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Committee on Transportation and Infrastructure
Subcommittee on Water Resources and Environment

Hearing on:
Climate Change and Energy Independence:
Transportation and Infrastructure Issues

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Summary

The Urgency and the Opportunity for Efficiency Policy

America's greatest energy challenges—energy security and global warming—are converging to force historic changes in U.S. energy and environmental policy. Our growing dependence on imported oil and natural gas, combined with high and volatile fuel prices threaten both our economic health and our geopolitical strength. The recent Intergovernmental Panel on Climate Change Fourth Assessment reports on the growing evidence of climate change, coupled with the Supreme Court's recent decision that carbon dioxide is a pollutant regulated under the Clean Air Act, increase the urgency and clarify the legal basis for national policy action to reduce greenhouse gas emissions.

Cost-effective energy efficiency is the one readily available resource that addresses both the energy security and climate challenges, while also enhancing economic prosperity. Put another way, efficiency is the one resource that every energy security and climate policy has in common. Domestic energy supplies with low carbon content will take time to develop; but we can start now to accelerate efficiency investment, which will enable low-carbon domestic supplies to begin reducing energy imports and carbon emissions. If we do not use efficiency as the "first fuel" in the race for clean and secure energy, clean energy supply technologies may not be able to be deployed fast enough to meet runaway energy demand.

Investing in America's Energy Efficiency Infrastructure

Investing in energy efficiency means rebuilding America's energy services infrastructure: the energy-using systems in our vehicles, buildings, and factories. Contrary to misperceptions that efficiency is only about behavior (driving less or turning off lights) or small purchases like compact fluorescent light bulbs, Americans spend more on energy-efficient technology than they invest in energy supply infrastructure. ACEEE estimates current spending on efficient technologies—efficient appliances, heating and cooling systems, lighting, new buildings, vehicles, and industrial technologies—is about $200 billion, whereas we invest only about $100 billion each year in energy supply infrastructure—for everything from refineries to powerplants and pipelines. So America's energy efficiency infrastructure—the hardware that uses energy more efficiently —is a larger part of the economy than the infrastructure that supplies energy.

The potential for accelerated energy efficiency investment remains very large, in the range of another $200 billion annually. This is supported by numerous studies, including ACEEE's own research as well as that of McKinsey Global Institute and America's national laboratories. The research shows that we can meet most if not all of the growth in America's energy service needs in the next several decades through energy efficiency. However, it will take public policy commitment to stimulate substantial efficiency investment beyond current trends; while market forces are working to an extent, there are significant market barriers and economic factors that are limiting the effect of market forces.

Energy Efficiency's Unique Role in Climate Policy

Climate policy poses special challenges for Congress in striking the right balance between economy-wide policies like carbon cap-and-trade and carbon taxes, and sector-specific policies aimed at stimulating efficiency investment more directly. While energy efficiency has been shown in numerous policy analyses to be the lowest-cost way to reduce carbon emissions, economy-wide policies have also been shown to be relatively weak in stimulating efficiency investment. Cap-and-trade systems are weak in stimulating efficiency investment for two main reasons:

- Caps set "upstream" near the point of energy production do not allow end-use efficiency investments to obtain emission allowance credit. This is particularly true in the power sector; because the cap is on emissions at the smokestack and not on energy use, changes in energy use are deemed "indirect" emission reductions and not eligible for credit in emissions trading markets. This same structural problem applies in different ways in the transportation sector. This fundamental, structural problem in cap-and-trade designs requires specific policies to compensate for it.
- Much of the expected efficiency investment from economy-wide climate policies comes from price elasticity effects. As carbon prices enter the economy, they are expected to motivate efficiency investment through higher energy prices. However, price elasticity effects are increasingly masked by income-elasticity and cross-elasticity effects: income elasticity increases the demand for energy services as incomes rise, and cross-elasticity causes consumers to reduce expenditures on other goods when energy prices rise, rather than saving energy directly.

Because of these limitations in economy-wide carbon policies, we recommend the Committee consider a hybrid policy approach: an economy-wide approach to cover all major emissions sources and to increase flexibility, and complementary, targeted policies that accelerate efficiency investment to sharply reduce the cost of compliance with overall emissions targets.

Policy Recommendations

We recommend the following components be included in U.S. energy climate policies:

1. **Emission allowance allocation policies that support efficiency.** A key element of a cap-and-trade system for carbon dioxide emissions is the design of the emission allowance allocation policy. Allow allocations should be output-based and updated, rather than input-based and fixed, to encourage the most efficient forms of energy production. A significant fraction of allowances should be auctioned, with the proceeds used for low-carbon technologies like energy efficiency that would not be realized through cap-and-trade alone. The Regional Greenhouse Gas Initiative, which produced the first binding regulation on carbon emissions in the U.S., requires participating states to allocate at least 25% of emission allowances for energy efficiency and other strategic carbon reduction purposes.
2. **Complementary policies to reduce the cost of economy-wide carbon dioxide policies.** The two largest carbon emissions sources in the U.S. are electric powerplants and motor vehicles. For the power sector, the most effective complementary efficiency policy is a national Energy Efficiency Resource Standard (EERS). Some 16 states have or are

developing EERS to address electricity and natural gas prices as well as greenhouse gas emissions challenges. An EERS is a natural complement to a federal Renewable Portfolio Standard (RPS) for electricity; some 21 states have RPS policies. Together, EERS and RPS policies can begin reducing carbon dioxide emissions in the U.S. power sector within the next two decades, while keeping electricity prices moderate and economic growth strong.

In the transportation sector, fuel economy policies must be used to reduce the growth in fuel use; but the demand for travel must also be addressed. The Committee's jurisdiction allows it to pursue directly such important policies as:

- Setting **prerequisites for federal funding assistance for new transit lines** to ensure that zoning in host municipalities will promote compact development;
- Requiring state and metropolitan transportation plans and programs **demonstrate reductions in mobile source greenhouse gas emissions;**
- **Shifting the formulas for allocating federal transportation dollars to states** to reflect the importance of reducing oil consumption and vehicle GHG emissions.

3. **Stronger building efficiency policies.** Buildings are the largest collective driver of carbon emissions, accounting for some 40% of total U.S. emissions. They also contain the largest portion of the nation's energy-using infrastructure: some 80 million buildings, most of which are more than 30 years old. There is vast potential for "mining" the efficiency potential of the American building stock. This can be accomplished by:
   - **Creating stronger building energy codes.** The U.S. government can lead the way by setting the nation's highest standards for building energy performance, beginning with 30% improvement beyond national model codes, and improving to 50%. The ultimate goal of building codes should be a "zero-carbon" standard, wherein the energy footprint of new buildings is kept to minimum, and any remaining energy use is offset by efficiency or renewable energy credits. Congress should also direct the executive branch to work with the national model code process to improve national model code energy performance levels by 30% by 2010 and 50% by 2020.
   - **Accelerating building code adoption and enforcement.** The Committee should consider tying federal funding under its jurisdiction to state adoption and enforcement of the most advanced national model building energy codes from the International Code Council. It should also support authorizations and appropriations to provide technical assistance and implementation support for state adoption and enforcement of better building codes.
   - **Setting and providing funding for efficiency targets for existing buildings.** Previous federal energy legislation, and a recent Executive Order, have set new efficiency targets for federal building energy performance. To support achievement of these targets, Congress should permanently authorize the Energy Savings Performance Contracting (ESPC) program that has been successful in bringing private capital into federal facilities, and should consider federal financing mechanisms to further support these investments. To accelerate efficiency in state-owned buildings, the Committee should consider tying federal funding in its jurisdiction to states' setting and achieving target such as states.
   - **Accelerating progress in appliance and equipment efficiency standards.** The U.S. has made great progress in setting and updating energy efficiency standards for dozens

of common household and business products and equipment. For example, all new refrigerators built since 2001 use only about ¼ the energy of comparable models sold in the 1970s. Congress should help accelerate this progress by creating greater flexibility for the Department of Energy's standards program to set standards on a regional basis, to set standards that regulated multiple features of a given product, to preserve states' rights by limiting federal pre-emption of state standards, and to create an expedited rulemaking process for the growing number of consensus-based standards.

