

Energy Efficiency Tax Incentives in the Context of Tax Reform

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ACEEE Tax Reform Working Papers

This is the fourth in a series of working papers on tax reform issues related to energy efficiency that ACEEE is preparing in 2012. We welcome feedback on this working paper. Send comments to taxreform@aceee.org. We also welcome suggestions on other topics to cover.

UPDATE: A summary report on this and the other working papers was published in February 2013 and is available at <http://aceee.org/research-report/e132>.

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Executive Summary

Over the years, Congress has enacted hundreds of tax incentives in order to encourage activities it considered desirable. These tax incentives have been politically popular because once enacted they do not require an annual appropriation and also because they reduce taxes for voters. However, the U.S. government's growing debt and chronic budget deficits mean that tax incentives are now under the microscope. There is interest on both sides of the Congressional aisle in tax reform that would simplify the tax code and reduce marginal tax rates.

This paper looks at tax incentives for energy efficiency in the context of tax reform. A review of experience with current and past energy efficiency tax incentives finds that the 10 percent energy efficiency tax credits enacted in 1978 were not very effective in spurring substantial energy savings as these credits promoted tried-and-true energy efficiency measures that many consumers and businesses were installing on their own, resulting in high expenditures for “free riders”—consumers and businesses who would have installed the efficiency measures even without a tax credit. Furthermore, the value of the tax credit was too small to spur additional installations.

Tax incentives enacted in 2005 were more targeted, emphasizing advanced technologies and paying higher incentives. The new homes and appliance tax incentives were particularly effective in spurring a much higher market share for qualifying homes and appliances and in the case of appliances have led to a permanent transformation of the market. Credits for heavy-duty hybrid vehicles, furnaces, air conditioners, and heat pumps have also been effective in spurring product introductions and increased market share. On the other hand, the windows tax credit had high levels of free riders and some of the other tax incentives had low participation, resulting in low impacts but also low costs.

We review the large cost-effective opportunities for energy efficiency investments and some of the market barriers that hinder these investments. To overcome these barriers will require a variety of strategies. As discussed in other papers in this series (noted in the References), modest and major reforms to the tax code will help. In addition, targeted tax incentives can also help, just as many of the incentives enacted in 2005 have made a difference. However, given current budget deficits, funds for energy-related tax incentives will be very limited. It is very unlikely that all energy-related tax incentives will be phased out. Therefore, we recommend that a specific budget be developed for energy-related tax incentives and this budget be allocated in ways that will maximize benefits per dollar of federal expenditure.

Experience with past tax incentives helps show the most effective ways to apply limited funds. Federal energy incentives should target only technologies or processes that provide a societal good in the energy sector, such as reducing energy use and saving money or encouraging new energy sources that will be important in the long term. We recommend that these limited available funds target technologies or practices that are not widespread, but that with medium-term support (e.g., 5 years) can experience market transformation and become much more widely used even after tax incentives end. Recent examples of such tax incentives include the appliance tax credit and the new homes tax credit. An example outside of energy efficiency might be the wind energy production tax credit, which helped to establish a major U.S. wind energy industry. There is now general agreement that the credit can be phased out, although there is disagreement on the length of the phase-out period.

Based on the experience with recent energy efficiency tax incentives, we recommend that future energy incentives should:

- Target energy-saving equipment and practices with substantial energy savings—we want “mountains” not “molehills”);
- Target only technologies or processes that provide a societal good in the energy sector, such as reducing energy use and saving money or encouraging new energy sources that will be important in the long term;
- Target efficiency levels and new energy sources that currently have a very small market share to keep costs down and minimize the number of “free riders”;
- Pay substantial incentives to motivate significant sales; and
- Be in place for a medium period of time (e.g., 5 years) so manufacturers and other market players know incentives will be available for long enough that it is worth making investments. Short-term incentives do not provide such assurance. After this medium period of time, incentives should either be phased out or eligibility levels increased, starting a new market transformation process.

In addition, for measures that are expensive and for which quick market transformation is not possible, such as comprehensive home and commercial building energy efficiency retrofits, Congress should enact initial tax incentives to help spur market growth, but then consider transitioning to repayable incentives after the initial 5-year incentive ends.

Repayable tax incentives are a way to limit long-term costs to the Treasury by requiring recipients to repay the incentive over time as benefits are realized. The initial credit helps reduce the upfront cost of the investment, and the latter payments reduce the cost to the Treasury. For example, if a business receives an initial tax credit of \$100,000 on a combined heat and power (CHP) system the year the system was placed into service, they might repay the federal credit at the rate of \$20,000 per year over the next 5 years. The initial credit encourages the investment, and the subsequent repayments channel the value of some of the energy bill savings back to the federal government, so that the long-term cost to the federal government is very low—just defaults plus interest costs. Essentially this would be a zero-interest loan.

To help guide how to put these principles into action, we analyzed the costs and savings of a 5-year federal tax credit for high-efficiency products and services, including estimated effects on the market for these products and services over the following decade. Results of this analysis are summarized in Table ES-1.

Table ES-1. Costs, Savings, and Federal Cost per Btu of Different Energy Efficiency Tax Incentives

Item	Five-Year	Electricity Savings			Fuel Savings			Federal \$/	Rank
	Cost to							Lifetime	
	Treasury	5th Year	15th Year	Lifetime	5th Year	15th Year	Lifetime	Lifetime	
	(\$millions)	(GWh)	(GWh)	(GWh)	(TBtu)	(TBtu)	(TBtu)	mBtu	
Increasing commercial building deduction to \$3/sf	\$52	552	2,636	158,139	2	10	599	\$0.02	1
New homes -- extend current credit	1,076	2,590	14,608	876,505	10	96	5,785	0.07	2
Commercial building retrofits (20%+ savings)	843	14,349	34,678	520,164	40	106	1,596	0.12	3
Water heaters -- heat pump and advanced gas	1,308	3,841	32,035	416,459	7	95	1,229	0.24	4
CHP -- remove size cap but limit to 25 MW/system	270	0	0	0	38	64	956	0.28	5
A/C & HP SEER 16 installed per ACCA-QI	2,426	8,162	35,262	634,707	13	94	1,698	0.30	6
Residential appliances -- extend and update	1,148	2,624	18,371	275,562	3	41	612	0.34	7
Furnaces (95% AFUE + efficient fan)	901	897	3,545	63,808	13	105	1,886	0.36	8
Advanced windows (DOE U .22 spec)	504	538	2,984	59,674	3	16	328	0.54	9
New homes -- 50% whole home savings	646	1,203	3,488	69,758	7	21	411	0.58	10
Whole house retrofits (20%+ savings)	1,875	1,269	3,808	68,544	13	40	722	1.33	11
Replace CFC industrial & commercial chillers	236	1,665	0	16,646	0	0	0	1.42	12
Insulation and sealing for homes per 25C	2,022	1,540	1,586	31,717	22	27	549	2.33	13
Totals	\$13,300	39,200	153,000	3,191,700	170	720	16,400	\$0.28	

All of the tax incentives examined are highly cost-effective, with a federal cost of \$0.02–2.33 per million Btu of energy saved, far less than the approximately \$10 per million Btu we now pay for energy. The new construction and equipment (appliances, air conditioners, furnaces, water heaters, and advanced windows) are particularly cost-effective (less than \$1 per million Btu, with most less than \$0.35 per million Btu saved) because they can help permanently transform markets by laying the foundation for improvements to building codes and product efficiency standards. The commercial building retrofit and CHP system incentives are also very cost-effective. Retrofitting homes and replacing chillers are more expensive but still very cost-effective, with federal costs ranging from \$1.33–2.33 per million Btu saved. These measures also have less of a long-term market transformation effect. While not included in this analysis, we plan to analyze incentives for heavy-duty hybrid vehicles and light-duty electric vehicles soon.

