to reaching these savings targets.
- Building owners have a greater appreciation for the benefits of efficient but quality lighting. These benefits extend well beyond lighting to include reduced glare and shadows, higher worker satisfaction, and improved worker productivity.

Barriers

Many barriers hinder use of the ASHRAE 2004 and commercial building tax deduction lighting power density specifications. General barriers include the following:

- Some lighting designers and many lighting contractors are unfamiliar with the techniques for meeting these lighting power density targets cost-effectively and with quality lighting.
- Most building owners are unaware of the benefits of advanced efficient quality lighting systems.
- Meeting the commercial building tax deduction 50% savings levels can be expensive in new construction and even more expensive in retrofits. Current costs are more than most building owners are willing to pay.
- Few states and municipalities have adopted the ASHRAE 90.1-2004 standard in their building codes.

In addition, there are some barriers specific to the tax deductions including the following:

- A major barrier is awareness, as is always the case for new initiatives. TIAP, NEMA's tax coalition, NEMA member lighting manufacturers, electrical distributors, EEI member electric utilities, and state energy offices are all promoting the provision. It takes time for the news to diffuse throughout the business community.

- Significant time was lost because the IRS did not issue guidance on use of the commercial building tax deduction until June 2, 2006. And even today, final regulations are many months away. Many potential implementers may be afraid of later potential complications (for example, tax auditors disallowing deductions), which means that many projects have been delayed. Also, a specific provision allowing government-owned buildings to assign the tax deduction to the building designer still lacks IRS guidance. Government buildings could be a major beneficiary of the provision once this guidance is issued.

- The current tax provision extends only until the end of 2007. This is too short a period to have a significant impact on the market.

- The IRS June 2006 guidance seems to require a whole-building analysis for lighting only projects, which takes both time and money, likely resulting in many fewer projects. Also, the IRS guidance seems to eliminate the interim lighting provisions that provide deductions for 25–40% savings. This provision is the key pathway for promoting retrofits of existing buildings. Both of these problems with the IRS guidance need to be addressed for the tax deductions to achieve the goals and objectives discussed above.

- Some project developers have balked at the additional cost for bi-level switching. The legislation may need to be revised to allow some alternative pathways for achieving the targeted level of savings.

Actions Needed

To address these barriers and meet the goals and objectives, several actions are needed and described in the paragraphs below.

The major need is for extension of the tax provision. This is particularly true for new buildings, as meeting the 50% below 90.1 energy cost would require in-depth design considerations. For lighting retrofits, extension would be beneficial to allow knowledge about the provision to spread through the marketplace; some players will doubtless not ramp up efforts to utilize the provision because of the short time window that is now available. A longer period would also benefit future retrofits as considerations of product life of existing product versus benefit of early replacement are accounted for.

Second, the IRS should clarify several parts of its recent guidance. A simplified pathway for lighting retrofits needs to be provided that does not require whole building computer modeling. In addition, it would be useful to continue the interim lighting provision.

Third, states and municipalities should be encouraged to adopt ASHRAE 90.1-2004, as this raises the bar for lighting systems, saving energy while narrowing the gap and cost between a baseline lighting system and one meeting the 50% savings target.

Fourth, increased efforts are needed to educate lighting contractors and designers as well as building owners on the techniques needed to reach the 25% and 50% savings targets and the benefits of doing so. Some limited efforts are in place (e.g., offered by manufacturers and some states) but much more is needed. The U.S. Department of Energy should fund the development and deployment of practical design guidance that can be used to educate and inform lighting contractors and designers regarding technologies and design options that can achieve the savings targets.

Fifth, local state and utility energy efficiency programs should promote the tax deductions and complement the deductions with education, technical assistance, and perhaps supplemental incentives. Utility and other DSM lighting incentive efforts should be aligned with and support

the 50% lighting savings target both in new construction and retrofit programs to enable owners to maximize the energy savings available through lighting upgrades. Supplemental incentives will particularly be needed if the interim lighting provision is not extended as the 50% savings target is too ambitious for most retrofit projects.

Tracking

NEMA is doing its best to track lighting retrofit activity and will periodically report on what it finds. For example, industry feedback as of May 30, 2006 indicates that many retrofits for warehouses and some manufacturing spaces will be implemented at the 50% below 90.1-2001 lighting power densities. Therefore, it may be that the tax deduction will work better than expected for some buildings. Although not a "market survey," NEMA has received questions from numerous manufacturers and contractors seriously considering retrofits; the mentioned number of retrofit square feet being actively pursued appears to be on the order of 13 million by May 30, 2006.

In addition, the IRS, perhaps working with DOE, should issue annual summary reports on use of the commercial building deduction, including information on lighting-only projects, separately breaking out projects with 50% savings from those using the interim lighting provision.

Recommendations

In summary, we recommend:

Congress: Extend the commercial building tax deduction to at least the end of 2010. An extension of the interim lighting provision for a few years would also be useful.

IRS: Complete final regulations including guidance and regulations on use of the deduction for government-owned buildings. As part of the final regulations, a simplified pathway for lighting projects is needed that does not require whole-building analysis. It would also be useful to continue the interim lighting provisions. In addition, IRS should issue annual reports on use of the commercial building deduction including specific information on use of the lighting-only provisions.

Manufacturers, Commercial Building Tax Incentive Coalition, TIAP, Utilities, and Others: Continue to vigorously promote the tax deduction provision in the marketplace including to building owners, contractors, designers, and organizations that work with these target audiences. Also, expand education and training efforts on efficient lighting techniques and their benefits. In addition, these groups should work with Congress and IRS regarding our recommendations for these bodies.