A significant part of America's energy efficiency infrastructure is its research and development institutions. The last 30 years have witnessed a disturbing decline in U.S. energy research and development; federal investment in energy efficiency and renewable energy is only about 1/3 of 1970s levels, and private R&D has also fallen during that time period. As a result, there has been a serious erosion in the capabilities of our national laboratories, our universities, and our state governments to rise to the unprecedented challenges of the 21st century. We urge the Committee to consult with the Science and Energy committees in finding ways to rebuild America's energy efficiency infrastructure, beginning with federal R&D program authorization and appropriations.

Energy and Carbon Savings

ACEEE research shows that new energy efficiency policy initiatives could make a big difference on the energy security and global warming fronts. For example:

- A 2006 ACEEE study finds that we can reduce U.S. oil use by more than 5 million barrels per day by 2020, equivalent to 680 million metric tons of carbon dioxide—nearly 10% of the federal Annual Energy Outlook reference case emissions. Improvements in passenger vehicle fuel economy account for more than 3 million barrels per day of savings, but more than 2 million barrels per day of savings are available in the residential, commercial, and industrial sectors, and in heavy vehicles and airplanes. Not reflected in this estimate are substantial additional savings that could be achieved through reduction in vehicle miles traveled.

- Another 2006 ACEEE study found that doubled efficiency investments in the Regional Greenhouse Gas Initiative (RGGI) cap and trade system for power-sector carbon dioxide emissions would add $13 billion to the regional economy in 2021. This increased energy efficiency investment would reduce average energy bills by up to 12%.

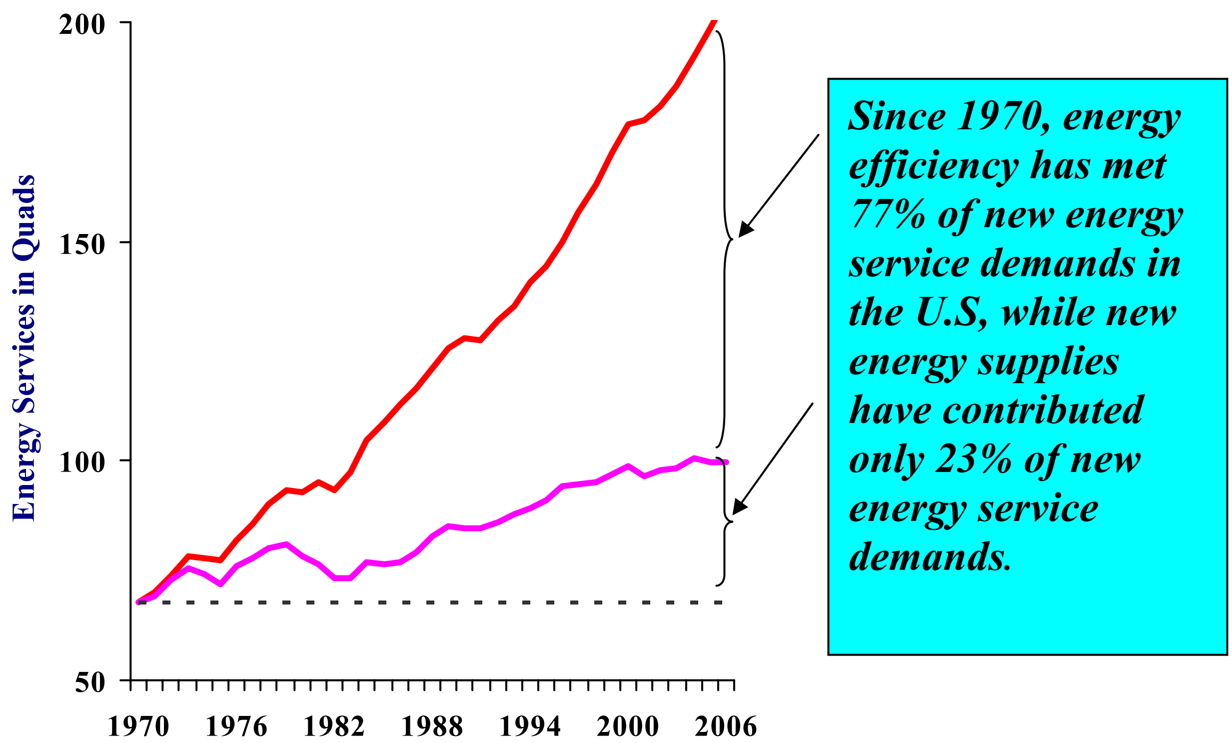
- ACEEE's analysis of Energy Efficiency Resource Standards (EERS) in the electricity and natural gas utilities sectors shows that an EERS target reaching 10% of electricity sales in 2020 would save utility customers a net $29 billion while reducing 2020 carbon dioxide emissions by 343 million metric tons, about 5% of the Annual Energy Outlook reference forecast.

Introduction

ACEEE is a nonprofit organization dedicated to increasing energy efficiency as a means of promoting both economic prosperity and environmental protection. We were founded in 1980 and have contributed in key ways to energy legislation adopted during the past 25 years, including the Energy Policy Acts of 2005 and 1992 and the National Appliance Energy Conservation Act of 1987. I have testified before the Committee several times and appreciate the opportunity to do so again.

Energy efficiency improvements in all forms have contributed a great deal to our nation's economic growth and increased standard of living over the past 30 years. Energy efficiency improvements since 1970 accounted for approximately 75 quadrillion Btus of saved energy in 2005, which is *about three-quarters of U.S. energy use and three times as much as total energy supply growth over the same period.* In this sense, energy efficiency can rightfully be called our country's largest energy resource. If the United States had not dramatically reduced its energy intensity over the past 30 years, consumers and businesses would have spent about $700 billion more on energy purchases in 2005. The figure below illustrates this effect.