All of the measures listed have a 5-year cost to the Treasury of about \$13 billion, which is less than \$3 billion per year. If funds are more limited, we would recommend concentrating on the most cost-effective items and further refining criteria to reduce the cost of items that have a 5-year cost of more than \$1 billion. For some of these items (those with a substantial credit per taxpayer), repayable incentives can also be considered.

These tax incentives are highly cost-effective investments, which will continue to pay off via energy bill reductions for decades to come. These tax incentives will leverage very substantial private investments as the tax incentives cover only a portion of the cost of efficiency measures. Furthermore, these tax incentives will help our economy as investments in energy efficiency help to create jobs, including direct jobs in the production and installation of efficient technologies and

induced jobs created as consumers and businesses re-spend their energy bill savings. For these reasons, modest medium-term federal energy efficiency tax incentives that help leverage long-term changes in markets should be included as part of tax reform.

Introduction

Over the years, Congress has enacted hundreds of tax incentives in order to encourage activities it considered desirable. These tax incentives have been politically popular because once enacted they do not require an annual appropriation and also because they reduce taxes for voters. However, the U.S. government's growing debt and chronic budget deficits mean that tax incentives are now under the microscope. There is interest on both sides of the Congressional aisle in tax reform that would simplify the tax code and reduce marginal tax rates.

This paper looks at tax incentives for energy efficiency in the context of tax reform. We do not look at tax incentives for other energy sources, such as renewable energy, nuclear, oil, and natural gas, except for a few places where we try to put energy efficiency incentives in context relative to other energy tax incentives. We begin by reviewing experience with current and past energy efficiency tax incentives. We then discuss opportunities for energy efficiency tax incentives and strategies for constructing such tax incentives so they are low cost and could potentially fit into tax reform plans.

Readers are also encouraged to read the other papers in this series. This paper on tax incentives is the fourth in a multi-part series of working papers by ACEEE on tax reform. We plan to issue a revised version in late 2012. We welcome any comments or feedback, which may be sent to us at taxreform@aceee.org.

Current and Past Energy Efficiency Tax Incentives

The current tax code includes some energy efficiency incentives, most established in the Energy Policy Act of 2005 but modified since then. These include:

- Commercial building tax deduction—Incentive of up to \$1.80 per square foot for new and renovated commercial buildings that use half the energy of a building built to model codes;
- Plug-in electric drive vehicles—A credit of \$2,500–7,500 per vehicle weighing less than 14,000 pounds gross capacity, with the incentive varying by battery capacity;
- CHP systems—Investment tax credit of 10 percent of cost for eligible systems;
- Ground source heat pumps—Investment tax credit of 30 percent of the cost for eligible systems;
- Fuel cells—A credit of 30 percent of cost up to a maximum of \$3,000 per kW of power that can be produced; and
- Microturbines—Investment tax credit of 10 percent of cost up to a maximum of \$200 per kW of power that can be produced.

Other incentives were provided over the 2005–2011 period for the following but have since expired:

- Upgrades to residential buildings including: insulation, windows, heating and cooling systems and water heaters
- Construction of new homes that use half the energy of a home built to model codes
- Manufacture of high-efficiency refrigerators, clothes washers, and dishwashers
- Purchase of hybrid, advanced diesel, and fuel cell light-duty vehicles, and hybrid commercial vehicles.

In addition, in 1978 Congress enacted a 15 percent tax credit for residential energy efficiency measures and a 10 percent tax credit for energy efficiency investments by businesses. The residential credits ended in 1985, the business credits in 1982.

In the following sections we summarize the experience with energy efficiency tax incentives in both the 1970's and the 2000's with a focus on lessons learned.

ENERGY TAX ACT OF 1978¹

Tax incentives were enacted during the 1970s to stimulate adoption of both residential and industrial energy efficiency measures. The Energy Tax Act of 1978 included a 15 percent tax credit up to a maximum of \$300 (i.e., a 15 percent credit on expenditures up to \$2,000) for residential conservation and renewable energy investments made between April 1977 and December 1985. Eligible conservation measures included insulation, storm windows and doors, weather stripping, and furnace modifications—standard energy efficiency measures at that time. During 1978–85, there were about 30 million claims for the residential energy conservation and renewable energy credits, amounting to nearly \$5 billion in lost revenues for the Treasury.

Early studies of the net benefits of the residential tax credit were deemed inconclusive (OTA 1992) due, in part, to the fact that a variety of policy and market changes occurred simultaneously. However, evidence emerged that the tax credit had relatively little impact on consumer behavior. First, a household survey conducted in 1983 found that 85 percent of households that implemented energy efficiency retrofits in 1983 did not claim a tax credit; in addition, 88 percent of the households that claimed a credit that year said they would have made the improvement even if the credit had not been available (EIA 1986). Also, the credits tended to be used by wealthier owner-occupied households. Based on this information as well as the small size of the credit, lack of promotion, and administrative burdens, one review concluded that the credit itself probably did little to motivate retrofitting and that most recipients were free riders who would have made the efficiency investment without the incentive (OTA 1992).

The Energy Tax Act of 1978 also included a 10 percent tax credit for specified energy efficiency measures installed by businesses. The measures covered included heat recovery equipment, waste heat boilers, energy control systems, and economizers (GAO 1985). The Act was amended in 1980 to add cogeneration equipment to the list of eligible measures. This credit was in effect during 1978–82 and it also cost the Treasury approximately \$5 billion. Surveys and analyses indicated that due primarily to the small magnitude, the credit had little effect on corporate decision-making (ASE 1983; OTA 1983). In other words, most of the measures probably would have been installed without incentives, indicating a high free rider level. The industrial tax credit also has been criticized for covering a relatively limited list of conventional "add-on" efficiency measures and thereby not supporting technological innovation (ASE 1983). The credits generally did not address opportunities for industrial process improvement, nor were they based on performance.

¹ This section is taken from Quinlan, Geller, and Nadel (2001).

In summary, it appears that both the residential and industrial tax credits in effect during 1978–85 cost the Treasury a substantial amount of money but had relatively little net impact on fostering energy efficiency improvements. The credits were relatively small in percentage terms while eligibility was limited to widely available and commonly adopted efficiency measures. Consequently, free rider levels were probably very high.

ENERGY POLICY ACT OF 2005

At the beginning of the 21st century, energy efficiency tax incentives again came under discussion but with a focus on encouraging advanced energy-saving technologies. The original discussions started in 1996 during the Clinton Administration. For example, in 2000 President Clinton proposed a variety of tax incentives as part of the Climate Change Technology Initiative (White House 2000). In subsequent years, this proposal went through many changes before being adopted by a Republican Congress and signed by President George W. Bush as part of the Energy Policy Act of 2005.

In 2011, ACEEE reviewed the experience with these tax incentives (Gold and Nadel 2011). Overall, these tax incentives were generally effective in spurring adoption of energy-saving measures, but that some of the incentives were more effective and more cost-effective than others.

