Overcoming Market Barriers and Using Market Forces to Advance Energy Efficiency

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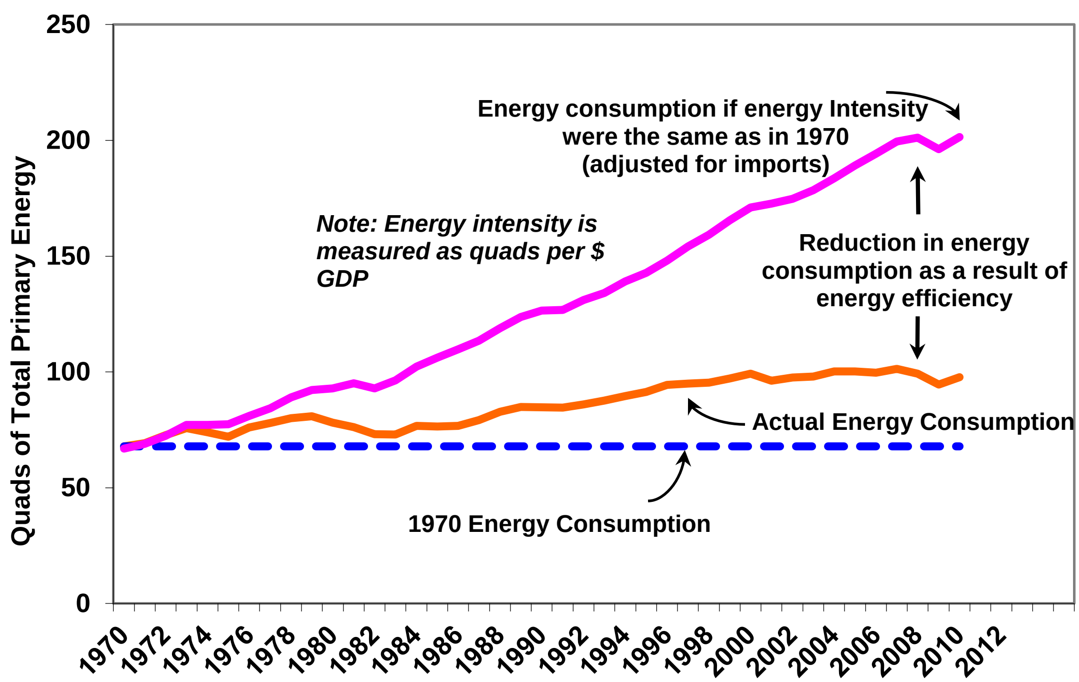
Executive Summary

The United States has made much progress in energy efficiency in recent decades. U.S. energy use is approximately half of what it would have been if we had not improved our efficiency over the past 40 years. Still, there are large, cost-effective opportunities to increase energy efficiency much further, thereby helping us to cut energy bills, reduce pollution, and encourage economic growth.

In 1970 the entire country used 68 quadrillion British thermal units (Btu) of energy ("quads"), for an economy-wide intensity of 15.9 thousand Btu per dollar of gross domestic product (GDP, expressed in 2005$). By 2011, consumption had increased to 97 quads, but real GDP had more than tripled, and we used only 7.3 thousand Btu per dollar of GDP. Energy use per unit of GDP declined by 54% over this period. A small portion of this improvement is due to the fact that we import more manufactured goods than in 1970, but even after we adjust for imports, U.S. energy use is approximately half of what it would have been if we had not improved our efficiency over the past 40 years (Figure ES-1).

Figure ES 1. U.S. Energy Use per Unit of GDP, 1970–2010



Source: ACEEE analysis of data in EIA 2012a [AER] and BEA 2012.

But much greater savings are possible, savings that are highly cost-effective. A 2010 National Academy of Sciences study estimated that energy efficiency technologies that exist today or that are likely to be developed in the near future could save considerable money as well as energy. Fully adopting these technologies could lower projected U.S. energy use by 17% to 20% by 2020, and 25% to 31% by 2030.

However, a variety of market failures and market barriers contribute to keeping us from fully realizing our energy efficiency potential. In the past, a variety of policies have been used to rectify these failures and barriers, generally with bipartisan support. For example, American cars can now go much farther on a gallon of gasoline, due in large part to uniform vehicle testing and labeling, fuel economy standards, and tax incentives. Likewise, policies have contributed to efficiency gains for appliances and other energy-consuming equipment and new and existing buildings, improved industrial processes, and emerging development of the "smart grid."

In the past few years, many conservatives have expressed a high level of skepticism regarding government mandates and government spending on incentives. This report responds to these concerns by analyzing several targeted policies that leverage market forces and address specific market failures and barriers to energy efficiency without spending a lot of money or using government mandates. The policies included in this report fall into the following categories:

1. Improving information to aid decision making
2. Removing existing regulatory and legal barriers
3. Addressing externalities
4. Increasing the salience of energy use at point of purchase
5. Reducing energy waste in government
6. Investing in precommercial research and development
7. Enhancing energy efficiency finance

The policies we discuss sometimes make sense at the federal level and sometimes at the state or local level. All of them are intended to improve the functioning of markets. We advance these suggestions as a menu that policymakers can choose among—they are not advanced as an "all or nothing" package.

Market Failures and Market Barriers

While there are large opportunities for cost-effective energy savings, a variety of barriers stand in the way. The most commonly cited market barriers are market failures (or, more subtly, imperfections)—systemic reasons that real markets are less economically efficient than the theoretical perfect competition market described by classical economics. A few key barriers are discussed below.

Imperfect information may be the most widespread barrier to energy efficiency. For energy efficiency, the most obvious information barrier is knowledge of the performance of different equipment, technologies, buildings, and other systems. Energy efficiency cannot be seen. Information related to energy consumption is also imperfect; for instance, energy savings are difficult to measure, future energy prices are unknown, and the energy use of individual devices is often hard to separate, since most customers get all their residential or commercial energy use information rolled into monthly utility bills.

Split Incentives or Principal-Agent Problems In energy efficiency a common problem is that the agent making decisions on efficiency investments or actions does not pay the energy bills, and thus has little incentive to reduce them. The landlord-tenant relationship, in which the property owner purchases equipment but the tenant generally pays the utility bills, is the most commonly cited split incentive for energy efficiency. Another example is how homebuyers pay energy bills, providing limited incentive to builders to improve the efficiency of new homes.

Externalities occur when costs or benefits of a transaction are realized by people outside the immediate participants in the transaction. Energy efficiency reduces large negative externalities due to energy supply and consumption: impacts on the environment, risks to energy security, and other societal costs not built into the price of energy.

Imperfect competition occurs when there is not a fully competitive market for a product or service, so prices may be inefficient or availability may be limited. In some energy efficiency markets there is a limited number of producers or sellers, either an oligopoly or monopoly (in some cases a natural monopoly of necessity), and barriers to entry such as high startup costs or patents.

Below we describe a variety of policies to help to overcome existing barriers in the market and to use market forces to advance energy efficiency.

Policies are grouped according to the categories defined above. Many of these policies work with and seek to leverage market forces. For example, vehicle and appliance labeling seek to address the information barrier by making consumers more informed. Likewise, policies to improve state utility commission regulatory practices, such as interconnection standards, can "level the playing field" so that energy efficiency and energy supply resources compete more fairly in the market. Going forward, there is even more opportunity to shape energy-efficiency policies in ways that unleash the power of markets. Such policies can address market failures without new mandates and with minimal government expenditures. By using markets they can leverage market forces, such as competition, to increase energy efficiency.

The policies we discuss sometimes make sense at the federal level and sometimes at the state or local level. All of them are intended to improve the functioning of markets. We advance these suggestions as a menu that policymakers can choose among—they are not advanced as an "all or nothing" package. Some of these ideas may have broad appeal, while others may prove more controversial. We welcome feedback to help guide us as to which suggestions might be more achievable and to help us refine and improve each of these proposals.

POLICIES TO LEVERAGE MARKET FORCES AND OVERCOME MARKET BARRIERS

1. Improving Information

Improved appliance labeling

Appliance energy labels provide information on product energy use and a mechanism for consumers to compare the energy use of a particular product with the full range of similar models available on the market. Without this information, consumers would be unable to include product operating costs in their purchase decisions.

Appliance labeling programs increase the information available to consumers at the point of purchase. Labels provide information in a standardized format for comparing the energy use or energy efficiency of a given product to similar models available in the market, thereby making product energy use transparent. Well-designed appliance labeling programs aid consumer decision making, motivate consumers to consider energy efficiency, and provide an incentive for manufacturers and retailers to offer and promote higher-efficiency products. Experience with the EnergyGuide program to date, research conducted with U.S. consumers, and extensive research and labeling experience from around the world suggest that the U.S. Energy Guide label for appliances is not as effective as it could be because consumers have difficulty understanding it and it does not motivate action. Experience in dozens of other countries, as well as market research in the U.S., indicates that a much more effective label would group products into categories based on their efficiency (e.g., one to five stars)—an easy-to-understand approach that also motivates consumers to purchase highly rated products.

Building labeling and disclosure

Building labeling and disclosure policies are intended to provide potential buyers, lessees, and financiers with information on a property's energy performance—data that can help these stakeholders compare properties and better understand the true costs of owning or leasing a property. For sellers and landlords, disclosure policies offer an opportunity to demonstrate the value of their investments in energy efficiency and obtain a return on that investment.

Building energy labeling and disclosure policies establish a means to provide market actors with information that has historically been nonexistent or very hard to obtain. In the absence of data on building energy use, the value of energy efficiency (as realized through lower energy bills) is not recognized by prospective building tenants and purchasers, and profitable investments in energy efficiency are therefore neglected. Well-designed labeling and disclosure policies make this information available to decision makers and also provide indicators of how structural and operational factors influence the building's energy performance.

Although such policies are implemented at the state and local level, there is a complementary role for the federal government and for private-sector stakeholders in the development and maintenance of building rating and benchmarking systems and in providing common guidelines for rating and labeling of commercial buildings.

Unfettering energy data

Households, businesses, and institutions can make more-informed energy decisions if they have better information about their energy use and potential savings. Specifically, the more accessible, relevant, and accurate the information, the more easily energy customers can make economically wise and energy-efficient decisions about their operations and capital investments. Utilities are the traditional custodians of energy data, providing buildings with metering equipment to measure energy use and capturing data for billing and other business purposes.

Greater access to energy data by customers, energy efficiency service providers, and software entrepreneurs will spur innovation in programs and services that will help close the information gap for customers. Information should only be made available to third parties with the permission of the customer. Policies ought to reduce regulatory barriers to customer data access at the utility and customer level to ensure that customers, utilities, and third-party applications have accurate information to inform the market.

2. Removing Existing Regulatory and Legal Barriers

CHP interconnection standards

Combined heat and power (CHP) systems generate both heat and electricity at the same time, using more of the energy in the fuel burned than if separate electrical generators and steam boilers were used. Most CHP systems are physically connected to the local utility's electric grid so that power from a CHP system can be shared with the grid and the facility can be supplied by backup electricity in case of CHP system outages or needed maintenance. The business practices of utilities in the interconnection processes are guided by interconnection standards. An interconnection standard provides CHP owners with a clearly delineated path to physically interconnect the CHP system to the grid. An interconnection standard clarifies what each party is responsible for during the interconnection process, and stipulates fees and timelines associated with the different interconnection activities. Well-structured interconnection standards can help encourage use of CHP systems by offering system owners transparency in the interconnection process. State utility commissions should require use of fair interconnection standards such as those developed by the Institute of Electrical Engineers (IEE).

Supplemental and backup power rates

Since CHP systems are most often designed and sized according to the thermal needs of a facility, the electricity production capacity of the CHP system usually does not perfectly match the electricity requirements of the CHP-using facility. If a CHP system is designed only to meet onsite thermal needs, the facility will typically purchase additional electricity from the grid to meet its remaining onsite electricity needs. This power is called *supplemental power*. CHP systems will also occasionally go offline, either during planned downtimes or unexpected emergencies. During these instances, the facility typically purchases additional power from the grid to meet its needs. This power is called *backup power*.

Regulated utilities set, and their regulators approve, the rates at which supplemental and backup power services are delivered. These rates can dramatically affect the economics of a CHP system, and in some cases have been responsible for causing facilities to choose not to invest in CHP. For instance, utilities often set rates based on the assumption that they might need to simultaneously meet the backup power requirements of all CHP-using facilities within their system during the system's peak load. Their rates thus reflect the required investment in infrastructure to meet such a peak demand. However, there is no evidence that such contingencies need to be planned for, as the chance of all CHP systems going down at the same time and moreover, during a system peak is virtually zero. Instead, we recommend fairly designed backup and standby power rates that would help more facilities see an economic incentive for investing in CHP. By transparently and fairly determining the amount of backup power capacity that utilities need to plan for, utilities could encourage new CHP systems while also ensuring that existing systems will have the backup power they require when needed.

Output-based emission standards

The efficiency benefit of a CHP system is due to the fact that more usable energy is generated from a single BTU of energy input. For instance, instead of just producing steam with natural gas, a CHP system can generate steam and electricity from the same natural gas input. Thus, when the same amount of fuel is burned, a CHP system will generate more useful energy than a traditional steam boiler.

Most air regulations set limits for certain pollutants on an *input* basis—that is, pounds of pollutant per measure of fuel input. Since a CHP system is doing more with the same amount of fuel input, such emissions rules fail to reflect the CHP system's increased efficiency. To address this problem, some regulators have developed *output*-based emissions rules, which measure the amount of pollutant per useful energy output. Developing output-based emission regulations helps CHP system owners justify the efficiency and environmental benefits of CHP systems, relative to more traditional thermal or electrical energy-generating systems. Most of the decisions on output-based emissions standards are made at the state level, although EPA has encouraged states in this direction.

Valuation of ancillary services

The environmental and economic benefits of highly efficient CHP systems are well known. Less appreciated are the benefits of CHP to the grid at large, which are not well understood and are rarely calculated. These benefits include higher system reliability, increased power quality and voltage support, high speed of dispatch relative to other generation assets, reductions in the need for transmission and distribution investments, reduced need for reliance on "peaker" reserve generation assets, spinning reserve assets, and higher amounts of "useful" energy due to avoidance of line losses. Because these benefits are time and location specific they can be difficult to calculate and fluctuate widely in value (Kirby 2007). As a result, these benefits usually fail to enter into a utility's cost-benefit calculation when determining whether to support a CHP project with assistance (such as incentives) or to invest in a CHP project itself.

If the various ancillary benefits of CHP systems were to be valued, the economic benefits of CHP would be clearer to customers and utilities alike. At present, no party has the means or incentive to calculate them, because there is no established mechanism to enter them into a utilities' cost-benefit analysis. By ascribing value to something across all systems that has previously been valued only in certain instances, the full economic value of CHP can be understood.

Utility regulatory reform

Investor-owned utilities (IOUs) are subject to regulation of their rates and other aspects of their business operations and investments because they are "regulated monopolies." This status means that regulation is authorized in order to protect and balance the public interest with the rights of IOUs. In addition to serving the public interest, IOUs have a fiduciary obligation to try to earn a profitable return on shareholder investments.

The obligation to earn a profit drives utilities to increase revenues by selling more electricity. Given this, investment in energy efficiency raises financial concerns for IOUs. IOUs need to be able to recover the money they invest in efficiency from ratepayers and just like investments in new power plants; they need to be able to earn a return on investments in energy efficiency. Further, the threat of reduced sales if an efficiency program is successful threatens to cut into utility profits.

In the traditional regulatory structure these concerns hinder a utility's willingness to invest in energy efficiency. No single policy mechanism can adequately remove the existing biases against utility investments in energy efficiency. However, several policies, when used in combination, can properly align financial incentives to remove the major market barriers to energy efficiency. These include cost recovery, decoupling, and providing shareholder incentives.

Restructure the corporate income tax to remove barriers to energy efficiency investments
Corporate income taxes are structured in ways that encourage energy waste and discourage investments in energy efficiency. Businesses are taxed on their profits, and virtually all expenses are deductible, including energy costs. However, capital expenses must be depreciated, meaning they are recovered over a multiyear period—as much as 39 years in the case of commercial buildings and equipment installed in these buildings. If depreciation periods are too long, investment in new efficient equipment is discouraged, since many businesses are reluctant to replace equipment until it is fully depreciated.

Furthermore, since energy bills count as a business expense and are subtracted from the total amount of taxable income, the federal government is effectively typically "paying" 25% of business energy costs (based on the average effective business tax rate of about 25%) and sometimes as much as 35% of a business's energy costs (the maximum business tax rate). Subsidizing energy costs enables higher energy consumption. When businesses do invest in energy efficiency, a portion of the energy savings go to the federal government in the form of higher taxes (e.g., 25% for a business with the typical effective rate of 25%, before adjusting for the effects of depreciation). When the full value of the savings does not accrue to the firm, the incentive to make investments goes down. Similarly, when a firm makes capital investments, these expenses must be depreciated, meaning that they are gradually charged against income.

Revising depreciation periods so they are based on the average useful lives of different types of equipment will address the depreciation barrier. To address the fact that energy costs are deductible, the corporate income tax could be based on tax revenue rather than profits. Such a step would dramatically simplify the code (since the hundreds of pages that define deductible expenses would no longer be needed) and would also mean that the marginal tax rate could be reduced to about 3.5% of revenue instead of 25% of profits.

3. Addressing Externalities

Markets sometimes create externalities—costs and benefits incurred by those not directly involved in a given market transaction. A cost imposed on an individual, group, or society as a whole is known as a negative externality (e.g., pollution and traffic). Rather than tax things whose growth we want to encourage, such as wages and income, it may make sense to tax things we want to discourage, such as pollution and traffic congestion. Correcting for externalities using a market-based approach requires the implementation of a tax or fee to internalize the third-party costs or benefits created by a given transaction. The resulting revenues can be used to reduce taxes on wages or income.

Emissions fees

An emissions fee would place a modest tax on emissions of greenhouse gases or other pollutants. Such a fee would be paid either by fuel producers or by consumers and businesses as they emit pollutants into the atmosphere.

The impact of using fossil fuels in the United States is a classic example of the "tragedy of the commons." When burning these fuels, private entities impact common resources—air, water, and the surrounding environment in general. Thus, we have a market failure: because the negative impacts of using fossil fuels have not been internalized to the energy market, the market on its own has failed to create a socially optimal outcome. An emissions fee is an economically efficient strategy for addressing the market failure stemming from the emissions associated with using fossil fuels.

Mileage charges

Vehicle miles traveled (VMT) fees charge drivers for the actual social cost of the roadway system. Relying on a gasoline tax does little to capture the true cost of traffic congestion or the environmental effects of vehicle emissions. A VMT fee is a form of road pricing levied on drivers for use of the road and highway system. Fees are applied based on the distance each driver travels in a given time period. VMT fees better align the true price of traveling a mile with the personal direct costs incurred by a given driver. Data can be obtained through odometer readings or through the use of GPS systems.

A mileage-based fee that is implemented in addition to the current gasoline tax is one way to efficiently price the highway system so that environmental and highway-related externalities that result from driving are addressed by charging motorists for the true cost of the highway system. The implementation of a complementary VMT fee on top of the federal gasoline tax would provide a sustainable source of funding as revenues from the gasoline tax decline with improved vehicle fuel efficiency and increased use of alternative technology vehicles.

4. Increasing the Salience of Energy Use at the Point of Purchase

Feebates

Many consumers focus on the initial cost of a product, such as a car, and not its long-term operating costs, such as fuel costs. If consumers do not fully value fuel economy improvements, manufacturers see limited benefit to increasing the fuel economy of their vehicles using existing, fuel-efficient technologies. Feebate programs are a market-based strategy to encourage the purchase of fuel-efficient vehicles by either charging new vehicle buyers a fee or providing them with a rebate based on the vehicle's fuel economy. They are typically revenue neutral, so that the fees fund the rebates. Feebates make fuel costs more salient by tying the upfront cost of the vehicle to its fuel economy, effectively shifting some of the price signal from fuel use to the vehicle itself. Such policies have been implemented in several European countries and Canada.

5. Reducing Energy Waste in Government

Federal, state, and local governments consume large amounts of energy in their facilities and vehicle fleets and represent a great opportunity to reduce waste and avoid cost to the taxpayer. The U.S. federal government is the largest single consumer of energy in the world. In 2007, federal agencies had an energy bill of approximately $14.5 billion. About 40% of those energy costs are for heating, cooling, and powering more than 500,000 federal buildings around the country. Many government facilities are old and technologically out of date. Improving the energy efficiency of these facilities could substantially reduce government expenses and reduce taxpayer burden.

Similarly, government vehicles represent half of the total government energy use and therefore a large potential for energy savings through efficiency. Governments may also set a mile-per-gallon requirement for their vehicle fleets. Government vehicles account for half of total government energy use and are therefore an important component in reducing energy consumption and costs.

In many cases, obtaining the necessary capital is the main barrier to making efficiency upgrades. Additionally, legislative requirements are often not translated into agency implementation action plans, because they do not offer incentives for meeting or disincentives for failing to meet the requirements. Finally, there are issues with split incentives where the government rents a facility or building owned by a private entity. To address these issues, the president, Congress, governors, and mayors should institute policies to steadily reduce waste in government facilities and vehicles.

6. Precommercial Research and Development

Science and technology are key drivers of economic growth, improved health and the quality of life throughout the world. Innovation in energy efficiency includes high-efficiency vehicles, appliances, manufacturing equipment, buildings, and much more. We have seen historically that there are places in the innovation process where market risks inhibit innovation. For example, a key market failure is the disincentive to invest in precommercial R&D because of the risk of others copying the technology. Government-funded precommercial research and development removes that type of risk and several others, helping foster innovative research and new technology and making them viable options on the market.

Government-funded research, development, and deployment (RD&D) efforts can address a number of barriers that impede the introduction of new, energy-efficient technologies and practices. Private industry investments can be too fragmented to fund significant energy efficiency innovation in a particular sector. Deployment time frames may be too long, or investment risk may be too great for any one business. Competitive and financial market pressures make it increasingly difficult for the private sector to take full responsibility for long-term RD&D. Industry can benefit from government and institutional RD&D efforts that provide a nonproprietary knowledge base, specialized resources, and risk sharing.

7. Removing Finance-Related Market Barriers

Capitalizing energy efficiency investment

Capitalizing energy efficiency projects, particularly in the current economic environment, can pose a significant challenge. While energy efficiency improvements are often cost-effective in the long run, challenges to adoption and implementation include high initial costs, budgetary and debt constraints, and split incentives in multitenant properties between those who pay for improvements and those who receive the benefits.

There are many barriers to getting energy-efficiency finance markets to scale, including limited availability of financing (particularly for hard-to-reach markets). In cases where financing is available, it can be difficult and expensive, due in part to high risk premiums and interest rates, to encourage adoption.

Financing for energy efficiency is an attractive option for capitalizing efficiency projects because there are opportunities to leverage private capital and reduce the need for government subsidization. Evidence suggests that energy efficiency loans are low-risk and could attract investors within a secondary market. To create such markets, there is a need for greater experimentation with energy efficiency finance and for standardization of energy savings and, more importantly, loan performance data collected from existing programs. Specific financing mechanisms that merit increased experimentation include Property Assessed Clean Energy (PACE), on-bill financing, and energy service agreements. Credit enhancements will likely be required during this initial experimentation period.

Incorporating energy costs into mortgage underwriting

Energy and transportation costs account for a significant proportion of a household's budget. Yet these costs are not considered when assessing an applicant's ability to pay their mortgage. Currently, energy costs and the impact of potential energy savings are ignored in financing decisions. Homes with high and low operating costs are treated the same during underwriting, even though risks to the lender are higher in homes that will generate higher energy bills.

Understanding the impacts of utility and transportation expenses on household finances and the ability to make mortgage payments will help lenders identify and measure the value of investment in energy efficiency and produce a better sense of a home's value. We recommend that the Federal Housing Administration and other federal- and state-affiliated mortgage programs explicitly include energy and transportation costs as part of loan approval determinations.

CONCLUSION

While substantial progress has been made toward reducing the nation's overall consumption of energy resources, much more can be done to take advantage of existing untapped efficiency potential and to save consumers money on their annual energy bills. This report has provided recommendations to overcome the barriers in the market for efficient technologies and programs that lead to underinvestment in energy efficiency. Spanning all key economic sectors, the included policies target information barriers that may cause consumers to invest in inefficient technologies or not to invest in efficient ones, externalities that result from the undervaluation of energy savings and regulatory and financial barriers that prevent the spread of efficient technologies and efficiency programs. These policies also use market forces to help drive future energy-efficiency savings.

The cost-efficient energy benefits highlighted in Table ES-1 below are order-of-magnitude estimates of potential costs and benefits for each policy. Even using a large-scale approach to estimating the impacts of each policy, it is apparent that there is plenty of untapped efficiency potential to take advantage of. Across these 16 policies, annual energy savings can be as much as 19 quadrillion Btu of energy by 2030, which is about 19% of projected energy use that year. The discounted net present value savings of such policies total up to $1.4 trillion over the 2014–2030 period.

The majority of potential savings can be achieved through the implementation of a national emissions fee, by adjusting the structure of corporate tax policy, and removing regulatory barriers to CHP projects. These policies also have the largest energy savings, along with financing policies to encourage energy efficiency and building labeling and disclosure.

Historically, energy efficiency has been a bipartisan issue. Several pieces of key legislation have passed in recent years with good collaboration between the Democrats and Republicans. Politically, the market-based interventions described in this report are ripe for bipartisan collaboration, particularly in light of the recent backlash against government mandates and spending on incentives. This report seeks to help to keep energy efficiency at the forefront of the political agenda for the current congress and state legislative sessions.

Table ES-1. Summary of Benefits by Policy

Policy	Percent Energy Savings	Quads of Energy Saved	NPV of Net Energy Savings 2014-2030 (billion 2011$)	Additional Benefits
Improved appliance labeling	10%	.4	$16	Reduced water use for clothes washers and dishwashers
Building labeling and disclosure	20%	1.6	$60	Improved tenant retention, increased net operating income, job creation and business development, water savings
Improved access to energy data	4%	0.1	$6	Improved transparency and control over energy use
Removing regulatory barriers for CHP	4%	2.3	$130	Reduced emissions, increases in power reliability, reduced transmission and distribution losses (not calculated in above), and improved power quality.
Utility regulatory reform	1%	0.2	$8	Over $100 billion in new capacity investments can be avoided by 2030
Adjusted corporate tax policies	5% for depreciation, 10% for taxing revenue	4.5	$165	Equipment turns over more quickly, creating jobs New industrial equipment improves productivity
Emission fees	6%	5.0	$495	GHG emissions reduction; greater certainty on emissions policies so businesses can plan; increased incentive to invest in efficiency and alternative fuels, spurring innovation and job creation
Mileage fees	2%	0.2	$14	Traffic reduction, GHG and criteria pollution reduction, revenue generation for the Highway Trust Fund
Feebates	3%	0.4	$4	Reductions in carbon dioxide emissions, job creation for auto manufacturers, increased vehicle sales
Reducing waste in government	20%	0.2	$13	Reduced emissions and water use. Also, some efficiency measures can reduce maintenance costs or increase in employee productivity.
Investing in pre-commercial research and development	1%	0.7	$17	Reduced technical risk; Reduced market risk; Accelerated introduction of technology into the marketplace.
Financing policies to encourage energy efficiency	20%	3.0	$62	Enhanced building comfort and affordability of energy
Energy costs in mortgage underwriting	16%	0.2	$10	Underwriting improves, allowing some good projects to move forward and bad ones not to
TOTAL		19	$1,000	

Note: The total line is the simple sum for all 13 policies. There is likely some overlap between the policies and therefore this total may be somewhat exaggerated.

Introduction

The United States has made much progress in energy efficiency in recent decades. U.S. energy use is approximately half of what it would have been if we had not improved our efficiency over the past 40 years. Still, there are large, cost-effective opportunities to increase energy efficiency much further, thereby helping us to cut energy bills, reduce pollution, and encourage economic growth. Studies discussed later in this Introduction written by the National Academy of Science, McKinsey Global Institute, and the American Council for an Energy-Efficient Economy all identify large, cost-effective efficiency savings available in the U.S., savings that would reduce energy bills and strengthen our economy. However, a variety of market failures and market barriers contribute to keeping us from fully realizing our energy efficiency potential.

A variety of policies have been used to rectify these market failures, generally with bipartisan support. For example, American cars can now go much farther on a gallon of gasoline, due in large part to vehicle labeling, tax incentives, and fuel economy standards. A recent report published by the International Energy Agency (2012) notes that the United States is reducing its dependence on oil imports and recognizes fuel economy gains as a primary contributor, along with increased domestic production of "tight oil."[1] Likewise, policies have contributed to efficiency gains for appliances and other energy-consuming equipment, new and existing buildings, improved industrial processes, and emerging development of the "smart grid." These energy efficiency gains reduce energy bills, improve our energy independence and energy security, and help to strengthen the U.S. economy and make it more competitive.

In the past few years, a substantial number of policy-makers have expressed a high level of skepticism regarding government mandates and government spending on incentives. This report responds to these concerns by discussing several targeted policies that leverage market mechanisms and address specific market failures to energy efficiency, without spending a lot of money or using government mandates. We are not saying that these are the only policies that should be pursued, but that we hope these types of policies will continue to see bipartisan support. These market-leveraging and barrier-busting policies fall into several categories:

1. Improving information to aid decision making
2. Removing existing regulatory and legal barriers
3. Addressing externalities
4. Increasing salience of energy use at the point of purchase
5. Reducing energy waste in government
6. Investing in precommercial research and development (R&D)

[1] "Tight oil" is a term used to describe oil from unconventional geological formations such as shale and tight sand formations that is now being produced using new technologies such as directional drilling and enhanced recovery by hydraulic fracturing or "fracking."