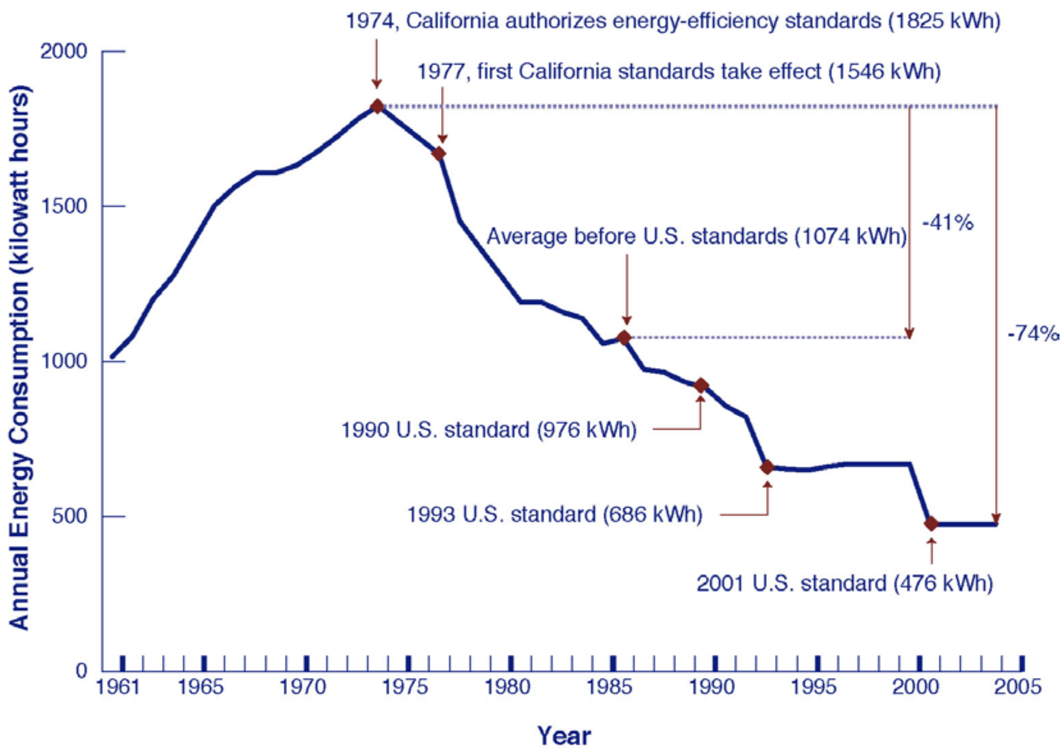
Figure 1. Energy Efficiency's Contribution to the U.S. Economy 1970-2006



Source: ACEEE Staff analysis

Efficiency's contribution to economic growth may seem abstract in the macro terms shown above. But it also shows up in the progress of individual technologies. For example, today's refrigerators, due to a combination of effective research and federal appliance standards, use about ¾ less energy than comparable models sold in the 1970s. Figure 2 below indicates this progress.

Figure 2. Refrigerator average electricity usage 1960-2005



Source: Collaborative Labeling and Appliance Standards Program

The Energy Efficiency Infrastructure

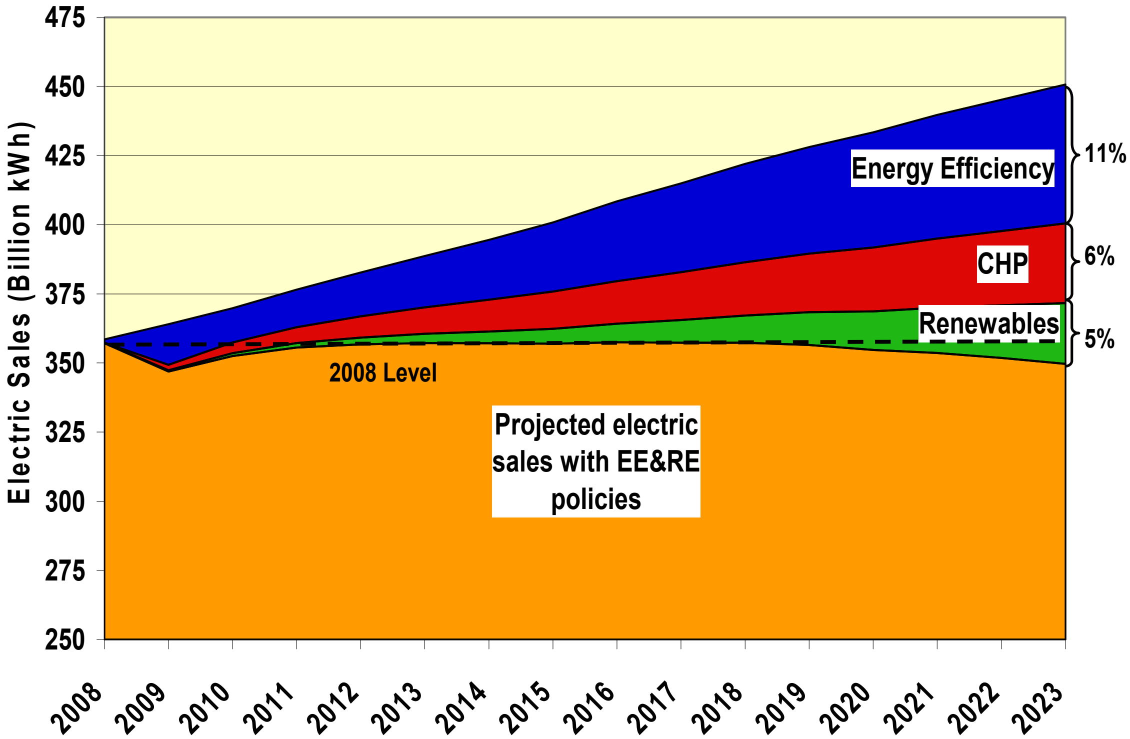
Energy efficiency has also become a major force in the economy in terms of infrastructure investment. ACEEE ongoing research indicates that total energy supply infrastructure investment in the United States in 2005 was approximately $100 billion. Energy efficient technology spending, from high-efficiency lighting to hybrid cars, was in the range of $200 billion in the same period.[1] This means that America spends many times more money on cost-effective energy-saving technology than on energy supply technology. However, this remarkable truth is masked, by the fact that efficiency is typically hidden inside our buildings, vehicles, and factories in millions of products, components, and systems. Yet collectively, these efficiency investments support a much larger fraction of the economy than do all the energy supply sectors combined.

[1] For a useful overview of this perspective, see Laitner, Ehrhardt-Martinez, and Prindle, 2007. "The American Energy Efficiency Investment Market," Washington, DC: American Council for an Energy-Efficient Economy.

Energy Efficiency's Future Potential

There is still enormous potential for additional cost-effective energy savings in America's energy service infrastructure. Some newer energy efficiency technologies have barely begun to be adopted. Other efficiency measures could be developed and commercialized rapidly in coming years, with policy and program support. For example, in a study from 2000, the Department of Energy's national laboratories estimate that increasing energy efficiency throughout the economy could cut national energy use by 10 percent or more in 2010 and about 20 percent in 2020, with net economic benefits for consumers and businesses.[2] Studies for many regions of the country have found similar if not even greater opportunities for cost-effective energy savings.[3] A recent analysis by McKinsey Global Institute found that U.S. energy demand growth through 2030 could be fully met through cost-effective energy efficiency improvements. Our ongoing research indicates that current estimates of $200 billion in annual spending on efficient technology could be doubled to $400 billion, with strong public policies and increase private investment.

Figure 3. Energy Efficiency and Renewable Energy Potential in Texas 2008-2023



Market Barriers to Energy Efficiency

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[2] Interlaboratory Working Group, 2000, *Scenarios for a Clean Energy Future*. Washington, D.C.: Interlaboratory Working Group on Energy-Efficient and Clean-Energy Technologies, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.