States and Municipalities: Adopt ASHRAE 90.1-2004 in building codes. Also, participate in promotion and education activities discussed above.

Fuel Cells and Microturbines

Tax Code Provision

Residential Fuel Cells

This provision offers cost-based 30% tax credits to individuals for qualified residential fuel cell property expenditures up to a maximum credit limitation of $500 for each 500 watts installed capacity. No efficiency requirement is necessary for the credit. The incentives apply to equipment placed in service after December 31, 2005 and before January 1, 2009

Fuel Cells and Microturbines Used in a Business

This provision offers tax credits for fuel cells and microturbines used in a business. To qualify for the credit, fuel cells are required to be 500 watt capacity or greater with a generation efficiency of 30% or greater. Microturbines are required to be of 2,000 kilowatt capacity or less with an efficiency of 26% at International Standards Organization conditions. Tax credits and limitations are as follows:

- For fuel cells, a tax credit of 30% of the expenditure up to a maximum of $500 per 500 watts of capacity.
- For microturbines, a tax credit of 10% of the expenditure with a credit limitation of $200/kW.

The incentives apply to equipment placed in service after December 31, 2005 and before January 1, 2009.

Goals and Objectives

The goal of a solid distributed generation (DG) policy (including technologies such as fuel cells and microturbines) should be to:

- encourage improved efficiency over traditional central-station generation,
- improve environmental performance, and
- eliminate transmission and distribution bottlenecks and constraints.

When considering whether or not to encourage an electricity-generating technology through the use of tax credits, the issues of efficiency, environment, and grid reliability should always be considered.

By generating power at or near the site, DG helps avoid the construction of new central station power plants, and capacity in existing facilities can be freed for use by other customers for whom DG is not an option. DG capacity can be constructed more quickly than large central facilities and the thermal energy can be recovered to meet local demand. In addition, DG reduces the load on the T&D infrastructure, helping to address capacity constraints and reliability concerns. DG reduces the need to build new T&D facilities, while allowing for demand growth. Adding

capacity within a transmission constrained area, thereby freeing capacity to meet other users' demand, reduces the load on the existing infrastructure. Our current electricity supply infrastructure relies upon power plants located remotely from the centers of electricity load growth. Transmission losses range from around 5% to near 20% in the United States, with the national average hovering near 7% (Elliott and Spurr 1999).

It is becoming more difficult and costly to site new supply infrastructure due to congestion and opposition from neighbors to T&D lines and substations. Many people consider these facilities unsightly and potentially dangerous. The process to gain approval for the construction of these facilities can take years. In some areas, the T&D system is becoming overtaxed, leading to increased concerns about the reliability of electricity service, particularly during periods of peak demand. DG technologies alleviate this problem by locating the generation near the demand.

With the overall electric efficiency of the grid averaging around 34% and transmission and distribution losses averaging 7%, it is questionable whether or not microturbines, at approximately 26% efficiency, have the potential to improve the overall system efficiency. Most distributed generation technologies, including fuel cells, engines, and small turbines, operate at much higher efficiencies. Microturbines, however, may offer some environmental benefits over competing natural-gas fired distributed generation technologies. Mainly, microturbines are capable of achieving NO_x emissions of approximately 0.4 lb/MWh of electricity produced. Fuel cells have the potential to generate very low environmental emissions, but the technology is still in very early stages of commercialization and has a lower equipment life than the other competing technologies. The electric efficiencies of fuel cell technologies are typically anywhere between 30 and 45%.

The one levelizing factor for all these technologies is the recovery of heat in combined heat and power (CHP) systems. While there is a cost premium associated with the additional equipment, efficiency and cost-effectiveness can be significantly improved. The fuel cell's reformer generates significant quantities of moderate temperature heat allowing system efficiencies to exceed 60% when this heat is recovered. Engines produce a lower temperature heat, though efficiency can approach 80% for systems that can make use of low temperature (i.e., 150^{o}F) hot water. Microturbines can offer a much higher temperature heat source, though this reduces electric efficiency well below 20%, resulting in a CHP efficiency approaching 60% (Shipley and Elliott 2004). In CHP mode, emission rates (on an output basis) from fuel cells are better than the cleanest central station power station, while both gas engines and microturbines can approach the best central station generation plant emissions levels (Bluestein 2002). From a public policy standpoint, the use of these technologies in CHP mode should be encouraged since they maximize efficiency of fuel conversion and minimize emissions. This goal would argue for including all these technologies under a comprehensive CHP tax credit.

Barriers

All DG technologies face similar barriers in the marketplace:

- A site-by-site environmental permitting system that is complex, costly, time consuming, and uncertain.

- Depreciation schedules for DG investments vary depending on system ownership and may not reflect the true economic lives of the equipment.
- The market is unaware of technology developments that have expanded the potential for DG.
- Many utilities currently charge discriminatory backup rates and require prohibitive interconnection arrangements. Increasingly, utilities are charging (or are proposing to charge) prohibitive "exit fees" as part of utility restructuring to customers who build DG facilities.
- Current air emissions regulations do not recognize the overall energy efficiency of DG technologies operating in CHP mode or credit the emissions avoided from displaced grid electricity generation.