7. Enhancing energy efficiency finance

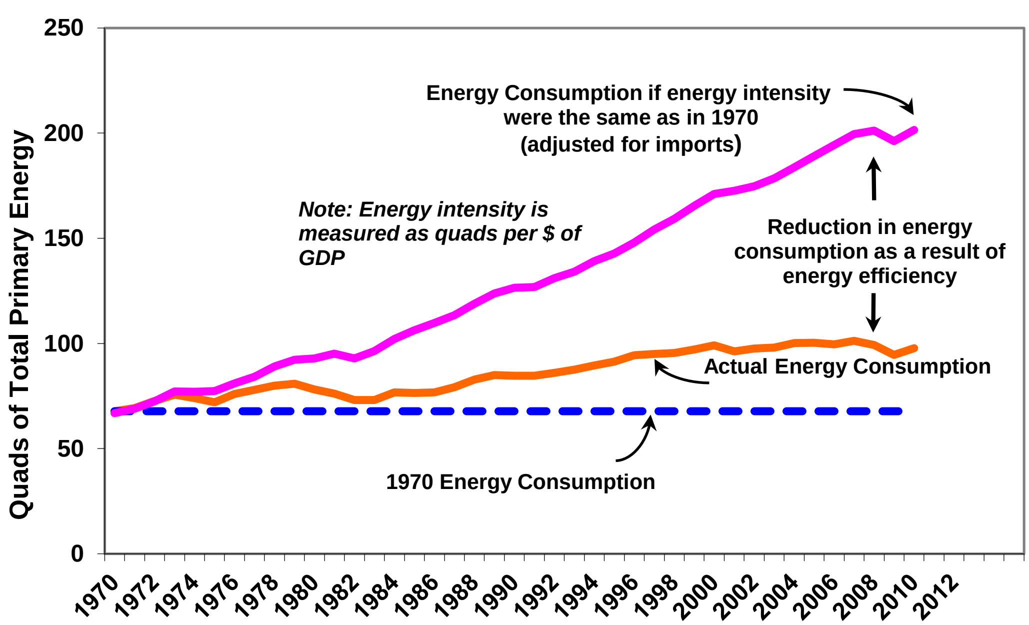
The policies we discuss sometimes make sense at the federal level and sometimes at the state or local level. All of them are intended to improve the functioning of markets. We advance these suggestions as a menu that policymakers can choose among—they are not advanced as an "all or nothing" package. Some of these ideas may have broad appeal, while others may prove more controversial. We welcome feedback to help guide us as to which suggestions might be more achievable and to help us refine and improve each of these proposals.

The next several sections of this report expand on these points, addressing energy efficiency opportunities, market failures, past policies, and the role of market-based policies. We then discuss 16 specific policies that leverage markets and address market failures in more detail and end with a discussion and conclusions.

Opportunities for Cost-Effective Energy Efficiency Savings

The United States has made much progress in energy efficiency in recent decades. In 1970 the entire country used 68 quadrillion Btu of energy ("quads"), an average of 15.9 thousand Btu per dollar of gross domestic product (GDP, expressed in 2005$). By 2011, consumption had increased to 97 quads, but GDP had more than tripled (excluding the effects of inflation), and we used only 7.3 thousand Btu per dollar of GDP. Energy use per unit of GDP declined by 54% over this period (EIA 2012a) [AER].

Figure 1. U.S. Energy Use per Unit of GDP, 1970–2010

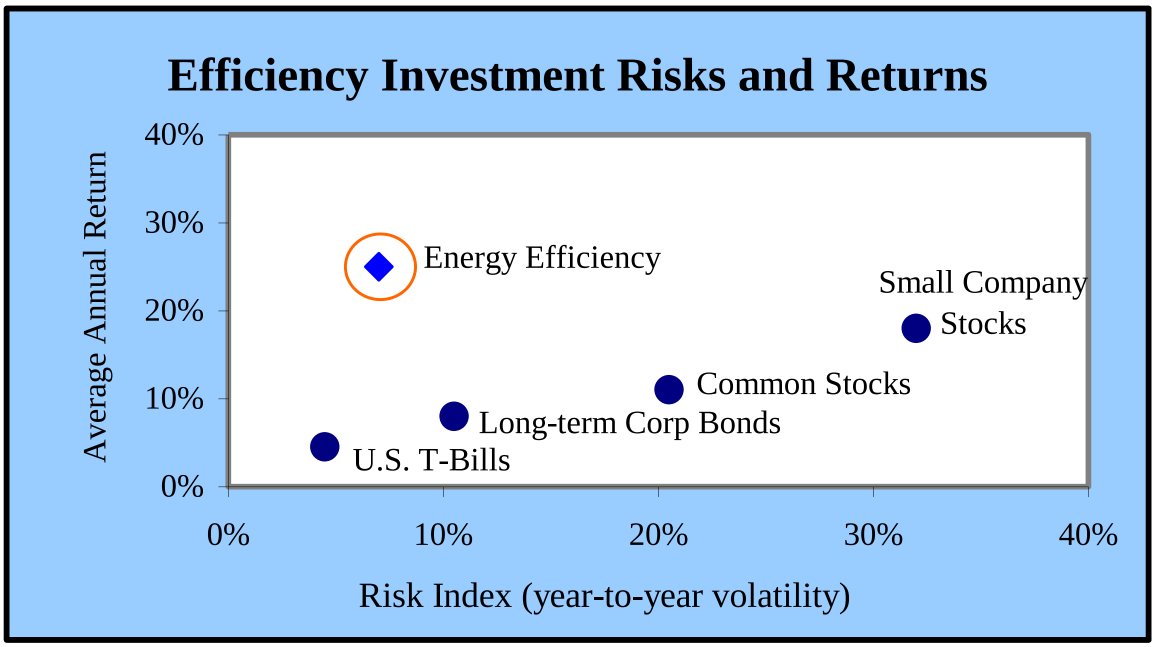


Source: ACEEE analysis of data in EIA 2012a [AER] and BEA 2012.

A small portion of this improvement is due to the fact that we now import more manufactured goods than in 1970, but even after we adjust for imports, U.S. energy use is approximately half of what it would have been if we had not improved our efficiency over the past 40 years (Figure 1). Without these energy efficiency gains, our energy imports would be much higher and our economy weaker.[2]

But much greater savings are possible, savings that are highly cost-effective – meaning that they offer a higher rate of return than most investments. The general concept of how energy efficiency is often cost-effective is highlighted in Figure 2, which shows the traditional risk-reward relationship of different types of investments, including energy efficiency. Such a relationship immediately raises the question – "if efficiency investments are so great, why doesn't the market invest in them?" We turn to this question shortly in the section on "Market Failures and Market Barriers".

Figure 2. Efficiency Investments: High Returns, Low Risk.



Source: Vanguard Group for stocks and bonds. ACEEE estimates adapted from the U.S. EPA data for energy efficiency.

Turning to some specifics, a 2010 National Academy of Sciences study estimated that energy efficiency technologies that exist today or that are likely to be developed in the near future could save considerable money and energy. Fully adopting these technologies could lower projected U.S. energy use by 17% to 20% by 2020, and 25% to 31% by 2030 (National Research Council 2010). Their results for buildings (residential and commercial) and industry are illustrated in Figure 2 which show business-as-usual energy use on the left, and available energy-efficiency savings on the right.

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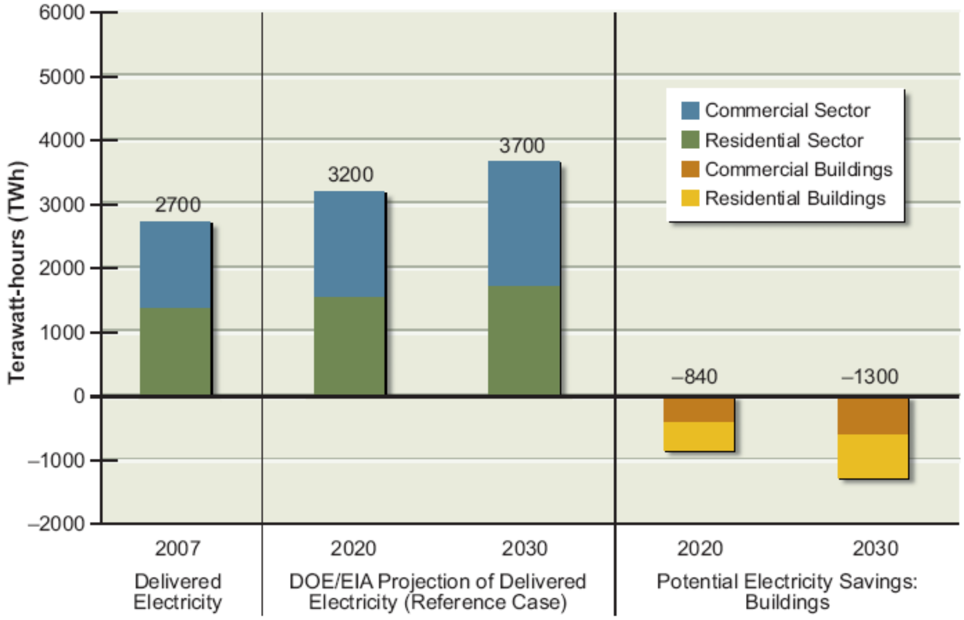
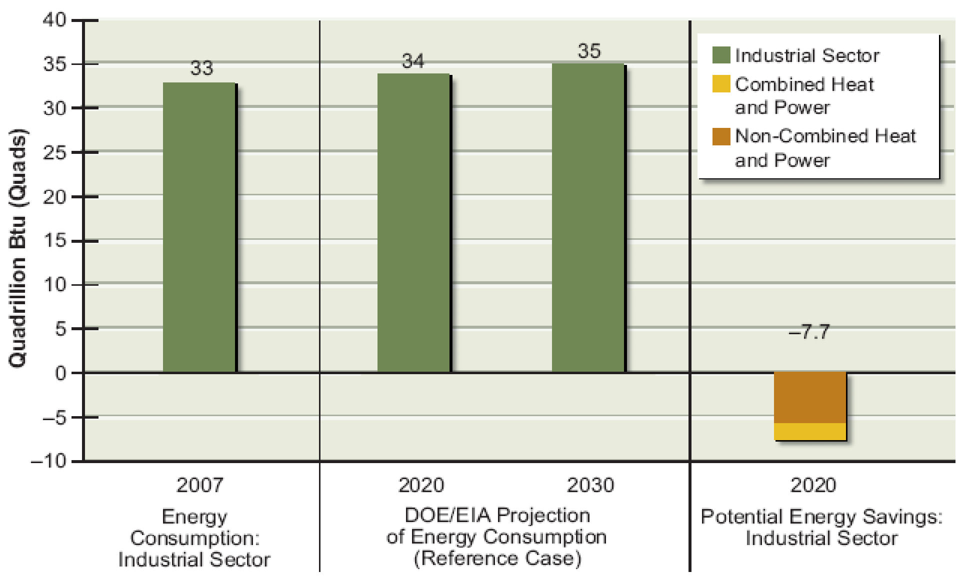
[2] ACEEE is now conducting a "backcasting" analysis to estimate the impact of these past efficiency gains on the U.S. economy. This analysis will be published in mid-2013.

Figure 3. Results of NAS 2010 Study on Energy Efficiency Opportunities

Buildings



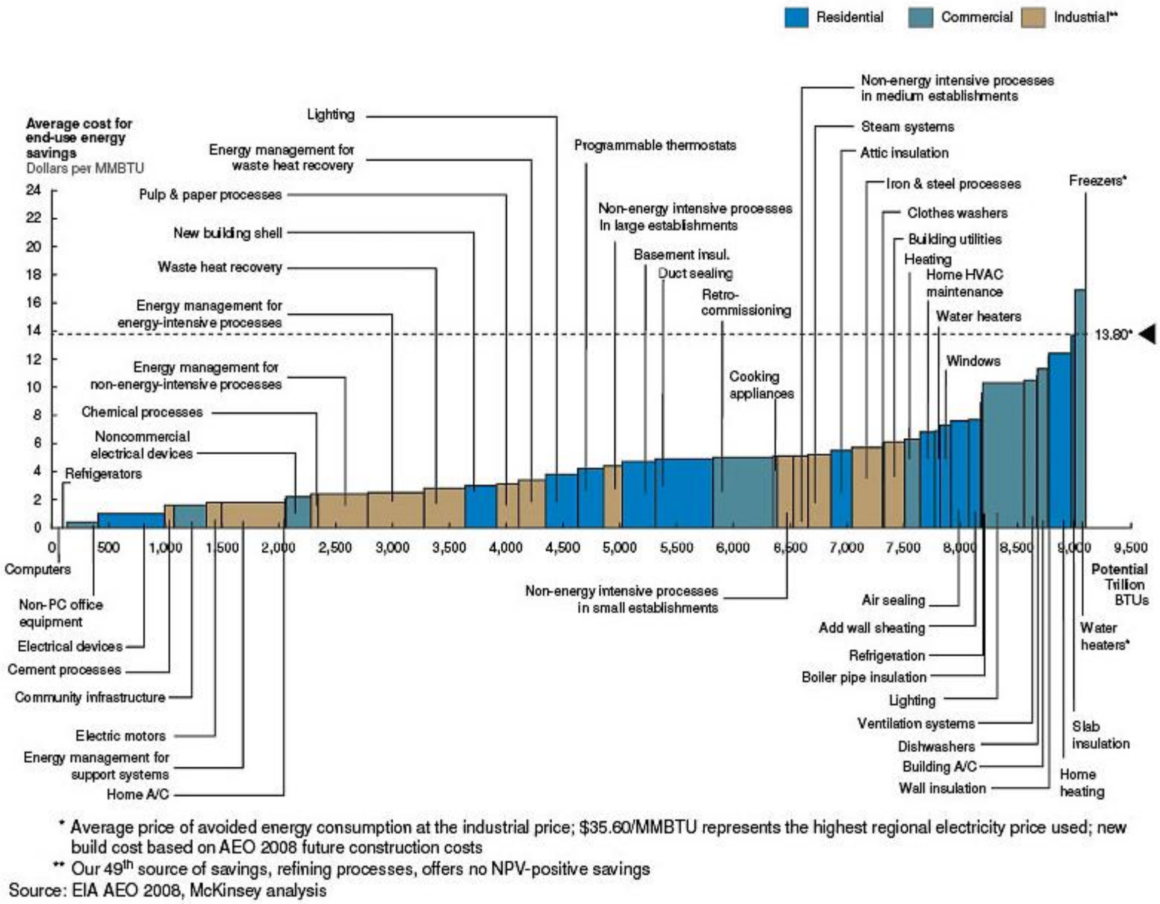
Indu



Source: National Research Council 2010.

Likewise, a 2009 study by McKinsey Global estimates a cost-effective opportunity to reduce U.S. 2020 energy use by 26% (Granade et al. 2009). These savings are achieved as a result of more than 100 different energy efficiency measures, as summarized in Figure 3. In this figure, measures are ordered from the lowest cost per million Btu of energy saved on the far left to the highest cost on the far right. Measures costing less than average energy costs are those below the horizontal dotted line.

Figure 4. McKinsey Global Estimate of Cost-Effective Efficiency in 2020



Source: Granade et al. 2009.

Looking over a longer time frame, the American Council for an Energy-Efficient Economy (ACEEE) estimated in 2012 that energy efficiency could reduce overall U.S. energy use by 42–59% in 2050 relative to a business-as-usual scenario based on the Energy Information Administration's Reference Case (Laitner et al. 2012). The longer time frame in the ACEEE analysis leads to higher savings than in 2020 or 2030, because by 2050 a larger portion of buildings, factories, and vehicles will be either new or substantially renovated, providing additional opportunities for cost-effective energy savings. Technology development over the 2020–50 period also plays a role. Similar savings estimates for 2050 are made in studies by the Rocky Mountain Institute (Lovins et al. 2012) and the California Council on Science and Technology (2011).

Market Failures and Market Barriers

While there are large opportunities for cost-effective energy savings, a variety of barriers stand in the way. There is a substantial literature on a range of barriers that prevent the implementation of cost-effective efficiency technologies (Golove & Eto 1996; Granade et al. 2009; IEA 2007; Jaffe & Stavins

1994). Ungar et al. (2012) have recently summarized this literature, and in the following paragraphs we reproduce what they wrote with a variety of edits and additions.

Market failures in the market for energy efficiency occur when markets fail to provide a sufficient level of efficient products and services to meet the demand of consumers (Bjornstad & Brown 2004). In the next section we discuss specific market failures, since policies to address these failures are the focus of this paper. In addition to market failures there are a variety of additional barriers that are not generally considered to be market failures but that do discourage cost-effective investments in energy efficiency. We discuss these in a subsequent section. While there is debate about how widespread these failures and barriers are and how large their impacts (see, for example, Allcott & Greenstone 2012), most economists agree that many of these issues deserve attention.

Market Failures

Imperfect information may be the most widespread barrier to energy efficiency. For energy efficiency, the most obvious information barrier is knowledge of the performance of different equipment, technologies, buildings, and other systems. Energy efficiency cannot be seen. There also is imperfect information related to energy consumption. For instance, energy savings are difficult to measure (Granade et al. 2009), future energy prices are unknown (Golove & Eto 1996), and energy use of individual devices is often hard to identify, since most customers get all their residential or commercial energy use information rolled into monthly utility bills. In addition, the market for energy efficiency is highly fragmented, with many technologies and many actors, meaning both that it can be difficult to get appropriate information and that the benefits of a single action are often low. These problems sometime lead to a state of "rational ignorance" where the cost of gathering and acting on information (particularly around small individual actions) can be greater than the expected return. Furthermore, in the commercial and industrial sectors, many purchasing decisions are made by purchasing or maintenance staff who are unfamiliar with the relative efficiencies and operating costs of the equipment they purchase (Nadel et al. 2002).

Split incentives, or **principal-agent** problems, also are common barriers to energy efficiency (in particular, see IEA 2007). In energy efficiency the usual problem is that the agent making decisions on efficiency investments or actions does not pay the energy bills, and thus has little incentive to reduce them. The landlord-tenant relationship, in which the property owner purchases equipment but the tenant pays the utility bills, is the most commonly cited split incentive for energy efficiency. However, many others exist: homebuilders making decisions that affect future buyers (ACEEE 2007), building owners who do not expect to stay in their buildings long enough to realize payback from an investment in energy efficiency (IEA 2007), cable companies that choose set-top boxes, and even organizations in which different departments have responsibility for purchasing and for energy bills (ACEEE 2007). One analysis claims that 35% of residential energy use is subject to split incentives (Murtishaw & Sathaye 2006).

Externalities occur when costs or benefits of a transaction are realized by people outside the immediate participants in the transaction. Energy efficiency reduces large negative externalities due to energy supply and consumption: impacts on the environment, risks to energy security, and other societal costs not built into the price of energy. More sales of energy-efficient products create positive externalities by lowering their price and making them more available, and second-order positive externalities by making the next generation of energy-efficient products profitable to sell. In addition, reduced energy consumption can reduce the marginal costs for other energy consumers. This externality particularly applies to electricity during high demand periods. Small changes in demand can lead to large changes in price as the marginal demand is served by very expensive sources of power.

An important type of externality relates to **public goods**, i.e., goods that can be consumed by more than one person without diminishing their value to others. In particular, information can be a double-edged sword. Information can be a public good with benefits for many, including those who did not invest in creating it. But because many can benefit from information, including potential competitors, firms underinvest in creating information. This leads to substantial underinvestment in energy efficiency research. In addition, simply being an early adopter of a new technology can be a useful source of information to others, who can learn from successes and failures of early adoption. As a result, firms may be reluctant to become early adopters, preferring to wait to exploit the experience of others (Jaffe & Stavins 1994). This has sometimes been labeled the **second-mover advantage** (Geroski & Markides 2005).

A subset of this failure is the fact that public and private benefits are not always aligned. Individuals and businesses make investment decisions based on their own implicit or explicit hurdle rates. Also known as discount rates, these hurdle rates are often very high, meaning that the benefits considered are largely those that accrue in the short term, and that long-term benefits are heavily discounted (Geller 2005). These high hurdle rates aren't economically real: a corporation that can raise debt capital at 4% cannot rationally claim to have a hurdle rate of 30%. An extreme manifestation of this problem is that operations managers may be reluctant to spend money on efficiency policies that do not pay for themselves in the same year that they are paid for (i.e., an implicit hurdle rate of 100%).

Likewise, if the benefits of an action are small (e.g., purchase of an efficient power supply), individuals will generally ignore the opportunity, even if millions of such actions would bring substantial collective benefits (Lowenberger et al. 2012). These differences between public and private benefits can result in extra costs that everyone shares, such as construction of new power plants that could have been avoided. These individual decisions can also mean that government often plays a critical role in making investments with long-term benefits such as pre-commercial research and development (e.g., the Internet).

Imperfect competition occurs when the market for a product or service is not a fully competitive, so prices may be inefficient or availability limited. In some energy efficiency markets there are a limited number of producers or sellers, either an oligopoly or monopoly (in some cases a natural monopoly of necessity), and barriers to entry such as high startup costs or patents. For example, for many years clothes washer manufacturers emphasized inefficient top-loading washing machines and domestically produced efficient clothes washers were not available. There was effectively a "group think" among manufacturers that efficient washers were not worth producing. A variety of policies were used to encourage development of high-efficiency washers, and after one manufacturer began making significant profits from these new machines, other manufacturers also responded (Nadel et al. 2003). Likewise, if there are few producers, sometimes the y cannot keep up with demand, creating scarcity.

Imperfect competition can be a problem at the retail level and not just at the manufacturer level. For example, when a refrigerator or water heater fails it generally needs to be replaced immediately—sometimes called a "panic purchase." If the nearest store or plumber does not stock an efficient model, the consumer is often forced to purchase whatever is available (Lowenberger et al. 2012). The inseparability of features can also be a barrier to energy efficiency when efficient equipment is available but only with other features that a purchaser might not want. When this is a result of producer decisions, it is sometimes called "**gold-plating**" (Ruderman, Levine & McMahon 1987).

Additional Market Barriers

In the following sections we discuss some additional market barriers that go beyond the narrow definition of what economists would label market failures.

Government regulations can address market barriers but can sometimes unintentionally create additional barriers. For example, regulations can result in economically inefficient levels of investment in energy efficiency, such as zoning laws that prevent efficient patterns of urban development or emissions standards and hook-up requirements that can impede investments in combined heat and power systems. Standards that specify or implicitly prefer particular materials or technologies can impede innovation and market entry. Regulations can also be slow to keep up with changing technologies and markets—for example, problems with legislatively enacted depreciation rates are discussed later in this paper. In addition to the many regulations affecting specific aspects of energy efficiency, one barrier present across almost all regulated energy utilities is energy pricing based on average rather than marginal cost (Blumstein et al. 1980) and that rewards utilities for increasing sales. This creates an economically inefficient price signal to consumers (either too low or too high) and to utilities. Similarly, utility regulations may not take into account the many ways that energy efficiency can provide value. For example, market regulations do not fairly value ancillary utility services such as reactive power, voltage control, load balancing, load following, and operating reserves that can be provided by energy efficiency and clean distributed generation (e.g., combined heat and power) (Hirst & Kirby 1996; Kirby 2007; and Kirby et al. 2011).

Another commonly cited barrier is **access to capital** (Golove & Eto 1996), which in turn reflects several issues. This amounts to an informal regulatory barrier. For example, there is no legal regulation on how home mortgages or commercial building development loans are originated. But in practice, all lenders follow the same exact procedure, just as if it were required legally. Thus, financiers usually fail to consider the value of energy savings when deciding whether a borrower can repay a loan. There are also issues of risk premiums for new technologies or new loan products. While some risk premium can be justified, some risk premiums are excessive. This barrier may be best understood as an information barrier for the lender, who either does not have or does not use information about potential energy savings to adjust the interest rate to a level appropriate for the energy efficiency investment.

Transaction costs, as well as information costs, can make efficiency investments more expensive. While some transaction costs may be inherent in an energy efficiency improvement, such as installation costs, others can be reduced, easing the choice of contractors and scope of work through such mechanisms as contractor certification and provision of technical assistance.

Cognitive and behavioral factors (ACEEE 2007; Houde & Todd 2011) provide additional reasons why individuals and organizations do not always make rational decisions that optimize their energy efficiency. “Bounded rationality” means that actors with imperfect information use shortcuts to make “good enough” decisions. Behavioral economics shows that many of these mental shortcuts lead to bias in systematic ways. For instance, studies have shown that people overvalue sunk costs; this can make it difficult for them to replace functional but inefficient equipment. People also tend to stick to the status quo or to choose the default option, rather than making an active decision for more efficiency.

Financial procedures sometimes 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 often less scrutinized. In other words, a life-cycle cost analysis is not conducted. 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 (Nadel et al. 2002). This latter issue is a variation on the split incentive problem.

Policy Paths to Address Market Failures

A variety of policies have been used to rectify these market failures, generally with bipartisan support. The first federal law with a major focus on energy efficiency, the Energy Policy and Conservation Act of 1975, was signed by President Gerald Ford. Other major laws followed in the Carter, Reagan, George H.W. Bush, and George W. Bush administrations.[3] The energy strategy crafted by Vice President Dick Cheney’s Energy Taskforce in 2001 included a significant focus on energy efficiency (National Energy Policy Development Group 2001).

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[3] These include the National Energy Conservation Policy Act of 1977 under President Carter, the National Appliance Energy Conservation Act of 1987 under President Reagan, the Energy Policy Act of 1992 under President George H.W. Bush, and the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 under President George W. Bush.

Some provisions in these laws were intended to address specific barriers. For example, the Energy Policy and Conservation Act of 1975 established labeling programs for passenger vehicles and residential appliances, providing information to consumers at the time of purchase and helping to address the imperfect information barrier. Provisions in many of these laws directed state utility regulators to consider policies that would address barriers in current utility regulations. A provision in the Energy Independence and Security Act of 2007 encouraged development of the "smart grid" through a series of reports and standards.[4]

Other provisions in these laws used financial incentives or regulations to surmount the barriers. For example, the Energy Policy Act of 2005 contains a variety of financial incentives for energy efficiency in addition to incentives for oil, gas, coal, nuclear, and renewable energy. The Energy Policy and Conservation Act of 1975 included the Corporate Average Fuel Economy (CAFE) program. The National Appliance Energy Conservation Act of 1987 and several of the other laws contain minimum efficiency standards for appliances that establish uniform national standards, replacing a patchwork of state standards. The Energy Policy Act of 1992 and subsequent laws encourage and assist states to adopt energy efficiency requirements in their building codes and encourage electric and gas utilities to offer energy efficiency programs.

Such strategies have been effective. The 2012–16 and 2017–25 fuel economy standards are expected to reduce oil consumption by 3.1 million barrels per day by 2030. A 2012 ACEEE analysis estimates that appliance and equipment efficiency standards already enacted will save consumers and businesses more than $1 trillion on a cumulative basis, even after subtracting the slightly higher cost of the more efficient products (Lowenberger et al. 2012). Energy savings in 2010 were approximately 3,360 trillion Btu, which is a little more than the state of Georgia used that year and a little less than was used by New York State.[5] Gold and Nadel (2011) estimate that the energy efficiency tax incentives in the Energy Policy Act of 2005 reduced U.S. energy use in 2010 by more than 130 trillion Btu, similar to the annual energy use of the state of Hawaii.[6] They project that annual savings will increase to more than 600 trillion Btu in 2020, since some of the tax incentives will result in major long-term changes in the market for energy-efficient products such as residential appliances, furnaces, and air conditioners. Policies to promote utility investments in energy efficiency where such investments are less costly than alternatives have also been very successful. Utility energy efficiency programs reduced electricity consumption by about 87 billion kWh in 2010 according to EIA (2011a), equivalent to the annual electricity use of Missouri or Louisiana.[7] Regarding building codes, a 2004 analysis estimates that state building codes for homes and commercial buildings saved approximately 540 trillion Btu in

[4] A **smart grid** is defined by Wikipedia as an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.
[5] See http://www.eia.gov/state/
[6] Ibid.
[7] http://www.eia.gov/state/rankings/?sid=US#/series/12

2000, equivalent to the annual energy use of the state of Idaho or Wyoming (Nadel 2004).[8] The Energy Policy Act of 2005 required states to consider adopting interconnection standards for combined heat and power systems and other forms of distributed generation. While there was no mandate, 15 states adopted interconnection standards after considering the pros and cons. This is in addition to the 17 other states that had such interconnection standards prior to the 2005 legislation (Gold & Nadel 2011).

The Role of Market-Based Policies

While some of the examples above may be considered by some to be "command and control" policies, many of these policies work with and seek to leverage market forces. For example, vehicle and appliance labeling seek to address the information barrier by making consumers more informed. Likewise, policies to improve state utility commission regulatory practices, such as interconnection standards, can "level the playing field" so that energy efficiency and energy supply resources compete more fairly in the market. Going forward, there is even more opportunity to shape energy-efficiency policies in ways that unleash the power of markets. Such policies can address market failures without new mandates and with minimal government expenditures. By using markets they can leverage market forces, such as competition, to increase energy efficiency.

In the following sections we describe a variety of policies that address market barriers and leverage market forces based on the seven categories discussed above: improving information to aid decision making; removing existing regulatory barriers; addressing externalities; increasing salience of energy use at point of purchase; reducing cross-subsidies; addressing differences between public and private hurdle rates; and reducing waste in government.

Policies addressed are:

1. Improved appliance labeling
2. Building labeling and disclosure
3. Improved access to energy use data
4. Interconnection standards
5. Supplemental and backup power rates
6. Output-based emission standards
7. Valuation of ancillary services
8. Utility regulatory reform
9. Restructured corporate income taxes
10. Emissions fees
11. Mileage charges (VMT fees)
12. Vehicle feebates
13. Reduction in energy waste in government

[8] See http://www.eia.gov/state/

14. Investment in precommercial research and development
15. Capitalizing energy efficiency investments
16. Energy efficiency mortgages

This report is intended simply to generate discussion about effective policies that leverage markets and target barriers in the market for energy efficiency. These are policies that we believe could be successful. For each policy, we provide an overview of the policy mechanism, its legislative history, and an order-of-magnitude estimate of related costs and energy cost savings. This report does not purport to be an exhaustive analysis of the detailed costs and benefits associated with each intervention.

1. Improving Information

INTRODUCTION

Asymmetrical and incomplete information are key barriers to the adoption of energy-efficient appliances and practices. Consumers often lack the necessary information about benefits and energy savings to make the most rational purchase or program decision. Information asymmetries create an imbalance of power in a buyer/seller transaction, leading to a market failure.

A number of existing programs provide consumers with the information they require to make the most cost-effective decisions. EnergyGuide, EnergyStar, and EPA vehicle labels all identify the energy use associated with a given product. Nevertheless, more can be done to make consumers aware of the energy usage and operating cost of the equipment and vehicles they purchase or rent. This chapter discusses the need for improved appliance and building labeling as well as the benefits of widely available consumer utility data.

IMPROVED APPLIANCE LABELING

Background

The average U.S. household spends $2,000 per year on home energy bills. More than two-thirds of in-home energy is used to operate major home appliances and heating and cooling equipment (EIA 2009). Each year, millions of households purchase new household appliances and equipment. Among available appliances, energy consumption varies by 10% to 50%; in many cases, more efficient appliances cost no more upfront than less efficient models; even those with an initial cost premium cost less to own over the product lifetime as energy bill savings offset and exceed the incremental purchase price.