[3] For a summary of many of these studies, see Nadel, Shipley and Elliott, 2004, *The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Unfortunately, a variety of market barriers keep energy efficiency investment from being accelerated. These barriers fall in two main categories: (1) principal-agent or "split incentive" barriers, in which, for example, home builders must invest added capital in efficient homes, but receive none of the energy savings benefits; and (2) transaction costs, which stem from inability of average consumers or businesses to make "economically optimum" decisions in time-and-information-limited real world conditions. A recent ACEEE study for the International Energy Agency found that, in the major residential and commercial end-use markets in five countries, half or more of the energy used is affected by these kinds of market barriers[4]. This finding suggests that public policies, beyond pricing policies, are needed to overcome such barriers.

In addition, basic forces in the economy work against the tendency of higher energy prices to moderate energy demand. This principle of "price elasticity of demand", while economically correct, is countered by "income elasticity of demand", under which rising incomes cause consumers to be less affected by rising prices. A large segment of our population continues to buy low-mileage, high priced vehicles with little concern for fuel costs. For less-affluent consumers, "cross-elasticities" come into play that cause them to keep using energy as an essential service, but to cut back on other goods and services to balance their household budgets. Recent research indicates that short-run elasticity of demand for motor fuel has fallen as much as sixfold since the 1970s; in other words, drivers are six times less likely than they were 30 years ago to change driving habits based on fuel prices.[5] This is an indication that income elasticity effects may be affecting driver behavior. Economists have documented the slowing of retail sales among low-and moderate-income people in response to rising energy price; this is an indication of cross-elasticity effects. Both the income elasticity and cross-elasticity effects suggest that energy prices alone won't balance our energy markets, and that we need stronger energy policies if we want to stabilize energy markets without wrecking our economy.

Drivers for Increased Efficiency Investment

Recent developments in our energy markets indicate that while efficiency is playing an important role in stabilizing energy markets, the U.S. needs to *accelerate* efforts to implement energy efficiency improvements to meet this century's unprecedented energy and climate challenges. Some of the key drivers appearing in the economy include:

- Oil, gasoline, natural gas and coal prices have risen substantially in recent years. For example, residential natural gas prices in 2005 averaged $13.83 per thousand cubic feet, up 61% from the average price three years earlier (prices averaged $8.57 per thousand cubic feet in 2002).[6] Likewise retail gasoline prices are up 87% relative to three years ago

[4] Prindle et al. 2007. *Quantifying Market Barriers in the End Use of Energy.* Draft report to the International Energy Agency. American Council for an Energy-Efficient Economy.
[5] Hughes, Knittel and Sperling, 2006. *Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand*. Center for the Study of Energy Markets, University of California Energy Institute.
[6] Energy Information Administration, 2006, *Natural Gas Navigator: U.S. Natural Gas Residential Price.* http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm . *Vis*ited June 20. Washington, D.C.: U.S. Dept. of Energy.

($2.917 per gallon 6/19/06 versus $1.558 per gallon 6/16/03).[7] Even more dramatically, Powder River Basin coal has more than doubled in price since three years ago (spot prices of $13.80 per short ton in May, 2006, up from about $6 per short ton in May, 2003).[8] Energy efficiency can reduce demand for these fuels, reducing upward price pressure and also reducing fuel-price volatility, making it easier for businesses to plan their investments. Prices are determined by the interaction of supply and demand—if we seek to address supply and not demand, it's like entering a boxing match with one hand tied behind our back.

- A recent ACEEE analysis found that gas markets are so tight that if we could reduce gas demand by as little as 4% over the next five years, we could reduce wholesale natural gas prices by more than 20%.[9] This analysis was conducted by Energy and Environmental Analysis, Inc. using their North American Gas Market Model, the same analysis firm and computer model that was employed by DOE and the National Petroleum Council for their 2003 study on U.S. natural gas markets.[10] These savings would put over $100 billion back into the U.S. economy. Moreover, this investment would help bring back U.S. manufacturing jobs that have been lost to high gas prices and also help relieve the crushing burden of natural gas costs experienced by many households, including low-income households. Importantly, much of the gas savings in this analysis comes from electricity efficiency measures, because much of the marginal electric load is met by natural-gas fired power plants.

- The U.S. is growing increasingly dependent on imported oil, with imports accounting for more than 60% of U.S. oil consumption in 2005, of which more than 40% came from OPEC countries.[11] The U.S. Energy Information Administration estimates that imports will account for 68% of U.S. oil use in 2020.[12] While moderate amounts of new oil are available in hard-to-reach areas of the U.S., much greater amounts of oil are available by increasing the efficiency with which we use oil. A January 2006 report by ACEEE found that the U.S. can reduce oil use by as much as 5.3 million barrels per day in 2020 through improved efficiency, including more than 2 million barrels per day in industry, buildings, heavy duty vehicles and airplanes.[13] In other words, *there are substantial energy savings outside of the highly contentious area of light-duty vehicle fuel economy*. These 5.3 million barrels per day of oil savings are nearly as much as we presently import from

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[7] Energy Information Administration, 2006, *Petroleum Navigator: U.S. All Grades All Formulatins Retail Gasoline Prices*. http://tonto.eia.doe.gov/dnav/pet/hist/mg_tt_usw.htm . *Vis*ited June 20. Washington, D.C.: U.S. Dept. of Energy.

[8] Energy Information Administration, 2006, *Coal News and Markets, Week of May 5, 2006.* http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html#spot . Washington, D.C.: U.S. Dept. of Energy.

[9] Elliott and Shipley, 2005, *Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets: Updated and Expanded Analysis.* http://www.aceee.org/pubs/e052full.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

[10] National Petroleum Commission. 2003, *Balancing Natural Gas Policy—Fueling the Demands of a Growing Economy: Volume I Summary of Findings and Recommendations*. Washington, D.C.: U.S. Department of Energy.

[11] Energy Information Administration, 2006, *Monthly Energy Review May 2006.* Washington, DC: U.S. Dept. of Energy.

[12] Energy Information Administration, 2006, *Annual Energy Outlook.* Washington, D.C.: U.S. Department of Energy.

[13] Elliott, Langer and Nadel, 2006, *Reducing Oil Use Through Energy Efficiency: Opportunities Beyond Cars and Light Trucks.* Washington, DC:. American Council for an Energy-Efficient Economy.

OPEC (OPEC imports were 5.5 million barrels per day in 2005).[14] Added measures to reduce vehicle miles traveled would lead to still greater savings. Energy efficiency can slow the growth in oil use, allowing a larger portion of our needs to be met from sources in the U.S. and friendly countries.

- Economists have increasingly raised concerns that the U.S. economy is slowing and that robust growth rates we have experienced in recent years will not be sustained. Energy efficiency investments can help spur additional economic growth; they often have financial returns of 30% or more, helping to reduce operating costs and improve profitability. In addition, by reducing operating costs, efficiency investments free up funds to spend on other goods and services, creating what economists call the "multiplier effect", and helping the economy broadly. This stimulates new economic activity and job growth in the U.S., whereas most of every dollar we spend on oil flows overseas. A 1997 study found that due to this effect, an aggressive set of efficiency policies could add a net of about 770,000 jobs to the U.S. economy by 2010.[15]

- Overall, the U.S. has ample supplies of electricity at present, but demand is growing and several regions (such as southwest Connecticut, Texas, New York, and California) are projecting a need for new capacity in the next few years in order to maintain adequate reserve margins.[16,17] Energy efficiency resource policies can slow demand growth rates, postponing the date that additional capacity will be needed.