Technology-Specific Barriers

Fuel cells make electricity directly from hydrogen and oxygen using a chemical reaction rather than combustion. As a result, fuel cells can emit no criteria pollutants. While the efficiencies of a fuel cell operating on hydrogen can approach 50%, there are no readily available sources of hydrogen, so a fuel such as natural gas must be reformed to produce hydrogen. This reforming process reduces system efficiencies to 25–35% and results in the production of criteria emissions, though at a lower rate than conventional combustion (Shipley and Elliott 2004).

Microturbines have been making significant headway in the marketplace. They are typically employed in locations with fairly strict NO_x emissions requirements such as urban NO_x non-attainment zones. The main barrier to the further adoption of microturbines is price, as explained below.

Neither technology has yet achieved cost competitiveness with utility power except in special situations. In the under 1 MW size, fuel cells typically exceed $4,500 per installed kW while microturbines are available in the $800–1,400 range (DOE 2006d). For comparison, natural gas engines are available for $500–1,100 per kW with better efficiency, though higher emissions.

While fuel cells, microturbines, and gas engines all can generate electricity, most market analysts feel they will not compete directly for the same market segment. Fuel cells offer significant emissions and noise advantages over the turbines and engines so are likely to command a price premium in the marketplace. Engines and turbines are more likely to compete because of their similar operating performance. While microturbines have a modest environmental advantage, engines appear to have a commanding advantage on a cost and performance efficiency basis.

Actions Needed

In order to encourage the adoption of fuel cells and microturbines in the marketplace, the following actions in addition to tax incentives should be encouraged:

- Continued government-supported research and design into fuel cell and microturbine technologies to help bring down technical and installation costs.

- Create tax depreciation schedules for DG equipment that more accurately reflects the life of the product. DG equipment is currently depreciated similarly to other commercial property, with a 30-year depreciation schedule. Since this type of equipment is not meant to be operated for such long periods of time, we suggest that the schedule be adjusted to 10 years.
- Propose minimum-efficiency standards or requirements (at or above current efficiency levels of average central-generation generation plants less transmission losses) for qualifying for tax incentives.
- Output-based emissions standards for generation technologies. Many current state air permitting regulations are stated on a parts-per-million (ppm) input basis. Output-based standards (on a lb/MWh of electricity-produced basis) are a much more accurate reflection of performance and environmental impact for DG technologies (Shipley et al. 2001).
- Encourage utilities to create fair interconnection policies regarding tariffs and exit fees. While progress has been made in a few states, we continue to lack national or state-based standards and some utilities continue to actively discourage new DG and CHP in their service territories (Elliott, Shipley, and Brown 2003).
- Labeling strategy or certification to encourage standardization of testing for both efficiency and environmental performance within the market. This will also help remove barriers to utility interconnection (Shipley et al. 2001). Labeling serves to differentiate products within the same product group. One of the goals of labeling is to educate the buyer in the hopes that s/he will purchase an energy-efficient technology, thus decreasing the market for less efficient technologies and eventually pushing them out of the market.
- Include energy-efficient DG as part of clean energy portfolio standards. Clean energy portfolios encourage generators to produce electricity with higher efficiencies and cleaner emissions than most central station generation.
- Creating incentives for DG under cap-and-trade programs. Under an emissions cap-and-trade program, an emission source must hold, and subsequently retire, emissions allowances equal to its past annual emissions. The rule of allowance allocation can both affect the costs of new generation and help create a more favorable environment for the adoption of clean, efficient technologies.

Tracking

There is currently no specific tracking system in place for monitoring the installation of fuel cell or microturbine systems. Fuel Cells 2000, a nonprofit educational organization formed to promote the development and early commercialization of fuel cells (http://www.fuelcells.org), tracks many current fuel cell installations in the United States. Specific information regarding system performance, costs, and efficiency is not always available. A labeling and certification system could provide the mechanism for tracking the sales and installation of DG technologies. Facilities qualifying for federal tax credits should be tracked and made public by the IRS.

Recommendations

General recommended actions are included above, but activities related to specific groups are summarized below:

Manufacturers: Continue to work to improve the cost and performance of systems through in-house and federally sponsored R&D partnerships and initiatives.

Utility and state energy efficiency programs: Continue to support the installation of efficiency fuel cells and microturbines through incentives while maintaining minimum-efficiency requirements.

State regulators and lawmakers: Promote clean energy portfolio standards that encourage the adoption of efficient and clean DG technologies. Adopt output-based emissions standards for air compliance. Consider implementing carbon cap and trade mechanisms.

U.S. Department of Energy: Continue R&D support for fuel cells and microturbines.

IRS: Track facilities that qualify for tax credits and make the list of recipients publicly available. Create tax depreciation schedules that accurately reflect the life of fuel cells and microturbines.

Efficiency advocates: Encourage DOE to continue funding research in distributed generation technologies and combined heat and power. Work with manufactures to create greater transparency in cost and performance data for systems. Advocate for tighter minimum efficiency requirements (at least at average central generation levels less losses) for tax credits for DG systems.

TIAP: Coordinate efforts and perform outreach to the above groups and organizations.

Light-Duty Vehicles

Tax Code Provision

Section 1341 of the Energy Policy Act of 2005 provides tax credits to original purchasers of "alternative motor vehicles." This group of vehicles includes hybrid-electric, advanced lean burn (diesel), alternative fuel, and fuel cell vehicles.[6] The tax credit provision differs for each of these categories, though in general light-duty vehicle tax credits are tied to the applicable vehicle's fuel economy improvement over a model year 2002 baseline of similar vehicle type and inertia weight.[7] Heavy-duty vehicle tax credits are discussed in a separate section of this report.