Appliance energy labels provide information on product energy use and a mechanism for consumers to compare the energy use of a particular product with the full range of similar models available on the market. Without this information, consumers would be unable to include product operating cost in their purchase decision. Since 1980, EnergyGuide labels have appeared on major appliances sold in the United States.

Barriers Addressed by Policy

Appliance labeling programs are designed to increase the information available to consumers at the point of purchase. Comparison labels provide information in a standardized format for comparing the energy use or energy efficiency of a given product to similar models available in the market, thereby making product energy use transparent to market actors. Well-designed appliance labeling programs aid consumer decision making, motivate consumers to consider energy efficiency, and provide an incentive for manufacturers and retailers to offer and promote higher efficiency products.

History

The Energy Policy and Conservation Act of 1975 (EPCA) authorized the Federal Trade Commission (FTC) to develop and administer a mandatory energy labeling program covering major appliances, equipment, and lighting.[9] The legislation suggests two goals for the labeling program: to improve energy efficiency and to assist consumers in making purchase decisions. The FTC issued the initial Appliance Labeling Rule (16 CFR Part 305) in 1979, and program implementation began in 1980.

Under the program, the FTC requires manufacturers to affix the EnergyGuide label (Figure 4) to products and/or product packaging. Table 1 lists the categories of products covered under the EnergyGuide program. EPCA also requires the Department of Energy (DOE) to support the FTC by determining new product categories warranting coverage under the labeling program. Since the program's launch a few products have been added, including, most recently, televisions in 2010. The FTC has solicited comment on expanding coverage to additional consumer electronics products, including personal computers, cable and satellite set-top boxes, and digital video recorders and monitors (FTC 2011).

The FTC has issued detailed guidance for manufacturers on the design and placement of the EnergyGuide label to ensure consistency of content and make it easier for consumers to locate and use the information. Online and catalog retailers are required to provide consumers the same information found on the EnergyGuide label, while manufacturers of heating and cooling equipment also must provide energy information in fact sheets or an industry directory.

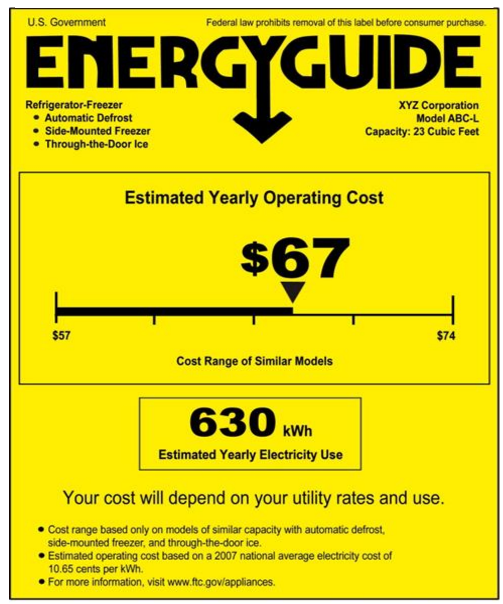

Figure 5. Sample of Current EnergyGuide Label

For most products, the EnergyGuide label provides the estimated annual energy use of the labeled product and uses a continuous-style comparison graphic to show how the annual operating cost of the labeled product compares to the energy use of similar models. Labels on space conditioning equipment—central air conditioners, heat pumps, furnaces, and boilers—provide a comparison based on the product's energy efficiency rating instead of estimated annual operating cost, given the wide variation in use by climate. Reported annual energy use and operating cost or energy efficiency rating must be determined in accordance with DOE test procedures.

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[9] In this paper, we focus on appliance and equipment labeling. Lighting labeling is not addressed in further detail.

The label must also provide information about the product (e.g., manufacturer, model number, size/capacity, features) and the assumptions used to calculate the annual operating cost, such as national average electricity or fuel cost and typical usage (e.g., loads of clothes or dishes washed per week) based on figures published by DOE.

Table 1. Products Required to Display the EnergyGuide

Appliances	Equipment	Consumer Electronics
Clothes washers	Central air conditioners	Televisions
Refrigerators	Heat pumps	
Room air conditioners	Furnaces	
Dishwashers	Boilers	
Freezers	Water heaters	
	Pool heaters	

Ideal Policy Design

The United States has a well-established and mature infrastructure for administering its appliance labeling program. Even so, experience with the EnergyGuide program to date, research conducted with U.S. consumers, and extensive research and labeling experience from around the world suggest a number of opportunities to improve the effectiveness of U.S. appliance labeling.

- Label design: Comparative labels allow consumers to compare the energy use of available models and are a valuable tool for providing information to aid consumer decision making. Using a categorical rating system (e.g., stars or letters) to compare product energy efficiency is widely regarded as best practice. Research in the United States (Thorne and Egan 2002; FTC 2006) and abroad (Wiel & McMahon 2005) demonstrates that categorical labels result in better comprehension, faster grasp of label information, greater ease of use, and increased motivation to consider energy efficiency compared to continuous-style labels. Further, categorical labels encourage manufacturers to improve the efficiency of products to achieve higher category thresholds (and to avoid the worst category). Of the 24 national or regional labeling programs around the world, only the United States, Mexico, and Canada use a continuous-style label rather than a categorical rating scheme.

- Comparison ranges: Within a particular product type (e.g., refrigerator-freezers or clothes washers), comparative labels are most valuable when they provide consumers with the information needed to compare the performance of a wide range of models. Cross-class comparisons give consumers ready access to information needed to compare the energy use of products with different features and configurations and to decide whether additional features warrant any additional energy use and operating cost. While it is unlikely to be useful for consumers to compare the energy use of full-size refrigerators with smaller apartment-size models, a comparison label showing how the energy use of a 21.0-cubic-foot refrigerator with bottom freezer and through-the-door ice dispenser compares to other full-size refrigerators (i.e., 18.0 to 22.0 cubic foot) of different configuration and features provides valuable input for informed decision making. The current EnergyGuide label provides comparison across a very narrow size range for a single configuration and ice service, making broader comparisons difficult, as demonstrated in FTC consumer research (FTC 2006). EPA recently decided to require comparisons across classes on new vehicle labels, and this practice is common in other national appliance labeling schemes.

- Expand coverage: As new products are introduced and widely adopted and as the energy usage of existing products evolves, the appliance labeling program should expand. Potential targets for EnergyGuide labeling include consumer electronics and clothes dryers. A number of consumer electronics products account for a growing share of household energy use, namely computers, set-top boxes, game consoles, and networking equipment. Clothes dryers have long been a major energy end use in American homes, but were not subjected to labeling given the perception that there was little difference in energy use among available models. With the advent of new features and additional settings and cycle selections over the past 10–15 years and the anticipated introduction of new heat-pump dryers and improved gas dryer technology, an EnergyGuide label for clothes dryers may be warranted.

- Label placement/display: In the years since the labeling program was launched, consumer shopping habits have changed considerably. Consumers are increasingly likely to purchase appliances online or make their purchase selections based on in-depth online research. In December 2012, FTC adopted new rules for display of the label on retailer and manufacturer websites. ACEEE and others have suggested several additional clarifications and enhancements to improve consumer access to the EnergyGuide when shopping online (Earthjustice et al. 2012).

- Coordination with other efficiency programs/policies: To date, manufacturers have been subject to multiple data reporting requirements to comply with FTC appliance labeling rules, DOE-administered minimum efficiency standards, and EPA ENERGY STAR® program requirements. Much of the data reporting is duplicative. The agencies are currently working on new rules to streamline the data reporting process to reduce the reporting burden on manufacturers and to minimize inconsistencies in the data made available to the public.

  FTC and DOE should explore further opportunities to coordinate the labeling and standards programs, including the pros and cons of moving the appliance labeling program to DOE. At present, informational elements on the EnergyGuide label are updated on a five-year schedule. Key data available to consumers—including average energy prices, estimated annual cost information, comparison scales, and usage assumptions—often lag far behind changes in the market and can be very misleading to purchasers. For example, failure to update the energy range information when a new efficiency standard takes effect results in a comparison that includes models that are no longer legally available in the market, giving consumers the mistaken impression that products they are considering are more efficient relative to the market than they really are (failing to include newer highly efficient models in the range has the same effect). A coordinated appliance standards and labeling program within a single agency has the potential to administer the program more effectively.

- Compliance and enforcement: A recent investigation of compliance with EnergyGuide labeling rules in retail outlets across the country found significant issues. Of more than 2,500 appliances observed on display, 22% were not labeled and another 33% were in violation of labeling rules (e.g., labels were loose, obstructed from view, damaged, or outdated) (Earthjustice et al. 2012). These findings support those of an earlier GAO study (GAO 2007). Under current FTC rules, the role of retailers in labeling program compliance is limited. Retailers are prohibited from removing EnergyGuide labels from products, but are under no obligation to replace labels that have been damaged in transit, removed by consumers, or are otherwise missing. The studies cited above suggest that some retailers do take steps to reattach or replace missing or damaged labels. Retailers are in a much better position than manufacturers to address situations where labels have been damaged or lost; they could easily print a new label from an online database of labels, for example. Compliance requirements with clearly defined roles for manufacturers and retailers would improve the labeling program's effectiveness.

Market Impacts

The FTC has not conducted any thorough evaluation of the program's cost and effectiveness. Although EPCA directs DOE to assess energy savings from the appliance labeling program, no such analysis has been published to date. As part of the 2007 rulemaking on revisions to the EnergyGuide, the FTC did conduct a survey on the effectiveness of the label design, but did not attempt to estimate the program's actual energy savings.

In 2002, ACEEE completed an in-depth evaluation of the efficacy of the EnergyGuide label and alternate label designs (Thorne and Egan 2002). The study found that while there was high consumer awareness of the label, the EnergyGuide had limited impact on consumer product selections. Research findings also provided strong evidence that a redesigned label could improve consumer comprehension, encourage wider use of the label, and motivate consumers to consider energy use more when purchasing a labeled appliance.

Improvements to the EnergyGuide label and labeling program as outlined above would increase the market impacts of the program by improving consumer decision making and influencing consumers to consider energy efficiency in their purchases, encouraging manufacturers to develop and produce more energy-efficient products, and motivating retailers to stock and promote higher efficiency models.

Benefits and Costs

Improved appliance labeling increases information available to consumers and other decision makers regarding the overall cost of ownership of major household appliances and equipment. Better labels have the potential to encourage consumers to purchase the most efficient appliance that meets their needs, freeing up some of the money budgeted for energy bills for other purposes. Similarly, by making product operating costs more transparent, labels provide an incentive for manufacturers to improve the efficiency of their products. Improved labels also provide a platform for retailers, consumer advocates, and others to educate consumers about product efficiency and their choices in the market.

Overall, appliance labeling is a relatively low-cost policy. The FTC has a limited budget for administration of the appliance labeling program. In recent years, the program budget has covered approximately 1.5 full-time employees. Table 2 presents the costs and benefits of an improved appliance labeling program based on policies recommended in the previous section.

Table 2. Costs and Benefits of Improved Appliance Labeling

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	15.72	Includes residential sector energy consumption of end-use categories currently covered under Appliance Labeling Program (heating and cooling, water heating, refrigeration, clothes washers, dishwashers, and televisions) and categories for which we recommend for expanded coverage (clothes dryers, set-top boxes, video game consoles, and computers and related equipment). Source: EIA 2013
Energy Benefits	% of market affected by policy	20%	Assumes 20% of consumers are motivated by the improved label and use it to select more efficient products. Source: ACEEE estimate based on prior labeling research
Energy Benefits	Average % energy savings	10%	Assumes consumer selects products that average 10% energy savings. Difference in energy use from least to most efficient product varies from 10% to 50% depending on product category according to FTC published ranges. We assume most consumers motivated by the label select a product that falls 1-2 categories more efficient (e.g., shift from 1-star to 2- or 3-star product, or from 3-star to 4- or 5-star product, etc.). Source: ACEEE estimate based on labeling research.
	Total energy savings (quadrillion Btu)	0.37	
Additional Benefits	Reduced water use for clothes washers and dishwashers.		
Costs & Benefits	Present value of national energy cost savings, 2014–2030 (billion 2011$)	$36.16	Based on projected energy use and average expected lifetime for each end-use category (Lowenberger et al 2012) and projected annual residential energy prices (EIA 2013). Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$20.06	Cost based on per unit incremental cost of $400 for space heating, space cooling and water heating products derived from an approximate weighted average of incremental costs for air conditioning and furnaces from latest DOE appliance labeling rule, and rounded down to take into account lower incremental cost of water heating (DOE 2011b). No incremental cost assumed for more efficient white goods or home electronics categories. (Lowenberger 2013 and ACEEE estimates).

Outlook

Experience in the United States and around the world demonstrates that appliance labeling can be a valuable component of an effective energy efficiency policy strategy. There is room for improvement in the U.S. appliance labeling program. Recent and ongoing efforts by the FTC, EPA, and DOE to streamline and enhance coordination of appliance standards and labeling activities are a promising start to strengthening compliance efforts and improving verification and credibility to increase the overall impact of these programs while reducing the reporting burden and errors. However, the FTC has expressed reluctance to pursue broader reforms to the appliance labeling program, citing limited resources and a lack of expertise on technical issues related to appliance energy consumption.

BUILDING LABELING AND DISCLOSURE

Background

Energy bills account for a significant portion of the overall cost of owning and operating a commercial building; for those occupying leased space, energy bills represent a major business expense.[10] Differences in building design, construction, systems, and equipment, as well as any energy efficiency measures installed, can result in substantial differences in energy performance. Building labeling and disclosure policies are intended to provide potential buyers, lessees, and financiers with information on a property's energy performance—data that can help these stakeholders compare properties and better understand the true costs of owning or leasing a property. For sellers and landlords, disclosure policies offer an opportunity to demonstrate the value of their investments in energy efficiency and obtain a return on that investment. In addition, state and local governments use benchmarking to support verification of energy savings from publicly funded retrofit programs and to develop a database of building energy performance to guide decision making regarding programs and investments.

As of 2012, commercial building labeling and disclosure policies have been enacted in two states and six major cities across the United States. While implemented at the state and local level, there is a complementary role for the federal government and for private-sector stakeholders in the development and maintenance of building rating and benchmarking systems and in providing common guidelines for rating and labeling of commercial buildings. Experience in the European Union, where building labels are increasingly used by member states under the Energy Performance of Buildings Directive, can provide constructive guidance for emerging policy efforts in the United States.

Barriers Addressed by Policy

Building energy labeling and disclosure policies establish a means to provide market actors with information that has historically been nonexistent or very hard to obtain. In the absence of data on building energy use, the value of energy efficiency (as realized through reduced energy bills) is not recognized by prospective building tenants and purchasers and profitable investments in energy efficiency are neglected. Research on building energy use demonstrates the salience of this

[10]Energy use labeling and disclosure for residential buildings can also be a valuable tool for homebuyers, tenants, and sellers in the housing market. While a handful of states and municipalities have residential disclosure requirements, policies for the commercial sector are more developed and have received much more attention in recent years. For the purposes of this report, we focus on commercial building labeling and disclosure. ACEEE will release a report focused on residential labeling and disclosure in the spring of 2013.

information to all parties in a real estate transaction: energy use in buildings of similar size and use in the same location can vary by a factor of three to five or even more (EIA 2008). Well-designed labeling and disclosure policies make this information available to decision makers and also provide indicators of how structural and operational factors influence the building's energy performance. As a result, buyers, tenants, and lenders have access to vital information about the cost of owning, operating, or leasing a given property. For income-producing properties, this data can help landlords and tenants negotiate leasing arrangements that address the split incentive issue and allow both parties to reap the benefits from energy efficiency improvements.

History

There is no single approach to building labeling and disclosure in the United States. However, many of the key elements needed for a comprehensive labeling infrastructure are in place or under development. A voluntary rating system and label has gained significant market share, and new approaches have recently been introduced at the state or local level or are in the pilot stage. In addition, the U.S. Department of Energy is developing national voluntary guidelines for building rating and labeling.

Commercial Rating and Labeling Systems

There are two categories of building ratings: *asset ratings* and *operational ratings*. Asset ratings compare the energy efficiency of a building based on its expected performance given its structural and systems characteristics. Examples of asset ratings include LEED and ASHRAE Building Energy Quotient (bEQ). Asset ratings can provide a good idea of the building's efficiency potential as it was designed to operate. Energy use simulation models and energy audits typically provide asset ratings. While simulation models and audits are quite common, none of the existing mandatory rating and disclosure policies use asset ratings. State legislation under consideration in Massachusetts, if passed, would be the first to require an asset rating. COMNET, a consensus standard for building energy modeling, is emerging as the infrastructure for both LEED and ASHRAE bEQ.

Operational ratings compare a building's energy consumption based on metered billing data. By comparing metered energy use, an operational rating includes the impact of building operations and maintenance practices, occupant behaviors, and deficiencies in building systems as installed and used. Current commercial rating and disclosure policies all require operational ratings, specifically ENERGY STAR Portfolio Manager.

The most widely adopted commercial building rating and label in the United States, the ENERGY STAR Buildings Program, provides a framework and tools to address the barriers to investment in energy-efficiency improvements in existing commercial buildings and to build demand for better building energy performance. Key program elements include ENERGY STAR Portfolio Manager and Performance Score and the ENERGY STAR Buildings Label.

Introduced in 2000 by EPA, ENERGY STAR Portfolio Manager is an online tool designed to allow users—primarily commercial building owners and building managers—to compare the operational energy performance of their buildings to that of similar buildings across the country. Portfolio

Manager is a free interactive energy management tool that allows the user to track and assess energy and water consumption and generate a benchmark score from 1 (the worst) to 100 (the best). The tool is widely used by building owners and managers to understand the energy performance of individual buildings or of an entire portfolio of buildings, identify underperforming buildings potentially in need of attention, and corroborate efficiency improvements, including savings from changes to operations and maintenance (O&M) practices.

Portfolio Manager uses basic building characteristics, such as size, location, operating hours, and number of occupants, along with 12 months of consecutive utility bill data to compute a set of performance metrics. These metrics are then normalized for climate, vacancy, and space use to generate the operational rating. Originally designed for commercial office buildings, Portfolio Manager can now be used to benchmark 15 nonresidential building types. Commercial buildings that earn a rating of 75 or higher using ENERGY STAR Portfolio Manager are eligible for the ENERGY STAR Buildings Label.

Commercial Building Rating and Disclosure Policies

Interest in commercial building labeling has led to growth in adoption of mandatory benchmarking and disclosure of commercial building energy performance ratings. Since 2007, two states (California and Washington) and six large cities (listed in Table 3) have passed legislation requiring benchmarking and disclosure of building energy ratings. Policies are now under consideration in an additional three states and five cities (BuildingRating.org 2012). Each of these jurisdictions requires benchmarking using ENERGY STAR Portfolio Manager. The specifics of each policy differ to some degree, particularly with regard to the size and type of buildings covered, whether disclosure is public or available only to transactional parties, and the timing of disclosure. Table 3 summarizes existing policies. These policies cover an estimated 60,600 buildings and more than 4 billion square feet of space (Burr 2012).

Table 3. Summary of Commercial Labeling and Disclosure Policies

Jurisdiction	Effective Date	Description
Austin, Tex.	2011	Requires benchmarking and disclosure of ratings for all public buildings and nonresidential buildings larger than 10,000 square feet to the city government and prospective buyers.
California	2010–12	Requires benchmarking and disclosure of ratings for all nonresidential buildings larger than 5,000 square feet to the state government and prospective buyers, lenders, and lessees.
New York, N.Y.	2010–13	Requires benchmarking and disclosure of ratings for public buildings larger than 10,000 square feet and commercial buildings larger than 50,000 square feet to the city government and the public via a website. Also requires follow-up audits to identify efficiency opportunities.
Philadelphia, Penn.	2013	Requires benchmarking and disclosure of ratings for commercial buildings larger than 50,000 square feet to the city government, prospective buyers, lenders, and lessees, and to the public via a website.
San Francisco, Calif.	2011–13	Requires benchmarking and disclosure of ratings for public and commercial buildings larger than 10,000 square feet to the city government, tenants, and the public via a website.
Seattle, Wash.	2011–13	Requires benchmarking and disclosure of ratings for public buildings larger than 10,000 square feet and commercial buildings larger than 20,000 square feet to the city government and tenants.
Washington	2011–13	Requires benchmarking and disclosure of ratings for public buildings and private nonresidential buildings larger than 10,000 square feet to prospective buyers, lenders, and lessees.
Washington, D.C.	2010–14	Requires benchmarking and disclosure of ratings for public buildings larger than 10,000 square feet and commercial buildings larger than 50,000 square feet to the city government and the public via a website. Also requires estimation and disclosure of asset ratings for new construction.

Source: www.buildingrating.org.

Ideal Policy Design

As indicated in Table 3, building labeling and disclosure policies are relatively new; initial implementation in many jurisdictions is still rolling out. There are roles for cities, states, and the federal government in establishing and implementing an effective labeling and disclosure policy infrastructure. Specifically, the federal government is needed to minimize redundant efforts across the country. State and local governments can establish size thresholds and other requirements best suited to the characteristics of their building stock and market.

Despite the limited experience, variations in requirements and implementation in each jurisdiction are already providing valuable insights into a few best practices and key components of effective policy design for use by other states and municipalities (DOE 2012a).

- Buildings covered. Public and private buildings should be covered. Requiring public buildings to comply first will give the implementing agency an opportunity to develop and test processes prior to full-scale implementation, demonstrate public-sector leadership, and highlight opportunities to save energy and taxpayer dollars.
- Building size thresholds. Initial focus on larger commercial buildings (e.g., those larger than 50,000 square feet) with coverage expanding to smaller buildings over time will focus on the largest energy savings opportunities and most sophisticated building owners first, ease initial implementation, and give owners of smaller buildings more time to prepare for compliance.
- Type of ratings. Include operational ratings initially and expand later to require asset ratings as these become cheaper and easier to implement, such as for new construction.[11]
- Annual benchmarking requirements create a record of energy performance over time, allowing building owners to assess the impact of efficiency improvements and operational changes. They also provide policymakers with a mechanism to track energy use trends; this applies to commercial buildings and for residential and mixed-use buildings of more than ten dwelling units.
- Disclosure of ratings to state or city government allows adequate analysis, compilation, and reporting.
- Public disclosure via website. This policy is most effective with public disclosure of ratings; public disclosure allows important market players to access the data (investors, real estate professionals, commercial data aggregators, and information resources like CoStar).
- Data access (including automated uploading of data where possible). Requirements or guidelines for access to utility data are needed for benchmarking, including guidance for utilities to provide aggregate building-level data that protects tenant privacy.

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[11] Asset ratings should be much more useful to the real estate industry than operational ratings: when a building is purchased, the new owner does not buy the energy management team that did the O&M and does not necessarily get the same tenants. Asset ratings neutralize these variables and provide apples-to-apples comparisons.

- Enforcement authority and penalties for noncompliance ensure broad participation.
- Technical assistance, training, and feedback to benchmarking consultants ensures that there is an adequate pool of qualified service providers to meet market needs.
- Auditing is necessary for evaluation, monitoring, and verification purposes.

Market Impacts

Since its introduction, Portfolio Manager has been used to benchmark more than 20.9 billion square feet of space—more than 25% of total U.S. commercial building floor space (EPA 2011a). Since the first building was labeled in 1999, more than 12,600 buildings representing close to 2 billion square feet of space have earned the ENERGY STAR label. Program participation continues to increase. In 2010, more than 6,200 buildings earned the ENERGY STAR label, an increase of almost 60% over 2009 (EPA 2011a). The ENERGY STAR label can signify dramatic energy savings relative to typical buildings; 10% of all ENERGY STAR-certified buildings use 50% less energy than typical buildings (EPA 2011a).

With the advent of mandatory benchmarking and disclosure policies requiring use of ENERGY STAR Portfolio Manager, many more buildings will be rated and the data can be used by buyers and tenants to identify more efficient properties and drive owner investment in energy efficiency while also building a growing database of U.S. commercial building energy use. A recent analysis of more than 35,000 buildings benchmarked with Portfolio Manager annually from 2008 to 2011 found average per building annual savings of 2.4% relative to prebenchmarking energy use, for a total of 7% over the analysis period (EPA 2012a). These findings suggest that regular benchmarking drives efficiency improvements over time.

Benefits and Costs

State and local governments are pursuing benchmarking policies as a way to verify the energy savings from publicly funded retrofit programs, develop a database of the energy performance of their building stock to guide decision making regarding programs and investments, and encourage greater consideration of building energy performance in purchase, lease, and financing transactions. Building benchmarking and disclosure policies represent a relatively low-cost policy for state and local governments. While most participating cities have approximately two full-time equivalent employees working on implementation of the rating and disclosure laws, their efforts are leveraging the efforts of other market actors and interested parties, including building owners, vendors, academics, and nonprofits representatives (Burr 2011).

While it is too early to know the impact of these new policies on individual decision makers, the benchmarking data is already being used to better understand energy use in the existing building stock. Detailed analysis of the initial benchmarking data submitted to the New York City government reveals significant potential for energy savings. According to this report (NYC 2012), "If all comparatively inefficient large buildings were brought up to the median EUI [energy use intensity] in their category, New York City consumers could reduce energy consumption in large buildings by roughly 18%... If all large buildings could improve to the 75th percentile, the theoretical savings potential grows to roughly 31% for energy."

Other benefits include job creation and business development opportunities: In New York City, vendors played a critical role in achieving a high rate of compliance (more than 70%) with the initial reporting deadline for private building benchmarking data. Auditing firms, consulting engineers, and others have begun offering benchmarking as a new service to clients and are using benchmarking to engage owners in further audits and upgrade projects (Burr 2011).

Table 4. Costs and Benefits of Building Labeling and Disclosure

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	15.87	80% of 2030 projected commercial buildings energy use (EIA 2013). According to CBECS 2003, 80% of commercial building space is in buildings >10,000 square feet and buildings >10,000 square feet consume 80% of commercial buildings energy use.
Energy Benefits	% of market affected by policy	80%	Percent of commercial building space in buildings types covered by Portfolio Manager
	Average % energy savings	20%	EPA reports average annual savings of 2.4% per year. We assume savings of 2.4% per year beginning in 2014 ramping up to maximum of 20% annual savings for 2022-2030.
	Total energy savings (quadrillion Btu)	1.58	
Additional Benefits	Improved tenant retention, increased net operating income, job creation and business development, water savings		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)	$118.56	Projected electricity and natural gas costs EIA 2013.Assumes labeling covers buildings over 50,000 square feet 2014-2019 and buildings over 10,000 square feet from 2020-2030. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$58.97	Assumes 5% discount rate.

Outlook

Mandatory labeling and disclosure policies are still in their infancy, but early indications are promising. These policies are a low-cost option for state and local governments interested in increasing transparency into a previously hidden cost to doing business. Experience from those jurisdictions with policies in place is providing valuable guidance for the most effective approaches for initial rollout and implementation, particularly ensuring compliance and engaging market actors. Recent data cited above demonstrating that annual benchmarking drives improved energy performance further supports the policy rationale.

Unfettering Energy Data for a Smarter Market Economy

Background

Imperfect information may be the most widespread barrier to energy efficiency. Energy is "invisible," making it challenging to measure the performance of buildings, equipment, and technology or see energy savings related to improvements. Efficient markets rely on a solid foundation of accessible and relevant information. Households, businesses, and institutions can make more-informed energy decisions if they have better information about their energy use and potential savings. Specifically, the more accessible, relevant, and accurate the information, the more easily energy customers can make economically and energy-efficient decisions about their operations and capital investments. Utilities are the traditional custodians of energy data, providing buildings with metering equipment to measure energy use and capturing data for billing and other business purposes. Improvements in metering technology in the last decade have made it easier for utilities to capture more detailed energy data and to share it with customers and energy efficiency service providers in an electronic format (National Renewable Energy Technology Laboratory 2008).

Greater access to energy data by customers, energy efficiency service providers, and software entrepreneurs will spur innovation in programs and services that will help close the information gap for customers. Proof that the energy information gap is causing energy and economic inefficiencies has been shown through research around "feedback," or when energy customers receive tailored reports on their energy use presented against a backdrop of energy use by similar customers. Normative information about one's energy use has been shown to influence customers to reduce consumption by an average 2% (Opower, Allcott & Mullainathan 2010; Allcott 2011). Such energy savings produce energy cost savings. Opower, a leading energy data feedback company, announced in October 2012 that its programs have helped save customers 1.5 Terawatt hours of energy, enough energy to "take a city the size of 340,000 people off the grid" (smartmeters.com 2012). These energy efficiencies have been unleashed by the innovation of several feedback report startups that rely on customer-specific energy data.

Barriers Addressed by Policy

There are many steps that industries, institutions, business, and households can take to minimize their energy costs. However, the "invisible" nature of energy use makes it difficult to "see" the energy performance of different appliances, practices, or investments. Without information on where and how energy is being used and its present and future cost, households, businesses, and institutions are unable to make informed decisions about their energy use and ways to save.

Access to meaningful energy data will allow energy customers to make sounder investments and decisions. Policy intended to increase data accessibility and overcome the information gap should consider the quality of data made available, the conduit through which data can be accessed, and the format in which the data is provided.

First, policy that encourages data access will allow customers to take advantage of a *higher quality* of energy data than has been previously available on a broad scale. Advanced metering technology increases the quality of customer-specific energy data by collecting and offering energy use data at shorter time intervals (DOE 2010). While energy bills provide monthly energy consumption data, and utility websites and bills can show longer-term trends in customer energy use using this monthly interval data, technology is making more "granular" energy data available, from hourly to near real time. Such data can be used to identify excessive or wasteful energy use and identify opportunities to save, whether through equipment upgrades or a change in operations. Increasing the quality of information will aid in optimizing household, business, and institutional operations and capital investment decision making.

Second, policies to guide making this data *easily available*, such that utility customers can download their data from a website, will lower the barriers of finding, accessing, and analyzing energy data. Great data accessibility, especially in electronic form, will eliminate (or minimize) the need to mail consent forms to utilities and to manually enter energy data into software or spreadsheets, as some benchmarking software requires. As customers become able to access energy data via the Internet, it will become increasingly easier for them to use this information in their decision making.

Third, policy that supports the emergence of *standard data format* and accessibility will unleash technological innovations that will better enable customers to view and interpret their energy data. Such applications have the potential to provide persuasive decision-making tools. Customer-specific energy data provides information about where energy customers can make new investments to improve their energy efficiency. Third-party application developers can provide valuable interpretation of this data to help customers see energy-saving opportunities.

