Chapter 23
Efficiency and Conservation

Introduction

Energy efficiency and conservation recently have been receiving increased attention — and not only in discussions about national energy policy and the impact of global climate change, but in television ads for light bulbs and cars, on the labels of new refrigerators and in monthly electric bills.

Energy conservation means using less energy and avoiding excessive or wasteful uses. Efficiency, on the other hand, means using less energy *while getting the same results*. Efficiency is therefore a subset of conservation; one way to conserve energy is to use it more efficiently.

Sometimes the two concepts are distinguished by how the savings are achieved. The U.S. Department of Energy (DOE) says that "energy efficiency is technology-based" (compact fluorescent light bulbs, for example), while conservation "is rooted in behavior" (such as turning off unneeded lights). Moreover, the energy savings from efficiency are easier to predict, measure and especially to sustain, making efficiency easier to treat as an energy resource.[1] This distinction, however, is not entirely clear cut; there are efficiency measures that rely on behavior, such as combining car trips to save gasoline. Nonetheless, the focus of this chapter is on conserving energy through broad-based, long-term efficiency programs.

In light of a rapidly growing demand for power, higher energy prices and increased awareness of environmental and energy security concerns, the concept of doing more with less offers an approach that seems both feasible and affordable. Governmental agencies, nonprofit organizations, utilities and their regulators, manufacturers, lawmakers and consumers across the country and internationally are considering energy efficiency and how to achieve it.

In July 2006, DOE and the Environmental Protection Agency (EPA) released a *National Action Plan for Energy Efficiency*, with the goal of creating "a sustainable, aggressive national commitment to energy efficiency." The action plan embodies the notion of treating increased efficiency as an energy resource; indeed, the first recommendation in the plan is for the U.S. to "recognize energy efficiency as a high-priority energy resource."[2]

As discussed in previous chapters, various fuels will help to meet Texas' growing energy needs in the coming decades. This chapter examines the potential role of efficiency in helping meet those needs by reducing energy use and offsetting the need to build new generating capacity. In general, investments in increased energy efficiency produce subtle and diffuse benefits, spread out among millions of consumers. Nonetheless, those results are quantifiable and justify the consideration of greater efficiency in energy policy development.

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History

The 1973 oil embargo and the resulting increased awareness of energy conservation, coupled with increasing demand and higher prices for electricity, led to a number of new federal policies and programs designed to cut energy demand. These include the Energy Policy and Conservation Act of 1975 (EPCA), the Energy Conservation and Production Act of 1976 and the National Energy Conservation Policy Act of 1978 (NECPA).

EPCA contained, among other efficiency programs, provisions for establishing the original Corporate Average Fuel Economy (CAFE) standards (discussed below). EPCA also directed DOE to establish efficiency targets for major household electrical appliances; NECPA added some commercial equipment to the call for standards. Due to resistance from manufacturers, these standards were never issued, but the legislation prompted several states including California, Florida, Kansas and New York to set such standards themselves.

The variability of these standards from state to state caused difficulties for manufacturers, spurring them to support a renewed push for a single set of national standards in the late 1980s. The National Appliance Energy Conservation Act of 1987 established minimum efficiency requirements for a dozen household appliances; the Energy Policy Act (EPAct) in 1992 added 12 more products, and EPAct 2005 another 16. Some states (not including Texas) continued to push beyond the national law, establishing standards for more electrical equipment; some of these standards were subsequently adopted nationally, preempting the state laws.[3]

NECPA, however, had a more significant effect than its impetus toward appliance efficiency standards. The law also required electric utilities to offer their residential customers energy audits in their homes to help them find ways to conserve electricity. This mandate marked the beginning of the demand-side management (DSM) programs that would grow quickly in scope and importance through the 1980s to the mid 1990s.[4]

The electricity market of the 1970s and 1980s was buffeted by volatile conditions, including an energy shortage; high construction costs, interest rates and electricity prices; slower growth in demand; and initial moves toward electricity deregulation. These events, combined with federal energy conservation legislation, all led to a new emphasis by regulators on demand-side management — that is, reducing the demand for electricity by changing the level or timing of its use — and new considerations in utility planning. Utilities' former reliance on increasing supplies in response to rising demand shifted with the emergence of DSM and gave rise to "least-cost" or integrated resource planning (IRP).[5]

IRP is defined in the 1992 Energy Policy Act:

> The term "integrated resource planning" means, in the case of an electric utility, a planning and selection process for new energy resources that evaluates the full range of alternatives, including new generating capacity, power purchases, energy conservation and efficiency, cogeneration and district heating and cooling applications, and renewable energy resources, in order to provide adequate and reliable service to its electric customers at the lowest system cost. The process shall take into account necessary features for system operation, such as diversity, reliability... and other factors of risk; shall take into account the ability to verify energy savings achieved through energy conservation and efficiency and the projected durability of such savings measured over time; and shall treat demand and supply resources on a consistent and integrated basis.[6]

IRP aims to find the most economical means of supplying sufficient electricity to consumers, weighing the costs of supply-side methods (e.g.,

In Texas, integrated resource planning (IRP) did not take hold until 1995, when the Legislature added it to the Public Utility Regulatory Act. The legislation required utilities to prepare, every three years, integrated resource plans covering a 10 year period. It also contained a one-line provision that had surprising consequences. The statute, in laying out the rules the Public Utility Commission (PUC) needed to establish to begin the IRP process, added some rules the commission *could* set if it wanted to. The commission could "define the scope and nature of public participation in the development of the [utility's integrated resource] plan."[7]

The PUC did, in fact, formulate a process for obtaining informed public feedback on priorities and directions for the utilities' IRP plans. The results of this two-year process surprised both PUC and the utilities: customers from all over the state showed a consistent preference and willingness to pay more for renewable and efficiency resources. Furthermore, when presented with a choice between energy sources with lower construction and higher operating costs, and those costing more up front but with level or lower costs for operation, they strongly preferred the latter.

As a result of this feedback, "the utility companies began to integrate customer values about energy choices into their IRP filings," according to the National Renewable Energy Laboratory. In the year after the conclusion of the public participation process, the Legislature considered and passed an electric restructuring bill; solid evidence of the public's inclinations undoubtedly had some influence on the lawmakers' decision to include a renewable portfolio standard (RPS) and efficiency requirements in the statute.[8]

building new power plants or buying electricity from other generators) against demand-side programs (e.g., increasing the energy efficiency of buildings and appliances and educating the public on saving electricity).

Electric utility efficiency programs developed from modest informational efforts, home energy audits and low-cost loan programs of the late 1970s and early 1980s, to more effective methods such as rebates for energy-saving home improvements, free installations of energy-efficient technology and technical assistance such as site-specific recommendations following energy audits. These programs also expanded from the residential market into the commercial and industrial sectors.

Early advocates of IRP for utilities emphasized that demand reduction programs were often more cost-effective than building new power plants, and high interest rates also added a disincentive to such large capital investments. Nationally, DSM spending by utilities rose sharply in the early 1990s, going from $900 million in 1989 to $2.7 billion in both 1993 and 1994. The resulting energy savings likewise increased significantly; from 1992 to 1996, total DSM savings went from 35.6 billion kilowatt-hours (kWh) to 61.8 billion kWh, more than 90 percent of which came from energy efficiency.[9] Over the same time period, the peak load reduction due to efficiency programs almost doubled, from 7,890 megawatts (MW) to 14,243 MW.[10] These results were not, however, uniform across the country; utilities in Washington, California, Wisconsin, Massachusetts, New York, North Carolina and Florida had the most DSM activities.[11]

The rise of efficiency programs did not continue unabated, however. According to some observers, the "stall" in DSM spending after 1994's peak was due to moves toward deregulation by large segments of the electric utility industry. The prospect of market competition and uncertainty as to its effects caused many utilities to cut spending on efficiency and also to delay investments in new generating capacity.[12]

Even so, the impetus for greater efficiency in energy use remained strong. The Energy Policy Act of 1992 (EPAct 1992), in addition to providing "encouragement of investments in conservation and energy efficiency by electric [and gas] utilities," set efficiency standards and guidelines for buildings, lighting, heating and cooling systems, windows, some electric motors and transformers and industrial facilities.[13] The more recent EPAct 2005 built on those programs, reauthorizing several and expanding the list of facilities and products covered by the federal efficiency standards. And the states have continued to push beyond the national standards by adding appliances not covered by national law, sometimes working in regional coalitions, often replicating California's efficiency standards.[14]