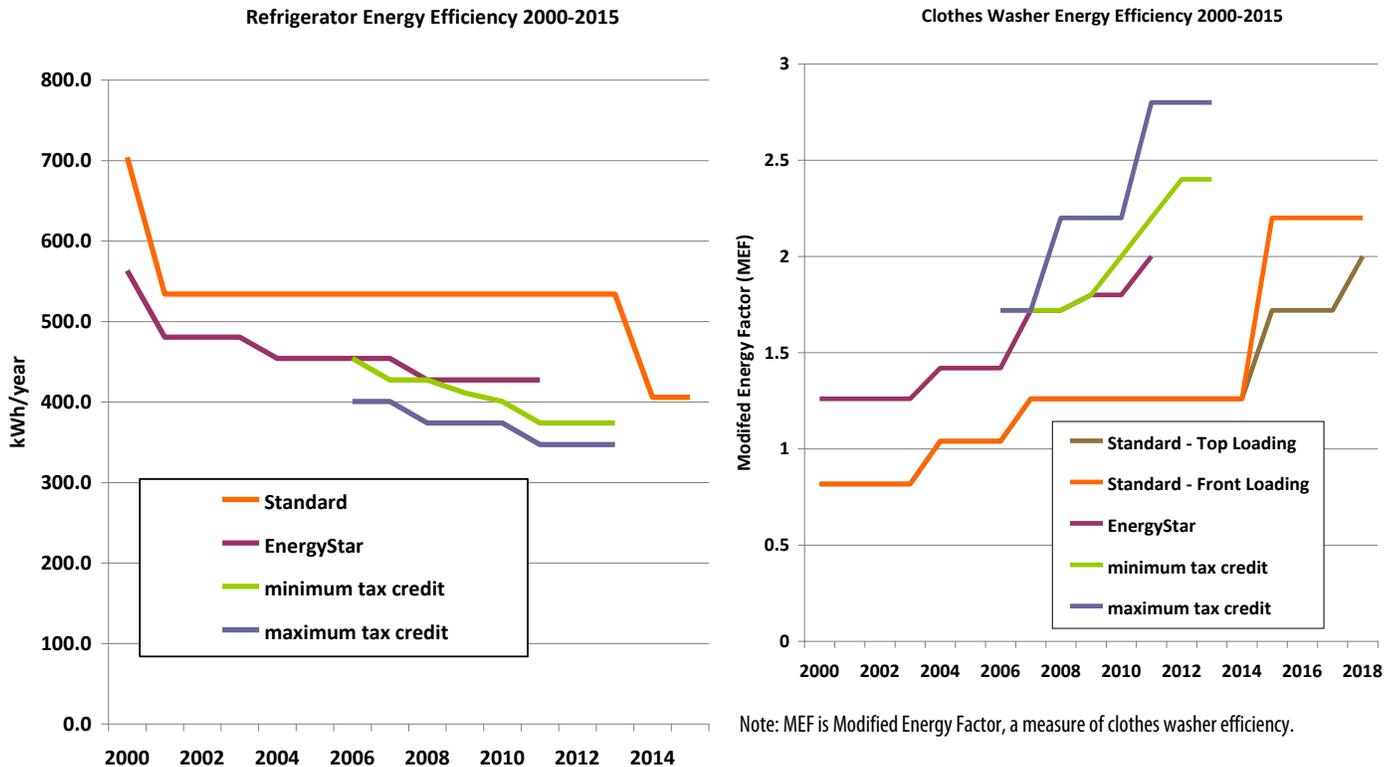
Of the tax incentives, probably the most successful were the appliance and new home tax incentives. The appliance incentives provided per-unit credits to manufacturers for the production of the most efficient refrigerators, clothes washers, and dishwashers. The original incentives only applied to appliances produced in the United States during 2006 and 2007, and had a total cap of \$75 million per manufacturer. These tax incentives were extended to cover 2008–2010 and incentive levels were made more stringent as a part of the Emergency Economic Stabilization Act of 2008. They were extended again in 2011 as a part of the Middle Class Tax Relief Act of 2010, with incentive levels adjusted to focus on even more efficient products.

The tax incentives encouraged manufacturers to produce more of their highest efficiency products on the market and to offer related discounts and promotions on these units. As these products gained greater market share, the ENERGY STAR specifications were tightened, and the next phase of the tax incentives was adjusted to increase tax credit qualification levels. Figure 1 shows the market transformation of refrigerators and clothes washers that has occurred in recent years, spurred in part by these tax incentives. Ultimately the efficiency levels originally covered by the 2005 incentives became the basis for new minimum efficiency standards adopted by DOE in 2012. Due to the significant growth in the market for high-efficiency appliances supported by these incentives, appliance manufacturers supported the increase in minimum efficiency standards to these levels.

Fortunately, the cost of these incentives has been moderate due to the cap on incentive per manufacturer plus the very high eligibility level. The Joint Committee on Taxation (JCT), in 2010, estimated that the cost to the Treasury of revising and extending the credit into 2011 would be \$78 million (JCT 2010). However, in 2010 and 2011 manufacturers emphasized sales of the very highest efficiency levels, which were not subject to the cap. This raised the cost. In 2012, based on the most recent data, JCT estimated that a 1-year extension of the appliance tax credit would cost the Treasury \$644 million (JCT 2012). In

our analysis later in this report, we look at an option that would result in costs midway between these two estimates.

Figure 1. Market Transformation of Refrigerators and Clothes Washers, 2000–2015



Another successful tax incentive is the new home tax credit, which has significantly raised the market share of qualifying energy-efficient homes at a modest cost. This provision provided a credit of \$2,000 for builders of homes that use 50 percent less energy for space heating and cooling than homes built according to the 2004 supplement to the International Energy Conservation Code (IECC). The credit was extended in the Emergency Economic Stabilization Act of 2008 until December 31, 2009, lapsed in 2010, but was renewed to cover new homes built in 2010 and 2011 as a part of the Middle Class Tax Relief Act of 2010.

The tax credit has been successful in moving the new homes market toward more energy-efficient homes. As shown in Table 1, the number of homes participating in the credit grew four-fold between 2006 and 2009. In addition, energy-efficient homes gained a greater market share, as the number of homes certified as complying with the tax credit rose to 10 percent of new homes sold in 2009, although due to the recession the number of new homes declined substantially. The proportion of new homes qualifying for the new homes tax credit declined to 7 percent in 2010, presumably largely because the incentive lapsed at the beginning of the year. It was extended retroactively in December 2010, but was not in effect when builders were making decisions on energy efficiency (RESNET 2012). This experience suggests that the market has been partially transformed but that the incentive continues to drive additional market share (e.g., an additional 4 percent in 2011).

Based on the number of new single-family homes eligible in 2011, the maximum cost of this credit for single-family homes will be \$64 million, though it is unlikely that all eligible builders will apply, reducing the cost. There is also a \$1,000 credit for manufactured homes that reduce energy use by 30 percent. In 2010, approximately 4,800 homes qualified (Gold and Nadel 2011) indicating that this provision for manufactured homes has a maximum cost of less than \$5 million.² Costs are likely to increase some as the home construction industry recovers from the recession.

Table 1. Number of New Homes Certified as Qualifying for the Federal Tax Credit

Year	Number of Homes Verified as Qualified for the Tax Credit	Percent of New Homes Sold
2006	7,110	0.7%
2007	23,000	3%
2008	22,000	5%
2009	37,000	10%
2010	21,000	7%
2011	32,000	11%

Source: RESNET (2012)

The heavy-duty hybrid vehicle credit in EAct 2005 was also successful to some degree in encouraging development and market introduction of new hybrid vehicles. Notwithstanding the large fuel savings potential from the hybridization of trucks used in urban applications, such as pick-up and delivery and refuse hauling, heavy-duty hybrid development lags light-duty hybrid development by several years. Consequently, there were few heavy-duty hybrids available in the early years of the credits. Use of the credit was also low because the dollar amount of the credits was too low given the high incremental cost of the heavy-duty hybrid technology. Nonetheless, by the time the credit expired at the end of 2009, ten manufacturers had placed over 50 eligible hybrid vehicles on the market, and interest in hybrids is very high in the heavy-duty vehicle market today. The California Hybrid Truck and Bus Voucher Project is a program that began partially as a result of the availability of this tax credit, and there have been repeated efforts to renew this credit at the federal level now that the market has shifted. A recent proposal was included in the Job Creation and Tax Cuts Act introduced by Senator Baucus in the 111th Congress.