As customer-specific energy data becomes more easily available in a standard format, entrepreneurs and market innovators will be more willing to invest in ideas that open new markets and empower customers and businesses to make better energy use decisions. Business innovators will also play an important role in the development of a format and standard for data delivery because their applications, software, and programs will play the value-added role of translating and displaying data in meaningful ways to customers. Greater access to customer-specific energy data will unleash private-sector activity in and around energy use data.

Data access policies alone, however, will not fully address the market barrier of imperfect information. Customers will still need to be prompted to download their data, share it with a desired (and relevant) application, and use that information when making energy decisions. Barriers exist for customers without Internet access, access to applications that help interpret data, or knowledge of how to use the data to make energy efficiency decisions. Additional policy guidance can ensure information symmetry by encouraging customers to refer to their energy data when making decisions, by supporting efforts to standardize the format of energy data, and promoting smart disclosure and privacy safeguards that make customers feel safe when sharing data.

History

Energy utilities have traditionally provided energy usage information to their customers in the form of a monthly energy bill. The breakdown of costs usually includes the energy units consumed (in kWh, therms, or some other unit), any additional fees, and a total amount owed.

Energy usage data in this form can be collected and consolidated to benchmark energy usage from month to month and year to year.[12] For the most part, households, businesses, and institutions interested in benchmarking their energy use have had to manually enter monthly data into a third-party application and request any historical data from their utility in writing.

Utilities around the nation are working to upgrade their metering technology. Some 36 million smart meters had been installed by May 2012 and 65 million smart meters are projected to be installed by 2015 (Institute for Electric Efficiency 2012; EIA 2012b). Advanced metering technology is increasingly able to collect detailed customer-specific energy usage data, allowing utilities to better manage grid reliability and demand response (National Energy Technology Laboratory 2008). The implementation of digital and advanced metering technology also allows utilities to provide the requested energy data in electronic form to customers and, through them, third-party providers who offer benchmarking services. Such energy data can be collected at much more frequent intervals, from hourly to every 15 minutes. The movement toward digital customer-specific energy data is at least partially driven by customers' desire for greater information about their energy use for tracking and decision making (Chartwell Inc. 2011).

In 2011, U.S. Chief Technology Officer Aneesh Chopra challenged the energy industry to develop an energy data standard that improves customer access to their data (Chopra 2011). The Green Button Initiative developed through a voluntary private-public partnership, supported by the Commerce Department's National Institute of Standards and Technology and several utilities and companies interested in providing third-party applications (Green Button 2012; DOE 2012b). One year later, in 2012, the initiative remains voluntary and includes commitments from 35 utilities that collectively serve over 36 million customers (DOE 2012b). Green Button represents a significant advance in customer accessibility to energy use data through utilities. The initiative is expected to spur business development by software developers and entrepreneurs around building applications to interpret and display customer energy information. Such applications will help customers choose rate plans that fit their needs, receive customized energy-saving tips, and do self-assessments of energy-saving opportunities (DOE 2010b; Nelson 2012).

The Green Button Initiative follows in the footsteps of other successful private-public partnerships. The initiative is voluntary, led by private industry, and has grown without new laws or regulations (Nelson 2012). While Green Button appears to be a successful initiative to increase data

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[12] Examples include ENERGY STAR Portfolio Manager, EnergyIQ from Lawrence Berkeley National Lab, and EnergyScoreCards™ by Bright Power, Inc.

standardization and accessibility, it is not policy nor does it provide guidance on data security and privacy.

State-level policy has begun to address energy data privacy and security issues. Data disclosure was discussed by some select states as early as the 1990s, but state policies, regulation, and utility dockets related to data disclosure and privacy have been passed in only a handful of states (20, including the District of Columbia) (SEE Action 2012). Such policies will be crucial in the effort to improve data accessibility.

Apart from the Green Button initiative, there are no formal federal-level guidelines for data access, disclosure, and privacy.

Ideal Policy Design

States are best positioned to provide policy guidance on energy data access. State utility regulatory institutions will be most familiar with the present state of utility and data access issues and are in a position to pass more detailed rules to increase data access. Federal policy and initiatives to aggregate and promote best practices (such as Green Button) can pave the way for successful state policy action.

Policy ought to reduce regulatory barriers to customer data access at the utility and customer level to ensure that customers, utilities, and third-party applications have accurate information to inform the market. This means streamlining customer access protocols, supporting a collaborative development of data format standards, and considering questions about data security, privacy, and ownership.

A well-designed data policy should reduce any restrictive regulations and should not prevent customers from accessing their own energy use data. Customers should have a clear process for accessing their energy data in a timely manner through electronic, written, phone, or in-person request. Access should ensure that customers receive the full benefit of having their energy use data available to them for monitoring and purchase decisions.

Additionally, this policy ought to reduce regulatory barriers that limit, in law or practice, customers from sharing their own energy use data. Utility customers ought to be able to request and provide third-party access to their energy data in a timely manner through electronic, written phone, or in-person request. Access should allow easy data transfer from utility to customer to third-party application. The format of energy use data will play a crucial role in this objective. Likewise, there should be an equally easy way for a utility or customer to revoke access to a third-party provider.

The implemented policy should also support the private sector's involvement with utilities to determine a format and standard for energy use data. Business innovators who will be developing and providing the applications, software, and programs to interpret and display data will be important stakeholders in the development of any data format or standard of delivery. Green Button has created a venue in which private innovators and utility companies can aggregate their best practices and promote a common format and standard that will provide a predictable and common language with which third-party developers can work.

Finally, the ideal policy design should clarify the responsibilities that both customers and utilities have to ensure data security. The personal nature of energy data raises privacy and data security issues for customers and for utilities as the collectors and custodians of the data. Near real-time energy use data can reveal personal specifics about a household or business (DOE 2010a). As customer-specific energy usage data becomes more widely accessible and used, policy will play an important role in guiding accessibility and addressing data security issues to ensure that the data drives economic efficiency, business development, innovation, and job creation. In addition, utilities and customers should be guided to take measures to prevent unauthorized access to customer-specific energy data. Customers from which detailed customer-specific data is being collected should be notified and made aware of access options, how to grant and revoke permission to third-party providers, and what their utility is doing to protect their data and privacy. A recent report by SEE Action on disclosure and privacy regulations covers these issues in greater detail.

In an unregulated market, privacy and security measures are considered qualities of services and goods, and firms have incentives to self-regulate. Due to the regulated nature of the utility industry, policy guidance on data security and privacy standards may be appropriate.[13]

Market Impacts

Market impacts expected to follow opening access to customer-specific energy data fall under four major categories. First, utility customers, including institutional, commercial, and residential, will have access to better-quality energy use information, allowing them to optimize operations and investment decisions. These decisions will help them consider long-term energy costs and reduction of what are often considered “fixed” costs. Second, customers will also be more equipped to participate in utility demand-side management programs that provide a financial incentive for shifting energy use patterns and that allow utilities to reduce generation and operating costs. With more granular energy data available, customers will begin to identify baselines for their monthly bills, and even for their daily use, and be able to identify whether they can reduce use during a peak pricing period.

Third, demand for third-party providers that provide management programs and systems, software, applications, displays, reports, and other interpretive services will increase as customers seek to understand their energy data and reap its market value. Entrepreneurs are already experimenting in ways to convert a spreadsheet of energy data into a sleek, easy-to-understand computer or phone app. Business developers who are successful in interpreting customer data in meaningful ways will likely

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[13] See Action’s recent report, “A Regulator’s Privacy Guide to Third-Party Data Access for Energy Efficiency” for examples of appropriate policies related specifically to security and privacy.

expand into a network that markets programs and products to help customers further control their energy use.

Lastly, customer-specific energy data can also be picked up by energy management programs themselves to aid in evaluation and energy savings contracts. The true value of programs and products can be easily measured and verified with better quality and accessible data. Institutions and commercial customers can especially benefit from the ability to monitor the impacts of equipment upgrades or other investments.

With customer-specific energy data, utilities and business can target their marketing of products and services to help save homes and business energy, increase profits by businesses, and encourage leaner public operations (schools, government buildings, other utility services). Greater access to energy data use will unleash an important market force, information that will drive demand for new services and technological innovations, increasing energy efficiency and creating jobs around a whole new sector in the energy industry.

Benefits and Costs

While access to energy data alone will guarantee energy savings, greater access will increase the visibility of energy use and energy-saving opportunities. Furthermore, the anticipated development of third-party applications based on this data, in the form of home energy reports, energy management software, social media applications, and mobile applications, has the potential to trigger small behavior changes broadly across energy users. These small energy-saving behaviors can have a significant collective impact.

The cost-benefit analysis in Table 5 uses research-confirmed savings from feedback programs (namely, 2% savings from Opower home energy reports) as a proxy for potential energy savings from behavior changes induced by energy use information.

Table 5. Costs and Benefits of Improved Energy Data Access

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	5.5	2030 projected electricity use in residential; EIA 2013
Energy Benefits	% of market affected by policy	44%	Foster and Alschuler. State of the Utility Bill Report. 2011. ACEEE: Washington, DC. 22% of customers interact with their bill online. We double this to account for growth in customer interactions over time and to account for contractors who access this information with customer permission.
	Average % energy savings	4%	Average of ODC (2012) and studies reviewed in Foster & Mazur-Stommen (2012).
	Total energy savings (quadrillion Btu)	0.10	
Additional Benefits	Improved transparency and control over energy use		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)	$8.23	Projected costs of energy from EIA 2013. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$1.93	Assumes 4.6 cents/kwh levelized cost and 43 cents/kwh for initial cost of program (Friedrich et al 2009). Assumes 5% discount rate.

Outlook

Customer-specific data access will challenge policy makers to anticipate the long-term impacts that increased data access will have for utilities, customers, and businesses. While a federal initiative, Green Button, is encouraging innovation and development in this area, it is also driving states to lead with their own solutions. Policy will play two important roles moving forward.

First, federal initiatives that promote Green Button will encourage utilities and third-party providers to work together to standardize both data format and best practices that give customers access and power to share their data in safe and secure ways. Second, expect to see states take the lead on privacy and security issues. Public utility commissions in eight states have adopted rules regarding third-party access to data.

Striking a balance of data accessibility and security will send a strong signal to customers to take advantage of their energy data and third-party applications to improve their energy decisions. While security and privacy will impact customer confidence in utilities to manager their customer-specific energy data, it will be crucial that customers feel a sense of control and efficacy when they allow third-party the use of their energy data. Safeguards that ensure both access and privacy will allow the market around customer energy data to flourish. Innovations from such market transformations are poised to unlock substantial energy savings.

2. Removing Existing Regulatory and Legal Barriers

INTRODUCTION

Regulations can play a significant role in preventing the implementation of efficiency measures by unintentionally creating additional barriers. Regulations can also be slow to keep up with changing technologies and markets, thus leading to an inefficient level of investment in energy efficiency. This chapter discusses regulatory and legal barriers that inhibit energy efficiency investment in the industrial, utility, and financial sectors.

In the industrial sector, potential energy savings can be realized through the implementation of combined heat and power (CHP) projects. Only a fraction of these opportunities have been realized, largely because of market and regulatory barriers that distort the economics of CHP projects. The following distortions disadvantage the owners of CHP projects relative to the owners of traditional power-only generation resources:

- interconnection standards
- supplemental and backup power rates
- output-based air quality emission regulations
- valuation of utility ancillary services

These barriers exist largely at the state and local level and are a product of particular approaches to utility and air quality regulation. It is difficult to attribute the failure of any individual CHP project to any single barrier. Rather, a combination of these barriers increases the cost and uncertainty associated with developing a CHP project and reduces the overall economic benefit of operating a CHP system, thus discouraging potential new projects.

Likewise, a number of market barriers in the utility sector discourage the implementation of energy efficiency programs. The majority of electricity and natural gas customers in the United States are served by investor-owned utilities. IOUs serve the public, but they also have fiduciary obligations to earn a profit for shareholders. The traditional regulatory approach creates barriers to energy efficiency by making a utility's profits dependent on selling more electricity or natural gas. A utility that serves customers by providing successful energy efficiency programs may be in conflict with the interests of its shareholders. Regulatory reform is needed to align utility financial incentives so that the utility can meet both customer interests and shareholder interests.

Finally, overhauling the current tax code with regard to business earnings could have important implications for energy efficiency by influencing investment decisions. Simplification is also a key element of more comprehensive proposals for tax reform, such as the Bipartisan Policy Center's Debt Reduction Task Force proposal (BPC 2012). In addition, by lowering marginal tax rates for businesses, it is hoped that tax reform will make U.S. businesses more competitive.

Currently, about half of primary energy in the United States is consumed by commercial and industrial entities, not including energy used for transportation (EIA 2010). Yet there is an enormous potential for savings: a 2012 ACEEE estimate suggests as much as 62% in the commercial sector and 51% in the industrial sector (Laitner et al. 2012). The tax code is potentially a powerful tool to remove disincentives for businesses to make investments to realize such savings.

INTERCONNECTION STANDARDS

Background

Most CHP systems are physically connected to the local utility's electric grid so that power from a CHP system can be shared with the grid and the facility can be supplied by backup electricity in case of CHP system outages. The technical aspects of interconnection are guided by national engineering standards, but the business practices of utilities in the interconnection process are guided by interconnection standards. An interconnection standard provides CHP owners with a clear guide to physically interconnect the CHP system to the grid. An interconnection standard clarifies what each party is responsible for during the interconnection process, and stipulates fees and timelines associated with different interconnection activities. Well-structured interconnection standards can encourage CHP systems by offering system owners transparency in the interconnection process.

Barriers Addressed by Policy

Absent an interconnection standard, utilities may require arbitrary paperwork or lengthy processing periods that can delay projects, require additional legal assistance, and increase project cost. Utilities may also require controls on projects that are not necessary to maintain system and worker safety. Interconnection standards help all parties address their unique concerns during the interconnection process and help ensure that one party does not dominate that process. Since they are developed in conjunction with regulators, utilities, and CHP system owners, the standards promote a level of transparency throughout the process that utilities by themselves often fail to provide. By increasing transparency and certainty in the process, CHP developers and system owners are better able to estimate and plan for the costs associated with system interconnection.

History

A requirement that utilities buy power from certain qualifying distributed generation systems, including CHP, was first codified in the Public Utility Regulatory Policies Act of 1978 (PURPA). This language defined a qualified facility (QF), and instructed the Federal Energy Regulatory Commission (FERC) to develop rules governing the interconnection of QFs. FERC established that QFs are entitled to interconnect at nondiscriminatory costs with their utilities, using interconnection procedures developed and approved by state regulatory commissions.

While QF status was widely sought post-PURPA, a number of utilities and regions are now not fully obligated to purchase power from QFs (Elefant 2011). Utilities have never been obligated to interconnect with non-QF CHP systems, unless states themselves have established such rules. Over the last decade, some states did begin to require the development of fair interconnection standards for non-QF systems, especially those interested in encouraging renewable energy and energy efficiency. However, most states still lacked such interconnection standards for non QF systems by the mid-2000s.

To address the lack of state-level standards, the Energy Policy Act of 2005 established a requirement that all states that had not previously developed such interconnection standards consider doing so. Since then, well over a majority of U.S. states have adopted new or improved interconnection standards (Varnado & Sheehan 2009). To date, 46 states have some interconnection standard in place, though only 11 states have interconnection standards that apply to the full range of CHP sizes, technologies, and fuels (IREC 2012; Foster et al. 2012).

Ideal Policy Design

The National Association of Regulatory Utility Commissioners (NARUC) clarifies interconnection best practices as those that offer facilities "Consistency, predictability, certainty, transparency, affordability, and accountability" (Erwin 2012). Several entities have developed specific guidelines for ideal interconnection standards, and all of them offer good models. These include:

- The Interstate Renewable Energy Council's *2009 Model Interconnection Procedures* (IREC 2009)
- The National Association of Regulatory Utility Commissioners' 2003 *Model Interconnection Procedures and Agreement for Small Distributed Generation Resources* (NARUC 2003)
- The Regulatory Assistance Project's 2011 *Interconnection of Distributed Generation to Utility Systems* (Sheaffer 2011)

Critical components of such model standards include:

- Multiple levels of screening, depending on system size include; "fast-track" application processes for the smallest systems
- Explicit inclusion of all types of CHP, including systems that are not necessarily net-metered and/or those that are powered by fossil fuels
- The clear delineation of reasonable and transparent time periods and the fees each party should anticipate during each step of interconnection
- A clear path toward interconnection for systems larger than 10 MW
- A clearly defined and reasonable schedule of insurance requirements, scaled to system size
- Clear guidance on how dispute resolution between parties will be handled

Outlook

Only a minority of states now lack interconnection standards, thanks in part to efforts of distributed generation advocates and the impact of the 2005 Energy Policy Act. However, as noted in ACEEE's most recent State Energy Efficiency Policy Database (ACEEE 2013), most states lack interconnection standards that offer a clear path toward interconnection for standard fossil fuel-fired CHP plants. A number of states are currently considering new or improved interconnection standards, and future federal legislation may also require states to consider whether their interconnection standards reflect latest best practices. However, since interconnection standards are largely developed and implemented at the state level, it is ultimately up to states to decide what their interconnection standards will look like.

SUPPLEMENTAL AND BACKUP POWER RATES

Background

Since CHP systems are most often designed and sized according to the thermal needs of a facility, the electricity production of the CHP system usually does not perfectly match the electricity requirements of the CHP-using facility. If a CHP system is designed only to meet onsite thermal needs, the facility will typically purchase additional electricity from the grid to meet the remaining onsite electricity needs. This power is called *supplemental power*.

CHP systems will occasionally go offline, either during planned downtimes or unexpected emergencies. The facility will then typically purchase additional power from the grid to meet its needs. This power is called *backup power*. Utilities sometime distinguish between backup power for unexpected downtimes and *maintenance power* for scheduled maintenance periods.

Regulated utilities set, and their regulators approve, the rates at which supplemental and backup power services are delivered. These rates can dramatically affect the economics of a CHP system and in some cases have led facilities to choose not to invest in CHP.

While utilities need to be paid for the services their supplemental and backup power is providing, the rates for these services do not always fairly reflect the costs and benefits of CHP systems. For instance, utilities often set rates based on the assumption that they might need to simultaneously meet the backup power requirements of all CHP-using facilities within their system. Their rates thus reflect the required investment in infrastructure to meet such a peak demand. However, there is no evidence that such contingencies need to be planned for, since the chance of all CHP systems going down at the same time is virtually zero.

Barriers Addressed by Policy

CHP and other distributed generation systems are supposed to offer CHP owners a tradeoff: buy less power from the grid, but take on the risk, cost, and responsibility of developing power yourself. While investing in CHP and fuel costs money, owners should be able to make an economic case for CHP systems by taking into account the reduction in grid-provided power they need to buy. Unfair supplemental and backup rates cause problems for CHP owners when "reduced consumption (in grid-provided electricity) does not result in reduced electricity bills" (Weston and Bluestein 2009). Unfair supplemental and backup power rates distort the basic economics of CHP.

Though no comprehensive national assessment of each utility's backup and standby power rates for CHP-using facilities exists, previous assessments by ACEEE determined that most states have supplemental and backup power rates that discourage CHP (Sciortino et al. 2011). These findings have been echoed by CHP developers, who find it challenging to make the economics of CHP work in the service territories of certain utilities, due largely to these rates and challenges with interconnection standards and policies (Chittum & Kaufman 2011). While each utility develops its own set of rates in conjunction with its regulator, typical barriers within these rates include demand ratchets as well as significant weighting of a customer's contract demand, as opposed to actual consumption.

Fair standby and backup power rates should also reflect demand spikes by CHP-using facilities, and facilities should have to pay more if their demand fluctuates more than facilities whose demands from the electric grid are more predictable. However, some utilities deploy demand ratchets, which knock a customer up to a higher rate for power after a volatile period. Some demand ratchets may be year-long penalties, so a customer could find that a single day's demand spike event causes its power costs to rise dramatically for an entire year.

History

Importantly for QFs, PURPA required that in addition to interconnecting with CHP systems, utilities had to sell supplemental and backup power at "just and reasonable" regulated rates (FERC 2012a). Most new CHP systems do not have QF status, and are thus subject to supplemental and backup power rates that may not fit the "just and reasonable" threshold.

Ideal Policy Design

Fairly designed backup and standby power rates would help more facilities see an economic incentive for investing in CHP. By transparently and fairly determining the amount of backup power capacity that utilities need to plan for, utilities could encourage new CHP systems while also ensuring that existing systems will have the backup power they require when needed.

Weston and Bluestein (2009) delineate several critical components of model supplemental and backup power rates and offer suggestions for model rate design:

- Rates should not use demand ratchets, "or, at worst, … 30-day ratchets."

- Actual energy used and peak demand should be larger components of a rate than a specified contract demand, sometimes referred to as a "reservation charge."
- Cost recovery for utilities' investments in system capacity should be met largely from charges for actual energy demand.
- The rate should offer the facility a clear economic benefit to generating its own power onsite instead of purchasing electricity at the applicable retail rate.

Outlook

At present there is no clear guidance on supplemental and backup power rates for non-QF systems. Recently, a small number of states have opened dockets to explore issues involving backup and supplemental power rates. States such as New Jersey have conducted preliminary studies on current rates and asked that utilities either clearly justify their existing rates or consider new ones in light of an identified need to "ensure equity between Distributed Generators and other public utility customers," among other considerations (NJ BPU 2012).

OUTPUT-BASED EMISSION STANDARDS

Background

The efficiency benefit of CHP systems is due to the fact that they produce more usable energy from a single BTU of energy input. For instance, instead of just producing steam with natural gas, a CHP system can generate steam and electricity from the same natural gas input. Thus, when the same amount of fuel is burned, a CHP system will generate more useful energy than a traditional steam boiler.

Most air regulations set limits for certain pollutants on an *input* basis—that is, pounds of pollutant per measure of fuel input. Since a CHP system is doing more with the same amount of fuel input, such emissions rules fail to reflect the increased efficiency of the system. To address this problem, some regulatory entities have developed *output*-based emissions rules, which measure the amount of pollutant per useful energy output.

Developing output-based emission regulations helps CHP system owners enjoy the efficiency and environmental benefits of CHP systems relative to more traditional thermal or electrical energy-generating systems.

Barriers Addressed by Policy

Input-based emissions regulations fail to credit the ability of a CHP system to through its increased efficiency, displace emissions from other, less-efficient energy resources. As a result, CHP systems are discouraged relative to large centralized energy generation sources, which typically are better able to afford pollution controls and thus satisfy input-based emission standards.

Output-based emissions regulations address the disincentive to build a new CHP system that some air regulations present. Limits on certain air pollutants might be hard to satisfy with a CHP system if that CHP system's useful energy output is not used as the denominator of its emission rates. Output-based emissions standards directly address the disconnect between how CHP systems actually work and the standard way we measure emissions from generation sources. They encourage CHP systems where input-based emissions regulations discourage them.

History

Over the last decade, the U.S. Environmental Protection Agency (US EPA) began integrating output-based emission standards into its existing and updated emissions rules. Output-based rules were most noticeably included in the state-developed implementation plans and trading programs to regulate SO_2 and NO_X, such as the Clean Air Interstate Rule. Since then, some states have developed output-based rules for regulating CO_2 emissions, and the US EPA has also established output-based rules in some federal standards, such as the New Source Performance Standard (EPA 2012b). Most states, though, still lack output-based rules in many of their air pollution regulations.

Ideal Policy Design

Several important models for output-based emissions exist. They include

- The Regulatory Assistance Project's 2003 *Model Regulations for the Output of Specific Air Emissions from Small-Scale Electric Generation Resources* (RAP 2003).
- The US EPA's 2004 *Output-Based Regulations: A Handbook for Air Regulators* (US EPA 2004).

In 2012 Texas became the first state to develop a specific "fast-track" permitting rule for CHP systems, thanks to a 2011 state law requiring the state air quality agency to do so. This "permit by rule" offers output-based emissions rules and expedited permit processing for smaller—up to 15 MW—CHP systems, and it could be a model for other states wishing to help CHP systems cut through red tape during the air permitting process (TXCHPI 2012).

Market Impacts

The expedited permitting process in Texas now allows qualifying systems to get permitted in four to six weeks, as opposed to the previous rule, which frequently made systems wait over one year to get a permit. This rule will thus reduce legal and administrative costs associated with deploying a new CHP system and help CHP developers see better economics for certain systems.

Outlook

States have generally adopted output-based air emissions rules only when pressed by the CHP community and CHP developers. While a number of recent and forthcoming US EPA rules provide output-based options for compliance, this guidance has been largely confined to federal rules. Specific state-level treatment for CHP, as in Texas, is rare and is not generally anticipated in the next few years, absent strong leadership by policymakers within a state.

VALUATION OF ANCILLARY SERVICES

Background

The environmental and economic benefits of deploying CHP are well known. Less appreciated are the benefits of CHP to the grid at large, benefits that are not well understood and are rarely calculated. These benefits include increased system reliability, increased power quality, voltage support, high speed of dispatch relative to other generation assets, reduced need for transmission and distribution investments, less reliance on "peaker" reserve generation assets, spinning of reserve assets, and higher amounts of "useful" energy due to avoidance of line losses. Because these benefits are local and temporally specific they can be difficult to calculate and fluctuate widely in value (Kirby 2007). As a result, these services usually fail to enter into a utility's cost-benefit calculation when determining whether to support a CHP project with assistance (such as incentives) or invest in a CHP project itself. In addition, the CHP system is not credited with these benefits, which accrue instead to the utility.

Barriers Addressed by Policy

Ancillary benefits are generally not presently valued for customer-sited CHP systems. Since they are not valued, the economics of CHP systems are biased. If the various ancillary benefits of CHP systems were to be valued, the economic benefits of CHP would be much more transparent to customers and utilities alike. At present, no party has the means or incentive to calculate these benefits, because there is no established mechanism to enter them into a utilities' cost-benefit analysis. By ascribing value to something across all systems that has henceforth been valued only in certain instances, the full economic value of CHP can be understood.

Utilities that struggle with supporting CHP within their energy efficiency programming would be better able to justify investments in CHP to their regulators by showing the full economic benefits of CHP systems to their ratepayers. Electric utilities may view CHP as an economic drag, because CHP users buy less electricity from the grid. However, the value of ancillary services and other benefits could well make CHP an economic boon to an electric utility, provided that some of that economic benefit goes to the utility and its shareholders

History

Valuation of ancillary services became a distinct set of products once previously vertically integrated utilities began to disaggregate. The ancillary services that were once part of a utility's integrated system were now provided by different entities throughout the system, and a market for these ancillary services emerged as result. Such markets have not considered the benefits offered by smaller customer-sited CHP systems. They typically only consider services offered by generators designed primarily to sell electricity, not those that meet on-site thermal and electric demands.

Utilities have never been formally required to measure or otherwise account for the ancillary benefits of customer-sited CHP. These values are simply not part of the cost tests and cost-benefit analyses conducted by utilities when assessing new CHP systems. Similarly, few studies have examined the actual value of CHP to utilities in the form of ancillary benefits (FERC 2007).

Ideal Policy Design

Ideally, ancillary services and other benefits of CHP systems would be identified, measured, and accounted for in any cost-benefit test employed by a utility when making decisions about energy efficiency programming and resource acquisition—even for the smallest CHP systems. To ensure that this occurs, cost-benefit tests must clearly delineate which benefits are to be included, and how they are to be measured or estimated.

Energy efficiency programming cost tests will often include some of the benefits related to the reduced energy consumption resulting from energy efficiency. However, CHP offers additional benefits that are not captured in cost-benefit tests. For instance, certain types of CHP are well suited to help supplement the sometimes intermittent power provided by renewable energy resources such as wind. This benefit could be measured and incorporated into the cost-benefit tests used by utilities when making decisions about their energy efficiency portfolios and programs.

Market Impacts

Most CHP systems that are considered but never ultimately built are viewed as too expensive or too risky because the time it would take to recoup the investment is longer than preferred. Valuing the additional benefits of CHP increases the applicable benefits within the cost-benefit analyses and risk assessments that potential owners undertake. It also increases the benefits that a utility will calculate within its cost-benefit test to determine which energy efficiency projects and programs to support. This in turn will cause CHP projects to be viewed more favorably by potential owners, investors, and utilities.

Benefits and Costs

The benefits of better valuing ancillary services and other benefits could be very substantial. Increasing the amount of deployed CHP can reduce energy costs and emissions for all customers of a utility system. The benefits are immense, as outlined in Table 6. The costs of measuring, quantifying, and incorporating these benefits into cost-benefit analyses are mostly administrative in nature, and would likely require time and resources from CHP users and utilities to work through the details of how these benefits ought to be calculated and valued.

Outlook

As seen in the impact of the Energy Policy Act of 2005, federal guidance to states to consider and address particular barriers can be very effective. Federal leadership is critical on the issues of ancillary services, because so few individual utilities are engaging in valuation practices today, and the benefits of CHP may go to transmission systems, which cross state borders and are affected substantially by federal rules.

In 2011, FERC issued Order 1000, which impacts the manner in which transmission infrastructure is planned and paid for (FERC 2012b). Importantly, the order requires that public policies, such as portfolio standards that prioritize CHP and other energy efficiency and renewable energy resources, be considered when siting and paying for new transmission infrastructure. This order may perhaps open a dialogue on how to confer economic gain to those areas and utility systems that are investing in CHP and thus reducing the need for new transmission infrastructure all together.

Market Impacts

As noted in the introduction to this chapter, addressing these four regulatory and market barriers—interconnection, standby rates, emission treatment, and valuation of ancillary services—will more fairly reflect the true costs and benefits of CHP. Clearly addressing these barriers will also reduce perceived the risk and uncertainty of projects by conveying to project developers and owners that CHP is an important resource. Steps need to be taken on many of these issues to improve the CHP market, so making progress on just one issue alone is unlikely to have significant impact. Action by the states is required to address many of these barriers, with support from the federal government as needed.

In August 2012, President Obama signed an executive order (Obama 2012) that calls on states to take the lead in overcoming these barriers, with support from the federal government to meet a national target of 40 GW of new CHP by 2020. This target was based on analysis conducted in support of the State and Local Energy Efficiency Action Network (SEE Action) and presented in its industrial energy efficiency and CHP blueprint (SEE Action 2011).

Benefits and Costs

To estimate the impacts of a concerted effort to remove these market barriers, we use some assumptions about CHP performance (see Figure 5) and an analysis performed for the SEE Action Blue Print (SEE Action 2012). This analysis assumes that the full 40GW of new CHP called for in the executive order is installed by 2020.