[6] This report addresses tax credits for hybrid-electric and diesel vehicles only. Fuel cell vehicles will not materialize in any significant quantities in the timeframe of this bill, while alternative fuels are outside the TIAP purview.

[7] Note: the baseline is not an actual vehicle, per se, but rather a computed weight-dependent average of model year 2002 vehicles meeting the given criteria. Baseline fuel economies for each vehicle type and inertia weight class are stated in Section 1341.

The total value of the credit is computed based on two parameters: (1) the percentage improvement of fuel economy over the appropriate baseline, and (2) the amount of fuel the vehicle will save over its lifetime (120,000 miles) relative to a vehicle with a baseline fuel economy.[8] This latter "conservation credit" was included to increase the tax credit amount for vehicles on the low end of the fuel economy spectrum, where modest fuel economy improvements translate to greater fuel savings.

Credits related to percentage improvement are tiered, beginning at $400 for 25% over the baseline fuel economy, up to a maximum of $2,400 for 150% over the baseline fuel economy. Conservation credits are also tiered, beginning at $250 for lifetime gasoline savings between 1,200 and 1,800 gallons, up to a maximum of $1,000 for lifetime gasoline savings of 3,000 gallons and above. Thus for gasoline- and diesel-powered vehicles, the maximum possible credit is $3,400. Finally, availability of the credit is contingent upon the vehicle's tailpipe emissions certification; passenger cars and smaller light trucks must meet Federal Tier 2 bin 5 emissions levels or better, while larger light trucks must at least meet the less stringent Tier 2 bin 8 emissions level.[9]

These tax credits are available to eligible vehicles placed into service on or after January 1, 2006 and purchased before December 31, 2010. However, manufacturers may only produce a limited number of eligible vehicles before a phase-down period is invoked. Beginning in the second full quarter *after* the quarter in which the 60,000th eligible vehicle made by a given automaker is sold, consumers will be able to receive tax credits for eligible vehicles from that manufacturer at 50% of the credit amount for a two-quarter period. Subsequent to that, consumers will be able to receive tax credits for eligible vehicles from that manufacturer at 25% of the credit amount for another two quarters. Thus, for example, if an automaker sells its 60,000th eligible vehicle in August 2006, consumers may still take the full value of the credit for the remainder of that quarter (Q3) and the entire following quarter (Q4). Following that, consumers would be able to take 50% of the credit amount for two quarters (Q1 and Q2, 2007) and 25% of the credit amount for the following two quarters (Q3 and Q4, 2007). Subsequent to that, credits would be expired for vehicles from that manufacturer. Vehicles of different make (e.g., Ford, Lincoln, and Mercury) all apply to a manufacturer's (e.g., Ford Motor Company) threshold of 60,000 vehicles.

The tax credits in the Energy Policy Act of 2005 replace a $2,000 deduction for the purchase of clean-fuel vehicles that applied to many of the same models. The new tax incentives are generally worth more to consumers than the provision they replace, since tax credits, unlike deductions, are subtracted directly from the amount of federal tax owed.

[8] Fuel economies and fuel savings are, as stipulated in the bill, determined on a gasoline gallon equivalent basis. This is relevant to the tax credit determination of diesel models, whose fuel contains 11–14% more energy per gallon than gasoline.

[9] A further technical stipulation about the maximum available power of applicable vehicles' rechargeable energy storage systems must also be met. To date, no vehicles have been excluded from receiving tax credits based on this measure. For more information about this requirement, see Section 1341.

Goals and Objectives

The broad goal that the credits will further is to improve the energy efficiency and reduce the emissions of cars and light trucks. The more specific market transformation goal is to maximize market penetration of hybrid and advanced diesel vehicles while ensuring that they bring economic and environmental benefits.

Objectives to work toward these goals include:

1. Reduce the incremental price of hybrids and advanced diesels relative to their conventional counterparts enough to make them competitive from the perspective of an average consumer.

2. Maximize the number of manufacturers producing hybrids and/or advanced diesels.

3. Achieve availability of hybrid-electric and advanced diesel vehicles in each of the major car and truck classes by 2011.

4. Put in place policies to ensure steady progress in light-duty vehicle fuel economy. Without a consistent ratcheting mechanism for fuel economy, market penetration achieved through tax incentive measures will not necessarily guarantee energy savings.

Barriers

A number of barriers exist to achieving the goals and objectives listed above.

First, hybrids and diesels are expensive. The production of hybrids in low volumes meant high costs early on, and while the incremental cost has declined and will continue to do so, hybrids are intrinsically more expensive to produce than conventional gasoline vehicles. The same is true of diesels. Moreover, diesels capable of meeting emissions requirements necessary for tax credit eligibility will carry a further cost premium and have yet to hit the market. Even to consumers that evaluate vehicle purchase price with full-life costs in mind, the economic case for hybrids and diesels is not clear-cut at present.

Second, consumers have cared very little about fuel economy in recent decades. While this may be changing in a $3+ per gallon environment, fuel economy still lags behind such consumer preferences as performance, style, capacity, price, and amenities. Furthermore, continued volatility in gasoline prices may limit consumers' interest in buying a more efficient vehicle.