Incentives for energy efficiency improvements to existing homes have been successful at spurring sales of qualifying measures, but have been more expensive. EAct 2005 also included a Nonbusiness Energy Property tax credit that provided tax credits for homeowners who installed new energy-efficient central air conditioners, heat pumps, and water heaters in existing homes. In addition, there were tax credits for upgrading building envelope components in existing homes, such as windows, insulation, and ENERGY STAR metal roofs. These provisions were originally for equipment put in place in 2006 and 2007. They were extended with some changes in eligibility levels as a part of the Emergency Economic Stabilization Act of 2008, covering improvements installed in 2009, but not 2008. The American Recovery and

² Maximum cost is 32,000 single-family homes times \$2,000 plus 4,800 manufactured homes times \$1,000, which equals \$68.8 million.

Reinvestment Act (ARRA) extended these through December 2010 and increased the incentive to 30 percent of equipment cost (from 10 percent previously) and increased the cap on incentives from \$500 to \$1,500 per household. These credits were extended to 2011, but with the original level of incentives and \$500 limit as a part of the Middle Class Tax Relief Act of 2010.

These tax incentives have had substantial participation. As shown in Table 2, GAO (2012) estimates about 4.3 million participants in 2006 and 2007, and 6.8 million in 2009 (data is not provided for 2008 or 2010). As shown in Table 3, available data indicates that nearly half of the spending under the tax credit was for windows and doors, with heating and cooling equipment accounting for about one-third of the spending.

Table 2. Participation, Total Spending, and Total Cost of Non-Business Energy Property Credit

Year	Total Tax Returns Filed (millions)	Total Claimants (millions)	Total Spending (\$million)	Total Credit Claimed (\$million)
2006	138.4	4.3	\$7,947	\$956
2007	153.6	4.3	7,484	938
2009	140.5	6.8	25,567	5,288

Source: GAO (2012)

Table 3. Total Spending by Measure Type under the Non-Business Energy Property Tax Credit

	Total Number	Total Spending (in millions)	Percent of Spending
Insulation	1,989,695	3,353	13%
Windows	2,370,582	8,688	34%
Doors	1,276,145	3,065	12%
Roofs	360,833	2,183	9%
Air Conditioners and Heat Pumps	991,864	4,029	16%
Furnaces and Hot Water Boilers	1,318,438	4,405	17%
Furnace Fans	<u>224,988</u>	<u>690</u>	<u>3%</u>
All Retrofit Types	6,750,950	25,567	100%

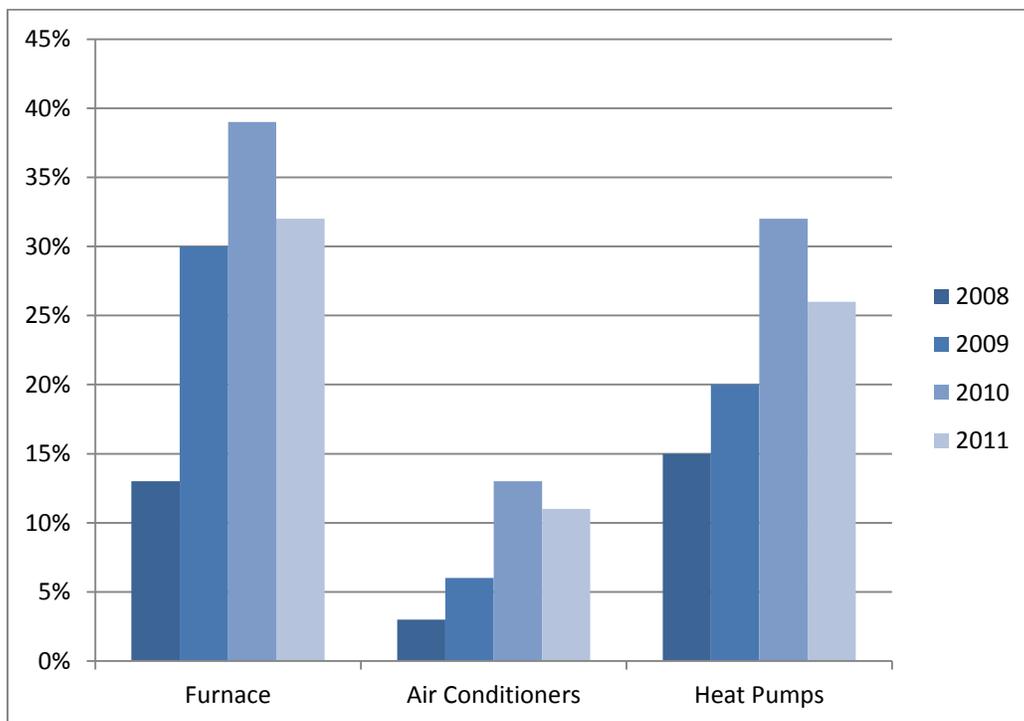
Source: GAO (2012)

Research by ACEEE and ASE (2011) estimates that about 90 percent of windows sold in 2010 and 2011 qualified for the tax credit, a level that indicates a high number of free riders. On the other hand, as shown in Figure 2, for air conditioners, heat pumps, and furnaces, 11–32 percent of equipment available on the market qualified in 2011, more than double the level in 2008.

Other energy efficiency tax incentives have not been as successful, according to Gold and Nadel (2011). The Commercial Buildings Tax Deduction has resulted in some lighting improvements, but it appears that the incentive has been too low and application requirements too onerous to result in many qualifying whole-building improvements. Impacts of the passenger vehicle, fuel cell, and microturbine incentives have also been modest. The passenger vehicle credit contributed to an increase in the hybrid vehicle market share from 1.2 percent in 2005 before the credit began to 2.8 percent in 2009. Likewise, regarding the credit for stationary fuel cells, according to one source cited by Gold and Nadel, the credit helped fuel cell sales to increase 10 percent in 2006.

While not examined by Gold and Nadel, the CHP tax credit is included in a recent review of CHP policies by Chittum and Kaufman (2011). This 10 percent investment tax credit was enacted as part of the Emergency Economic Stabilization Act of 2008. The credit is limited to the first 15 MW of a system's capacity and is only applicable to systems of 50 MW or smaller. The credit has not been substantially used by developers, and all uses of the tax credit have been under the unique temporary parameters authorized by the ARRA, which allows the tax credit to be taken as a grant instead of a tax credit.

Figure 2. Percentage of Air-Conditioner, Heat Pump, and Furnace Shipments Qualifying for Federal Tax Incentives by Year



Note: Tax incentive was 10 percent of cost in 2008 and 2011 and 30 percent of cost in 2009 and 2010. This likely explains lower penetration in 2011.

Source: AHRI (2012)

Energy Efficiency Tax Incentives with Tax Reform

THE NEED

Studies by ACEEE and others, such as McKinsey and Company, have found large potential for cost-effective energy efficiency savings. For example, McKinsey (2009) found:

If executed at scale, a holistic approach would yield gross energy savings worth more than \$1.2 trillion, well above the \$520 billion needed through 2020 for upfront investment in efficiency measures (not including program costs). Such a program is estimated to reduce end-use energy consumption in 2020 by 9.1 quadrillion BTUs, roughly 23 percent of projected demand, potentially abating up to 1.1 gigatons of greenhouse gases annually.

Looking farther into the future, Laitner et al. (2012) found that by 2050, energy efficiency measures and practices could reduce U.S. energy use by 42–59 percent relative to current projections, and in the process save consumers and businesses billions of dollars, raise gross domestic product in 2050 by \$100–200 billion, and support 1.3–1.9 million jobs in 2050.

BARRIERS

Realizing this potential will require substantial investments by consumers and businesses, but a number of market barriers hinder such investments. These barriers have been discussed by others including Golove and Eto (1996); IEA (2007); and Parfomak, Sissine and Fischer (2009). To briefly summarize, these market barriers include the following demand- and supply-side barriers.