Figure 6. Representative Schematic of Combined Heat and Power

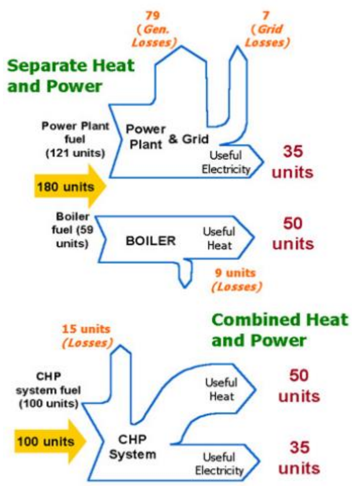

Image source: Kaarsberg and Elliott 1998.

Table 6. Costs and Benefits of Removing Regulatory Barriers to CHP

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	43	The whole market is affected. EIA 2012c
Energy Benefits	% of market affected by policy	100%	CHP is implemented across market sectors, in electricity generation, etc.
	Average % energy savings	4%	85% total CHP fuel efficiency, and extant electric generation efficiency of 35%. 1086 GW total capacity
	Total energy savings (quadrillion Btu)	2.32	Assume 40GW installed by 2020 (SEE Action 2011). Includes 1.5 multiplier for better heat rate and higher operational hours
Additional Benefits	Reduced emissions, increases in power reliability, reduced transmission and distribution losses (not calculated in the above), and improved power quality.		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (2011$)	$167.83	Avoided BTUs in electricity. Energy prices from EIA 2013. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$37.46	Assume $1,200/kW installed capital cost. Assumes 5% discount rate.

UTILITY REGULATORY REFORM

Background

Investor-owned utilities are private companies owned by shareholders. IOUs are subject to regulation of their rates and other aspects of their business operations and investments because they have exclusive rights as "regulated monopolies" to serve customers in designated service territories within states. This status means that regulation is authorized in order to protect and balance the public interest with the rights of IOUs. In addition to serving the public interest, IOUs have a fiduciary obligation to try to earn a profitable return on shareholder investments.

Utility regulatory commissions are responsible for determining the amount of money a utility needs to collect from its customers to cover its costs ("authorized revenues"). This includes operating expenses and financing costs associated with capital investments (including reasonable shareholder profits). Generally, the formula is (in its simplest form):

Authorized Revenues = (Rate Base Investment x Authorized Rate of Return) + Operating Expenses

- **Rate base investment** is the total of all long-term capital investments made by the utility to serve customers, with some adjustments such as depreciation. The rate base investment includes physical assets such as power plants, buildings, and power lines.
- **Authorized rate of return** is a rate of earnings on investments that includes both profit to the company and recovery of interest on debts incurred to provide utility service. This rate is determined by regulatory commissions and varies according to the risks associated with various sources of utility capital, principally shareholder equity and bondholder debt. The authorized rate of return is not guaranteed, meaning that the utility may earn this return on investment if its forecasts and costs match those used to determine rates.
- **Operating expenses** include expenses required to keep the utility running, such as the cost of fuel used to generate electricity and staff salaries.

Once authorized revenues are determined, rates are set to allow the utilities to recover this amount from their customers. The general formula for setting rates is:

Customer Rate = Authorized Revenues/Volume of Energy Sales

- **Customer rate** is the dollar amount charged to customers per unit of energy consumed.
- **Volume of energy sales** is estimated once a utility commission has established rates. Variations from the volume of sales used to determine rates will affect utility revenues and profits.[14] If actual sales volume is greater, revenues and profits will increase. If actual sales are lower, revenues and profits will decrease.

These two rather simple formulas govern the primary business model for investor-owned utilities that has been in place in most states since IOUs were created. Examination of these formulas reveals two primary opportunities to increase profits that drive utility decision making. These drivers are: (1) to increase authorized revenues by increasing the rate base investment; and (2) to increase the volume of energy sales after rates are established (e.g., to exceed the estimate of sales used to calculate rates).

Under this model, investment in energy efficiency raises three primary financial concerns for IOUs:

1. The need to recover the costs for providing programs.
2. Reducing sales through customer energy efficiency savings reduces utility profits.
3. Money spent by utilities on customer energy efficiency programs does not provide a return on investment as do capital investments in power plants and other assets.

These problems can be addressed through a combination of policy mechanisms. These are program cost recovery, fixed-cost recovery, and shareholder incentives.

Barriers Addressed by Policy

[14] Estimated volumes are typically based on historical sales, though sometimes a forward-looking forecast is used.

Under traditional rate regulation, the revenues that IOUs are authorized to recover (including costs and profits) are used to set the utility's rates based on forecast sales levels. IOUs then earn profits by selling electricity, or natural gas, and managing costs to generate shareholder returns. Generally, increasing the amount of electricity or natural gas sold ("throughput") increases revenues to shareholders. This happens because revenue for each additional unit of sales covers variable costs associated with that sale, but also includes a component to pay fixed costs, even if fixed costs have already been fully recovered by meeting forecast sales. Consumers who reduce energy consumption by improving efficiency reduce the amount of electricity or natural gas sold. The direct relationship between sales and revenues in the traditional IOU regulatory model creates a fundamental challenge to securing utility cooperation and support for improving customer energy efficiency. Further, in contrast to the earnings opportunity regulators provide utilities if they invest capital in new supply facilities and equipment, there is generally little or no financial incentive for utilities to spend money on programs that reduce customer demand ("demand side management" programs). This is, in part, because the traditional utility model permits utilities to earn a rate of return on investments of capital, but not for expenses, such as the cost of efficiency programs.

In the traditional IOU system the drive to earn profits and satisfy shareholders is a powerful incentive for increasing sales. This is a significant barrier to utility support of energy efficiency programs and policies. No single mechanism can adequately remove the existing biases against utility investments in energy efficiency. However, there are several policies that, when used in combination, can properly align financial incentives to remove the major barriers to energy efficiency.

History

States have experimented with policies to align utility financial incentives for decades. Recovery of energy efficiency program costs is now universally recognized by states. Policies to address the disincentive to reduce sales by investing in energy efficiency gained popularity in the 1990s and then saw a downturn as states experimented with deregulation. In the last decade policies such as decoupling and lost revenue adjustment mechanisms (both discussed later in this chapter) have seen a resurgence, and 41 states have now authorized one of these policies for at least one major electric and/or natural gas utility (Foster et al. 2012). Shareholder incentives also emerged in the 1990s but have grown in popularity more recently: 28 states have authorized shareholder incentives for at least one major electric and/or gas utility (Foster et al. 2012).

Ideal Policy Design

The regulatory and market barriers hindering energy efficiency in the utility sector can be addressed through a combination of policy mechanisms, including program cost recovery, fixed-cost recovery, and shareholder incentives. Each of these solutions is discussed below.

Cost recovery

Cost recovery of energy efficiency program expenditures simply means that utilities have the ability to recoup the money they spend on energy efficiency programs at some point in the rate-making process. ACEEE has performed periodic reviews of state regulatory practices, and our work demonstrates that cost recovery of program expenditures is fundamental to enabling utilities to provide energy efficiency programs beyond merely marketing or information-only campaigns (Kushler et al. 2006, 2009). To our knowledge, all jurisdictions with utility energy efficiency programs allow utilities to recoup the costs of these expenditures through rates.[15] Regulators of IOUs allow such cost recovery as part of regular rate cases when they review and approve the full set of utility costs that comprise authorized revenues. Typically, such expenditures are treated as operating expenses in rate cases so that utilities can recover these costs as they do other types of expenses, such as employee salaries and administrative expenses.

Decoupling

Under the traditional rate-making model, a utility with actual sales that are lower than the estimates used to set rates may not be able to fully recover its fixed costs. Successful customer energy efficiency programs can reduce energy sales, resulting in undercollection of fixed costs and thereby cutting into profits. Similarly, if the volume of actual sales exceeds estimates used to set rates, the utility overcollects for fixed costs, overcharging ratepayers. As long as utility revenues are a direct function of energy sales, the utility will have an incentive to increase profits by selling more energy. Decoupling is a rate adjustment mechanism that allows the utility to recover its fixed costs included in rate base investment and operating expenses independent of the volume of actual electricity sales. Generally, a symmetrical "true-up" is applied to adjust rates up or down to compensate for any difference between authorized revenues and actual revenues. This true-up occurs periodically regardless of the cause of the change and whether the change is an increase or decrease from expected sales. For example, a gas utility serving an area with a particularly cold winter may adjust rates down if sales exceed forecast estimates. Alternatively, a successful home weatherization program could reduce electricity sales from what a utility has forecast. In this case, a utility's rates may be increased.

An alternative revenue stabilization measure used by a number of regulatory commissions is a lost revenue adjustment mechanism (LRAM). An LRAM allows a utility to collect revenues for sales that are "lost" due to a successful demand-side management program. This removes the disincentive for utilities to support energy efficiency because fixed costs will be recovered through the LRAM, but it does not address the motivation to maximize profits by increasing the volume of sales.

Shareholder Incentives

Utilities seek to invest in activities and assets that can provide a financial return on those investments. Any money spent on customer energy efficiency programs is thus not available for other investments and does not provide earnings for investors. Utility managers seeking to maximize company earnings and profits for shareholders are therefore reluctant to divert available financial resources to customer efficiency programs. Shareholder incentives provide earnings opportunities for utility investments in

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[15] The exception occurs in rare cases where utility expenditures are found to be imprudent.

energy efficiency. Several shareholder incentive approaches have been developed and applied in states. These approaches can be divided into three general categories:

- Performance Targets. These incentives reward utilities for meeting energy savings goals and other targets. For example, a utility may earn a percentage of efficiency program costs for achieving pre-established energy savings goals. The incentives available via performance target mechanisms are generally based on a percentage of program costs, with the percentage varying depending on how targets are met or exceeded. Many of the performance target mechanisms are tiered; different earnings potentials are available as a function of the percentage of targets reached, with the highest incentives for exceeding targets. Maximum available incentives range from 4.4–12% of program costs. On average utilities earn incentives that are roughly equivalent to 6% of program spending (Hayes et al. 2011).

- Shared Benefits. This approach allows utilities to earn some portion of the benefits of a successful energy efficiency program. For example, a utility may earn a share of the positive difference in efficiency program spending and the value to all ratepayers (in terms of benefits) of energy savings achieved as a result the program. The value of energy savings is often based on the avoided costs from reduced demand for electricity. Additional variables considered may include program-specific valuations or weighting and cost effectiveness. Of the states that have a shared benefits mechanism in place, the average maximum incentive that may be earned is approximately 11% of net benefits. Incentive payments in shared benefit states averaged approximately 14% of program spending. The fact that incentives are a higher share of program spending than net benefits implies that the average benefit/cost ratio of these mechanisms is greater than 2:1 (Hayes et al. 2011).

- Rate of Return. These incentives allow utilities to earn a rate of return based on efficiency spending or savings. For example, a utility may earn a rate of return for efficiency investments equal to, or even exceeding, the rate it earns for new supply capacity investments. This is the rarest of the three approaches, possibly because utilities prefer to avoid incorporating intangible assets (efficiency resources) into the rate base with tangible assets.

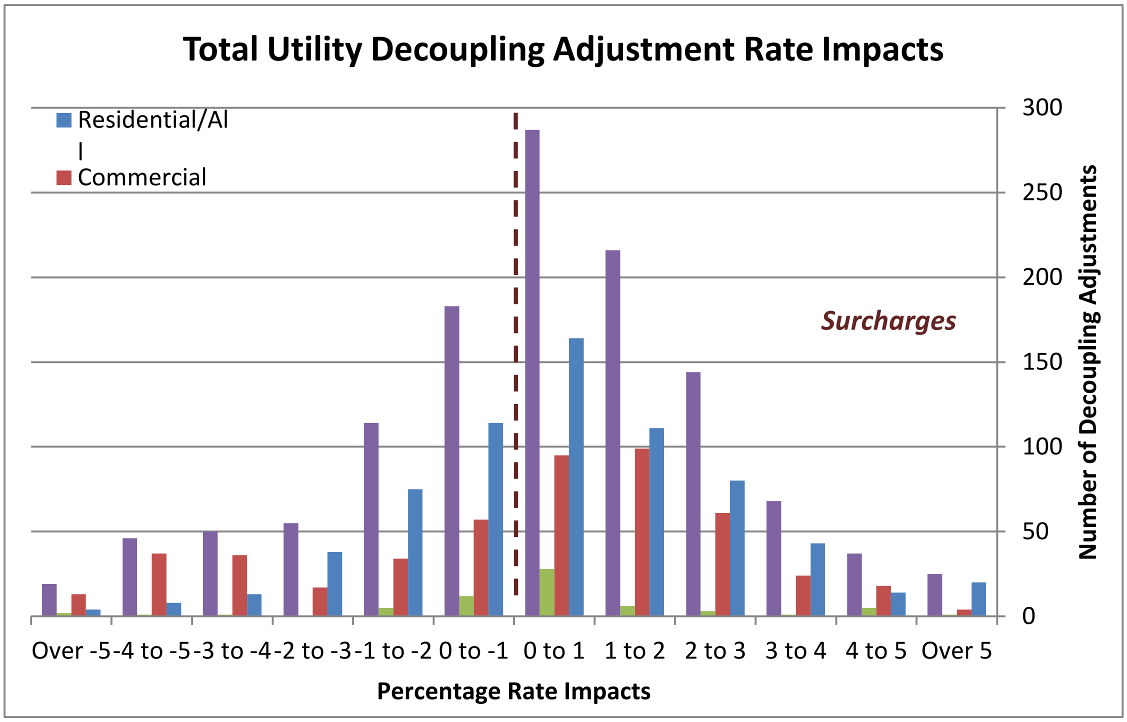
Market Impacts

Separating the cause and effect of a single policy mechanism in the context of a complex, real-world system is extremely difficult. Energy savings and use depend on a range of variables such as demand from consumers, which fluctuates with changes, literally, in the weather. Changes in economic conditions, environmental regulations, generation capacity, and fuel prices can all play a role in how much energy is used in a given area from one year to the next. Despite the difficulties in isolating the specific impacts of policies to remove barriers to efficiency, evidence suggests that these policies influence utility behavior.

ACEEE analysis indicates that at IOUs, the ability to assign a dollar value to efficiency investments via a shareholder incentive has significantly contributed to "buy-in" by corporate management in some states. In some cases a shareholder incentive has been viewed as "leveling the playing field" between efficiency investments and investment in new energy supply capacity, effectively "legitimizing" efficiency as an investment option. A survey of states with shareholder incentives found that the incentive had influenced planning at the utility, allowing efficiency to be treated as a long-term investment strategy (Hayes et al. 2011). In many cases respondents indicated that the shareholder incentive mechanisms motivated utilities to maximize the net benefits created from efficiency spending—i.e., to achieve the most cost-effective energy savings available. Many states have attempted to ensure that incentive mechanisms encourage actual and cost-effective energy savings by tying incentive earnings to energy savings. However, there were reports of efficiency spending that did not achieve effective savings, particularly when incentives were based on spending rather than energy savings.

In practice, rate adjustments made under decoupling mechanisms tend to be small. Even in states with energy efficiency programs, the majority of these adjustments are less than 2% up or down, typically amounting to a change of less than $1.50 and $2.00 per month for natural gas and electric residential customers, respectively (Lesh 2012). Most decoupling policies adjust rates annually, though some utilities do so more frequently (Lesh 2012). Figure 6 shows the small amount of annual rate adjustments made in recent years by utilities in states with decoupling.

Figure 7. Annual Rate Adjustments in Decoupled States

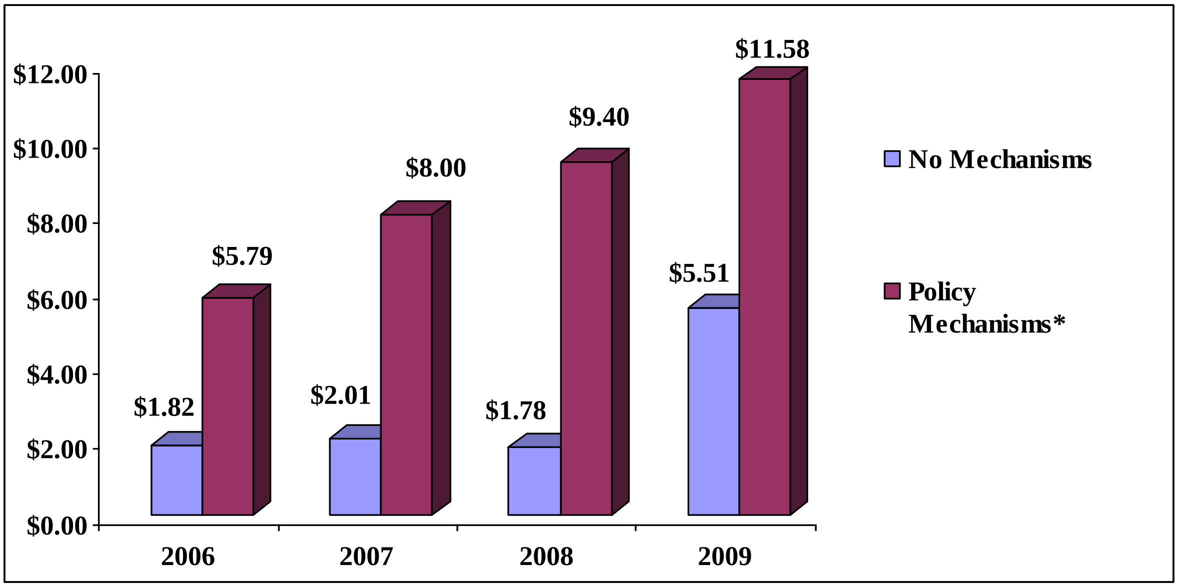


Source: Lesh 2012.

Benefits and Costs

Several barriers inherent in the utility regulatory business model discourage investment in energy efficiency. This makes it difficult to attribute energy savings directly to any specific policy mechanism. In a 2011 analysis, ACEEE compared states that have one or more of the three recommended policies for aligning utility financial incentives with states that have none of these policies. Figure 7 shows that in states with policy mechanisms in place utilities invested more than double the amount per person in energy efficiency than utilities operating in states with no policy mechanisms.

Figure 8. Utility Energy Efficiency Spending per Person.



*Includes states with shareholder incentives and a decoupling and/or lost revenue adjustment mechanism.

States are best equipped to implement policies to address these market barriers, given that best approaches will vary depending on circumstances in a particular state. Oklahoma is a state where a combination of policies to align financial incentives for utilities have been adopted. Public Service Oklahoma (PSO) and Oklahoma gas and Electric Company (OG&E) have shareholder incentives that allow the utilities to collect up to 25% of net savings for cost-effective energy efficiency. Both utilities also recover program costs and have mechanisms for recovering lost revenues. In the initial years of the shareholder incentive program (2008–9) OG&E invested over $5 million in energy efficiency programs and received an incentive of almost $1.88 million. OG&E's budget for the next three-year period (2010–12) increased to $14.9 million per year ($44.7 million total), and the incentive was capped at $2.7 million per year.[16]

In Kentucky, cost recovery and a mechanism to recover lost revenues are in place. Kentucky Power (AEP) also receives a shareholder incentive of 10% of the net savings of the program. In 2007 through 2010, Kentucky Power steadily increased the amount it invested in energy efficiency, earning increasing incentives and saving over 8,100 MWh of electricity in 2010 alone.[17]

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[16] See Order 556179 of the Corporation Commission of Oklahoma, dated May 20, 2008, in Cause No. PUD 200800059, available at http://imaging.occeweb.com/AP/Orders/OCC3770635.PDF; and Order 573419 of the Corporation Commission of Oklahoma, dated January 15, 2010, in Cause No. PUD 200900200, available at http://imaging.occeweb.com/AP/Orders/02FB7659.pdf.

[17] See *Demand-Side Management Status Report of Kentucky Power* (AEP) dated February 13, 2012, available at http://psc.ky.gov/pscscf/2012%20cases/2012-00051/20120213_kentucky%20power%20company_application.pdf.

Table 7 shows some of the estimated costs and benefits if all states adopted the recommended policies to align utility financial incentives including cost recovery (see Table 7 footnote), decoupling and shareholder incentives.

Table 7. Costs and Benefits of Aligning Utility Financial Incentives

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	30	This is total energy consumption by all IOUs in 2030. Uses EIA 2013 for energy consumption and assumes IOUs represent 70% of market.
Energy Benefits	% of market affected by policy	42%	Represents percentage of IOU customers that are in states that don't have decoupling/LRAM and shareholder incentives (EIA).
	Average % energy savings	1%	Based on difference in energy efficiency spending between states with performance incentives and revenue recovery mechanisms (decoupling or LRAM) ($14.63 per person) and states with neither ($5.51 per person). These numbers come from the ACEEE Carrots report. The difference in spending under each scenario is multiplied by the total number of IOU customers in states without these policies and divided by the cost of energy efficiency programs (22 cents per kwh levelized at 5% over 13 years to get 2 cents per kwh). This provides spending and total savings in kwh under a scenario with these policies and without.
	Total energy savings (quadrillion Btu)	0.16	This is based on kwh saved in scenario with policies as compared to scenario without described in calculation above. Based on IOU sector only and uses AEO 2030 total energy consumption and electric sector output to determine supply-side savings
Additional Benefits	Brattle Group (2008) estimates over $100 billion in new capacity investments can be avoided by 2030		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)	$9.44	Assumes average retail price of electricity is 11 cents per kwh multiplied by total kwh saved (EIA AEO). Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$1.85	Difference in EE spending between scenario with policies and scenario without (see above). Assumes 5% discount rate.

Note: All states already effectively allow cost recovery, so we have no recent baseline we can compare against for changes in investment without cost recovery. In 2009 we found that per capita spending in states that have decoupling and/or LRAM and shareholder incentives is significantly higher than in states that don't have these policies. Specifically, the difference is $5.51 per person in states with neither policy, $8.48 per person in states with decoupling/LRAM, and $14.63 in states with shareholder incentives. We also assume that energy efficiency savings cost states approximately $0.025 per kWh. The numbers in this table are a rough approximation of the potential savings available through the implementation of these measures for IOUs in states that don't currently have decoupling/LRAM and shareholder incentives. The numbers reported are national totals.

Outlook

As previously described, all states have authorized cost recovery for energy efficiency programs. Further, a large majority of states have authorized a mechanism to recover lost revenues such as decoupling. A smaller number of states have authorized shareholder incentives, but in the last decade the number of states with such programs has grown steadily. While these three policies have been widely adopted, only a few states have uniformly applied all three of them to both electric and gas utilities. There is now adequate evidence that these policies are effective and enough experience to design policies to suit a variety of circumstances and policy goals. With new and pending retirements of a large number of old coal-fired power plants, states will increasingly be considering the lowest-cost approach to meeting energy demands: energy efficiency. States that want to align utility financial incentives to encourage development of the lowest-cost energy resource will adopt policies that include both decoupling and shareholder incentives.

RESTRUCTURE THE CORPORATE INCOME TAX TO REMOVE BARRIERS TO ENERGY EFFICIENCY INVESTMENTS

Background

Corporate income taxes are structured in ways that encourage energy waste and discourage investments in energy efficiency. These problems do not apply to the individual income tax. Individuals pay taxes on income, and most expenses are not deductible. Exceptions may include interest on home mortgages and high medical expenses, but not energy expenses. With business taxes, the reverse is true. Businesses are taxed on their profits, and virtually all expenses are deductible, including energy costs. However, capital expenses must be depreciated, meaning they are recovered over a multiyear period—as much as 39 years in the case of commercial buildings and the equipment installed in them.

Barriers Addressed by Policy

The structure of corporate income taxes creates three main disincentives to energy efficiency:

1. Since energy bills count as a business expense, and are subtracted from the total amount of taxable income, the federal government is in effect typically "paying" 25% of business energy costs (based on the average effective business tax rate of about 25% [Markle & Shackelford 2011]), and sometimes as much as 35% of a business's energy costs (the maximum business tax rate). Subsidizing energy costs enables higher energy consumption.

2. When businesses do invest in energy efficiency, a portion of the energy savings go to the federal government in the form of higher taxes (e.g., 25% for a business with the typical effective tax rate of 25%, before adjusting for the effects of depreciation). When the full value of the savings does not accrue to the firm, the incentive to make investments goes down.

3. When a firm makes capital investments, these expenses must be depreciated, meaning they are gradually charged against income. If the equipment fails before it is fully depreciated, any un-depreciated value must be written off if the equipment is replaced. Such write-offs discourage replacement of old, inefficient equipment, since many businesses will repair this equipment instead of replacing it in order to avoid writing it off. This is particularly a problem for equipment attached to commercial buildings. Under federal tax law, this equipment must be depreciated over 39 years, even though many types of energy-consuming equipment have much shorter average useful lives. For example, commercial rooftop air conditioners and lighting fixtures have an average useful life of only about 15 years—less than half the depreciation period mandated by federal law.

History

The corporate income tax was established in 1913 and has always been based on taxing profits, so the problem of subsidizing energy use and taxing energy savings has been with us for a century. The depreciation problem is much more recent: the 39-year depreciation period for commercial buildings and equipment was established by Congress in 1986. Prior to 1986, depreciation periods were largely determined by the Internal Revenue Service via administrative action, based on the average useful lives of different types of equipment.

Ideal Policy Design

ACEEE has identified several strategies for dealing with the disincentives to energy efficiency for businesses that are inherent in the tax code, all of which would need to occur in the context of fundamental tax reform (Nadel & Farley 2012b; Sachs et al. 2012). We recommend two major reforms—one based on common sense and the other more substantial and potentially challenging to implement.

First, depreciation periods need to be reset, based on the average useful lives of different types of equipment. We recommend that Congress return these decisions to the IRS so that depreciation periods can be periodically reviewed and adjusted without an act of Congress. Such a process would allow for changes to equipment and accounting practices that occur over time and to new data on useful service lives that periodically become available. Short of delegating such authority to the IRS, Congress should at least adjust depreciation periods to reflect the best current data on useful equipment lives. For example, the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) has been recently collecting data on the service lives of heating and cooling equipment.[18] Further information on rationalizing depreciation periods can be found in an ACEEE working paper (Sachs et al. 2012).

[18] See http://xp20.ashrae.org/publicdatabase/service_life.asp.

Second, a major change in the corporate income tax should be considered: taxiing revenue rather than profits. Under the current system, energy expenditures are a business expense and are not taxed. As discussed above, the government effectively subsidizes businesses for a portion of their energy expenditures, giving businesses less of an incentive to invest in energy efficiency. Taxing all revenue would remove this disincentive. Such a change would dramatically simplify the tax code, since the many hundreds of tax code pages dealing with expenses would no longer be needed. Such a change would also lower tax rates because revenues are much greater than profits, meaning that a much lower portion of revenues would need to be collected in order to collect the same amount of money as the current profit-based tax code. Since current taxes average about 25% of profits and since corporate profits average about 9% (Markle & Shackelford 2011), all other things being equal, a tax rate of about 2.8% of revenue would be needed to collect the same amount as the current code.[19]

When calculating the tax due, in order to prevent "pancaking" of taxes on products assembled from many purchased components, a credit should be provided for taxes paid by suppliers. Thus, a car manufacturer should pay taxes on its revenues, minus a credit for taxes incorporated into the price of the components it purchases, such as car batteries, seat cushions, and shock absorbers.

Further information on revenue-based taxes and other approaches to this issue can be found in an ACEEE working paper (Nadel & Farley 2012b).

Market Impacts

The depreciation changes would encourage replacement of old, inefficient equipment. As a rough estimate of the impacts, consider the following examples. Investments in lighting, heating, and air conditioning equipment likely exceed $60 billion per year.[20] Basing depreciation periods on actual useful lives might speed equipment replacement by an average of five years from a current average of approximately 15 years.[21] This means roughly a 33% increase in equipment investments,[22] resulting in an additional $20 billion annually. If energy savings average 15% over the five years that the investment was accelerated, savings would average about 5% across the stock of this equipment.[23] The Energy Information Administration estimates that the commercial sector will use about 10 quads of

[19] 1/.09 times 25%.
[20] The sum of the value of manufactured goods manufacture shipments from the most recent U.S. Census Bureau Current Industrial Report series for electric lighting fixtures, electric lamps, fluorescent lamp ballasts, and refrigeration, air-conditioning, and warm air heating equipment totals $35 billion. This includes only equipment and not controls, wiring, ductwork, etc. This is a wholesale cost; retail prices are approximately double wholesale prices, and installation labor needs to be added. We conservatively estimate that labor costs are the same as wholesale prices. On the other hand, this also includes residential equipment, which we estimate at around 40% of the total. Thus, $35 billion x 3 x 60% for businesses and not residences = $63 billion for equipment and installation.
[21] ACEEE estimate.
[22] A 15-year replacement period means 6.67% replaced each year. A 20-year replacement period means that 5% is replaced each year: 6.67%/5%=1.33.
[23] A 15% savings over the 15-year life equipment means a 5% savings over each five-year period.

energy for lighting, HVAC, and refrigeration in 2030. Therefore, 2030 savings will be roughly half a quad.

The change from a profit-based to a revenue-based corporate income tax would eliminate the approximately 25% subsidy now provided for energy expenditures and also the approximately 25% tax on energy savings. This means that a firm that presently looks for a two-year simple payback on energy saving investments, might, all other things being equal, make investments with a three-year simple payback. Calculations by Laitner (2012) based on data in the LIEF model (Ross et al. 1993; Cleetus et al. 2003) estimate that this increase in payback threshold can reduce energy use by 10%. The Energy Information Administration estimates that the commercial and industrial sectors will together use about 40 quads of energy in 2030, so 2030 savings are 10% of this, or roughly 4 quads.

Benefits and Costs

Based on the discussion above, Table 8 presents an order of magnitude estimate of savings and costs.

Table 8. Costs and Benefits of Restructuring the Corporate Income Tax

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	10 for depreciation; 40 for taxing revenue	EIA 2012c
Energy Benefits	% of market affected by policy	100%	
	Average % energy savings	5% for depreciation, 10% for taxing revenue	ACEEE estimate; Laitner 2012
	Total energy savings (quadrillion Btu)	4.50	
Additional Benefits	Equipment turns over more quickly, creating jobs, new industrial equipment improves productivity.		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)*	$330.09	Based on AEO 2012 energy price projections, straight-line ramp up to the 2030 level over the 2014-2030 period, and a 5% real discount rate
	Present value of national total cost (for 2014-2030 (billion 2011$)	$165.04	Based on an average B/C ratio of 2 (From Friedrich et al. 2009). Assumes 5% discount rate.