- Greenhouse gas emissions continue to increase. Early signs of the impact of these changes are becoming apparent in Alaska and other Artic regions.[18] And several recent papers have identified a link between warmer ocean temperatures and increased hurricane intensity.[19,20] Energy efficiency is the most cost-effective way to reduce these emissions, as efficiency investments generally pay for themselves with energy savings, providing negative-cost emissions reductions. The term "negative-cost" means that, because such efficiency investments cost less than current energy sources, they achieve emission reductions at a net savings for the economy. This important point has been missed in much of the climate policy analysis modeling performed to date. Too many economic models are incapable of characterizing the real economic effects of efficiency investments, and so forecast

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[14] See note #9.

[15] Alliance to Save Energy et al., 1997, *Energy Innovations: A Prosperous Path to a Clean Environment.* Washington, DC: American Council for an Energy-Efficient Economy. See also, Laitner, Bernow, and DeCicco, 1998. "Employment and Other Macroeconomic Benefits of an Innovation-Led Climate Strategy for the United States." *Energy Policy*, 1998, 26(5), pp. 425-33.

[16] North American Electric Reliability Council, 2005, *2005 Long-Term Reliability Assessment: The Reliability of Bulk Electric Systems in North America.* Princeton, N.J.: North American Electric Reliability Council.

[17] New York Independent System Operator, 2005, "The NYISO Issues Reliability Needs Assessment." Press release of December 21. Schenectady, N.Y.: New York Independent System Operator.

[18] Hassol, 2004, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment.* http://www.acia.uaf.edu. Cambridge University Press.

[19] Webster, Holland, Curry and Chang, 2005, "Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment." *Science,* 309, 16 September, 1844–1846.

[20] Emanuel, 2005, "Increasing Destructiveness of Tropical Cyclones over the Past 30 Years." *Nature,* 436, 4 August, 686–688.

inaccurate economic costs from climate policies. Fortunately, this kind of flawed policy analysis is beginning to be corrected. For example, a 2006 ACEEE study just released by ACEEE found that the Regional Greenhouse Gas Initiative (RGGI – the planned cap and trade system for greenhouse gases in the northeastern U.S.) would increase the output of the regional economy by about $13 billion in 2021, provided increased energy-efficiency programs are a key part of implementation efforts.[21] This analysis also showed that efficiency would reduce carbon prices (see Figure 5 below).

The Unique Challenges for Energy Efficiency in Climate Policy

It is widely accepted that energy efficiency reduces the cost of carbon emission reductions, because it is widely available as a resource that costs less than conventional energy. In electricity markets, efficiency potential has been shown to be about 25% of total electricity usage, at a levelized cost of about 3 cents per kilowatthour[22], much less than that the average national retail price of electricity, currently at more than 8 cents per kWh[23], or the marginal generation cost of new power plants, estimated by industry experts to cost 5 cents per kWh and higher, depending on the technology. Figure 4 below illustrates this effect—when a resource like efficiency costs less on a levelized basis than the current cost of energy, it provides a net savings to the economy.

Economic modeling of climate policy often fails to capture efficiency investment effects. ACEEE's research on econometric modeling of energy efficiency investments has identified flaws in some of the principal modeling approaches used to project the costs of climate policies. One school of econometrics takes a highly aggregated view of the economy, applies the estimated effects of climate policy in a fairly simple and aggregated way, and produces findings that tend to show somewhat negative economic impacts. The EIA, MIT, and CRA international studies of the Climate Stewardship Act fall in this category[24].

Another set of analyses tends to look in more depth at the technology and sector impacts that would result from climate policy, including shifts of capital, energy, and labor resources among various sectors of the economy. These more fine-grained studies tend to show that carbon emissions can be realized at much lower levels of economic impact, and indeed can produce positive net economic benefits.[25]

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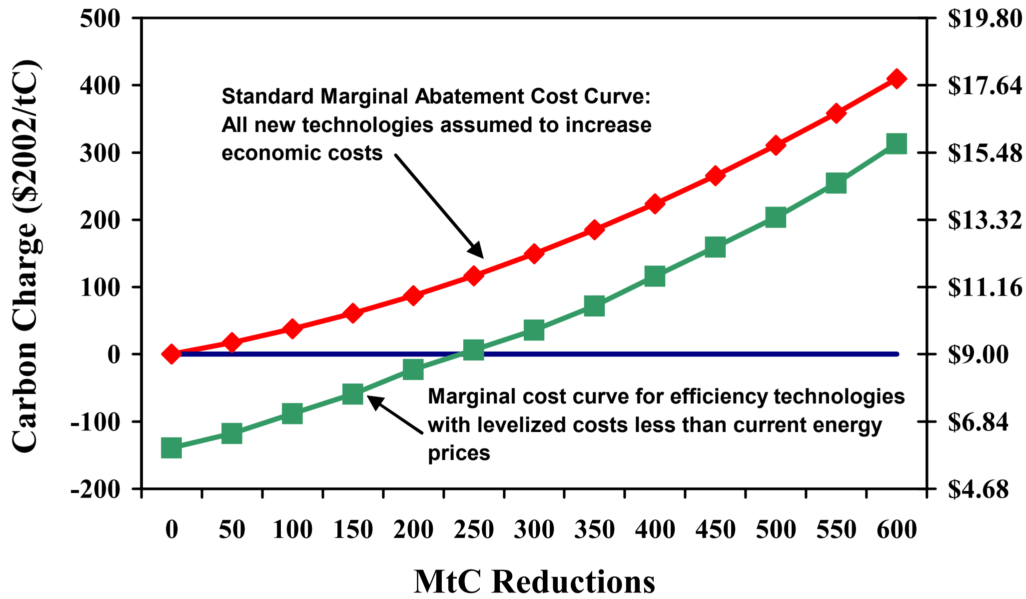
[21] Prindle, Shipley and Elliott, 2006, Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative. Washington, DC: American Council for an Energy-Efficient Economy.
[22] Kushler et al. *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies.* American Council for an Energy-Efficient Economy, 2004.
[23] See the U.S. Energy Information retail electricity price website at http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html
[24] Energy Information Administration. 2003. *Analysis of S.139, the Climate Stewardship Act of 2003.* Washington, D.C.: U.S. Department of Energy, SR/OIAF/2003-02). http://www.eia.doe.gov/oiaf/servicerpt/ml/pdf/sroiaf

Sergey Paltsev et al.. 2003. *Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: The McCain-Lieberman Proposal* Cambridge, MA: Joint Program on the Science and Policy of Global Change, Report 97.

Anne E. Smith, Paul Bernstein, and W. David Montgomery. 2003. *The Full Cost of S.139, With and Without Its Phase II Requirements* Washington, D.C.: Charles River Associates.

[25] Barrett, James, et al. 2005. *Jobs and The Climate Stewardship Act. How Curbing Global Warming Can Increase Employment.* Natural Resources Defense Council.