Third, there has been much discussion in the consumer press recently about overstated miles-per-gallon estimates and battery replacement costs for hybrid vehicles. With respect to diesels, auto market analysts routinely assert that poor image based on the poor performance of U.S. diesels in the 1970s and 1980s constitutes a barrier to acceptance of new diesels today. At the same time, domestic manufacturers have exhibited ambivalence toward both hybrids and diesels. Due in part to current financial troubles and declining market share, the Big Three are reluctant to invest in technologies that are perceived as potentially risky. Recently, these manufacturers have made

much of the potential to reduce U.S. oil consumption through increased use of ethanol, which involves no technology breakthroughs and little investment on their part.

Fourth, all manufacturers have hedged against the possibility that consumers' newfound interest in fuel economy will be short lived. Whereas the first few hybrid-electric models on sale in the U.S. offered significant fuel economy improvements over conventional counterparts, more recent hybrid designs have diverted the technology to provide performance rather than efficiency gains. Also, manufacturers do not always meet demand for hybrids fully, presumably because profits margins are lower than for conventional vehicles. While many fleets have a strong interest in purchasing hybrids, they have found it quite difficult to do so in some instances, due to supply limitations.

Fifth, the federal tax credits are short in duration and number. As noted earlier, the Energy Policy Act of 2005 phases out the incentives once manufacturers reach sales of 60,000 eligible vehicles. One manufacturer has already reached that threshold. Other manufacturers may not achieve production levels sufficient to take full advantage of the credits before their expiration in 2010.

Sixth, tax credit implementation has been slow and has left important issues unresolved. Prospective buyers have not had access in a timely manner to information on such matters as the amount of credit for a given model and availability of credits for consumers subject to Alternative Minimum Tax.

Finally, due to the structure of fuel economy regulations, which constrain the average fuel economy of each manufacturer's vehicles, increased penetration of high-efficiency vehicles does not guarantee an improvement in efficiency overall.

Actions Needed

Over the next few years, various actions would help support the market transformation potential of light-duty vehicle tax credits.

First, consumers need reliable and up-to-date information on several aspects of hybrid and advanced diesel vehicles. This includes explanations of such issues as on-road fuel economy vs. label fuel economy; battery replacement; full-life costs; and resale values. Several good hybrid vehicle Web sites exist, which, together with the Tax Incentives Assistance Program site, should ensure that this information is readily available.

Second, it is important to gain a better understanding of manufacturers' production and timing decisions for hybrids and what role the credits are playing. Manufacturers may be reluctant to discuss these issues publicly, but tracking production, pricing, and sales of hybrids by manufacturer will provide useful insights.

Third, from a public policy perspective, it is also important to make clear that biofuels can complement efficiency but cannot displace it in the effort to reduce oil dependence.

Fourth, federal policy to ensure a steady increase in average fuel economy is needed to ensure that advanced technology is applied to improved fuel efficiency, especially if fuel price volatility continues. Fleets should communicate their interest in purchasing hybrids to manufacturers.

Fifth, additional credits should be made available beyond those in the Energy Policy Act of 2005. Raising or changing the cap (e.g., by allowing manufacturers to reach the cap in each vehicle class separately) would make more eligible vehicles available to consumers and encourage manufacturers to produce advanced technology vehicles in a broader range of classes. Extension of the expiration date of the credits may be appropriate as well. A public commitment to future tax incentives (approximately 5–15 years out) that would apply to less mature technologies such as advanced batteries or hydrogen fuel cells may prove helpful in spurring research and development in those areas today.

Sixth, information concerning credits for individual models and consumers' ability to take advantage of those credits needs to be provided in a timely fashion. It is not sufficient to provide such information to assist in filing for the credits; it must be available at the time consumers are considering a vehicle purchase.

Finally, an enforceable mechanism is needed to ensure that the adoption of new technologies is accompanied by an overall improvement in vehicle efficiency.

Tracking

The IRS and auto manufacturers post information about models eligible for a tax credit. To ensure the information is made available to consumers as soon as possible and in a single location, ACEEE has been posting its estimates of credit amount prior to IRS certification (and the verified amounts following certification), which to date have been quite accurate. The TIAP site and ACEEE also post updates on manufacturers' progress relative to the 60,000-vehicle threshold to allow consumers to anticipate the amount of credit they will be able to receive for each model. Monthly hybrid sales numbers are made available monthly on greencarcongress.org. Overall vehicles sales data is available through various commercial sources (see below), so market share will be straightforward to track. In the immediate future, hybrid sales will remain a small fraction of total sales. Thus even more relevant to the success of the credits than market share will be the question of whether sales have reached a point at which incremental cost can decline. Tracking of individual manufacturer data and of how the credits are influencing production and sales will be key, as discussed above.

Vehicle and technology sales are tracked by a number of public and private entities, including EPA, DOT, *Automotive News* magazine, and Ward's Communications (2006). Sales-weighted fuel economy is tracked each year in EPA's *Light-Duty Automotive Technology and Fuel Economy Trends* report (Heavenrich 2005). Publications and data sets from these groups can be used to track overall efficiency progress in the passenger car and light truck market segments as well.

Recommendations

Based on the list of necessary actions above, we recommend the following for various parties involved with tax credit implementation and or improved vehicle efficiency more generally:

Automotive industry: Share information on considerations in production of advanced technology vehicles, specifically how utility of tax credits could be enhanced through regulatory and legislative means.

U.S. Department of Energy: Clarify the roles of vehicle efficiency and biofuels in achieving targets for reduced oil dependence. Assist Clean Cities fleets in taking advantage of tax credits.