Outlook

Rationalizing depreciation periods so they are based on average service lives makes intuitive sense, and we receive support whenever we raise the issue. In the long-term there are no costs to the federal treasury because all equipment is eventually fully depreciated when calculating taxes.[24] Thus, we conclude that the outlook for rationalizing depreciation is good.

On the other hand, switching to a revenue-based income tax instead of a profit-based tax would be a major change to current practice, and one with many winners and losers. The losers will fight hard against such a change, while most winners have not yet been identified and few are therefore working in support. Given these considerations, enactment is highly unlikely.

[24] However, there are short-term costs because more rapid depreciation (e.g., over 15 years) reduces taxes paid in those 15 years, while increasing taxes paid from years 16–39. Tax reform will involve many changes to the tax code, with many complex impacts on tax collections from year to year. In this environment long-term thinking is more likely to dominate because shorter-term impacts will vary substantially based on the arbitrary selection of analysis periods.

3. Addressing Externalities

INTRODUCTION

Markets that operate inefficiently create externalities—costs and benefits accruing to those not directly involved in a given market transaction. An externality that provides a benefit to an individual, group, or in some cases, society as a whole, is referred to as a positive externality. A cost imposed on an individual, group, or society is a negative externality (e.g., pollution and traffic). Correcting for externalities using a market-based approach requires implementation of a tax or fee to internalize the third-party costs or benefits created by a given transaction. These are also known as Pigovian taxes. A number of policies do the dual job of improving efficiency in a particular sector while also addressing the negative externalities that result from day-to-day activities. Such policies can also be used to reduce income and wage taxes to improve overall economic performance. This chapter addresses two such policies: emission fees and mileage (or VMT) fees.

EMISSIONS FEES

Background

An emissions fee would place a modest tax on emissions of carbon dioxide or other pollutants. Such a fee would be paid either by fossil fuel producers or by consumers as they emit pollutants into the atmosphere. Most major previous national proposals suggest a fee on the order of $25 per metric ton of carbon dioxide equivalent (CO_2e) (e.g., BPC 2010; EIA 2012c; Inglis 2009; Muro and Rothwell 2012). A metric ton of CO_2e is about equal to the quantity of carbon released into the atmosphere from consuming just over 100 gallons of gasoline in a car, or about 2.1 barrels of oil (EPA 2012c).

Emissions fees can be implemented at the state or even local level, but most effectively by the federal government. A state or local emissions fee increases the potential for carbon “leakage” as businesses that emit large amounts of CO_2e move their operations elsewhere to avoid the tax.

Barriers Addressed by Policy

The impact of using carbon-based fuels in the United States is a classic example of the Tragedy of the Commons (Hardin 1968). By using fossil fuels, private entities impact common resources—air, water, and the surrounding environment in general. Emissions from a coal-fired power plant might contribute to acid rain or cause health problems in people who live nearby, but the cost of these external effects is not fully included in the price of coal. The benefits of using coal are fully realized by the company that owns the power plant (and absent efficiency gains, they keep fuel costs low in the form of lower energy prices for consumers—though not as low as they could be with greater efficiency). However, the negative effects are diffused across the economy and do not directly affect the company enough to persuade it to use less coal. Thus, we have a market failure: because the negative impacts of using carbon-based fuels have not been internalized to the power market, the market on its own has failed to create a socially optimal outcome.

An emissions fee is an economically efficient strategy of addressing the market failure stemming from using fossil fuels. The idea that taxes can be used to discourage activities that produce negative externalities was originally suggested in 1920 by the economist Arthur Pigou, then the head of the economics department at the University of Cambridge in England. In the economics literature, these are now commonly known as Pigovian taxes. Many prominent economists and politicians have spoken in favor of using Pigovian taxes to regulate pollution, including Milton Friedman, N. Gregory Mankiw, and President George W. Bush speechwriter David Frum (Nadel & Farley 2012).

History

Several national carbon taxes have been proposed in the United States. In 1993, President Bill Clinton proposed a BTU tax, which would have taxed all fuel based on heat content, with exceptions for renewable energy like wind and geothermal. However, this proposal proved unpopular with affected industries and was eventually dropped (Rosenbaum 1993).

More recently, Congress has considered a number of bills that would have implemented a cap-and-trade program, which would have had many of the same economic effects as an emissions fee. The most notable was the Waxman-Markey Bill of 2009, titled the American Clean Energy and Security Act (H.R. 2454). This bill passed the House, but was not brought up for a vote in the Senate.

A handful of other countries have implemented emissions fees, which could serve as models for best practices. For example, Australia has implemented a national carbon tax, and the Canadian province of British Columbia has implemented a provincial carbon tax. Additionally, local governments in the United States, including Boulder, Colorado, the San Francisco Bay Area in California, and Montgomery County, Maryland, have begun to implement modest carbon taxes, though these are generally much smaller than the fee we propose here.

Ideal Policy Design

There are a number of important variables to consider when designing an emissions fee. First, a carbon tax can be an "upstream" or a "downstream" tax. An upstream tax would tax fossil fuels as they are produced—at the mine or wellhead, or as an additional fee on imported goods produced in countries without an analogous carbon tax system. The advantage of an upstream system is simplicity—such a system would levy a tax on about 2,300 entities, representing about 80% of total U.S. GHG emissions (Ramseur et al. 2012). Alternatively, a downstream tax would be applied at the point at which carbon enters the atmosphere. Taxpayers who are responsible for carbon emissions above a certain threshold would be responsible for reporting their emissions to the federal government, and would be taxed accordingly.

A mandate for large GHG emitters to report to the government already exists, through EPA's Greenhouse Gas Reporting Program (GHGRP). Only large sources of greenhouse gases (over 25,000 metric tons of CO_2 equivalent) are required to report to the program; ordinary households and small businesses are unaffected. In 2010, about 6,200 facilities, representing about 80% of total emissions in the U.S., reported to the EPA. A new rule has added additional categories of facilities that are required to make reports. In future years, around 13,000 facilities, which are responsible for 85–90% of total U.S. GHG emissions, will be required to report (EPA 2011b). Although the EPA is unlikely to administer an emissions fee, it would be relatively easy to transfer data to the Treasury or other agency that would be responsible for collecting such a fee.

Another important variable is the magnitude of the tax. A tax that is too small would have relatively little impact on overall energy consumption and related emissions, and a tax that is too large would likely place an undue burden on the poor and on energy-intensive industries, particularly if they are given little time to prepare. A relatively large carbon tax, such as $40/mt$CO_2$e and increasing by a small percentage annually, would initially yield large amounts of revenue before revenues fall as energy use decreases. However, revenues generated by such a large emissions fee could decrease not just from a switch to low-carbon fuels and energy efficiency, but potentially from a disincentive to investment that could result in a reduction in GDP (Palmer et al. 2012). A less-dramatic emissions fee would be approximately $20–25/mt$CO_2$e, increasing by 4–6% annually. Various models estimate that such a carbon tax could raise over $1 trillion in cumulative revenue by the early 2020s, or annual revenues around $40 billion when the tax is implemented, increasing to over $80 billion annually by the 2030s (BPC 2010; CBO 2011; Ramseur et al. 2012; Palmer et al. 2012).

Unfortunately, an emissions fee would likely have a disproportionate impact on low-income taxpayers. A tax that primarily affects energy prices is inherently regressive; the poor spend a larger percentage of their income on energy. Emissions fees would also disproportionately affect energy-intensive, trade-exposed industries (EITEs). An EITE is an industry that uses highly energy-intensive processes but is also exposed to global competition. Glass, steel, pulp and paper, and chemical manufacturing are all examples of EITEs. An emissions fee that impacts an EITE could render that industry unable to compete on a global level, resulting in "carbon leakage" as industries relocate factories that consume large amounts of energy to countries with less stringent regulations. To offset these problems, a portion of the revenue generated by an emissions fee could be dedicated to a rebate for EITEs and low-income taxpayers to offset some of the impacts of higher energy prices. An alternative option is a border tax adjustment, where foreign products from EITEs would be subject to an additional fee intended to level the playing field.

To summarize, an ideal emissions fee would feature:

- An upstream or downstream tax using existing energy production or GHG reporting systems
- A fee on the order of $25 per metric ton of CO_2 equivalent, increasing at a rate of approximately 5% annually
- A rebate for low-income taxpayers
- A rebate or border tax adjustment for EITEs

Market Impacts

The effects of an emissions fee on the market would be complex. Electricity prices would likely go up. In 2030, electricity is projected to cost, on average, around 9 or 10 cents per kilowatt hour (in 2010 dollars). With a $25/metric ton of carbon dioxide equivalent (CO_2e)tax increasing by 5% per year, electricity prices could rise to 11.5 to 12.5 cents per kilowatt hour, though changes to the generation and consumption mix could decrease or even eliminate such a price increase. In both scenarios, electricity prices on the lower end of the range are more likely if natural gas prices are also low (Palmer et al. 2012).

An emissions fee would also have a significant impact on the mix of fuels used for electricity generation. Natural gas power plants will likely become increasingly common. Coal use would decrease significantly, because coal CO_2 emissions are high. The higher the fee on emissions, the less coal will be used for electricity generation in future years. (However, it is worth noting that high natural gas prices could offset some of this effect.) Additionally, an emissions fee makes electricity generated by wind, biomass, and nuclear potentially more appealing (Palmer et al. 2012). Higher energy prices would also make energy efficiency projects more cost-effective. An emissions fee could provide a greater incentive for companies to make large investments in industrial modernization and combined heat and power.

An emissions fee also could be a significant source of revenue at the federal level. The Brookings Institution recently investigated the potential for a carbon fee to generate revenue for the government. They concluded that a carbon tax would be a suitable way for the government to raise revenue and reduce the deficit with minimal distortionary effects to the economy, while simultaneously benefiting the environment (McKibben et al. 2012).

Benefits and Costs

Table 9 presents an estimate of the costs and benefits of an emissions fee scheme based on this analysis.

Table 9. Costs and Benefits of Emissions Fees

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	104.00	EIA 2013
Energy Benefits	% of market affected by policy	80%	Ramseur et al. 2012
	Average % energy savings	6%	AEO 2012, with a $25/mtCO2e tax beginning in 2013, increasing at 5% annually (EIA 2012c, carbon tax side case)
	Total energy savings (quadrillion Btu)	4.99	
Additional Benefits	GHG emissions reduction; greater certainty on emissions policies so businesses can plan; increased incentive to invest in efficiency and alternative fuels, spurring innovation and job creation		
Costs & Benefits	Present value of national energy cost savings from 2014–30 (billion 2011$)	$742.72	Calculated from EIA 2012c. Assumes 5% real discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$247.57	1/3 of cost savings based on a 3-year simple payback calculation. Assumes 5% real discount rate.

Outlook

An emissions fee may be politically challenging to get through Congress, due to strong opposition to tax increases as well as regulations that may be related to climate change. However, many believe the federal deficit to be one of the greatest threats to the economy of the United States, and that additional revenue sources will likely be needed to significantly cut the deficit, particularly if marginal tax rates are also reduced. An emissions fee may be appealing to those who are reluctant to increase taxes on income or capital, especially since many economists agree that an emissions fee would be less detrimental to the economy than many other types of taxes. Emissions fees are very unlikely to be enacted on their own, but could perhaps be part of a "package deal" on tax reform that reduced marginal tax rates and also included significant cuts in government spending.

MILEAGE CHARGES

Background

A vehicle miles traveled (VMT) fee is a form of road pricing that is levied on drivers for use of the highway system. Fees are applied based on the distance each driver travels in a given time period. Data can be obtained through odometer readings or GPS systems.

While a number of pilot projects have been carried out across the country to assess the usefulness of a VMT fee, no municipality or state has actually implemented such a program. Federally, VMT fees can be an appropriate complement to the national gasoline tax as a means to raise transportation funding.

Funding of transportation infrastructure development and maintenance projects in the United States is sourced largely from the Highway Trust Fund, which is seeded by the national gasoline tax. The Trust Fund allocates the majority of its monies to highway repair and maintenance (FHWA 2012). As of September 2012, approximately 68% of total available funding has gone to highway-related projects (FHWA 2012.). This continued spending trend indicates the need for a more sustainable form of funding for transportation projects in the United States in addition to the gasoline tax.

The implementation of a complementary VMT fee on top of the federal gasoline tax would provide this sustainable source of funding as revenues from the gasoline tax decline with improved vehicle fuel efficiency and increased use of alternative technology vehicles (NSTIFC 2009). In addition to being a fundraising strategy, VMT fees charge drivers for the actual social cost of the roadway system. Relying on a gasoline tax does little to capture the true cost of the environmental damage and other negative externalities to society. VMT fees better align the true price of traveling a mile with the personal direct costs incurred by a given driver (NSTIFC 2009). To some extent, the implementation of VMT fees can also lead to a reduction in driving, leading to additional energy savings. The Victoria Transportation Policy Institute estimates that, nationally, a 1.5-cent-per-mile fee could reduce mileage and subsequently gasoline consumption by about 2.7% (VTPI 2011)

Barriers Addressed by Policy

Pricing strategies as a whole are an effective way of addressing negative externalities that result from the overuse of the American highway system. The social cost of travel includes not only transportation costs borne directly by the driver but also the external costs imposed on society from traffic congestion and air pollution (Safirova et al. 2007). Drivers typically do not incorporate these external costs in their decision making, which means that the U.S. highway system is a consistently undervalued commodity.

Direct costs borne by highway drivers include fuel cost and vehicle maintenance costs, as well as any tolls and travel-related taxes (FHWA 2008). One of the most important components of the cost of travel to drivers is the amount of time spent in transit, because it represents the opportunity cost of traveling that could be spent doing other activities that have more utility for the driver (FHWA 2008). Nevertheless, considering only the direct costs to a driver fails to take into account the social burden of driving.

A mileage-based fee that is implemented on top of the current gasoline tax is one way to efficiently price the highway system to so that environmental and highway-related externalities that result from driving are addressed by charging motorists for the true cost of the highway system. These fees can be varied to incorporate the costs associated with maintaining and operating the American highway system and system damage associated with congestion and pollution (NSTIFC 2009).

History

VMT fees have been discussed at the federal level but have never been implemented or even incorporated into proposed legislation. This lack of movement has much to do with two common unsubstantiated concerns that are often voiced during discussions of mileage-based fees. Equity is consistently brought up by the motoring public as a primary concern (NDOT 2010). Drivers who have no access to alternative modes of transportation and must rely on automobile travel to make frequent long trips would be subject to a greater proportion of total VMT fees (NDOT 2010). It is therefore important to ensure that any such fees are implemented gradually and that the resulting revenues help to address the transportation needs of such drivers.

The other common complaint is that VMT fee programs require periodic odometer readings or GPS systems to track mileage in participating vehicles, raising concern about potential privacy violations and data security. Despite these concerns, a number of municipalities and regional organizations have taken big steps toward incorporating VMT fees into their transportation plans. The Bay Area Metropolitan Transportation Commission and the Association of Bay Area Governments approved funding in 2010 to evaluate the efficacy of a regional VMT fee to fund transportation improvements (Dawid 2012).

In 2006, the state of Oregon undertook a year-long pilot project to find funding alternatives to the state gasoline tax. Payment of a VMT fee of 1.2 cents per mile was set up through two participant gas stations. Mileage-based fees were paid by each motorist whenever they stopped to refuel their vehicles. Gas taxes for participants were waived. The state found that implementing a VMT fee would be feasible and easy to do using existing payment infrastructure. Participating drivers also saw a 12% reduction in overall miles driven (Whitty 2007).

Ideal Policy Design

A well-designed VMT fee system must be very careful to not penalize drivers who have little or no access to other transportation options and who rely on their personal vehicle for simple day-to-day activities. To avoid inequities and take into account variable driving habits, a VMT fee system could incorporate a sliding scale of fees, based on distance driven. Additionally, an effective VMT fee program must be designed to include the following components:

- Users must pay fees in proportion to their road use.
- The program must be perceived as fair and acceptable to the motoring public.
- The fee must generate a reliable revenue stream.
- Funding for such a program should support the entire road and highway system, in addition to alternative transportation projects.
- Revenues must be apportioned accurately to different jurisdictions (NDOT 2010).

VMT data can be collected in a number of ways. Odometer readings that are self-conducted and tied to the registration process, conducted by a public agency such as a state department of motor vehicles, could be used to levy fees on drivers (NCHRP 2009). On-board diagnostic units and GPS systems that track VMT are equally viable options, particularly when considering the possibility of human error in odometer readings, although the upfront cost of installing these units into new and existing vehicles would be significant. Complaints about privacy intrusions may also make these GPS-based methods less palatable to the driving public.

Whatever the chosen method, the most promising fee programs should be capable of metering VMT across the entire road network and should be reasonably enforceable to prevent any revenue losses or gaming of the system. Additionally, such revenue-generating programs should not be overly burdensome for either drivers or state implementers and should be put in place gradually to give drivers time to adjust to the new system (NCHRP 2009).

Market Impacts

The primary impact of a VMT fee on energy use will be an overall reduction in the number of average miles driven on an annual basis. The exact reduction in VMT depends directly on the elasticity of vehicle travel with respect to the cost of travel (Litman 2012). The Victoria Transportation Policy Institute estimates that the price elasticity of driving is between -0.2 and -0.25 (Litman 2012). This means that a 1-cent-per-mile VMT fee would reduce overall miles traveled by 2% to 2.5%.

This reduction in VMT results directly from drivers changing their driving behavior as a result of the mileage charge. VMT fees induce drivers to reduce the number of trips they take altogether by encouraging them to combine trips and switch to alternative modes of transportation such as transit, bicycling, or commuting by foot. For those who must rely on their personal vehicles, the VMT fees that have been suggested by experts would be small enough that the increased cost of driving would not be burdensome to most drivers.

Benefits and Costs

The benefits and costs highlighted in Table 10 are based on the implementation of a 1-cent-per-mile national VMT fee for light-duty vehicles. The primary purpose of a mileage fee of this design is to generate revenue as a complement to national gasoline and diesel taxes. We assume that the elasticity of driving increases from approximately 6% in 2014 to 21% in 2030.

Table 10. Costs and Benefits of Mileage Charges

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	13.14	Total Light Duty Energy Consumption (EIA 2012c)
Energy Benefits	% of market affected by policy	100%	
	Average % energy savings	1.6%	Savings incorporate short term elasticity beginning at 4.8% (short term) and ramping up to 22% (long term) based on a 20 year time period window (Hymel, Van Dender & Small 2010
	Total energy savings (quadrillion Btu)	0.22	
Additional Benefits	Traffic reduction, GHG and criteria pollution reduction, revenue generation for the Highway Trust Fund		
Costs & Benefits	Present value of national energy cost savings from 2014–30 (billion 2011$)	$379.24	Gasoline costs from EIA 2013. Assumes 5% discount rate. Revenues generated from the VMT fee are counted as both a cost and a benefit.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$365.35	Assumes that annual operating costs amount to 7% of projected revenues from a VMT fee program (Based on proposed Netherlands VMT Fee program), GAO 2012. Also incorporates incoming revenues from national mileage fee program. Assumes 5% discount rate.

Outlook

Creative solutions to transportation funding are necessary to create a sustainable stream for the Highway Trust Fund. A VMT fee can satisfy this need while addressing the direct externalities that result from overuse of the highway system. While VMT fees have been discussed at the federal level, no action has been taken to adopt legislation that would support development of such a system. However, given looming shortfalls in the Highway Trust Fund, a VMT fee could very well become an attractive option for lawmakers as a supplement to the national gasoline tax. VMT fee programs can be designed to be equitable for drivers with differing income backgrounds and driving habits, making a national VMT fee program a real possibility (NSTIFC 2009).

BOX 1. ALTERNATIVES TO MILEAGE FEES

In the absence of mileage fees, a number of alternative policies can be implemented to achieve the same market outcomes. ***Pay-as-you-drive insurance (PAYD)*** ties the rate paid by an individual to the number of miles driven over a fixed period of time. One reason that people use their vehicles as much as they do is that a high percentage of vehicle-related costs are "fixed," i.e., independent of the number of miles the vehicle is driven. PAYD insurance converts these fixed costs to variable costs. Drivers would pay a portion of their premiums up front, and the remainder would be charged in proportion to mileage, as determined by a global positioning device or periodic odometer readings. Converting fixed insurance costs to variable costs through PAYD insurance could reduce vehicle use by as much as 8% given varying insurance rates (Bordoff & Noel 2008).

Decisions about implementing PAYD insurance typically need to happen at the state level, since state insurance laws govern whether such plans can be offered in a given jurisdiction. Pilot programs for PAYD insurance have been tested in Texas and Minnesota, but no state has implemented such a program to date.

Similarly, ***congestion pricing*** schemes can be applied to improve travel efficiency. Congestion pricing shifts highway traffic onto other modes of transportation or to off-peak hours of the day, thus allowing the system to flow more efficiently and reducing the overall miles driven (FHWA 2010). In 2010, highway congestion lasted an average of 6 hours per day in the largest metropolitan areas, cost the nation approximately $101 billion, and wasted 1.9 billion gallons of fuel (TTI 2011). Like a VMT fee, congestion pricing charges drivers more of the true cost of a roadway and highway system, thus reducing the externalities associated with driving and highway use. Additionally, congestion pricing can also be used as an innovative financing method for transportation-related expenditures. Funds generated can be invested in maintenance and development of transportation facilities to provide commuters with alternative forms of transportation (VTPI 2011).

A number of municipalities across the United States have implemented congestion pricing in the form of variable toll rates during rush hour. Singapore, London, and Stockholm have city-wide schemes that charge users a variable rate to access congestion-prone areas during peak-hour traffic using a combination of gantries and satellite technologies (ICCT 2010). No federal congestion pricing program has been proposed in the United States to date, although several pilot programs have received federal funding.

4. Increasing the Salience of Energy Use at the Point of Purchase

INTRODUCTION

Consumers are rarely able to identify the true value of potential savings from energy efficiency investments due in large part to inadequate information or misinformation. As a result, most consumers forgo the most cost-effective purchase or investment when it comes to energy efficiency. While educational programs can help correct this market barrier to a certain extent, programs that make a product's energy use more visible to the consumer at the point of purchase have a greater impact.

In the transportation sector, one of the most effective ways to increase the salience of the fuel economy of a given vehicle is through the use of a feebate. Feebates promote the purchase and manufacture of energy-efficient vehicles by assessing a system of fees and rebates on inefficient and high-efficiency vehicles, respectively.

VEHICLE FEEBATES

Background

Recent research has shown that consumers tend to undervalue their future fuel economy savings when considering the purchase of a new vehicle (EPA 2010). Much of this behavior has to do with the fact that consumers lack the necessary information to determine future benefits. The current fuel economy label that appears on every vehicle provides potential vehicle buyers with complicated and typically imprecise information if they are unable to characterize their driving habits accurately (Greene 1999). Additionally, consumers are unlikely to know how to calculate the cost of their future fuel savings due to lack of information, and it is also not cost effective for them to obtain that information (Greene 1999).

An approach that has been considered many times in recent years to correct this problem is the creation of a revenue-neutral vehicle feebate program. Feebate programs are a market-based strategy to encourage the purchase of fuel-efficient vehicles by either charging new vehicle buyers a fee or providing them with a rebate based on the vehicle's fuel economy (Langer 2005).

A number of countries have implemented feebates in recent years to curb petroleum use. France adopted a bonus/malus program in 2007 to encourage the purchase of fuel-efficient vehicles. Likewise, Canada has a feebate-like system in place that targets a small range of highly inefficient vehicles. However, most vehicles sold in the country fall into a zero rebate band, which limits the overall effectiveness of the program (ICCT 2010b). Ireland and Germany have fee-only versions of a feebate that place high fees on vehicles with poor fuel economy, as does the U.S. gas guzzler tax (ICCT 2010b). The French program was particularly successful, resulting in a 3% decline in new vehicle fuel consumption in the first year alone (Friedrich et al. 2010).

The direct impacts of a feebate program are twofold. Feebates induce manufacturers to provide consumers with a wider array of fuel-efficient vehicles, creating a market shift toward greener vehicles. They also provide consumers with a financial incentive to purchase efficient vehicles by tying the upfront cost of a new vehicle to fuel performance and making the future potential fuel savings by an efficient vehicle more visible to consumers.

In light of the aggressive fuel economy standards established by the U.S. Department of Transportation, and the U.S. Environmental Protection Agency, a complementary feebate program could help auto manufacturers meet their targets by increasing consumer demand for the more fuel-efficient vehicles required to meet the standards.

Barriers Addressed by Policy

Feebates directly address the market barrier that results from the fact that consumers tend to undervalue fuel economy improvements and future fuel savings appropriately when it comes to purchasing a new vehicle. Consequently, if consumers do not fully value fuel economy improvements, manufacturers see limited benefit to increasing the fuel economy of their vehicles using existing fuel-efficiency technologies (Greene et al. 2005). Feebates fix this market barrier by tying the upfront cost of the vehicle to its fuel economy performance, effectively shifting some of the price signal from fuel use to the vehicle itself (Greene et al. 2005). Feebate programs give consumers the tools they need to optimize their vehicle purchase decisions.

History

Several attempts have been made to incorporate feebates or feebate-like policies into federal energy and transportation legislation. However, none of these proposals was ever implemented. In 2003, Senator Dick Durbin introduced S.295, calling for an income tax credit ranging from $770 to $7,000 for purchasers of vehicles that obtained at least 5 miles per gallon more than the Corporate Average Fuel Economy (CAFE) standard.

Similarly, in 2009, Senator Dick Lugar from Indiana proposed the implementation of feebates as part of his Practical Energy and Climate Plan (S. 3464), in an effort to cut oil consumption in the U.S. transportation sector. Lugar's plan would have initially implemented only the rebate portion of the program, phasing in the fees for inefficient vehicles two years later. Also in 2009, a bipartisan feebate-specific bill sponsored by Senators Bingaman, Snowe, Lugar, and Kerry, called the Efficient Vehicle Leadership Act (S.1620), created a system of fuel efficiency-based rebates and fees to be assessed on new vehicle buyers. At the state level, Maryland adopted a feebate program in the early 1990s, but never implemented it. At present, California is considering a feebate program. In an effort to satisfy the requirements of AB 32 (California's Global Warming Solutions Act), the state Air Resources Board has been evaluating the implementation of feebates to meet greenhouse gas reduction goals.

Ideal Policy Design

A simple feebate would assess rebates and fees according to a straight-line relationship with fuel consumption, i.e., rebates would decline with an increase in the fuel consumed per vehicle mile driven. However, a number of other approaches exist. These include the use of nonlinear feebates and attribute-based systems that use vehicle characteristics to gauge whether a buyer would receive a rebate or a fee for a new vehicle. Nevertheless, determining an appropriate schedule of fees and rebates depends on the rate and the pivot point if the feebate is linear.

Choosing the right pivot point is especially important to good feebate design, since that point determines the balance between rebates awarded and fees collected and ensures the long-term viability of the program (ICCT 2010b). A feebate program can be designed to be revenue neutral, where fees collected offset the rebates that are granted. Alternatively, the pivot point can feasibly be set to generate revenue for use in other transportation-related areas. As vehicles become more efficient under a feebate structure, the pivot point would have to be adjusted accordingly (Langer 2005).

The rate of a feebate program specifies the fee or rebate as a function of distance from the pivot point (Greene et al. 2005). Rates can either be continuous or noncontinuous. Noncontinuous feebate structures can further be divided into stepwise feebates and feebates that include “donut holes.” Stepwise feebate schedules specify different pivot points and rates for different fuel improvement categories, while the “donut hole” refers to a range of emission levels where no fees or rebates are imposed (Eilert et al. 2010).

The feebate proposed in the Efficient Vehicle Leadership Act of 2009 set fees and rebates according to a stepwise function with three different rebate categories. Fees and rebates were based on a given vehicle’s incremental fuel economy improvement over its attribute-based CAFE fuel economy standard. Fuel economy standards in the United States are determined for individual vehicles based on their footprint—the area between the four wheels of the car or truck. Using an attribute-base standard as the basis for a feebate system ensures that larger vehicles are compared to vehicles of the same size. Ultimately, no matter what design template is used, feebate programs must be designed to address specific policy priorities (Langer 2005).

Market Impacts

The specific market impacts of a feebate program depend heavily on the structure of the implemented system (Bunch & Greene 2011). In general, feebate programs alter the behavior of new vehicle markets by inducing manufacturers to provide a greater array of fuel-efficient vehicles while encouraging consumers to invest in future fuel savings. While the fee or rebate may be targeted at buyers, dealers, or vehicle manufacturers, manufacturers typically bear the greatest impact of a feebate program. Manufacturers do not gain or lose funds directly from the consumer fee or rebate, but they will seek to keep their vehicles competitive and will focus vehicle production plans on alternative vehicles to keep up with consumer demand (Langer 2005). Additionally, implementing a feebate will have varying impacts on different manufacturers due to the difference in relative efficiencies of a given manufacturer's offerings and the distribution of vehicles among the different size classes (Langer 2005). However, these impacts can be addressed by implementing a feebate where vehicles are evaluated using an attribute-based system (such as the current CAFE standards).

A well-designed feebate can therefore accelerate the adoption of certain advanced technology vehicles such as hybrid, plug-in hybrid, and electric vehicles by making energy use more salient at the point of vehicle purchase. A study by Liu et al. in 2011 modeled the impacts of a number of types of feebates and found that simply using a linear feebate structure increased the market share of hybrid vehicles to 20% by 2020.

Benefits and Costs

Savings and cost figures in Table 11 are derived from a footprint-based (vehicle track width multiplied by wheelbase) feebate program with a rate of $20 per g/mile of carbon dioxide and a pivot point that maintains revenue neutrality (Bunch & Greene 2011). The estimates allow for fuel economy improvements above and beyond the 2012–16 CAFE and 2017-25 standards.

Table 11. Costs and Benefits of Feebates

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	13.14	Total Light Duty Energy Consumption (EIA 2012c)
Energy Benefits	% of market affected by policy	100%	
	Average % energy savings	3%	Liu et al 2011
	Total energy savings (quadrillion Btu)	0.39	
Additional Benefits	Reductions in carbon dioxide emissions, job creation for auto manufacturers, increased vehicle sales.		
Costs & Benefits	Present value of national energy cost savings from 2014 -2030 (billion 2011$)	$136.66	Fuel prices from EIA 2013. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$133.10	Assumes revenue neutral feebate. Fees from feebate offset program costs. Includes additional cost to the consumer. Assumes 5% discount rate.