Demand-Side Barriers

- *Lack of awareness*: Many purchasers underestimate the amount of energy consumption and the associated environmental impacts of operating equipment. Very often, they are not even aware that different models can consume significantly different amounts of energy and that buying more efficient products or retrofitting existing homes and facilities can lead to substantial energy and utility bill savings.
- *Uninformed decision-makers*: Even when the purchaser is aware of variations in energy efficiency or opportunities to save, often they still lack information on the specific savings from specific measures. They may also be too busy or rushed to research the cost-effectiveness of a decision, or information on high-efficiency products may not be readily available. Many of these products are purchased once a decade and renovations occur on a similar timescale, so maintaining awareness to facilitate this occasional decision is not something most consumers can do.
- *“Panic purchases”*: When purchases are made, often the buyer is in a rush (e.g., a broken-down furnace or refrigerator must be replaced quickly). In such “panic purchase” situations, efficiency performance gets little attention and choices are, at best, limited to what is in stock. In the commercial/industrial sector, many purchasing decisions are made by purchasing or maintenance staff that are unfamiliar with the relative efficiencies and operating costs of the equipment they purchase.
- *Third-party decision-makers (“split incentive”)*: Many times the decision-maker (e.g., builder, developer, landlord, purchasing department, etc.) is responsible for purchasing equipment or making renovation decisions but someone else (e.g., tenant, operating department, etc.) is responsible for

paying the energy bills. In these instances, the purchaser tends to buy the least expensive equipment or cut efficiency improvements from renovation specifications because he or she receives none of the benefits from improved efficiency.

- *Financial procedures that overemphasize initial costs and de-emphasize operating costs:* In the commercial/industrial sector, accounting procedures often closely scrutinize capital costs, favoring purchase of inexpensive equipment, while operating costs are generally less scrutinized. Furthermore, when operating costs are reduced, the savings typically show up in a corporate-level account and are rarely passed on to the department that made the decision and the investment. This diversion of benefits discourages decision-makers from making energy-saving investments.

Supply-Side Barriers

- *Limited stocking of efficient products:* Equipment distributors generally have limited storage space and therefore only stock equipment that is in high demand. This creates a "Catch-22" situation: users purchase inefficient equipment so distributors only stock inefficient equipment. Purchasing efficient equipment thus may require a special order, which takes more time. Most equipment that fails needs to be replaced immediately. Thus, if efficient equipment is not in stock, even customers who want efficient equipment are often stuck purchasing standard equipment.
- *Efficiency bundled into premium products only:* Often manufacturers will produce commodity-grade and value-added product lines. The commodity-grade line just meets efficiency standards and includes only basic features. The value-added line includes improved efficiency and other extra non-energy features at a significantly higher cost than commodity-grade products. A portion of the extra cost is for the improved efficiency but much of the extra cost is for the added "bells and whistles." Consumers desiring improved efficiency without the extra features are out of luck.
- *Shortage of skilled contractors:* For many energy-saving projects, skilled contractors are needed to assess energy saving opportunities, design projects, and implement these projects successfully. In some regions of the country where efficiency projects have been promoted for many years, such contractors are available. But in much of the country (e.g., "the Heartland"), such contractors are often in short supply.

ROLE OF ENERGY EFFICIENCY TAX INCENTIVES IN TAX REFORM

To overcome these barriers will require a variety of strategies. As discussed in other papers in this series (Nadel and Farley 2012a, 2012b; Sachs et al. 2012), modest and major reforms to the tax code will help. In addition, targeted tax incentives can also help, just as many of the incentives enacted in 2005 have made a difference. However, given current budget deficits, funds for energy-related tax incentives will be very limited. It is very unlikely that all energy-related tax incentives will be ended. Therefore, we recommend that a specific budget be developed for energy-related tax incentives and this budget be allocated in ways that will maximize benefits per dollar of federal expenditure. Experience with past tax incentives helps show the most effective ways to apply limited funds. In the next section, we discuss setting priorities for energy efficiency tax incentives. In the following section, we also discuss an innovative way to minimize long-term costs to the Treasury—repayable tax incentives.

TARGETING ENERGY EFFICIENCY TAX INCENTIVES

Federal energy incentives should target only technologies or processes that provide a societal good in the energy sector, such as reducing energy use and saving money or encouraging new energy sources that will be important in the long term. We recommend that these limited available funds target technologies or practices that are not widespread, but that with medium-term support (e.g., 5 years) can experience market transformation and become much more widely used even after tax incentives end.

As discussed above, recent examples of such tax incentives include the appliance tax credit (Section 45M) and the new homes tax credit (Section 45L). An example outside of energy efficiency might be the wind energy production tax credit, which helped to establish a major U.S. wind energy industry. There is now general agreement the credit can be phased out, although disagreement on the length of the phase-out period. Likewise, to provide an illustrative example for another energy sector, a tax credit for new experimental oil and gas drilling techniques could be provided and phased out as the techniques become established. Based on the experience with recent energy efficiency tax incentives, we recommend that future energy incentives:

- Target energy-saving equipment and practices with substantial energy savings—we want “mountains” not “molehills”);
- Incentives should target only technologies or processes that provide a societal good in the energy sector, such as reducing energy use and saving money or encouraging new energy sources that will be important in the long term;
- Target efficiency levels and new energy sources that currently have a very small market share to keep costs down and minimize the number of “free riders”;
- Pay substantial incentives to motivate significant sales; and
- Be in place for a medium period of time (e.g., 5 years) so manufacturers and other market players know incentives will be available for long enough that it is worth making investments. Short-term incentives do not provide such assurance. After this medium period of time, incentives should either be phased out or eligibility levels increased, starting a new market transformation process.

In addition, for measures that are expensive and for which quick market transformation is not possible, such as comprehensive home and commercial building energy efficiency retrofits, Congress should enact initial tax incentives to help spur market growth, but then consider transitioning to repayable incentives after the initial 5-year incentive ends. We discuss such repayable tax incentives in the next section. After this discussion we turn to an analysis we conducted to develop specific priorities for energy efficiency tax incentives.

REDUCING COSTS—REPAYABLE TAX INCENTIVES

Repayable tax incentives are a way to limit long-term costs to the Treasury by requiring recipients to repay the incentive over time as benefits are realized. The initial credit helps reduce the upfront cost of the investment, and the latter payments reduce the cost to the Treasury. For example, if a business receives an initial tax credit of \$100,000 on a combined heat and power system the year the system was

placed into service, they might repay the federal credit at the rate of \$20,000 per year over the next five years. The initial credit encourages the investment, and the subsequent repayments channel the value of some of the energy bill savings back to the federal government, so that the long-term cost to the federal government is very low—just defaults plus interest costs. Essentially this would be a zero-interest loan.

This idea has already begun to circulate in Congress. In 2011 Senator Shaheen from New Hampshire circulated a draft bill that would provide a repayable tax incentive for CHP systems. Under the proposal, an incentive is given to electric utilities that finance CHP systems. The amount of the incentive is then repaid to the Treasury through an annual installment payment paid by the customer who owns the CHP system equal to the amount of the subsidy divided by an installment period, specified in years. In this case, the installment period is 3 years (e.g., the customer repays the subsidy over 3 years) but payments don't begin until the third year after the subsidy is paid (i.e., the customer repays nothing for the first 2 years, then repays one-third of the subsidy each year for the next 3 years). However, this particular proposal is complicated by the fact that the electric utility receives the tax incentive, but a business that hosted the CHP system would make the repayment, resulting in some tricky legal issues. These issues would be much more limited if the same firm received the credit and then made the repayments.

Under current federal procedures for “scoring” the cost of tax expenditures, costs and income are estimated for each year, as well as a simple total, without any discounting. Thus a \$100,000 expense followed by 5 years of \$20,000 repayments would be scored as zero over the life of the program. There would, however, be some small cost risk to the Treasury based on the potential for businesses or individuals to go bankrupt before they fully repaid their obligation.

Such a repayable tax incentive would be easier to implement for businesses than for individuals, since businesses already depreciate capital investments over many years and thus need to track past investments and depreciation from year to year when compiling their annual taxes. Tracking repayments would be very similar. Likewise, this system could work well for individuals who use the federal long-form, as this form already includes such items as capital gains and losses relative to expenditures in previous years.