Figure 4. Negative Cost of Carbon Emission Reductions from Energy Efficiency



Because of these differences between modeling techniques, and because their results can be so important to policymakers, we urge the Committee and others in Congress to take a more comprehensive look at the economic modeling issues around climate change, especially those that involve energy efficiency. We offer two key observations:

- Some macroeconomic models do not assess the economic effects of energy efficiency with any specificity. They tend to simply simulate energy price increases in the economy and assume that energy efficiency will occur through price elasticity effects. They tend to treat reduced energy expenditures simply as a reduction of output from a given sector, ignoring

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Barrett, James and J. A. Hoerner, *Clean Energy and Jobs: A Comprehensive Approach to Climate and Energy Policy* (Washington, D.C.: Center for a Sustainable Economy and the Economic Policy Institute, 2002)

Energy Innovations: A Prosperous Path to a Clean Environment (American Council for an Energy-Efficient Economy (ACEEE), The Alliance to Save Energy, Natural Resources Defense Council, Tellus Institute, and Union of Concerned Scientists, June 1997)

Florentin Krause et al., "Cutting Carbon Emissions at a Profit (Part II): Impacts on U.S. Competitiveness and Jobs," *Contemp Econ Policy*, Volume 21 (2003)

Hanson, Don, and Laitner, John A. "Skip". 2004. "An integrated analysis of policies that increase investments in advanced energy-efficient/ low-carbon technologies". *Energy Economics* 26 (2004) 739– 755.

Hahneman, Michael, et al. *Managing Greenhouse Emissions in California.* The California Climate Center at UC Berkeley. 2006.

Sanstad, Alan H., Stephen J. DeCanio, and Gale A. Boyd, "Estimating Bounds on the Macroeconomic Effects of the Clean Energy Future Policy Scenarios," *Energy Policy*, Volume 29, Issue 14 (November 2001)

the inter-sectoral substitutions of capital, energy and labor that more detailed models capture.

- Some models use a general equilibrium approach in which it is assumed that energy technology is optimally deployed in the economy. This means that any shift in the technology mix must, by the design of the model itself, impose costs on the economy. Yet ACEEE and others have amply documented that market barriers and other forces extensively limit the deployment of cost-effective technologies, meaning that a large measure of efficiency investment can occur at net savings to the economy.

Given these limitations in some of the models used to assess the economic impacts of climate policy, we urge the Committee to conduct a thorough investigation of these issues, so that a more balanced picture can be developed of the likely economic impacts of climate policy.

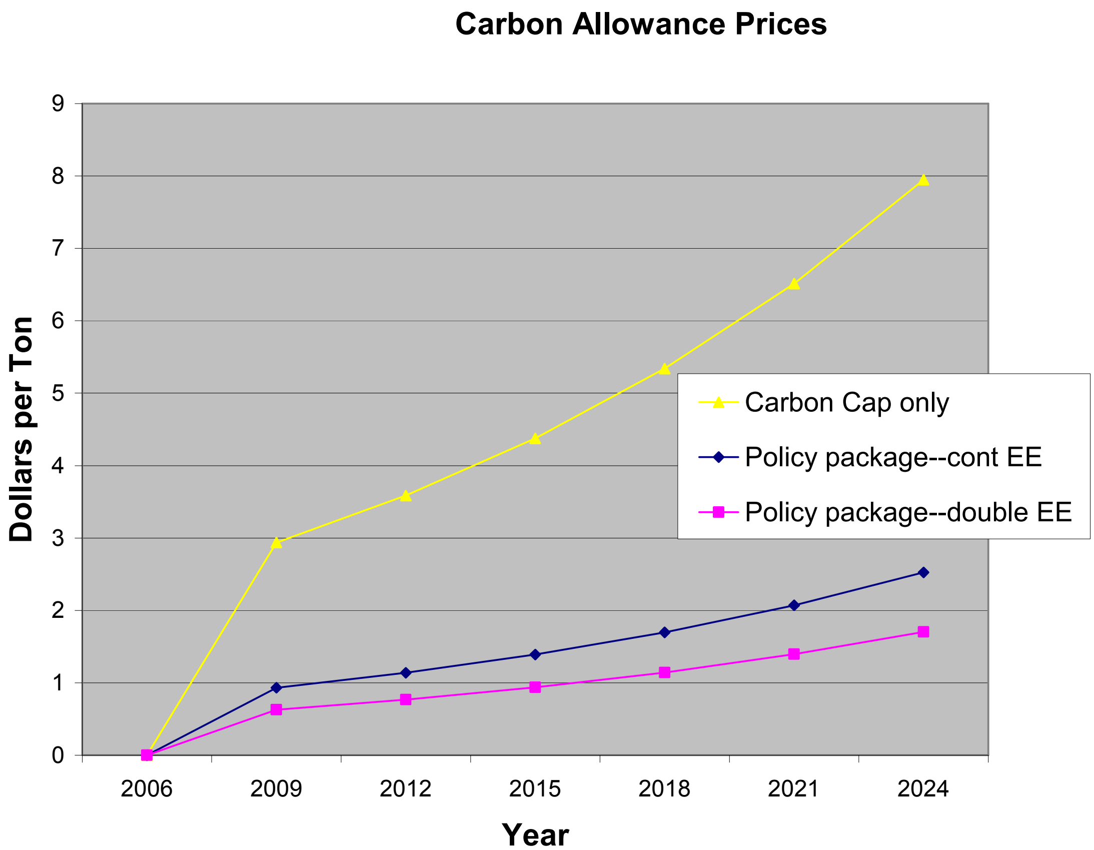
Some opponents of climate policy action have uses flawed modeling approaches in a selective way to claim that vigorous climate policy would exact a heavy toll on the economy. Yet at least as many analysts have found that climate policy, if studied in enough depth, can be shown to generate positive economic impacts. Investing in efficiency thus reduces the cost of climate policy by reducing the average cost of energy, and by stimulating new economic activity in the form of capital investment, increased labor demand, and increased personal income. Research conducted for the Regional Greenhouse Gas Initiative showed that increased efficiency resource investment added $13 to the regional economy, reduced customer energy bills by up to 12% and cut the price of carbon allowances by about one-third, while increasing gross regional product, employment, and personal income[26]. Figure 5 below illustrates these effects.

These results suggest that Congress should take a harder look at the economic analyses conducted for past climate policy bills, and that for future consideration of climate policies, the Committee should seek a more balanced set of economic analyses.

Investing in efficiency thus reduces the cost of climate policy by reducing the average cost of energy, and by stimulating new economic activity in the form of capital investment, increased labor demand, and increased personal income. Research conducted for the Regional Greenhouse Gas Initiative showed that increased efficiency resource investment added $13 to the regional economy, reduced customer energy bills by up to 12% and cut the price of carbon allowances by about one-third, while increasing gross regional product, employment, and personal income[27]. Figure 5 below illustrates these effects.

Figure 5. Energy Efficiency Investment and Carbon Prices in the Regional Greenhouse Gas Initiative

[26] Prindle et al. *Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative.* American Council for an Energy-Efficient Economy, 2006.
[27] Prindle et al. *Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative.* American Council for an Energy-Efficient Economy, 2006.



Source: Prindle et al. 2006. *Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative*. ACEEE, Washington, DC.