Thirty years of energy efficiency efforts have had an effect. The U.S. economy is significantly more energy-efficient than it was in the mid-1970s. The amount of energy needed to produce one dollar's worth of goods (known as the "energy intensity") fell by about 50 percent between 1970 and 2003, though about half of that drop is attributable to the shifts in the economic base such as the change from manufacturing to service industries (whose "goods" are not in physical form).[15] DOE has developed a new economy-wide energy intensity index to reflect only those changes in energy intensity resulting from energy efficiency improvements. According to that index, energy intensity dropped by 10 percent from 1985 to 2004, meaning that because of increased efficiency, the same amount of goods is produced with 10 percent less energy.[16]

The U.S. economy is significantly more energy-efficient than it was in the mid-1970s.

In the area of transportation, the National Academy of Sciences and the U.S. Department of Transportation studied the effects of the CAFE standards in 2001. The study concluded that the program "has clearly contributed to increased fuel economy of the nation's light-duty vehicle fleet," and that in their absence, gasoline use would have been "about 2.8 million barrels per day greater than it is" [in 2001].[17]

Uses

Efficiency improvements can affect every type of energy use, although they vary widely in their ease and the amount of energy savings they can yield. Considerations such as cost versus benefits, length of the "payback" period for investments, the potential for public funding, maintainability and technological questions must be weighed carefully.

Generally speaking, areas of high energy use are prime targets for efficiency improvements. Most efficiency programs and proposals have focused on electricity use, but there have been improvements in natural gas use as well. Transportation also offers an obvious potential for savings, but other than the CAFE standards there have been relatively few efforts in this area.

Energy Efficiency in Texas

Texas, with its heavy industrial base, large population and hot climate consumes more energy than any other state, with more than half of the state's energy use going to industry. Demand for residential electricity for air conditioning, combined with the fact that the state relies more heavily on electricity for residential energy needs than most states, raises the per capita residential electricity use above the national average, according to the U.S. Energy Information Administration.[18]

Texas ranked eleventh overall among the states in the American Council for an Energy-Efficiency Economy's 2006 state efficiency scorecard. The ranking would have been higher but the state scored only 13 percent in the "utility spending on energy efficiency" category. Texas' score on transportation policies also was low, at 20 percent, although most states scored 20 percent or less in this category. As stated previously, however, improving transportation efficiency has not generated the same level of interest as has electricity.[19]

A July 2007 report on the results of the state's energy efficiency programs found that IOUs not only met, but exceeded, mandated savings.

It should be noted that Texas scored well (80 percent) for the efficiency in building codes and the state's use of combined heat and power (making use of the energy in heat put off by industrial processes). Texas' highest 2006 score was for its renewable energy and energy efficiency portfolio standards (RPS and EEPS). These standards establish state or national goals for energy source or use. An RPS sets a certain percentage of annual energy use that must come from renewable energy sources; these goals are usually set for some years in the future and can be on an increasing scale, such as 10 percent by 2015 and 15 percent by 2020.

Less generally well known, perhaps, are EEPS, standards that require certain percentages of energy needs to be met with energy efficiency. EEPS, also known as EERS (energy efficiency resource standards), are modeled after RPS and sometimes are incorporated into an existing RPS by allowing some portion of the requirement to be met with efficiency improvements. The energy savings can be a percentage of the total sales (total load) or of the projected increase of use in coming years (load growth or demand growth). An EEPS can cover gas utilities as well as electricity and can include an efficiency credit trading system. As with an RPS, the percentages can increase over time; for example, in 2007 Illinois' legislature passed an EEPS requiring a reduction of total electricity use of 0.2 percent in 2008 that grows to 2 percent by 2015.[20]

According to DOE, Texas' EEPS pioneered the policy of requiring electric utilities to meet a portion of their load growth through greater efficiency. In 1999, the Legislature created an EEPS that requires investor-owned electric distribution utilities to cover 10 percent of each year's projected growth in demand with efficiency programs.[21] For 2003, this was 136 MW.[22]