Outlook

There have been numerous attempts to adopt a feebate program in the United States, albeit unsuccessfully. However, successful feebate and feebate-like programs have been implemented in France, Canada, Ireland, and Germany. Nevertheless, feebates are a necessary complement to fuel economy standards to overcome the barrier of consumers undervaluing future fuel savings. As manufacturers begin producing vehicles that meet the national demand for such vehicles, significant energy savings can be realized from a feebate program.

5. Reduce Energy Waste in Government (Lead by Example)

INTRODUCTION

Federal, state, and local governments consume large amounts of energy in their facilities and fleets and represent a great opportunity to reduce waste and avoid cost to the taxpayer. There are already examples of government energy management programs and energy savings goals that have successfully reduced government waste. However, there is still a large potential for government to streamline and lead the private sector in increasing energy efficiency.

REDUCING WASTE IN GOVERNMENT

Background

The U.S. federal government is the largest consumer of energy in the world. In 2007, the federal agencies had an energy bill of approximately $14.5 billion (DOE 2010b). A little more than half of the energy used by the federal government, and just under 40% of its energy costs, is for heating, cooling, and powering more than 500,000 federal buildings around the country. The rest is for vehicles and equipment, primarily military aircraft, ships, and land vehicles. Incorporating energy efficiency measures into government facilities and fleets achieves significant energy cost savings to taxpayers. In addition, state governments spend more than $11 billion annually on energy, which can account for as much as 10% of a typical government's annual operating budget (DOE 2007; EPA 2009). As states attempt to reduce expenditures, implementing cost-effective energy efficiency processes and technologies is a proven solution to reduce wasteful spending.

Public buildings (buildings owned by the federal, state, or local government) represent a substantial portion of buildings in the United States, and therefore a large potential for energy savings through efficiency. Federal buildings are already required to purchase energy-efficient products, a practice that is managed through the Federal Energy Management Program (FEMP). ICLEI (Local Governments for Sustainability) provides resources for cities and municipalities interested in implementing energy-efficient practices. Almost every state has established energy saving targets for facilities, which require a certain reduction in energy usage by a set date (Foster et al. 2011). A sizable amount of work has also been done to identify energy efficiency opportunities in schools (specifically K-12). Energy savings can be realized through improved windows and other building shell measures, the upgrade of heating, ventilation, and air conditioning and lighting systems, and better office and kitchen equipment.

Governments may also set a mile-per-gallon requirement for vehicle fleets. Government vehicles account for half of total government energy use and are therefore an important component in reducing energy consumption and costs. The value of fleet-oriented strategies depends both on the fraction of fleet vehicles they affect and their transferability to non-fleet vehicles. Energy efficiency strategies include reducing fleet size, training drivers to drive more efficiently, improving tire or lubricant quality, and reducing miles traveled by the fleet. Governments can also reduce fuel consumption by purchasing more fuel-efficient vehicles.

Barriers Addressed by Policy

Over two decades of federal energy management has led to significant energy savings but has also served to highlight the barriers to energy efficiency in the public sector. The federal government is comprised of three branches, with 15 departments, and more than 50 independent agencies. In addition, there are 50 separate state governments with their own agencies and departments and the web is even broader and less defined on the local level. These government organizations perform a variety of missions and functions, making managing their various operations challenging. Government also often reacts gradually to new directives or changes in policy because decision making is dispersed among many people and many organizations, all with varied mission-related responsibilities, experience, training, manpower, and budgets. Further complicating matters, each agency has its own unique legal requirements and stakeholder demands that compete for its attention. Policies to overcome these and many other barriers are important to achieving substantial energy savings and saving taxpayer money.

In many cases, obtaining the necessary capital is a key barrier to making efficiency upgrades. Appropriations for energy efficiency have varied dramatically over the years. In some cases, agencies requested larger budgets for energy efficiency projects, and Congress appropriated the funds. In other cases, either agencies did not request enough money for efficiency projects or Congress did not fund agencies' requests. The constant shifting of agency energy efficiency budgets is a challenge for programs, since investments in efficiency projects often require a long and predictable lead time for planning and execution. In addition, the downsizing of in-house facility energy managers in agencies and the privatization of operations and maintenance has resulted in losses in experience and expertise. Short-term savings from personnel cuts have spawned long-term increases in wasted energy. One option for addressing this issue is to examine alternative financing mechanisms, since energy efficiency investments will pay for themselves over the long run. Using energy services company (ESCOs) or other financing mechanisms can help address these barriers.

Often legislative requirements are not translated into agency implementation action plans, because they do not offer incentives or disincentives for meeting or failing to meet the requirements. While incentives and accountability are a vital part of implementing policies, the challenge is to reward/ penalize people for things they have control over. It is difficult to hold agencies accountable for failure to implement efficiency projects if budgets are not adequate, procurement rules impede action, or supervisors give conflicting direction.

In addition there are issues with split incentives—e.g., where the government rents a facility or building owned by a private entity. A split incentive occurs when a facility owner pays for the upgrades, while the renter benefits from lower bills. The facility owner is usually motivated by profit margins alone, and if they do not see a direct increase in profits they are unlikely to implement energy-saving measures that cost capital upfront. Under standard "net leases" tenants are responsible for paying operating expenses, including utility bills. Owners have little direct incentive to enhance energy efficiency when tenants pay the bills. Tenants have little incentive to make capital improvements to a building they do not own. Further, often there is no submetering to assess energy costs to tenants based on their individual usage, so energy costs are allocated by square footage, giving no incentive for operational energy efficiency among multiple tenants. The benefits of one tenant's good efficiency practices are shared with less motivated tenants, and a tenant's waste of energy penalizes careful and careless tenants alike. As a result, potential savings in government buildings and facilities are lost.

In government agencies, high-impact decisions about energy policies and operations are frequently made by individuals with little or no training, experience, or expertise in energy matters. There is also frequent turnover of top-level officials, such as the commanding officers of military bases, which limits institutional memory within upper management. In response, some of the mechanisms developed to help overcome barriers to greater energy efficiency, such as financing, have added to the prerequisite knowledge base of energy managers.

History

Despite the barriers listed above, several successful federal, state, and local programs and policies cost effectively improve energy efficiency and save taxpayers money. Energy-intensity reduction requirements have been the foundation of efforts to promote energy efficiency in the federal government for nearly two decades through legislation, executive orders, and government programs. In addition, federal policy has helped spur state and local governments to implement lead-by-example (LBE) programs.

Programs

The Federal Energy Management Program is a program within the Department of Energy that guides agencies to use funding to meet energy management goals and objectives. FEMP provides services, tools, and expertise to federal agencies to help them achieve their legislated and executive-ordered energy, greenhouse gas, and water goals. These service and tools are delivered through project, technical, and program services (DOE 2012c). FEMP had 570 energy savings performance contracts (ESPC) projects worth $3.9 billion awarded to 25 federal agencies and organizations by May 2011. These projects reduced annual energy consumption by 32.8 trillion Btu and resulted in energy savings of $13.1 billion, of which approximately $10.1 billion went to finance project investments, leaving a net savings of $3 billion, showing that these projects pay for themselves (DOE 2011).

Legislation

Federal buyers are required by the Energy Policy Act of 2005 (EPAct 2005) to purchase products that are ENERGY STAR qualified or FEMP-designated for energy efficiency and low standby power. These products are in the upper 25% of energy efficiency in their class (DOE 2012d).

The Energy Independence and Security Act of 2007 (EISA) sets federal facility energy and water management and benchmarking standards. The EISA Section 432 Compliance Tracking System (CTS) tracks agency performance of energy and water evaluations, project implementation and follow-up measures, and annual building benchmarking requirements (DOE 2012e). EISA also requires federal agencies to reduce energy intensity by 3% per year, or 30% by FY 2015 (compared to an FY 2003 baseline).

The American Recovery and Reinvestment Act of 2009 (ARRA) spurred new energy efficiency projects at the state level in municipal, university, school, and hospital (MUSH) buildings. While the MUSH energy efficiency market was already well established, drawing billions of dollars in energy efficiency investments annually (Bharvirkar et al. 2008), most state energy offices learned a great deal from the process, starting new financing programs and creating the staff expertise for such initiatives. Since the end of ARRA funding, states and localities are looking for new ways to continue efficiency improvements and to sustain the momentum started by ARRA. This is an area where additional resources and support could help achieve significant cost-effective savings since the opportunities at the state and local level are considerable.

Executive Orders

Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, was signed by President George W. Bush on January 24, 2007, to strengthen key goals for the federal government. It set more challenging goals than the Energy Policy Act of 2005 and superseded two previous executive orders, EO 13123 and EO 13149 (DOE 2012f).

Executive Order (E.O.) 13514, Federal Leadership in Environmental, Energy, and Economic Performance, signed on October 5, 2009, by President Barack Obama, requires all federal agencies to establish an integrated sustainability plan to reduce GHG emissions, use water more efficiently, promote pollution prevention and eliminate waste, construct high-performance sustainable buildings, purchase energy efficient and environmentally preferred products, and reduce the use of fossil fuels through improved fleet management.

These federal policies and programs lay a foundation for federal government energy management programs. However, much remains to be done, particularly at the state and local levels, where there are typically fewer financial and staff resources to address energy issues. In addition, energy saving is an ongoing effort and these programs must be sustained and embedded into institutional operations.

Ideal Policy Design

Ideal policies to ensure that governments reduce energy consumption must be comprehensive and help overcome the barriers discussed in the previous section. Successful policies include a variety of designs and implementation methods, including:

- **BENCHMARKING** Establishing a baseline set of energy data is a key action for state and local governments planning to retrofit their facilities. Documenting the baseline energy use of government facilities and identifying patterns of waste strengthens the business case for an energy management program by demonstrating the opportunities for energy cost savings. Benchmarking energy use through tailored or widely available tools such as EPA ENERGY STAR Portfolio Manager ensures a comprehensive set of energy use data that drives cost-effective energy efficiency investments. State officials can use energy data to understand which buildings present the greatest opportunities for energy savings.

- **Comprehensive Energy Efficiency Programs** Programs that focus on whole building projects, not just replacement of pieces and parts, more effectively address areas of energy waste and produce greater energy savings.
- **Long-Term Budgeting** Programs suffer from limited funding, and often agencies are apprehensive of implementing a program that will run out of funding in a year or two. Long-term budgeting and revolving funding mechanisms can help overcome this barrier and encourage federal, state, and local energy efficiency projects.
- **EM&V** All energy projects must lay out the steps necessary to properly evaluate, measure, and verify progress. The plan should include goals and metrics to indicate levels of progress, as well as the tracking, evaluation, and reporting mechanisms that will be used. As discussed above, establishing baseline energy data is a critical component of any energy management program. Once a tracking system is in place, it can be used throughout the project lifetime to evaluate progress.
- **Employee Outreach** Energy management programs depend on the agency employees tasked with its implementation, so the program must gain support from agency personnel. To do so, the program must communicate the multiple benefits of these efforts and recognize program achievements. Throughout the implementation of the energy management programs, efforts should be matched with a well-planned communications and outreach campaign to agency personnel, which can be achieved through training seminars and the dispersal of educational materials. Communications and outreach should extend to stakeholders outside government as well.

In addition, creative financing projects can help governments save energy. The federal government has been a pioneer in using energy service performance contracts (ESPCs). An ESPC is an agreement between a federal facility and an energy services company. ESPCs enable agencies to reduce energy use and costs through private investments. The ESCO designs a project to increase energy efficiency at a facility and then purchases and installs the necessary equipment. In exchange for not having to pay for the equipment, the federal agency promises to pay the company a share of the savings resulting from the energy efficiency improvements. The ESCO is responsible for maintaining the equipment as well as measuring the energy consumption and savings (EPA 2012d).

There are also opportunities to overcome the previously discussed issue of split incentives through financing agreements. Innovative lease language that realigns the allocation of costs, benefits, and financial risks of energy efficiency investments between tenants and owners offers a highly promising approach (Ungar 2012).

Market Impacts

Government energy management programs can advance energy-efficient technologies and practices in the marketplace by promoting energy efficiency in their own everyday operations. Taking actions to improve the energy efficiency of government-owned and government-leased facilities and fleets can accrue multiple benefits for both the government and the people it serves. Energy management programs help to foster markets for energy-efficient products by purchasing highly efficient products to replace appliances and equipment in buildings. In many cases, public facilities and vehicle fleets are the largest energy consumers in the state (National Governors Association 2008). With energy reduction standards for state-owned fleets and facilities, states have the opportunity to encourage future investment in the public and the private sector alike. Such purchases in turn encourage economic development in local and regional communities.

Benefits and Costs

It is extremely difficult to calculate total government consumption of energy at the federal, state, and local level. Many states do not calculate their energy consumption and therefore many state energy management programs and policies require energy measurements. For more detailed information on state-by-state examples of lead-by-example programs, including goals and energy savings, see the ACEEE State Energy Efficiency Database.[25] The federal government has more agencies and policies to promote energy efficiency than do state governments. Energy savings at the federal level are therefore not as difficult to measure and quantify. Local governments are the hardest to calculate because it is difficult to clarify the scope of a local government to prevent double counting. However, the magnitude of implementing government energy and cost savings opportunities is extremely large, and there are many examples of successful programs already being implemented. Table 12 shows the potential energy savings and costs if all governments implemented energy savings starting today.

As Table 12 indicates, the cumulative savings in net present value are double the upfront cumulative national costs. In addition to all the benefits attributed to energy savings, federal, state and local government energy management programs pay for themselves and, possibly, twice over.

[25] The ACEEE State Energy Efficiency Database can be found here: http://aceee.org/sector/stat)e-policy.

Table 12. Costs and Benefits of Federal, State, and Local Government Energy Management

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	1.23	Total energy spending divided by the average price of energy in 2030 based on the projections from EIA 2012c for federal, state and local governments. Sources for the energy spending are below
Energy Benefits	% of market affected by policy	100%	
	Average % energy savings	20%	This policy assumes that all governments adopt a 20% savings goal by 2030 starting now. This does not include the current federal government goal of 30% by 2015 or any state or local lead by example goals.
	Total energy savings (quadrillion Btu)	0.24	This is 20% of the total energy consumption for federal state and local governments ($35 billion)
Additional Benefits	Reduced emissions and water use. Also, some efficiency measures can reduce maintenance costs or increase in employee productivity.		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)	$25.82	This is 20% of the total annual spending on energy for federal state and local governments ($35 billion). Energy prices from EIA 2013. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$12.74	$260 million per year for states (2008$) from state scorecard; 868,062,000 (2011$) EERE investment in EE from international scorecard. Assumes 5% discount rate.

Outlook

Historically, appropriated funding for energy-efficiency improvements has fallen far short of what is necessary to meet energy reduction targets, even in years like 1995 or 2005 when appropriations for these projects were relatively high. The balance must be made up by alternative financing, namely energy savings performance contracts and utility energy services contracts (UESCs). This trend will likely continue. Meeting current energy-intensity requirements could easily require an investment of $10 billion through 2015, more than $1 billion per year. Given current appropriations levels of about $300 million per year, there could be a cumulative funding shortfall of as much as $7.5 billion over the next eight years. ESPCs and UESCs will be called on to fill the gap.

When applied, investments in ESPCs and UESCs have resulted in 32.8 trillion Btu and an energy savings valued at $13.1 billion. These cost savings resulting from the energy management programs not only proves that these programs pay for themselves but are net positive, providing additional billions of dollars in savings to the government and the tax payers.

Federal government energy efficiency goals are set to expire in 2015. EISA requires federal agencies to reduce energy intensity by 3% per year, or 30% by FY 2015 (compared to an FY 2003 baseline). Additional, more aggressive goals will help not only reduce consumption in federal, state, and local governments but will also help increase market penetration of efficiency measures and products.

Therefore we recommend that the federal government implement aggressive efficiency goals after the 2015 expiration.

In addition, many states already have state lead-by-example and energy management programs for public buildings, but only a handful have implemented energy efficiency policies for fleets and facilities more broadly. We recommend that more state and local governments implement energy measurement programs to obtain energy data on their buildings, fleets, and facilities.

We also recommend that state and local governments implement energy savings goals and targets with benchmarking to help them achieve energy savings and reduce overall government waste. Better information enables people, businesses, and government to make smarter decisions and identify where energy is being wasted. Many cities and states have already implemented benchmarking and building labeling programs to measure and report on energy use in buildings. These are proven policies that increase transparency, improve the quality of available data, and better identify energy and money savings opportunities.

6. Precommercial Research & Development

Introduction

Science and technology are key drivers of economic growth and improved health and quality of life in the United States and throughout the world. Economists estimate that up to half of U.S. economic growth over the past five decades is due to advances in technology (Clemins 2012). Innovation in energy efficiency includes high-efficiency vehicles, appliances, manufacturing equipment, buildings, and much more. We have seen historically that there are places in the innovation process where market risks inhibit innovation. For example, a key market failure is the disincentive to invest in precommercial research, development, and demonstration (RD&D) because of the risk of others copying the technology. Government funded precommercial research and development removes that risk and several others, helping to foster innovative research and new technology and help make them viable options on the market. Government energy efficiency RD&D programs have helped to improve the energy efficiency of buildings, industry, and transportation. This chapter examines RD&D programs and the benefits they have provided to the energy efficiency sector.

Precommercial RD&D

Background

Technological innovation has historically been central to U.S. prosperity and leadership on the world stage. The United States fosters a market system that allows a free flow of ideas and capital. Of all the sectors in the economy where innovation has a critical role to play, the energy sector stands out. Access to reliable and affordable energy is not only vital for the functioning of the U.S. economy, it is vital to people's everyday lives. Energy access significantly impacts the nation's national security and environmental well-being. Historically, businesses, entrepreneurs, and researchers have worked to create new and revolutionary technologies in every economic sector. But while businesses have driven much of this progress, targeted public support has also been crucial (Lohr 2012). The federal government has an integral role to play in advancing energy research, development, and demonstration (RD&D).

Emerging energy efficiency technologies hold promise in increasing the efficient use, production, and distribution of energy. Advances in technology and policy are expected to provide a wide array of energy efficient options, such as smart appliances, solid-state lighting, smart web-based controls, ability to monitor energy use through the Internet, and the ability to recover wasted energy for distributed generation.

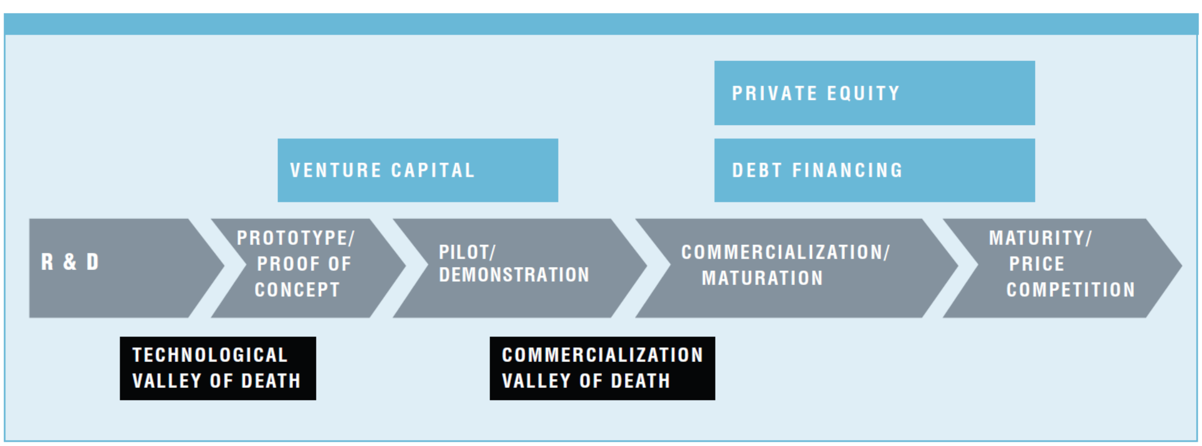
Precommercial government RD&D is meant to help reduce the risk of investing in energy technology innovation and therefore speed up the technology's rate of adoption. RD&D is critical to advancing energy efficiency by promoting the creation, development, and commercialization of new, energy-efficient technologies and practices. At the most basic level, government can help foster an environment that is conducive to the creation, development, and commercialization of new ideas and technological advances by reducing some of the embedded risks in an unproven technology. A diverse set of institutions, including federal and state governments, universities, and utilities, fund and implement RD&D programs to advance energy efficiency. Such programs include development of energy-saving technologies and demonstration through public/private partnerships.

Barriers Addressed by Policy

Government-funded RD&D efforts can address a number of barriers that impede the introduction of new, energy-efficient technologies and practices. Private industry investments can be too fragmented to fund significant energy efficiency innovation in a particular sector. Also, deployment time frames may be too long or investment risk may be too great for any one business. Competitive and financial market pressures make it increasingly difficult for the private sector to take full responsibility for long-term RD&D. Industry can benefit from government and institutional RD&D efforts that provide a nonproprietary knowledge base, specialized resources, and risk sharing.

As described in the Breakthrough Institute's report, *Bridging the Clean Energy Valleys of Death: Helping American Entrepreneurs Meet the Nation's Energy Innovation Imperative*, there are five stages of technology development, and each phase involves a set of public and private actors working to develop and finance innovative technologies (Jenkins & Mansur 2011). The report identifies two barriers to energy technology during its development stages (two "Valleys of Death"). The barrier to precommercial technology, the "Technological Valley of Death," occurs after the initial R&D phase, when technology innovators seek further capital to develop precommercial products from laboratory research and prove market viability (Jenkins & Mansur 2011). Figure 8 shows where the Valleys of Death are in the technology development time frame. These barriers exist because of a perception of risk, and as a result many innovative ventures fail to reach commercialization, preventing customers from choosing more efficient technology and products. Effective public policy can help overcome these barriers.

Figure 9. The Energy Technology Innovation Cycle



Source: Jenkins and Mansur 2011.

History

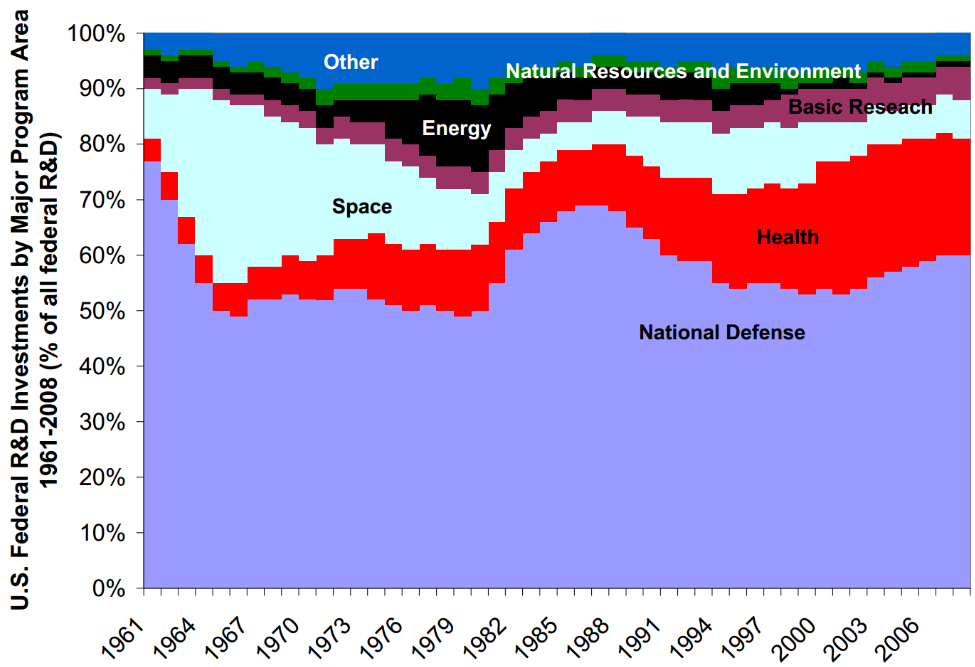
The U.S. government has a long and successful history of supporting publicly funded RD&D projects that foster the development of new technologies. In the nineteenth century government scientists mapped out natural resources and army officers surveyed routes for railroads, including helping to plan and sometimes to manage construction. In the early and mid-twentieth century, the government engaged in rural electrification programs and massive public works projects. NASA, for instance, developed methods to enhance mobility and connectivity in the United States, contributing to the development of new technologies and industries. Ultimately these investments spread transportation, telecommunications, and public health advances across the country.

Broad-based government support for science and technology RD&D did not fully emerge until World War II, when policy makers became concerned that the United States was lagging behind Britain and Germany in development of military technology. This realization spurred government support of technologies and scientific enterprises with considerable success, largely for the military. At the start of World War II almost all of America's scientific and technological talent was in universities and industry, but in a war environment the U.S. military had to harness the scientific and engineering knowledge of its entire population. The federal government established a number of ad hoc university-based RD&D organizations around specific technological programs such as radar, the computer, and the atomic bomb. With the war's end, there was concern among defense policy makers that these innovation programs would dissipate, and with the geopolitical threat of the USSR military preparedness became the cornerstone of American postwar technology policy.

Since then the U.S. government has played an integral role in the development of groundbreaking technologies. One of the most famed examples of government-supported innovation is the Defense Advanced Research Projects Agency (DARPA), which created a distributed network of computers called Advanced Research Projects Agency Network (ARPANET), laying the early foundation for the Internet. The visible hand of government was there to nurture the Internet's development when there were few incentives and little market rationale to support it.

Despite the proven effectiveness of government RD&D, the federal government's spending on energy RD&D has historically accounted for a relatively small proportion of total federal spending on all RD&D (Figure 9), even when defense-related spending is included (Dooley 2009). Spending on energy RD&D includes energy efficiency, renewable energy technology, fossil fuels, nuclear energy, and basic energy sciences. Federal RD&D spending on end-use efficiency began in the mid-1970s. A federal RD&D program on efficient end-use energy technology was created by President Ford in 1975 and was then absorbed by DOE upon the latter's creation by President Carter in 1977. The peak share of energy RD&D spending between 1961 and 2008 was from 1977 to 1981, when energy spending was 10% of total RD&D spending (Dooley 2009).

Figure 10. U.S. Allocations of Federal R&D by Major Focus Area



Source: Dooley 2009

Historically, funding for government energy efficiency RD&D has only made up around 10% of total energy RD&D funding (approximately $1.1 billion in 2011). Over the last 65 years, cumulative funding for energy efficiency RD&D was $18.79 billion (2011$) and total funding for energy RD&D was $193.97 billion, only a fraction of total government RD&D budgets (Sissine 2012).

Ideal Policy Design

If the United States is to realize the full potential for energy efficiency we must substantially increase investment in energy efficiency innovation (Laitner et al. 2012). The United States cannot remain competitive in the global energy marketplace without increasing federal support for energy innovation across the entire innovation continuum, but particularly at the Valley of Death points. RD&D investment in energy efficiency technologies must be brought closer to the levels typical of other technologically intensive sectors, nearly all of which receive more government RD&D investment than energy (OMB 2012). Energy efficiency investment would benefit from being doubled to $2 billion per year. Some examples of government RD&D programs and policies that have been successful in the past are described in the following sections.

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense. NSF had an annual budget of about $6.9 billion in FY 2011, and it provides funding for approximately 20% of all federally supported basic research conducted by colleges and universities (NSF 2012). NSF allocates funding through competitive merit reviews, and funding for research in mathematics and science went to nearly 2,000 institutions, primarily academic, across the country. NSF is an example model of how the government can allocate funding for energy efficiency RD&D.

The DOE energy efficiency programs, managed by the Office of Energy Efficiency and Renewable Energy (EERE), continue to make important contributions toward increasing the efficiency of buildings, appliances, vehicles, and industries across the United States. EERE consists of ten programs and several offices that support the office and its mission. EERE programs support research and development of energy efficiency or renewable energy technologies.

In the industrial area, DOE has been particularly successful in partnering with manufacturing trade associations to co-fund RD&D through the Industries of the Future Program (IOF), which focuses on major technical barriers identified by the industries involved. For instance, IOF has successfully targeted areas that are priorities for industry and worked with industry in selecting and directing research on them. These efforts help ensure that industry is poised to quickly implement the results of the research (Elliott 2009). The National Academies singled out this approach as an example of the most effective RD&D approach. Though the DOE has abandoned this approach in recent years, the idea of involving the target market for the research in directing and co-funding it increases the impacts of the results (National Research Council 2007).

The Advanced Research Projects Agency – Energy (ARPA-E) is an agency within DOE that has funded the development and deployment of transformational and disruptive energy technologies and systems since 2009. The America COMPETES Act of 2007, signed into law by President George W. Bush, authorized the establishment of ARPA-E within the DOE, but ARPA-E did not come into existence until early 2009, when it received $400 million through the American Recovery and Reinvestment Act of 2009. ARPA-E focuses on high-risk concepts with potentially high rewards. The mission of ARPA-E is to overcome long-term and high-risk technological barriers in the development of energy technologies between laboratory research and development of commercial products. To achieve this mission, ARPA-E aims to enhance the economic security of the United States through the development of energy technologies and to help ensure that the United States maintains a technological lead in developing and deploying advanced energy technologies. ARPA-E was appropriated $275 million for FY 2012 (ARPA-E 2012).

Market Impacts

RD&D does not in and of itself save energy, but with government RD&D the Valleys of Death previously described can be overcome and new technologies can become cost competitive sooner and increase savings by being deployed earlier. DOE's programs work to reduce technical risk, reduce market risk, and accelerate the introduction of the technology into the marketplace. DOE RD&D and support for efficiency research has resulted in a number of key efficiency technologies for buildings, including high-efficiency refrigerators, compact fluorescent and electronic-ballast lighting technologies, and low-emissivity windows (Auffhammer and Sanstad 2011). Similarly, the technologies supported by DOE's IOF program have contributed to the revitalization and modernization of U.S. manufacturing, e.g., in the steel industry (Laitner et al. 2012). Without these government RD&D programs, many of these savings would not have been realized or would have taken decades to come to market.

Benefits and Costs

Measuring the direct impacts of federally funded RD&D in universities and agencies on the economy and society is a complex task and it is even more complex to attribute energy savings to RD&D programs. Though there are several indicators that show the successful projects have justified expenditures in RD&D many times over. The National Research Council (NRC) has done a series of studies over the last decade analyzing the success of federal RD&D efforts and funding using a variety of indicators (NRC 2007). They found that DOE-sponsored research resulted in large commercial successes such as advanced refrigerator compressors, electronic lighting ballasts, and emissions control technology. There are instances where RD&D expenditures did not result in commercial energy technology. Despite some of the failures there many programs are successful and the future payoffs (i.e. costs savings from energy efficiency gains) from surviving programs significantly outweighed the failures.