Efficiency requires specific policy focus to produce its full benefits. The emissions cap-and-trade policy designs most often proposed to reduce carbon emissions will not, in and of themselves, provide sufficient impetus for the level of efficiency investment needed to realize its benefits. These limitations stem from two principal factors:

- **Upstream caps.** Most cap-and-trade policies place emissions caps "upstream" or at the energy production level. End-use efficiency potential is found "downstream" in individual buildings and vehicles. An upstream cap makes it difficult for covered entities to invest in downstream energy use reductions, because such reductions are "indirect" emission reductions in an upstream cap, and so are not generally accepted as tradable allowance credits. Even if energy users reduce consumption, upstream emitters possess no fewer allowances, and thus can operate high-emitting sources longer, or can sell the unused allowances. It can also be difficult for upstream entities to reach across markets to effectively identify, aggregate, and market such reductions.
- **Limited price effects.** Climate policy analysts often assume that price effects introduced in energy markets by carbon caps or carbon taxes will stimulate sufficient investment in efficiency and other low-carbon technology choices. This argument is flawed because:

- Carbon prices are expected to be relatively low for many years, resulting in very limited price elasticity effects on demand. Efficiency provides its greatest benefits in the early years of a carbon policy, by holding down demand growth until low-carbon energy supplies can come on line over the longer term.
- Demand elasticities are countered in industrialized economies by income elasticity, which tends to drive demand upward as incomes grow, and cross-elasticities, which tends to reduce demand for other goods when energy prices rise, with limited effect on energy demand itself.
- Persistent market barriers, such as the principal-agent problem and information costs, significantly limit efficiency investment by isolating large segments of end-use markets from price elasticity effects. ACEEE's earlier-cited study for the International Energy Agency shows that up to 50% of residential energy use in the U.S. is affected by such barriers.

Policy recommendations for effectively engaging efficiency. In a cap-and-trade policy framework, the following options are needed to effectively tap the benefits efficiency investment offers for attaining emissions targets cost-effectively:

- **Auctioning or directly allocating allowances.** In the restructured electricity markets that prevail in the U.S. today, there is no reason to give generators emission allowances for free, as these costs are embedded in power prices such that generators overall tend to increase their revenues. Accordingly, the most recent cap-and-trade programs such as the RGGI policy require at least 25% of allowances to be auctioned, with the proceeds targeted for such purposes as energy efficiency and other low-carbon options. Many RGGI states are auctioning 100% of their allowances. Allowances can either be auctioned by the administering agency, or can be allocated directly to a designated entity for that purpose.
- **Output-based allowance allocation.** In the past, emissions allowances have typically been allocated to emitters based on their fuel input. However, it is their efficiency in converting fuel into energy output that determines their total emissions, so an output basis is more accurate. Output-based allocation also rewards emitters that use higher-efficiency generation technologies. To make this work, allocations should also be periodically updated to encourage emitters to make regular technology improvements.

Under a carbon tax policy, the allocation issues would be less complex, but the need to dedicate a portion of tax receipts to energy efficiency investment would be important, as the price effects from carbon taxes alone would not stimulate efficiency investment at the rate needed to reach carbon emission goals.

Policy-makers should also pursue complementary efficiency policies in parallel with cap-and-trade or carbon-tax programs, to get at markets that are most affected by market barriers. Such policies include: **Energy Efficiency Resource Standards (EERS),** which several states and three European Union nations have instituted, by setting numerical energy savings targets for utilities to meet through customer efficiency investments, combined heat and power, and other efficiency measures; a**ppliance and vehicle efficiency standards,** which have been very effective in the U.S. and should continue to be upgraded and expanded; and **building energy codes,** because new construction markets are among the most severely affected by market barriers, as builders are not motivated to invest the extra design time and capital to optimize energy efficiency for the building's life cycle.

Transportation Planning and Funding Programs

With reauthorization of SAFETEA-LU approaching, it is time to develop ways that federal transportation funding and planning requirements can contribute to the national effort to reduce GHG emissions. Several programs already in place to promote alternatives to driving and to use existing roads more efficiently—including transit system "new starts", the Value Pricing Pilot program, the Congestion Mitigation and Air Quality program, and the Non-Motorized Transportation Pilot—should be considered for major expansion. But new ideas will need to be developed as well, some representing major departures from existing policies.

There is a nearer opportunity for action as well. Members of Congress working on climate change legislation in this session are giving much focus to the transportation sector because it is responsible for one-third of U.S. greenhouse gas emissions. While there has been much discussion on how transportation fuels and vehicles can best be brought into an economy-wide climate policy, the transportation system and other determinants of how much people drive have received far less attention. This is a serious oversight, because vehicle and fuels policies, while important, will not be sufficient to achieve the GHG reductions that will be required of the transportation sector in a comprehensive climate plan for the nation. Shifts in land use planning practices and transportation infrastructure investment decisions can and must make a substantial contribution to reducing emissions.

New policies in the purview of this Committee could be offered as elements of the nation's climate policy, including prerequisites for federal funding assistance for new transit lines to ensure that zoning in host municipalities will promote compact development near transit nodes. Congress could also set requirements that state and metropolitan transportation plans and programs demonstrate reductions in mobile source greenhouse gas emissions consistent with the nation's economy-wide objectives for greenhouse gas reductions. It could also shift state allocation formulas for federal transportation funding to reflect the national importance of reducing oil consumption and vehicle GHG emissions, by rewarding successful travel demand management. Adoption of these actions as part of a national climate policy would set the stage for additional, coordinated actions in the transportation bill reauthorization in 2009.

In addition, climate change legislation introduced prior to the reauthorization should clearly acknowledge and quantify the role of vehicle miles traveled in determining greenhouse gas emissions. Gaining this acknowledgement would serve the additional purpose of positioning transportation planning and infrastructure programs that reduce emissions to be awarded funds that are raised from sales of carbon allowances.

ACEEE analysis has demonstrated the importance of complementing a carbon trading scheme for the power sector with efficiency programs, both to allow the setting of a stringent cap and to minimize the cost of meeting that cap. To ensure that efficiency resources are fully tapped, we recommend that a large percentage of revenues arising from the distribution of allowances be used to fund efficiency investments. The same argument applies in the transportation sector: both vehicle efficiency and transportation system efficiency will be essential to meeting the sector's carbon reduction obligations, but neither can be tapped easily through a cap-and-trade system. Transportation sector efficiency should therefore be eligible for funds associated with the sales of allowances.

Finally, sound land use planning and neighborhood development can bring major energy savings opportunities in the buildings sector as well as the transportation sector. Compact development not only eliminates trips, reduces trip length, and increases the viability of alternative modes, but also can allow the use of more efficient building designs, district cooling systems, streamlined water/wastewater systems, and other infrastructure efficiencies. In California, the enormous climate benefits of smart growth have been acknowledged in the planning documents for the implementation of the state's new climate legislation (AB 32)[28].