Federal and state government: Implement regulatory and market-based mechanisms to promote the application of vehicle technologies to fuel efficiency rather than increased vehicle performance.

Fleets: Communicate consistent interest in high-efficiency vehicles to manufacturers; change purchasing criteria to facilitate their purchase.

IRS: Resolve issues on credit implementation quickly and post information in a timely fashion.

TIAP: Continued to fill data tracking needs and provide other information on hybrid and diesel vehicles as needed. Investigate manufacturers' response to the tax credits and how new guidance or better public information might enhance use of the credits.

U.S. Congress: Extend and adjust tax credits in the near term and use them to encourage continued production and market penetration of advanced vehicle technologies into all major vehicle classes.

Heavy-Duty Vehicles

Tax Code Provision

Heavy-duty hybrid and alternative fuel vehicles[10] are among those eligible for tax credits under Section 1341 ("alternative motor vehicles") of the Energy Policy Act of 2005. The heavy-duty hybrid credits are available through 2009, one year less than the light-duty credits. They are not subject to the sales volume limitation that applies to light-duty vehicles.

The credit amount is specified as a percentage of incremental cost, i.e., the cost relative to that of a comparable conventional vehicle. This percentage, in turn, depends upon the percent increase in city fuel economy relative to the comparable conventional vehicle:

[10] Alternative fuel vehicles are not discussed further here.

Improvement in city fuel economy	Hybrid credit as percent of qualified incremental cost
At least 30% and under 40%	20%
At least 40% and under 50%	30%
At least 50%	40%

The maximum allowable incremental cost is capped by weight class:

Gross vehicle weight (GVW) rating	Maximum qualified incremental cost
8,501–14,000 pounds	$7,500
14,001–26,000 pounds	$15,000
> 26,000 pounds	$30,000

So, for example, the most efficient 20,000-pound hybrid truck or bus could receive a credit of up to $6,000.

To be eligible, a vehicle must also meet a threshold value of "maximum available power," a measure of the percentage of total vehicle power available from the rechargeable energy storage system of the vehicle. For a vehicle of 8,500 to 14,000 pounds GVW, the requirement is 10% maximum available power; over 14,000 pounds, the requirement is 15%. This is to ensure that a qualifying vehicle incorporates substantial hybrid technology. The credits are not specific to hybrid-electric vehicles; hydraulic hybrids, for instance, which store energy by compressing a gas and use a hydraulic pump in place of an electric motor/generator, can qualify.

Goals and Objectives

The goal for a market transformation effort for heavy-duty hybrids is to have hybrids competitive with conventional vehicles available for all appropriate applications as soon as possible. Cost-competitiveness of hybrids is clearly a key element of this goal, and this is the role for tax credits in the market transformation effort.

The notion of cost-competitiveness is not completely well-defined. Large fleets often turn over vehicles quickly, so a cost criterion often suggested is three-year payback (i.e., increment in purchase price equal to three years of savings in fuel or other monetary costs). This implicitly assumes that superior fuel economy will not be valued in the resale market, which while not sound in principle may be the appropriate working assumption for the near future. Hybrids can also offer non-energy benefits such as noise and pollution reduction, expanded on-board auxiliary power, reduced frequency of refueling, reduced maintenance costs, and a boost to company image. Such considerations call for breadth and flexibility in the notion of cost-competitiveness; but this does not diminish the fact that heavy-duty hybrids will need to establish a clear business case to make inroads in the market.

Hybridization is only one of many technological approaches needed to realize the potential to increase the efficiency of heavy-duty vehicles. While hybrids can deliver fuel savings far in excess of incremental cost, this is not always the case. Whether hybridization makes sense for a given application depends critically on such factors as the amount of urban driving, annual miles traveled, and the demand for auxiliary loads. Tractor-trailers are responsible for over two-thirds of all heavy truck fuel use, and these vehicles are driven primarily on the highway, where aggressive hybridization is unlikely to provide sufficient advantage over conventional vehicles to offset the higher purchase price.[11] Efforts to establish a market for hybrids can contribute to this broader goal, which could be quantified as a 50% improvement in average fuel economy of new heavy-duty trucks by 2015 (Langer 2004).

Given these considerations, objectives to help achieve the stated goal for the hybrid vehicle market include the following:

1. Get hybrid production beyond the prototype and demonstration vehicle stages so that prices can be brought down through higher volume production, preferably to achieve a payback period of three years or less.

2. By 2009, have hybrid models on the market in all suitable applications.

3. Establish the business case for hybrids to the satisfaction of the user community.

4. Use the development of hybrids to move forward more broadly in heavy-duty vehicle efficiency.

Barriers

While heavy-duty hybrids have the potential to deliver very large fuel savings to purchasers, the heavy-duty market lags the light-duty market by several years. Commercial trucks owners have a keen interest in improving fuel economy to control fuel costs, but given the critical role the expenses and operation of vehicles play in business success, they are understandably cautious about major technology changes. On the manufacturer side, introducing a dramatically different truck technology involves a high risk and expense, with a low volume of vehicle sales over which to spread those costs.

Hence the first barrier to entry of hybrids in the heavy-duty market is one of information. Buyers need solid evidence of performance with regard to fuel efficiency, drivability, reliability, and maintenance needs of a new power train before they can commit to a purchase. Lack of a standard test procedure for measuring the fuel economy of heavy-duty vehicles is therefore a major obstacle to acceptance of new technologies, preventing the buyer from having the necessary confidence that a hybrid truck would deliver the promised fuel savings.