Such a repayable incentive should probably be limited to fairly large investments, such as an individual credit of \$1,000 or more. Having to go through the extra tracking and paperwork for small investments probably would not make sense. For example, Senators Snowe, Bingaman, and Feinstein recently introduced a bill that would provide \$2,000–5,000 tax incentives to homeowners who reduced the energy use of their homes by at least 20 percent (Cut Energy Bills at Home Act, S. 1914). The same Senators are working on a somewhat similar bill for commercial building retrofits. These incentives are large enough that adding a repayment provision might be feasible.

RELATIONSHIP BETWEEN FEDERAL ENERGY EFFICIENCY TAX INCENTIVES AND OTHER POLICIES TO PROMOTE ENERGY EFFICIENCY

In addition to federal tax incentives, there are other policies to promote energy efficiency. Perhaps most importantly, many utilities offer energy efficiency programs, with budgets now in the billions of dollars per year. However, these are not offered in all states, and even many of the states with some programs have only limited efforts. For example, in 2010, ACEEE estimates that utility-sector energy efficiency expenditures totaled \$5.5 billion, but of these expenditures the top ten accounted for 67 percent and the

bottom half accounted for only 7 percent (Sciortino et al. 2011). Federal tax incentives help to serve the rest of the country. In addition, manufacturers prefer consistency in incentives across the country as consistency makes it easier and more likely that they will design and sell new products that qualify for the incentives. In those states with significant utility-sector incentives, program operators will focus incentives where there are no federal incentives or will fund complementary activities to help promote use of the federal incentives.

Likewise, other programs and policies can be a useful complement to federal tax incentives. Appliance and other labels provide useful information to consumers, making them more aware of efficiency choices and therefore helping to point out high-efficiency products and services that may be eligible for incentives. Likewise, as discussed above for refrigerators and clothes washers, federal incentives can help lay a foundation for improved equipment efficiency standards. The same applies to improved building codes.

ANALYSIS OF POTENTIAL SAVINGS AND COST-EFFECTIVENESS

To help guide how to put these principles into action, we prepared an analysis of the costs and savings of a 5-year federal tax credit for high-efficiency products and services, including estimated effects on the market for these products and services over the following decade.

Specific tax incentives analyzed are:

- Increase the current commercial building tax deduction (section 179D) from \$1.80 per square foot of building floor area to \$3 per square foot. This provision primarily applies to new commercial buildings.
- Complement the current commercial building tax deduction with a similar deduction focused on comprehensive energy-saving retrofits to existing buildings.
- Extend the existing new homes tax credit.
- Add a higher efficiency tier to the new homes tax credit, targeting 50% savings in whole building energy use including lighting and appliances.
- Extend and update the appliance tax credit.
- Extend and update the credit for high efficiency furnaces to strengthen the qualifying criteria relative to that in the 25C credit that expired at the end of 2011. Specifically, we examine a furnace with a 95% efficiency and a high-efficiency furnace fan.
- Extend and update the credit for high-efficiency air conditioners and heat pumps strengthening the qualifying criteria relative to that in the 25C credit that expired at the end of 2011. Specifically, we examine a unit with an efficiency rating of 16 (Seasonal Energy Efficiency Ratio—SEER) that is installed in a quality manner in accordance with a quality installation specification developed by the Air-Conditioning Contractors of America (ACCA). The specification is called ACCA-QI. Quality installation will increase energy savings.
- Extend and update the credit for high-efficiency water heaters. The credit will target heat pump and condensing gas water heaters, but with a lower incentive for non-condensing tankless water heaters.
- Add a new tax incentive to promote comprehensive retrofits to new homes. This would be similar to the Home Star program that nearly passed Congress a few years ago.

- Improve the current tax credit for combined heat and power systems, removing the size cap but limiting the incentive to 25 MW per system.³
- Extend the recently expired credit for insulation and related measures. The credit would be 20 percent of cost up to a \$1,000 credit.
- Provide an incentive for replacement of old inefficient commercial and industrial chillers that still use CFC's (chlorofluorocarbon refrigerants). Replacing these units will save energy and reduce release of refrigerants that harm the ozone layer.

In addition, we recommend that two other incentives be considered. We have not yet analyzed them but plan to soon. These are:

- Heavy-duty hybrid vehicles
- Light-duty electric vehicles and their batteries

Our analysis of these options is summarized in Table 4. Detailed calculations and data sources are provided in the Appendix to this report. In cases where we could not find specific data, we made estimates based on our experience evaluating similar incentives, and consultations with experts for specific efficiency measures. As a result, our analysis should be considered approximate and small differences between measures (e.g., \$0.30 per million Btu saved versus \$0.33) are not significant.

Table 4. Costs, Savings and Federal Cost per Btu of Different Energy Efficiency Tax Incentives

Item	Five-Tear	Electricity Savings				Fuel Savings			Federal \$/	Rank
	Cost to								Lifetime	
	Treasury	5th Year	15th Year	Lifetime	5th Year	15th Year	Lifetime	mBtu		
	(\$millions)	(GWh)	(GWh)	(GWh)	(TBtu)	(TBtu)	(TBtu)			
Increasing commercial building deduction to \$3/sf	\$52	552	2,636	158,139	2	10	599	\$0.02	1	
New homes -- extend current credit	1,076	2,590	14,608	876,505	10	96	5,785	0.07	2	
Commercial building retrofits (20%+ savings)	843	14,349	34,678	520,164	40	106	1,596	0.12	3	
Water heaters -- heat pump and advanced gas	1,308	3,841	32,035	416,459	7	95	1,229	0.24	4	
CHP -- remove size cap but limit to 25 MW/system	270	0	0	0	38	64	956	0.28	5	
A/C & HP SEER 16 installed per ACCA-QI	2,426	8,162	35,262	634,707	13	94	1,698	0.30	6	
Residential appliances -- extend and update	1,148	2,624	18,371	275,562	3	41	612	0.34	7	
Furnaces (95% AFUE + efficient fan)	901	897	3,545	63,808	13	105	1,886	0.36	8	
Advanced windows (DOE U .22 spec)	504	538	2,984	59,674	3	16	328	0.54	9	
New homes -- 50% whole home savings	646	1,203	3,488	69,758	7	21	411	0.58	10	
Whole house retrofits (20%+ savings)	1,875	1,269	3,808	68,544	13	40	722	1.33	11	
Replace CFC industrial & commercial chillers	236	1,665	0	16,646	0	0	0	1.42	12	
Insulation and sealing for homes per 25C	2,022	1,540	1,586	31,717	22	27	549	2.33	13	
Totals	\$13,300	39,200	153,000	3,191,700	170	720	16,400	\$0.28		

All of the tax incentives we examined are highly cost-effective, with a federal cost of \$0.02-2.33 per million Btu of energy saved, far less than the approximately \$10 per million Btu we now pay for energy.⁴ The new construction and equipment incentives are particularly cost-effective (less than \$1 per million Btu, with most less than \$0.35 per million Btu saved) because they can help permanently transform markets by

³ The current tax incentive does not expire until 2016 so we only analyzed the expansion and not the current incentive.

⁴ In 2009, the last year for which full data are available from the EIA (2011), energy costs in the U.S. averaged \$10.83 per million Btu. Total energy bills were \$1.061 trillion and total energy consumption was 98,003 trillion Btu. $\$1.061 \times 1 \text{ million} / 98,003 = \10.83 .

laying the foundation for improvements to building codes and product efficiency standards. The commercial building retrofit and CHP system incentives are also very cost-effective. Retrofitting homes and replacing chillers are more expensive but still very cost-effective, with federal costs ranging from \$1.33–2.33 per million Btu saved. These measures also have less of a long-term market transformation effect.