Policy Recommendations

Based on our analysis of energy markets, carbon policy options, and energy efficiency resource characteristics, we recommend the Committee consider several policies to gain the best use of energy efficiency resources in meeting the twin challenges of energy security and global warming. We recommend the following components be included in U.S. energy climate policies:

- **Emission allowance allocation policies that support efficiency.** A key element of a cap-and-trade system for carbon dioxide emissions is the design of the emission allowance allocation policy. Allow allocations should be output-based and updated, rather than input-based and fixed, to encourage the most efficient forms of energy production. A significant fraction of allowances should be auctioned, with the proceeds used for low-carbon technologies like energy efficiency that would not be realized through cap-and-trade alone. The Regional Greenhouse Gas Initiative, which produced the first binding regulation on carbon emissions in the U.S., requires participating states to allocate at least 25% of emission allowances for energy efficiency and other strategic carbon reduction purposes.
- **Complementary policies to reduce the cost of economy-wide carbon dioxide policies.** The two largest carbon emissions sources in the U.S. are electric powerplants and motor vehicles. For the power sector, the most effective complementary efficiency policy is a national Energy Efficiency Resource Standard (EERS). Some 16 states have or are developing EERS to address electricity and natural gas prices as well as greenhouse gas emissions challenges. An EERS is a natural complement to a federal Renewable Portfolio Standard (RPS) for electricity; some 21 states have RPS policies. Together, EERS and RPS policies can begin reducing carbon dioxide emissions in the U.S. power sector within the next two decades, while keeping electricity prices moderate and economic growth strong. In the transportation sector, fuel economy policies must be used to reduce the growth in fuel use; but the demand for travel must also be addressed. The Committee's jurisdiction allows to pursue directly such important policies as:

[28] California Environmental Protection Agency, "Climate Action Team Report to Governor Schwarzenegger and the Legislature," March 2006

- Setting **prerequisites for federal funding assistance for new transit lines** to ensure that zoning in host municipalities will promote compact development;
- Requiring state and metropolitan transportation plans and programs **demonstrate reductions in mobile source greenhouse gas emissions;**
- **Shifting the allocation formulas for federal transportation dollars** to states to reflect the importance of reducing oil consumption and vehicle GHG emissions.
- Conducting a **study of the climate benefits of smart growth and federal policies** in support of coordinated transportation and land use planning

- **Stronger building efficiency policies.** Buildings are the largest collective driver of carbon emissions, accounting for some 40% of total U.S. emissions. They also contain the largest portion of the nation's energy-using infrastructure: some 80 million buildings, most of which are more than 30 years old. There is vast potential for "mining" the efficiency potential of the American building stock. This can be accomplished by:
  - **Creating stronger building energy codes.** The U.S. government can lead the way by setting the nation's highest standards for building energy performance, beginning with 30% improvement beyond national model codes, and improving to 50%. The ultimate goal of building codes should be a "zero-carbon" standard, wherein the energy footprint of new buildings is kept to minimum, and any remaining energy use is offset by efficiency or renewable energy credits. Congress should also direct the executive branch to work with the national model code process to improve national model code energy performance levels by 30% by 2010 and 50% by 2020.
  - **Accelerating building code adoption and enforcement.** The Committee should consider tying federal funding under its jurisdiction to state adoption and enforcement of the most advanced national model building energy codes from the International Code Council. It should also support authorizations and appropriations to provide technical assistance and implementation support for state adoption and enforcement of better building codes.
  - **Setting and providing funding for efficiency targets for existing buildings.** Previous federal energy legislation, and a recent Executive Order, have set new efficiency targets for federal building energy performance. To support achievement of these targets, Congress should permanently authorize the Energy Savings Performance Contracting (ESPC) program that has been successful in bringing private capital into federal facilities, and should consider federal financing mechanisms to further support these investments. To accelerate efficiency in state-owned buildings, the Committee should consider tying federal funding in its jurisdiction to states' setting and achieving target such as states.
  - **Accelerating progress in appliance and equipment efficiency standards.** The U.S. has made great progress in setting and updating energy efficiency standards for dozens of common household and business products and equipment. For example, all new refrigerators built since 2001 use only about ¼ the energy of comparable models sold in the 1970s. Congress should help accelerate this progress by creating greater flexibility for the Department of Energy's standards program to set standards on a regional basis, to set standards that regulated multiple

features of a given product, to preserve states' rights by limiting federal pre-emption of state standards, and to create an expedited rulemaking process for the growing number of consensus-based standards.

A significant part of America's energy efficiency infrastructure is its research and development institutions. The last 30 years have witnessed a disturbing decline in U.S. energy research and development; federal investment in energy efficiency and renewable energy is only about 1/3 of 1970s levels, and private R&D has also fallen during that time period. As a result, there has been a serious erosion in the capabilities of our national laboratories, our universities, and our state governments to rise to the unprecedented challenges of the 21st century. We urge the Committee to consult with the Science and Energy committees in finding ways to rebuild America's energy efficiency infrastructure, beginning with federal R&D program authorization and appropriations.

Energy and Carbon Savings

ACEEE research shows that new energy efficiency policy initiatives could make a big difference on the energy security and global warming fronts. For example:

- A 2006 ACEEE study finds that we can reduce U.S. oil use by more than 5 million barrels per day by 2020, equivalent to 680 million metric tons of carbon dioxide—nearly 10% of the federal Annual Energy Outlook reference case emissions. Improvements in passenger vehicle fuel economy account for more than 3 million barrels per day of savings, but more than 2 million barrels per day of savings are available in the residential, commercial, and industrial sectors, and in heavy vehicles and airplanes.

- Another 2006 ACEEE study found that doubled efficiency investments in the Regional Greenhouse Gas Initiative (RGGI) cap and trade system for power-sector carbon dioxide emissions would add $13 billion to the regional economy in 2021. This increased energy efficiency investment would reduce average energy bills by up to 12%.

- ACEEE's analysis of Energy Efficiency Resource Standards (EERS) in the electricity and natural gas utilities sectors shows that an EERS target reaching 10% of electricity sales in 2020 would save utility customers a net $29 billion while reducing 2020 carbon dioxide emissions by 343 million metric tons, about 5% of the Annual Energy Outlook reference forecast.

Conclusions

ACEEE's research and experience with energy efficiency in the context of climate policy leads us to several conclusions:

- Efficiency is a very low-cost carbon emissions reduction strategy.
- Efficiency can reduce carbon emissions with positive economic impacts.
- Efficiency resources are a major contributor to the U.S. economy, and their future potential is large.

- Efficiency investments, however, lag far behind their economic potential, because of real and persistent market barriers.
- Conventional economy-wide climate policies, including cap-and-trade and carbon taxes, will not by themselves stimulate the level of additional efficiency investment that would be best for the economy. The structure of cap-and-trade designs tends to keep efficiency out of carbon allowance trading markets, and the relatively weak price elasticity effects of carbon prices limit efficiency investment driven by price signals alone.
- Econometric modeling of climate policy has often been flawed in capture the positive economic effects of energy efficiency investment, and Congress should take a deeper look at these issues.
- Efficiency requires explicit policy treatment in climate policy designs. While an economy-wide approach makes sense as a flexible framework to capture all major GHG emission sources, allowance allocation policies should be used to direct funds to efficiency investments. Also, complementary policies should be used to keep the cost of economy-wide policies down by targeting low-cost resources like efficiency that are locked behind market barriers or blocked by cap-and-trade designs.
- We recommend the Committee examine several of these issues in greater detail, and consider policies to support the greater use of energy efficiency resources in responding to the nation's energy security and global warming challenges.

This concludes my testimony. I thank the Committee for the opportunity to share ACEEE's views on these important topics.