Energy efficiency RD&D programs represent a wide array of sectors and sizes and therefore it is difficult to identify an ideal funding level. NRC estimated that the total realized economic benefits associated with the energy efficiency programs were in the $30 billion range (valued in 1999 dollars), substantially exceeding the roughly $7 billion (1999 dollars) investment for energy efficiency RD&D over the 22-year life of the programs (NRC 2001). This shows that the, total energy cost savings greatly outweigh the upfront costs. Table 13 estimates the future energy savings and cost savings from DOE energy efficiency RD&D programs in to 2030.

Table 13. Costs and Benefits of Federal Energy Efficiency Funded Precommercial RD&D

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	104.31	Total End use energy Consumption in the U.S. in 2030, not including power sector (EIA 2012c).
Energy Benefits	% of market affected by policy	100%	
	Average % energy	0.71%	
	Total energy savings (quadrillion Btu)	0.65	Total energy saved from Nadel & Geller 2001 with ramp-up over 17 year period
Additional Benefits	Reduced technical risk; reduced market risk; accelerated introduction of technology into the marketplace.		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)	$29.59	Energy prices from EIA 2013. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$12.40	Average spending on EE RD&D (Sissine 2012). Assumes 5% discount rate.

Outlook

The benefits of RD&D are large relative to the cost, particularly when some of the most effective research can be co-funded by the targeted industries that stand to benefit from the new technologies and practices. However, in the current tight fiscal climate funding for public goods such as energy efficiency RD&D can fall prey to the budget knife. Even in these challenging fiscal times, however, underfunding energy innovation is a mistake. Supporting energy efficiency innovation is not a cost to the taxpayer; it is an investment in the future. To remain competitive and to attract businesses and scientific talent, the United States needs to bolster its scientific innovation.

As stated above, approximately $1.1 billion was spent on federal energy efficiency RD&D in 2011. Investments in energy efficiency RD&D in the past have saved around $30 billion in avoided energy expenditures. Over the last 65 years the cumulative funding for energy efficiency RD&D has been $18.79 billion (2011$), while total funding for energy RD&D has been $193.97 billion, which is only a fraction of total government RD&D budgets (Sissine 2012). We recommend that the United States invest a greater percentage of its RD&D budget into energy efficiency technology because these investments help to reduce long-term energy bills and improve the competitiveness of the U.S. economy.

Federal RD&D programs are also complemented by policy measures such as tax incentives encouraging early adoption of advanced technologies by consumers, efficiency standards for energy-using equipment, and production tax credits for advanced energy sources. We recommend that complementary policy be deployed in addition to enhanced federal RD&D.

7. Financing Energy Efficiency Investments and Improving Mortgage Underwriting

INTRODUCTION

Several factors make this an appropriate time to promote energy efficiency financing. In the current economic environment, consumers and businesses are often experiencing capital constraints and could benefit immensely from opportunities to make the installation of cost-saving efficiency measures financially accessible. In this era of fiscal austerity these programs can be designed in cost-effective ways that do not require direct federal stimulus. While financing in and of itself is not sufficient to scaling energy efficiency investment, innovative and attractive financing mechanisms are a cost-effective way to stimulate activity in the marketplace.

This chapter first addresses the availability of financing for reducing first-cost barriers to investing in energy efficiency. It then discusses the incorporation of energy costs into mortgage underwriting to improve the availability and affordability of energy-efficient housing.

CAPITALIZING ENERGY EFFICIENCY INVESTMENTS

Background

Capitalizing energy efficiency projects, particularly in the current economic environment, can pose a significant challenge. While energy efficiency improvements are often cost effective in the long run, challenges to adoption and implementation include high initial costs, budgetary and debt constraints, and split-incentives in multitenant properties between those who pay for measures and those who receive the benefits. Fortunately, over the past several years numerous strategies and mechanisms to reduce upfront cost barriers to energy efficiency improvements have emerged and are experiencing increased popularity and adoption.

Financing for energy efficiency is an attractive option for capitalizing efficiency projects because there are opportunities to leverage private capital and reduce the need for government subsidies. While there is limited experience and a need for standardization of energy savings and loan performance data collected from existing programs, the evidence suggests that energy efficiency loans are low risk and could attract investors within a secondary market. ACEEE reports have found that energy efficiency lending products to date have had low default rates—generally between 0–3% (Hayes et al. 2011).

The Rockefeller Foundation and Deutsche Bank estimate that private-sector entities could invest more than $279 billion across the buildings sectors. Such investment would generate more than $1 trillion in energy savings over 10 years and create 3.3 million jobs (Rockefeller and Deutsche Bank 2012).

In this section, we provide a brief description of innovative mechanisms and structuring schemes for financing efficiency and outline some policy approaches that remove barriers to adoption and implementation.

Barriers Addressed by Policy

There are many barriers to getting this market to scale, including limited availability of financing (particularly for hard-to-reach markets), and in cases where financing is available it can be difficult and expensive to encourage adoption, due in part to high risk premiums and interest rates. Many innovative approaches are being piloted, and it is important to encourage those that have the most promise to overcome structural barriers in existing real estate and lending markets. Access to private-sector capital and the emergence of energy efficiency finance projects in secondary markets are essential to the sustainability and scaling of emerging and existing programs.

Mechanisms for financing energy-efficient improvements span residential, commercial, MUSH (municipalities, utilities, schools, and hospitals), and industrial markets with varying degrees of success. Many, particularly on-bill financing, have tremendous potential to provide financing to traditionally underserved markets, including low- and moderate-income, multifamily, and small business sectors. Innovative structuring, in the form of leases, service agreements, and property tax financing, has also helped provide incentives for adoption in challenging markets.

Additionally, many program models are administered by or in partnership with institutions that have little experience with consumer lending laws and regulations, and they may become more willing participants with technical assistance and regulatory support.

It is important to note that the funding and establishment of financing mechanisms alone will not be sufficient to scaling the market. It is also important to identify structural barriers to investment such as split incentives and debt constraints in the real estate market and to identify opportunities to work within these constraints. An additional challenge is driving demand, which can be boosted by requiring reporting and benchmarking of buildings' energy use and the associated costs to owners and occupants.

History

Financing programs are a means of reducing upfront costs for energy efficiency improvements. Many existing energy efficiency financing programs incorporate elements such as attractive lending terms and creative marketing to encourage adoption.

Financing programs for energy efficiency have been a trending area of interest since the 1980s. Until recently these programs have been relatively small, and program participation rates are generally low. According to Hayes et al. (2011), the percentage of total customers in the classes served by programs compared to the total number of program participants reveals that only two programs had rates that exceeded 3% of the customers targeted by the programs, and more than half of the programs had participation rates below 0.5%.

Ideal Policy Design

The majority of policy activity to provide energy efficiency financing incentives is occurring at the state and local level. Effective policies that can be implemented at this level include setting energy standards that encourage efficiency; establishing public benefit funds and loan-loss reserves to assist programs in providing attractive financing terms, such as low interest rates and no money down, and mitigating default risks; and enabling utilities to offer voluntary tariffs for financing energy efficiency improvements.

This section examines federal policy approaches for promoting specific financing mechanisms as well as recommendations for helping the market grow.

Financing Mechanisms

1. Property Assessed Clean Energy (PACE)

Description: Property Assessed Clean Energy (PACE) legislation enables municipal governments to offer a specific bond to investors, and to subsequently loan the money to consumers and businesses for energy efficiency improvements. The loans are repaid through an annual assessment on the borrower's property tax bill. PACE legislation, first introduced in Berkeley, California, in 2008 and since adopted by 26 states (DSIREUSA 2012), overcomes several recognized barriers to the adoption of energy efficiency: high first costs, high transaction costs involved in identifying and financing projects, and payback times that often exceed expected occupancy.

Target Markets: PACE can be used in residential, commercial, or industrial markets. Most recent activity has been concentrated in commercial markets due to regulatory barriers.

Key Barriers: In 2010, the Federal Housing Finance Agency (FHFA) prohibited Fannie Mae and Freddie Mac from purchasing mortgages with PACE assessments on them, effectively blocking the establishment and implementation of residential PACE programs. This move was made due to concerns that PACE liens may materially increase risk to Fannie Mae and Freddie Mac's portfolios. Yet the impact of PACE on home values and homeowners' cash flow remains unclear. Furthermore, the evidence suggests that energy efficiency upgrades increase the value of the home, and that energy savings enhance homeowners' ability to repay debt obligations (NRDC et al. 2012). FHFA's final rule, which will determine the future of residential PACE, is due in spring 2013.

Another major debate surrounding both commercial and residential PACE is whether it is necessary for the mortgage lender to give consent to property owners before the owner takes on a PACE assessment. In a PACENow lender support study, surveyed lenders unanimously agreed that consent was essential, citing that many loan documents require notification of alterations to property as well as reserves and guarantees for alterations, completion guarantees, and escrow of assessment payments. Lenders that have provided approvals for PACE assessments have verified that generally the projects have been small relative to the building value, about 1–2% of the property value, and were an "insignificant" risk to the mortgage (PACENow 2012).

Policy Approaches: To move forward with residential PACE programs, it is essential to work with FHFA to identify acceptable underwriting criteria to establish pilot programs, and to track financing performance as programs are implemented. H.R. 2599, the PACE Assessment Protection Act, was introduced in the House in July 2011. The bill reinstates residential PACE and provides underwriting criteria and consumer protections that directly address FHFA's initial concerns. As reported in PACENow, these requirements include:

- Homes must have 15% or more positive equity to qualify.
- Projects are limited to 10% of the home value.
- Prohibits acceleration of non-delinquent payments.
- Projects must show a positive cash flow savings compared to the cost of the PACE investment; i.e., the estimated utility bill savings must exceed the assessment payments.
- Requires an energy audit or feasibility study prior to approval.
- Requires that the work must be performed by accredited professionals.
- Requires that, prior to levying a PACE assessment, the local government must determine that there are no signs of an inability to pay (PACENow 2011).

H.R. 2500 has received bipartisan support from 55 co-sponsors (OpenCongress.org 2012).

Standardization of PACE programs will also help PACE gain lender support. Regulators with experience in commercial lending can help to identify standards that minimize risks to lenders.

2. On-Bill Financing

Description: On-bill financing allows utility customers to invest in energy efficiency improvements and repay the funds through an additional charge on their utility bill. If structured properly, an on-bill program can substantially improve access to financing and its cost. In many cases, energy savings are sufficient to cover the monthly payments for the financing, so that the total monthly charge on utility bills is less than or equal to the preinvestment amount. Capital for on-bill programs comes from a variety of sources, including utility ratepayer funds, public benefit funds, and third-party financial institutions. Recently, programs capitalized through third-party financial institutions, often referred to as on-bill repayment programs, have started to emerge and are becoming more popular.

Currently, at least 24 states are home to utilities or other parties that have implemented or are about to implement on-bill financing programs, many of which (Illinois, Hawaii, Oregon, California, Kentucky, Georgia, South Carolina, Michigan, and New York) have legislation in place that supports adoption in various ways. Some states, such as Illinois and California, require utilities to implement on-bill programs. Other states remove barriers to implementation by allowing a tariff for energy efficiency services or financing to be collected through utility billing. In New York, legislation allows utilities to receive funding to update their billing systems. Additionally, a number of state utility regulators have taken action to explore the feasibility of on-bill programs.

Some on-bill programs are overcoming split incentives in multifamily spaces and driving deeper retrofits in owner-occupied buildings by structuring their products as tariffs. A tariff can refer to any number of rates or charges imposed by a utility. Tariff financing is thus a type of on-bill financing structure. On-bill tariffs are a mechanism for charging customers for energy efficiency investments or upgrades provided as a service by the utility. On-bill tariffs assign a financial obligation to a property (often by tying the service to the building's meter), allowing the receivables incurred from the investment or upgrade to transfer to subsequent owners or renters. In many states tariffs are not considered loans and thus are subject to different laws and regulations. In addition, tariffs address gaps in energy finance for rental customers and also allow the flexibility to match financing terms to the extended payback period for some energy efficiency improvements (Fuller 2009).

On-bill tariff programs can be attractive to utilities, since they often do not have to stray too far from their business model in order to implement them. The process for imposing a voluntary tariff is one that may be familiar, and the product does not necessarily have to offer debt to consumers. Such a distinction can be necessary for a municipal utility that is statutorily prohibited from lending to its ratepayers (Bell 2011).

Target Markets: On-bill financing can be used in residential, commercial, and industrial markets. Currently, residential and small commercial programs are the most common. On-bill tariffs can aid in overcoming split incentives in both market-rate and low-income multitenant spaces. In addition, these products could also encourage deeper retrofits by providing longer payback periods in commercial and residential markets.

Key Barriers: On-bill financing requires program administrators to take on some characteristics of lending institutions, which potentially subjects them to consumer lending laws. These entities may not have the human resources to navigate or find it costly to comply with these complex laws, which vary by state.

While tariff programs are seeing increased adoption, there is a degree of uncertainty as to whether they might be flagged for posing consumer protection concerns, particularly since many of these products are securitized with utility disconnection in the event of nonpayment.

Policy Approaches: A key approach to supporting on-bill financing programs is to provide technical assistance for compliance with consumer lending laws, and to ensure that these energy-saving programs are given the tools to remain viable in the changing financial regulatory landscape. Coordinated efforts between the Department of Energy and financial regulators such as the Consumer Financial Protection Bureau, the Federal Deposit Insurance Corporation, the National Credit Union Administration, the Federal Housing Administration, and the Federal Reserve Board of Governors could facilitate these desired outcomes.

In addition, bringing sufficient third-party capital to scale this market has been a slow process. Leveraging federal funds as credit enhancements such as loan-loss reserves could play a key role in driving private-sector activity in the market.

It is also essential, as initial programs are offered, to encourage the states to experiment and evaluate their programs so that all can learn from their experience.

3. Energy Service Agreements

Description: Energy Services Agreements (ESAs) and Managed Energy Services Agreements (MESAs) are contracts that allow energy services providers to provide upfront costs for the installation of energy efficiency measures. Repayment terms are predetermined and can be based on the cost-per-avoided-unit of energy, historical energy usage, or a proportion of the monthly utility bill.

Target Markets: Target market agreements work well for large commercial and industrial projects. There are fixed transaction costs that make the business case challenging for smaller projects.

Key Barriers: The Dodd-Frank Act, passed in July 2010, brought significant changes to the financial regulatory landscape. A key focus of the act is to close loopholes in areas of financial supervision, including regulation of the shadow financial services industry. These provisions have called attention to the use of off-balance sheet accounting practices and could lead to significant restrictions on companies that are eligible to leverage them as well as impose additional reporting requirements. Furthermore, companies providing such financial services could eventually be designated as "nonbanks" and become subject to new regulatory requirements. Compliance costs for these and other provisions might impose an insurmountable barrier to tapping the benefits of this innovative source of financing.

Policy Approaches: Exempting ESAs and MESAs from regulatory action that would halt off-balance sheet accounting practices that cause material risks to the financial system would limit the unintended consequences to financing efficiency resulting from regulatory reform. It is important to set criteria and standards akin to those proposed for PACE to mitigate risk.

Increasing the Flow of Private Capital

Credit Enhancements and Securitization

Description: Part of the appeal of energy efficiency financing programs from a policy perspective is that they do not necessarily depend on direct subsidization by the government. Yet the government can play an active role in scaling programs by catalyzing access to private-sector capital, which is likely essential to the sustainability and scaling of emerging and existing programs through several policy mechanisms.

Key Barriers: Representatives of commercial banks have indicated that an absence of reliable, standardized, aggregated data on the performance of energy efficiency programs, including energy savings and loan performance data, is a major obstacle inhibiting investment in this market. As a result, where capital is available, interest rates are often greater than 10% due to risk premiums.

While a September 2011 ACEEE study found that default rates on energy efficiency loans generally range from 0–3%, this data was from a limited number of programs and often reflected payment histories of only a few years and not the entire term until the loan was paid off. As a result, private-sector financiers are still hesitant to invest in what could be a risky market.

Policy Approaches: Financing programs that are confident about customer repayment can signal the value and security of the investment opportunity to financial stakeholders by making use of credit enhancements provided by federal, state, or local government, or by utilities. While direct stimulus funds such as the ARRA monies no longer available, loan-loss reserve funds provided by the Department of Energy could induce private-sector participation by boosting investor confidence in the market. Credit enhancement could be critical for stimulating activity in bond financing, which is a growing source of capital for this market. We recommend loan-loss reserves instead of loan guarantees so that the private sector retains some risk.

Additionally, requiring standardized reporting on energy savings and financial product performance from programs receiving stimulus from government agencies could provide important information that would aid formation of secondary markets for energy efficiency loans.

Currently, the Department of Energy is developing protocols for standardized reporting on building performance. The DOE's Buildings Performance Database, which should be launched in spring 2013, will be a publicly accessible database intended to support decision making on investments in building efficiency improvements by providing empirical data on the actual energy performance of commercial and residential buildings. This information could be an important driver for investment in the market. However, it is also essential for potential investors to have access to financial and project performance data in order to scale the market. Cooperation and coordination with entities attempting to set standards for this type of data collection, such as the Environmental Defense Fund's Investor Confidence Project could expedite market transformation.[26]

Market Impacts

The market impacts of energy efficiency financing will vary significantly depending on program design, implementation, targeted measures, and consumer adoption. A recent ACEEE report on the long-term potential of energy efficiency suggests that cost-effective energy efficiency investments have the potential to reduce U.S. energy usage by 40–60% and support 1.3 million jobs by 2050 (Laitner et al. 2012).

Benefits and Costs

The benefits and costs of financing programs will vary substantially depending on the incentives and structure of financial products, implementation, adoption, project performance, and a number of other factors. A Rockefeller Foundation and Deutsche Bank (2012) report estimates the market potential, as shown in Table 14:

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[26] See http://www.eeperformance.org/.

Table 14. Costs and Benefits of Energy Efficiency Financing

	Costs & Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	47.80	EIA 2012c
Energy Benefits	% of market affected by policy	32%	Rockefeller and Deutsche Bank 2012
	Average % energy savings	20%	Rockefeller and Deutsche Bank 2012
	Total energy savings (quadrillion Btu)	3.03	Rockefeller and Deutsche Bank 2012 extrapolated to 2030.
Additional Benefits	Enhanced building comfort and affordability of energy.		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)	$222.48	Energy prices from EIA 2013. Assumes 5% discount rate.
	Present value of national total cost (for 2014-2030 (billion 2011$)	$160.22	From Rockefeller and Deutsche Bank 2012 with investments spread over 16 years (first 2 year ramp up that totals an additional year). Assumes 5% discount rate.

Outlook

While we are experiencing a period of rapid innovation and experimentation in energy efficiency finance, there continue to be significant barriers preventing these financing mechanisms from achieving scale. Since ARRA and other public-sector sources of funding are ending, many of the most innovative program models, which could be poised to transition to more market-based financing, are at risk. Additionally, many program models are administered by or in partnership with institutions that have little experience with consumer lending laws and regulations, and may become more willing participants with technical assistance and regulatory support. Furthermore, uncertainty within the financial regulatory landscape is a major risk to the innovations that make energy efficiency financing programs cost effective and attractive. Thus, it is essential for collaboration between regulators and program designers and implementers to ensure the availability of viable, safe, and effective financing products on the market.

To date, large commercial banks and other large-scale private entities have engaged very little in this market, but there is evidence to suggest increasing interest. ACEEE's 6th Annual Finance Forum saw a record 250 participants and excellent representation from notable private-sector institutions such as Citibank, Deutsche Bank, JPMorgan Chase, Wells Fargo, Bank of America, and US Bank, as well as other private institutions such as community development financial institutions (CDFIs) and credit unions.

It is important to note that availability of financing options does not necessarily guarantee demand. They are one tool in the toolkit for scaling investment in energy efficiency, and have been shown to be most effective when coupled with credit enhancement and additional incentives such as loan-loss reserves and interest rate buydowns (Borgeson et al. 2012; Hayes et al. 2011).

INCORPORATING ENERGY COSTS INTO MORTGAGE UNDERWRITING

Background

Energy and transportation costs account for a significant proportion of a household's budget. Yet these costs are not accounted for when assessing an applicant's ability to pay a mortgage. The average homeowner spends over $2,000 each year on energy costs, more than on either real estate taxes or home insurance, both of which are regularly accounted for in mortgage underwriting. And the average costs for transportation exceed $10,000 a year.

The Sensible Accounting to Value Energy (SAVE) Act[27] would improve the accuracy of mortgage underwriting used by federal mortgage agencies by requiring federal loan agencies to include projected energy costs when reviewing financing for a house, reduce the amount of energy consumed by homes, and facilitate the creation of energy efficiency retrofit and construction jobs (IMT 2011). These efforts could result in more accurate mortgage values on properties that are more energy efficient (Plautz 2011). The SAVE Act addresses only utility energy costs; transportation costs should be included as well, not only to increase location efficiency but to open up the housing market and to make home loans less likely to default.

Barriers Addressed by Policy

Currently, energy costs and the impact of potential energy savings are ignored in financing decisions. Homes with high and low operating costs are treated the same during underwriting, even though risks to the lender are higher in homes that will incur higher energy bills.

Understanding the impacts of utility and transportation expenses on household finances and the ability to make mortgage payments will help lenders identify and measure the value of investment in energy efficiency and obtain a better sense of a home's value (NRDC et al. 2012). Legislation such as the SAVE Act could potentially drive growth in energy-efficient home construction and retrofits, and would make low-energy-use homes more attractive to potential purchasers.

History

Senator Michael Bennet (D-CO) and Senator John Isaakson (R-GA) introduced the SAVE Act on October 19, 2011, to the Senate Banking, Housing, and Urban Affairs Committee. The bill directs the Department of Housing and Urban Development (HUD) to issue guidelines for Fannie Mae, Freddie Mac, and the Federal Housing Administration (FHA) for accounting for the expected cost of energy savings during the loan application process. No further action has been taken on the bill.

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[27] S.1737 in the 112th Congress.

On July 9, 2012, the Natural Resources Defense Council (NRDC), Institute for Market Transformation (IMT), Alliance to Save Energy, Environmental Defense Fund (EDF), and ACEEE submitted joint comments to the Consumer Financial Protection Bureau (CFPB) on Regulation Z, also known as the Truth in Lending Act. The comments urged the agency to consider the adequacy of the conventional debt-to-income ratio (DTI) as a measure of a loan applicant's ability to repay a mortgage loan, and suggested that the agency lead a project with federal mortgage agencies to determine how homeowner utility and transportation expenses relate to the ability to pay using historical loan information. The comments also recommended that the agency require federal mortgage agencies to collect an estimate of utility and transportation expenses for loan applicants for analysis at a later date (NRDC et al. 2012).

Ideal Policy Design

The current legislation has two components: the Affordability Test and Loan-to-Value Adjustment. The Affordability Test requires lenders to incorporate estimated energy costs with other recurring payments in the debt-to-income qualifying ratios. The Loan-to-Value Adjustment requires lenders to add the net present value of estimated energy savings to the loan-to-value ratio calculation (IMT 2011).

Energy costs can be determined in two ways. One is a baseline calculation based on the average per-square-foot energy cost for properties of that building type in that region, which can be derived from the Department of Energy's Residential Energy Consumption Survey (RECS) database; the second is an optional, qualified independent energy report of the subject property (IMT 2011).

It also makes sense to explore the impact of transportation costs on affordability to ensure more accurate underwriting and encourage location-efficient development and the market for fuel-efficient vehicles.

Market Impacts

A typical new home that is 30% more energy efficient than a similar-sized average house will save about $20,000 in utility expenses over the life of a mortgage. Under the SAVE Act, the increase in value could be approximately $10,000 since appraisers would be required to add savings to the current market valuation of the house (Harney 2011).

Legislation such as the SAVE Act could potentially drive growth in energy-efficient home construction and retrofits. Presumably, this activity would create 16,000 annual jobs and $95 million in annual energy savings in 2015 (IMT and ACEEE 2011). Improved mortgage underwriting that accounts for the actual costs of homeownership could also increase the safety and soundness of the financial system more broadly.

Benefits and Costs

Table 15. Costs and Benefits of Incorporating Energy Costs into Mortgage Underwriting

	Costs and Benefits	2030	Assumptions & Sources
Reference Case	Affected source energy use (quadrillion Btu)	11.14	EIA 2012c
Energy Benefits	% of market affected by policy	12%	IMT and ACEEE 2011
	Average % energy savings	16%	IMT and ACEEE 2011
	Total energy savings (quadrillion Btu)	0.22	IMT and ACEEE 2011
Additional Benefits	Underwriting improves, allowing some good projects to move forward and bad ones not to		
Costs & Benefits	Present value of national energy cost savings, 2014–30 (billion 2011$)*	$27.31	Energy prices from EIA 2013. Assumes 5% discount rate.
	Present value of national total upfront cost for 2014–30 (billion 2011$)	$17.72	Based on average of $3000/new home and $5000/retrofit. (IMT and ACEEE 2011). Assumes 5% discount rate.

Outlook

The SAVE Act has received bipartisan report, and a version of the bill could potentially pass depending on competing priorities on the legislative agenda. There have been no indications that the CFPB intends to explore the impact of energy and transportation costs on household finances.

Conclusion

While plenty of progress has been made towards reducing the nation's overall consumption of energy resources, much more can be done to take advantage of existing untapped efficiency potential and to save consumers money on their annual energy bills. This report has provided recommendations to overcome the barriers in the market for efficient technologies and programs that lead to under investment in energy efficiency. Spanning all the key economic sectors, the included policies target information barriers that may cause consumers to invest in inefficient technologies or not to invest in efficient ones, externalities that result from the undervaluation of energy savings and regulatory and financial barriers that prevent the proliferation of efficient technologies and efficiency programs.

The cost-efficient energy benefits of the policies included in this report are substantial. Improved appliance and building labeling alone have the potential to reduce energy use in the building sector by approximately 10% and 20% respectively by 2030. Implementing a national emissions fee, and removing barriers to CHP projects could save approximately 6% and 4% in national energy use respectively. In addition to energy savings, the non-energy benefits from these policies include increases in power reliability, a reduction in greenhouse gas and criteria emissions, job creation, improved traffic flow, and improved tenant retention. Table 15 summarizes the benefits of the interventions described in the report. Additional energy and non-energy benefits can be achieved if a comprehensive package of market-based policies is implemented at either the federal, state or local levels.

Table 16. Summary of Benefits by Policy

Policy	Percent Energy Savings	Quads of Energy Saved	NPV of Net Energy Savings 2014-2030 (billion 2011$)	Additional Benefits
Improved appliance labeling	10%	.4	$16	Reduced water use for clothes washers and dishwashers
Building labeling and disclosure	20%	1.6	$60	Improved tenant retention, increased net operating income, job creation and business development, water savings
Improved access to energy data	4%	0.1	$6	Improved transparency and control over energy use
Removing regulatory barriers for CHP	4%	2.3	$130	Reduced emissions, increases in power reliability, reduced transmission and distribution losses (not calculated in above), and improved power quality.
Utility regulatory reform	1%	0.2	$8	Over $100 billion in new capacity investments can be avoided by 2030
Adjusted corporate tax policies	5% for depreciation, 10% for taxing revenue	4.5	$165	Equipment turns over more quickly, creating jobs New industrial equipment improves productivity
Emission fees	6%	5.0	$495	GHG emissions reduction; greater certainty on emissions policies so businesses can plan; increased incentive to invest in efficiency and alternative fuels, spurring innovation and job creation
Mileage fees	2%	0.2	$14	Traffic reduction, GHG and criteria pollution reduction, revenue generation for the Highway Trust Fund
Feebates	3%	0.4	$4	Reductions in carbon dioxide emissions, job creation for auto manufacturers, increased vehicle sales
Reducing waste in government	20%	0.2	$13	Reduced emissions and water use. Also, some efficiency measures can reduce maintenance costs or increase in employee productivity.
Investing in pre-commercial research and development	1%	0.7	$17	Reduced technical risk; Reduced market risk; Accelerated introduction of technology into the marketplace.
Financing policies to encourage energy efficiency	20%	3.0	$62	Enhanced building comfort and affordability of energy
Energy costs in mortgage underwriting	16%	0.2	$10	Underwriting improves, allowing some good projects to move forward and bad ones not to
TOTAL		19	$1,000	

The set of policies highlighted in this report could save the United States a combined total of 19 quadrillion Btus and $1.4 trillion dollars in 2030, approximately 19% of projected energy use that year. However, note that the total savings shown here is a simple sum for all 16 policies described in the report and that the real-world total is likely to be lower given overlap in energy use amongst different industries and interactive effects between policies.

Table 17 ranks the policies based on their respective magnitude of net benefits. The majority of potential savings can be achieved through the implementation of a national emissions fee, by adjusting the structure of corporate tax policy, and removing regulatory barriers to CHP projects. These policies also have the largest energy savings, along with financing policies to encourage energy efficiency and building labeling and disclosure.

Table 17. Ranking of Policies by Net Benefits

Policy	Quads of Energy Saved	NPV of Net Energy Savings 2014-2030 (billion 2011$)
Emission fees	5.0	$495
Adjusted corporate tax policies	4.5	$165
Removing regulatory barriers for CHP	2.3	$130
Financing policies to encourage energy efficiency	3.0	$62
Building labeling and disclosure	1.6	$60
Investing in pre-commercial research and development	0.7	$17
Improved appliance labeling	.4	$16
Reducing waste in government	0.2	$13
Mileage fees	0.2	$14
Energy costs in mortgage underwriting	0.2	$10
Utility regulatory reform	0.2	$8
Improved access to energy data	0.1	$6
Feebates	0.4	$4
TOTAL	19	$1,000

A number of policies highlighted in this report have an improved chance of success if implemented at the state or local level. While support for a carbon fee or movement on tax policy will have to come from federal legislators, other interventions are better suited to local policy-making. For instance, local and state government can implement aggressive policies on top of federal guidance to tackle energy waste in municipal and state-owned buildings and fleets. In any case, the policies in this report do not necessarily rely on federal action in order to succeed.

Historically, energy efficiency has been a bipartisan issue. Several pieces of key legislation have passed in recent years with good collaboration between the Democrats and Republicans. Politically, the market-based interventions described in this report are ripe for bipartisan collaboration, particularly in light of the recent backlash against government mandates and spending on incentives. This report seeks to help to keep energy efficiency at the forefront of the political agenda for the current congress and state legislative sessions.

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