All of the measures listed have a 5-year cost to the Treasury of about \$13 billion, which is less than \$3 billion per year. If funds are more limited, we would recommend concentrating on items in the upper half of Table 4 and further refining criteria to reduce the cost of items that have a 5-year cost of more than \$1 billion. For some of these items (those with a substantial credit per taxpayer), repayable incentives can also be considered.

Conclusion

There are large opportunities for cost-effective energy savings in the U.S., but a variety of market barriers serve to constrain the investments that are actually made. Tax reform can and should address some of these barriers but other barriers will remain. Tax incentives can help address some of these barriers, but given federal budget deficits, while some funds are likely to be used for energy-related tax expenditures, available funds are likely to be very limited.

Past experience with energy efficiency tax incentives shows that modest incentives for measures that already have substantial market share result largely in providing funds to “free riders”—consumers and businesses who would have purchased efficiency measures even without tax incentives. On the other hand, when incentives have been substantial enough to make a difference and have targeted measures with a very small market share, the tax incentives can help to develop a market that can be sustained after the tax incentives end.

Based on these findings, we recommend that future energy tax incentives:

- Target energy saving equipment and practices with substantial energy savings and target energy sources that can produce substantial energy in the long-term (we want “mountains” not “molehills”);
- Target efficiency levels and new energy sources that currently have a very small market share to keep costs down and minimize the number of free riders;
- Pay substantial incentives to motivate significant sales; and
- Be in place for a medium period of time (e.g., 5 years) so manufacturers and other market players know incentives will be available for long enough that it is worth making investments.

Our analysis of the relative cost-effectiveness of different energy efficiency tax incentives indicates that the following incentives are particularly cost-effective because they can leverage substantial market changes that will likely persist even after the incentives end:

- Commercial new construction
- New homes
- Commercial building retrofits
- Furnaces, air conditioners, heat pumps, and water heaters
- Residential appliances

As noted earlier, we plan to analyze incentives for heavy-duty hybrid vehicles and light-duty electric vehicles soon.

In addition, for measures that are expensive and for which quick market transformation is not possible, such as comprehensive home and building energy efficiency retrofits, CHP systems, and chiller retrofits, Congress should enact initial tax incentives to help spur initial market growth, but then consider transitioning to repayable incentives after the initial incentive ends.

These tax incentives generally have a cost to the federal government of less than \$1 per million Btu saved, far less than the approximately \$10 per million Btu average U.S. energy cost, making them highly cost-effective investments, which will continue to pay off via energy bill reductions for decades to come. These tax incentives will leverage very substantial private investments as the tax incentives cover only a portion of the cost of efficiency measures. Furthermore, these tax incentives will help our economy as investments in energy efficiency help to create jobs, including direct jobs in the production and installation of efficient technologies and induced jobs created as consumers and businesses re-spend their energy bill savings (ACEEE 2011). For these reasons, modest medium-term federal energy-efficiency tax incentives that help leverage long-term changes in markets should be included as part of tax reform.

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Appendix A: Estimating Costs and Benefits of Energy-Efficiency Tax Incentives: Methodology, Data Sources and Detailed Analysis Results

We examined the various energy efficiency tax incentive options discussed in the body of the text using a spreadsheet model we developed. The model includes a variety of specific assumptions and then uses these to estimate the cost to the federal Treasury, electricity and fuel savings, and the ratio of federal spending to the amount of energy saved. Specific assumptions are provided in Table A1. Sources and explanations for these assumptions are summarized in Table A2.

Based on these values, several values are calculated as follows:

Participation over 5 years = Sum of the individual annual participation rates.

Cost to the Treasury = Average Incentive * Annual Sales or Stock * Participation over 5 Years * % eligible who take the credit. For this last factor we assumed 60 percent.

Electricity and Fuel Savings = Average Unit Savings * Annual Sales or Stock * # Years in Analysis * (Average Annual Participation Rate – Current Market Share). For measures with a free rider rate (shown in Table A1 as “FR”), instead of subtracting Current Market Share from the participation rate we multiplied total savings by 1 minus the FR rate. For 5 year savings used Participation over 5 Years. For 15 year savings, took Participation over 5 Years and added Average Participation Subsequent 10 Years. Lifetime savings = 15th Year Savings * Average Lifetime.

Federal \$/Lifetime million Btu = Cost to Treasury / ([Lifetime GWh savings * 10,000 Btu/kWh / 1 million] + Lifetime TBtu savings). The 1 million is to convert millions to trillions.

In a few cases, special adjustments were made as follows:

- For residential appliances, federal costs were cut in half because only incremental sales relative to a 2-year rolling base receive the tax credit. Cost was divided in half again because of the cap per manufacturer.
- For water heaters, the average life is only 13 years so savings in the 15th year do not include participants from the first 2 years as those water heaters will be retired by the 15th year.
- For chillers, we estimate that these chillers would be replaced anyway after 10 years so lifetime savings credit only 10 years of savings. Also, no savings in 15th year since all of these chillers would be replaced by then without the incentive.

**Table A1. Savings and Costs of Prospective Energy Efficiency Tax Incentives
(5-year incentive plus market transformation effects over subsequent decade)**

Item	Average Incentive	Average Unit Savings kWh	Annual Sales or Stock mBtu Fuel	Average Lifetime (years)	Current Market Share	Participation Rate Annual	Participation Over 5 Years	Cost to Treasury (\$millions)	Average Participation Subsequent 10 Years	Electricity Savings			Fuel Savings			Federal \$/ Lifetime per mBtu	Rank	
										5th Year (GWh)	15th Year (GWh)	Lifetime (GWh)	5th Year (TBtu)	15th Year (TBtu)	Lifetime (TBtu)			
Increasing commercial building deduction to \$3/sf	\$0.75	4.86	0.02	287.7	60	0.1%	2.5+5+7.5+10+15%	0.4	\$52	15%	552	2,636	158,139	2.1	10.0	599	\$0.02	1
New homes -- extend current credit	2,000	2,888	19.1	1,435	60	5%	7.5+10+12.5+15+17.5%	0.625	1,076	37%	2,590	14,608	876,505	10.3	96.4	5,785	0.07	2
Commercial building retrofits (20%+ savings)	0.38	3.8	0.0118	31,205	15	0.2%	1+2+3+3+3%	0.12	843	2%	14,349	34,678	520,164	40.4	106.4	1,596	0.12	3
Water heaters -- heat pump and advanced gas	500	881	2.6	8.72	13	3.5%	5+7.5+10+12.5+15	0.5	1,308	43%	3,841	32,035	416,459	7.4	94.5	1,229	0.24	4
CHP -- remove size cap but limit to 25 MW/system	180	0	20	0.5	15	1/4 FR	See Annual Sales column	5	270	25%	0	0	0	38	64	956	0.28	5
A/C & HP SEER 16 installed per ACCA-QI	500	1009	2.7	6.47	18	11%	15+20+25+30+35%	1.3	2,426	58%	8,162	35,262	634,707	12.5	94.3	1,698	0.30	6
Residential appliances -- extend and update	142	81	0.2	32.4	15	10%	20% average over period	1	1,148	75%	2,624	18,371	275,562	2.9	40.8	612	0.34	7
Furnaces (95% AFUE + efficient fan)	500	299	8.2	2.86	18	16%	25+35+45%	1.1	901	55%	897	3,545	63,808	13.4	104.8	1,886	0.36	8
Advanced windows (DOE U .22 spec)	\$50	32	0.2	33.6	20	1.5%	5+7.5+10+12.5+15	0.5	504	25%	538	2,984	59,674	2.5	16.4	328	0.54	9
New homes -- 50% whole home savings	5,000	5,588	32.9	1,435	20	0.1%	1+2+3+4+5%	0.15	646	3%	1,203	3,488	69,758	6.9	20.6	411	0.58	10
Whole house retrofits (20%+ savings)	2500	1692	17.8	NA	18	0.10	.15+.2+.25+.3+.35	1.3	1,875	0.25	1,269	3,808	68,544	13.4	40.1	722	1.33	11
Replace CFC industrial & commercial chillers	170	900	0	9,2475	10	1/5 FR	25% over the period	0.25	236	0%	1,665	0	16,646	0.0	0.0	0	1.42	12
Insulation and sealing for homes per 25C	\$337	231	3.2	2	20	1/3 FR	See Annual Sales column	5	2,022	10%	1,540	1,586	31,717	22	27	549	2.33	13
Totals									\$13,300		39,200	153,000	3,191,700	170	720	16,400	\$0.28	

Note: "FR" = free riders.