The second barrier is the high cost of hybrids. Many of the large fleets that are in a good position to make an investment in a new technology keep vehicles for only a few years; for these fleets, new technologies must have a very short payback period, or their resale value must be high. For

[11] Manufacturers are now considering some degree of hybridization even in this application, however.

smaller fleets, the increment in purchase price may be prohibitive, regardless of the payback period. Given these cost considerations, manufacturers may be hesitant to invest in the development of hybrids.

Third, the timing of the heavy-duty credits with respect to the hybrid market is not optimal. The credits were intended to help manufacturers to achieve economies of scale in production vehicles, and thereby bring down price. In the case of light-duty hybrids, where over a dozen models are already on the market, development is far enough along to take advantage of this opportunity, and in some cases the credit is large enough to make up a very high percentage of incremental cost of the vehicles. The heavy-duty credits, by contrast, are not sufficient to cover most of the incremental cost; in fact, the eligible incremental cost is capped at a relatively low level, and the credits cannot exceed 40% of these capped incremental costs. But the more fundamental point is that, with the exception of transit buses, heavy-duty hybrids are at pre-production stages and therefore very expensive on a per-unit basis. Manufacturers will need to cover development costs and are not ready to move to production levels that will allow economies of scale. Yet the heavy-duty credits are available only through 2009.

A fourth obstacle, specific to the utility of the credits, is the provision relating to non-taxpaying entities. For certain types of heavy-duty hybrids, such as transit buses, utility vehicles, and refuse carriers, non-taxpaying entities will comprise a large fraction of the market. The Energy Policy Act states that tax credits for vehicles, light- or heavy-duty, purchased by such entities will go to the seller, rather than the buyer. The seller must disclose the amount of the credit to the buyer. It is assumed that the buyer will be able to use this information to negotiate a favorable price, but there is no guarantee that this will be the case. Furthermore, the seller may not have sufficient tax liability to claim the credits or may be subject to the Alternative Minimum Tax.[12] An additional consideration is that the seller of a heavy-duty vehicle will typically be the manufacturer. In principle, a manufacturer credit could be as useful as a consumer credit. In practice, however, eliminating the buyer's direct involvement could reduce the transparency and motivational benefits of the tax credits.

Actions Needed

First, with regard to adequacy of information, establishing a widely accepted measure of the fuel economy of heavy-duty hybrids is essential, both for purposes of determining user savings and because the size of the tax credit assigned to a given vehicle is dependent upon the improvement in fuel economy that the vehicle achieves. EPA is now developing heavy-duty hybrid fuel economy test procedures. In order to maximize the utility of the credits and, more generally, to facilitate the marketing of hybrids, the test needs to achieve an adequate degree of accuracy without being overly burdensome for manufacturers. In fact, a sound test protocol could make a major contribution to higher fuel economy for all heavy-duty vehicles, because it could allow purchasers to compare vehicle efficiency across manufacturers and on a component-by-component basis as they specify the particulars of the vehicles they plan to order. While certain

[12] In fact, these same tax liability issues may prevent taxpaying entities purchasing a hybrid vehicle from receiving the tax credit as well.

elements of the test protocols will be specific to hybrids, much will be applicable to heavy-duty trucks across the board.

Second, the cost barrier is, of course, the motivation for the tax credits. Given the short time horizon for the heavy-duty credits, implementation of the credits needs to be expedited, including the testing protocol, outreach to the user community, and resolution of tax issues. With regard to the issue of vehicle turnover, fleets with longer vehicle life cycles will be the best targets for early hybrid implementation, because they can recover the investment over a longer time period.

The third barrier cited, namely the fact that almost all hybrids are in preproduction stages, calls for accelerating commercialization. Certain manufacturers are poised to begin commercial production within the next few years. In some cases, however, an additional ramp-up in volume may be needed before the tax credits will provide a large enough share of the incremental cost to make the vehicle affordable. An extension of the heavy–duty credits beyond 2009 will be needed to sustain the momentum towards commercialization. This is not to suggest that hybrids will need to be subsidized indefinitely; there is good evidence that a hybrid in full production can provide large economic benefits to the user in many applications. A five-year extension of the credits (through 2014) at the current levels seems warranted.

Fourth, the restriction on credits when the buyer is tax-exempt calls for further assessment and guidance. For a hybrid entering the commercial production phase, it will be important to determine how the existence of the credits will affect the manufacturer's production and pricing decisions.

Much of the work called for here is well underway through the Hybrid Truck Users Forum (HTUF; see http://www.calstart.org/programs/htuf/),[13] whose mission is precisely to expedite the commercialization of hybrid trucks. HTUF has established working groups, including many of the key fleets, for each of the first anticipated applications of heavy-duty hybrids. These working groups have developed specifications, detailed information central to the business case for hybrids, and sufficient total demand for these vehicles from participants to justify preproduction runs.

Tracking

Production of heavy-duty hybrid trucks is only beginning and will continue to remain small enough for the next few years to allow tracking of individual models and purchases through trade press and conversations with the parties involved. The IRS, TIAP, and HTUF should post this information.

An important exception to this is transit buses, which were the first and, to date, only heavy-duty hybrid to be produced commercially. More than 1,600 buses have been ordered already, many of which are now on the road (HTUF 2005). Given that the market is 3,500–5,000 vehicles per year, hybrid transit buses are on their way to achieving substantial market penetration. The role of

[13] The Hybrid Truck Users Forum is an initiative of WestStart, which promotes advanced technology vehicles to make the transportation sector more sustainable. (See http://www.WestStart.org.)

credits in advancing this progress, both with respect to availability of the credits and their function in reducing prices, needs to be documented. Given the commonalities between bus and certain truck platforms, progress in the bus market will also have major implications for development of hybrid trucks.

Actual use of the tax credit will be important to track; only the IRS is in a position to do so. This information should be made available and updated periodically; no information about individual recipients will need to be divulged.

Recommendations

In summary, we recommend:

EPA: Promptly address any features of the heavy-duty hybrid testing protocol that hinder the commercialization of new hybrids or the claiming of tax credits. In particular, work with manufacturers and fleets to add guidance on testing new vehicle types before they become available for purchase. Adapt the testing protocol to meet the needs of others, including participants in EPA's SmartWay Transport partnership, for a reliable means of comparing the fuel economy of heavy-duty vehicles, especially tractor-trailers, across all technologies.

Fleets: Participate in efforts such as the Hybrid Truck Users Forum to ensure the proper specification of hybrid vehicles for suitable applications and to establish a market for these vehicles.

IRS: Expedite guidance or regulations for heavy-duty hybrids so that buyers can claim credits for purchases beginning in 2006. Update promptly as new vehicle types become available. Keep track of tax credits awarded to heavy-duty hybrids and make information on specifications of vehicles receiving credits (including weight, type and fuel economy) available to the public.

TIAP: Ensure that IRS rulemakings and guidance, and EPA actions to support them, facilitate the entry of new hybrid models into the market. Investigate the issues relating to tax-exempt entities and Alternative Minimum Tax.

U.S. Congress: Extend tax credits for heavy-duty hybrids through 2014.

Vehicle manufacturers: Work with fleets to develop hybrid specifications and with EPA to develop test protocols. Make data regarding volume and incremental cost of hybrid vehicle production publicly available. Support an extension of hybrid tax credits for five years.

Common Action Items Across Measures

While the different tax incentives cover many disparate technologies and practices, a number of common threads emerge from the market transformation strategies discussed above. Key commonalities among action items are as follows:

- *Need to clarify IRS rules:* The IRS has issued guidance on most items but guidance is still needed on a few issues such as the heavy-duty vehicle incentives and on how a public building owner can assign the tax incentive to the building designer. In addition, several areas need additional clarification, particularly for the commercial building provisions but secondarily for some of the residential retrofit provisions.

- *Need for increased outreach, training, and technical support:* Essentially all of the tax incentives could benefit from increased outreach to building designers, contractors, retailers, and other key trade allies. These are the people who specify, sell, and install eligible measures and who can play a major role in encouraging the purchase of high-efficiency products. In some cases, technical training and "how-to" publications are needed, such as on ways to meet the new home and commercial building savings targets. In addition, increased marketing to the consumers and businesses that purchase eligible equipment would be helpful, so that these people hear about the benefits of efficiency from several sources.

- *Need for complementary state and utility programs:* Utilities and other energy efficiency program operators should complement the tax incentives by providing outreach and technical support, and in some cases, should complement the federal tax incentives with their own incentives. As a low-cost strategy, these program operators should be marketing the tax incentives, so that local participation in the federal program increases. But where local resources permit, local incentives will be helpful in many cases, both to pick up a portion of costs not covered by the federal incentives and to continue efforts when the federal incentives expire.

- *Need to extend most of the tax incentives and to refine some of them:* The tax incentives were originally designed as a five-year effort, not the two-year effort passed by Congress. For the most part, these incentives should be extended another three years, and in some cases (e.g., commercial buildings and heavy-duty vehicles), an even longer extension would be worthwhile. In some cases, refinements and updates to the current provisions would be useful as discussed in each of the sections above.

- *Need for work on test procedures in several cases:* In some cases, additional work on test procedures is needed to advance market transformation objectives. A test procedure is needed for heavy-duty vehicles and the air conditioner test procedure needs revision.

- *Need for continued RD&D on specific items:* In some cases, additional research, development, and deployment work would help to develop improved ways to reach the tax incentive energy-savings targets. This suggestion particularly applies to new homes and commercial buildings but also applies to such items as fuel cells, microturbines, and heavy-duty vehicles.

- *Need for work to bring specifications, codes, and standards into alignment with the tax incentives:* In the near- and mid-term periods, there is a need to align ENERGY STAR specifications and the tax incentives. This applies to refrigerators in the near term and air conditioners, heat pumps, and new homes in the medium term. In the longer term,

building codes should ultimately be revised to reflect the tax incentive savings levels, and appliance and HVAC equipment standards should receive similar updates.

Conclusion

The federal tax incentives are designed to be a key element in a long-term market transformation strategy to make these products and practices "business as usual." But in no case will tax incentives alone transform markets. The tax incentives need to be complemented with outreach, training, and technical support if they are to have significant impact. A variety of other actions will be needed as well, including extension of most of the credits for at least another three years. If all of these tax incentives are successful in transforming markets, U.S. energy use will be reduced by roughly 5%, reducing consumer and business energy bills by billions of dollars annually. In order to achieve these worthwhile objectives, states, utilities, manufacturers, federal agencies, Congress, and efficiency organizations will each need to undertake significant actions as specified in earlier sections of this report. While there is significant work involved, the benefits are large, and the costs of inaction substantial.

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