Table A2. Key Data Points and Sources

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
Increasing commercial building deduction	\$3/sf, 25% tax bracket.	16.2 kWh/sf from CBECS 2003 for buildings built 2000-2003 * 60% of electricity use covered by 90.1 (estimate) * 50% savings.	35 cf gas/sf in bldgs built 2000-2003 from CBECS 2003 * 1029 Btu/sf * 50% savings /1m to convert to mBtu.	Annual average for new construction over 2000-2003 from CBECS 2003.	ACEEE estimate.	Very small. NBI has identified just a few hundred buildings at this level, built over about a decade -- http://buildings.newbuildings.org .		
New homes -- extend current credit	Set in existing law.	SH, AC and WH consumption for homes built 2000-2005 from 2005 RECS * 50% savings.	See box to left.	Economy.com is projecting about 757k in 2013, 1,099 m in 2014, 1,646 m in 2015, 1,858 m in 2016 and 1,814 m in 2017.	ACEEE estimate.	11% in 2011 per RESNET but this is with construction levels ~1/3 of those estimated for the future.		15% in 1st year, 65% in 5th year and beyond due to new building codes, steady ramp between the two.

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
Commercial building retrofits	Snowe-Bingaman bill has a deduction of \$1.50/sf for 25% savings. Avg. business tax rate ~25%.	Average use per sq. ft. for buildings 50,000 sq. ft. or more per CBECS 2003 times 25% average savings.	See box to left.	Buildings over 50,000 sf. Derived from data in CBECS.	Estimates by ACEEE and by Lane Burt at USGBC.	ACEEE estimate.		
Water heaters –heat pump & advanced natural gas	ACEEE recommendation -- fixed incentive, not % of cost.	From final DOE water heater TSD, Table 10.4.1. Savings relative to new standard.	From DOE TSD.	10-year average from AHRI -- 2002-2011.	From DOE TSD.	Based on estimates of the entire market provided by AO Smith.		10% for 5 years then 75% for next 5 years due to new minimum standards.

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
CHP—remove size cap but limit to 25 MW/system	Assumes cost of 1800 per installed kW X 10% ITC.		Credits all savings to fuel displaced in electric generation with average heat rates of 8000 (util) and 4600 (CHP). Assume 6000 op hrs./yr.	Assumes new installations of 500 MW per year incremental to existing credit. Only first 25 MW of a system is eligible for the credit.	ACEEE estimate.	Estimate ¼ are free riders.	"Annual sales" is an annual participation rate.	ACEEE estimate of what happens after credit expires due to impact of tax credit (not baseline).

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
A/C & HP SEER 16 installed per ACCA-Q	ACEEE recommendation -- fixed incentive, not % of cost.	Derived from ACEEE analysis of savings from AC & furnace standards. Assume most participants are in the south and upgrading from SEER 14. These AC improvements save 12.5%. Duct sealing adds ~9%. Estimate 10% free riders on the equipment, none on duct sealing.	Derived from estimates compiled for Home Star program. 8.2 is for furnace+duct sealing. 2.8 is furnace only. Will get a more limited sealing job with ACCA-Q and therefore cut savings in half.	10-year average from AHRI -- 2002-2011.	From DOE TSD for AC & HP standards.	In 2011 11% of AC and 26% of HP were SEER 16 according to AHRI. Take 2/3's of this since very few of these installations will capture savings from ACCA-Q. We weight the total 2/3 AC, 1/3 HP per AHRI shipment data for 2011.		35% in 1st year, 60% in 5th year and beyond due to new minimum standards in the south, steady ramp between the two.

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
Residential appliances -- extend and update	Average of midpoint incentive for CW, DW and RF.	Average from ACEEE analysis of appliance standards agreement.	See box to left.	Sum of sales of RF, CW and DW.	Approximate average from DOE TSDs.	ACEEE estimate.	Eligibility thresholds increased to limit market share. Assume will save and cost at same rate as current incentives.	Become basis for new minimum efficiency standards a few years out.

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
Furnaces (95% AFUE + efficient fan)	ACEEE recommendation -- fixed incentive, not % of cost.	Derived from estimates compiled for Home Star program. 1009 is for AC+duct sealing. 561 is AC only. ~2/3 homes have CAC.	Derived from ACEEE estimate of savings from furnace standards. Assume mostly in north and upgrading from 90%. Duct sealing saves 9% (ACEEE NW study), the furnace saves 5.26% (90->95% AFUE). Estimate 20% free riders on the equipment, none on duct sealing.	10-year average from AHRI -- 2002-2011.	From DOE TSD.	AHRI reports 32% share for 95% AFUE in 2011 but we cut in half because we also require an efficient furnace fan.	Only 3 years -- after that free riders too high.	40% in 1st year, 60% in 5th year and beyond due to new minimum standards in the north, steady ramp between the two.

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
Advanced windows (DOE U .22 spec)	ACEEE recommendation -- fixed incentive, not % of cost.	Weighted average calculated from LBL software as compiled by Nils Petermann, ASE. This is for average savings from U .22 windows relative to a 50-50 mix of Energy Star and "conventional new" windows.	See box to left.	Ducker study for 2011 and 2012, provided by Nils Petermann at ASE.	ACEEE estimate.	ASE estimates 1-2%.		Growth in availability and market share allows these windows to be incorporated into building codes across the far north.

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
New homes—50% whole home savings	\$5000 incentive contained in legislation introduced by Senators Snowe and Bingaman .	Total consumption for homes built 2000-2005 from 2005 RECS * 80% in covered end-uses * 50% savings.	Total natural gas use is 1000 cf for homes built 2000-2005 per RECS 2005 * 50% savings.	Economy.com is projecting about 757k in 2013, 1.099 m in 2014, 1.646 m in 2015, 1.858 m in 2016 and 1.814 m in 2017.	ACEEE estimate.	Very small. ACEEE estimate.		
Whole house retrofits	For 25% savings from legislation introduced by Senators Snowe and Bingaman .	Base from RECS 2005; assume participants are higher use households and use 50% more. 25% average savings.			ACEEE estimate.	In millions, not %. DOE website says over 150,000 homes. Our understanding is that majority have been recent.		

	Average Incentive	Average Unit Savings		Annual Sales or Stock (Millions)	Average Lifetime (years)	Current Market Share	Participation Rate (All are ACEEE estimates.)	Average Participation Subsequent 10 years (All are ACEEE estimates.)
		kWh	mBtu Fuel					
Replace CFC industrial & commercial chillers	1/4 take advantage of downsizing credit.	New system 0.3 kW/ton more efficient, average of 3,000 hrs/year.		30,000 units from AHRI, avg size 411 tons, 75% installed during 1980-1992 period.	Before would be replaced anyway.	Estimate 1/5 are free riders.		
Insulation and sealing for homes per 25C	Average expenditure in 2009 for insulation per GAO (2012), 20% incentive.	kWh/home from ACEEE Home Star analysis; 1.25 is allowance for participants using more energy than average home. Use attic insulation from ACEEE good/better/best analysis to estimate energy savings (which are 4%).	See box to left.	Number of participants in 2009 per GAO (2012).		Estimate 1/3 are free riders.	"Annual sales" is an annual participation rate.	Helps grow the market for air- and duct-sealing after credit expires.