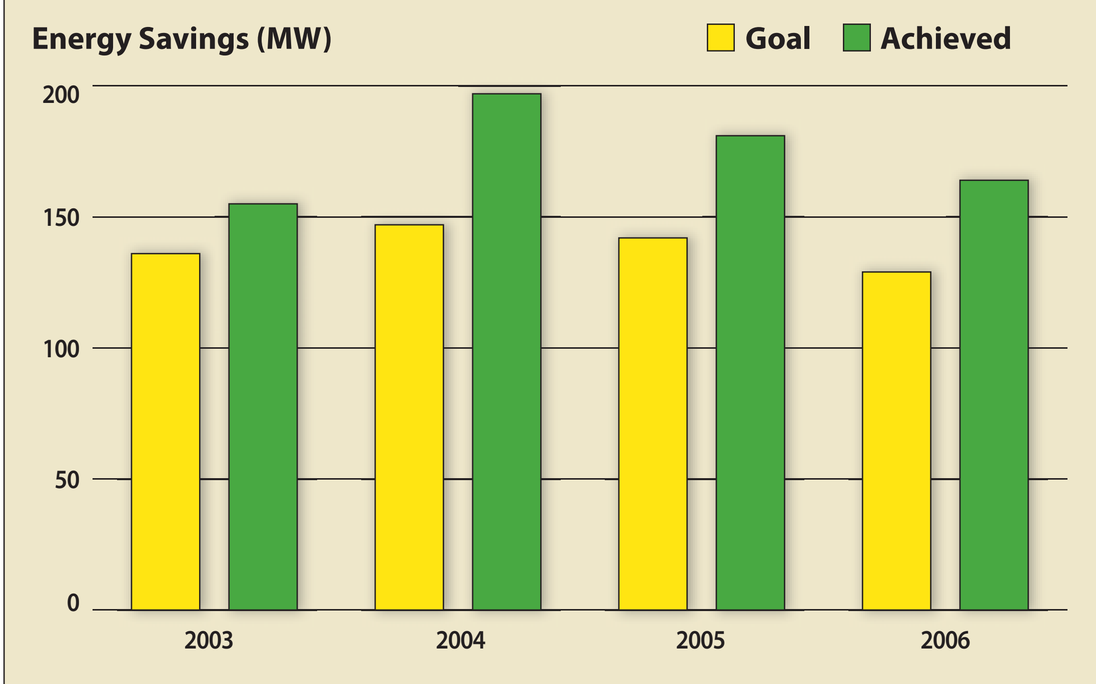
The 1999 legislation (Senate Bill 7) that established the Texas EEPS for most investor-owned electric utilities (IOUs) also introduced competition into the state's electricity market. S.B. 7 required the IOUs to create programs that would "acquire cost-effective energy efficiency equivalent to at least 10 percent of the electric utility's annual growth in demand," and that the Texas Public Utility Commission [PUC] "shall provide oversight and adopt rules and procedures, as necessary, to ensure that the goal of this section is achieved by January 1, 2004."[23] The Legislature gave the PUC and the IOUs those three years to decide on the types of efficiency programs and incentives to use, offer them to the customers and measure the results.

A July 2007 report on the results of the state's energy efficiency programs found that IOUs not only met, but exceeded, the mandated savings in each of the four years running from 2003 to 2006 (**Exhibit 23-1**). Even in the first year of the program, EEPS generated reported savings 11 percent above the goal. In addition, these efficiency efforts produced a reduction in air pollution; the report calculates that the creation of Texas' EEPS has kept about 2,660 tons of nitrous oxide (NO_X) out of the air.[24]

Although utilities self-report savings from the efficiency programs, the utilities have oversight procedures in place to measure and calculate the results and PUC also has a review process to verify

EXHIBIT 23-1

Total Energy Savings by IOUs, 2003-2006



Source: Frontier Associates.

their numbers. A contractor reviewed the 2003 and 2004 savings figures produced by six participating utilities for PUC; in January 2007, the consultant reported that, while some values were too high, others under-reported savings, and in all the utilities had actually achieved 102 percent of the demand reduction they reported.[25]

Efficiency programs generate costs as well as savings. The cost-effectiveness of spending on energy efficiency can be examined through PUC's annual reports on emission reduction to the Texas Commission on Environmental Quality. The findings of the 2005 and 2006 reports are summarized in **Exhibit 23-2**.

In addition to calculating the NO_X reductions from reduced electricity use due to efficiency, PUC also reports the value of the energy savings. The efficiency measures are required to have at least a ten-year lifespan, and the reports show the electricity cost savings achieved in the first year and over ten years. The utilities, in addition to exceeding their MW reduction goals, produced cost savings that will be cumulatively greater than 350 and 150 percent of the '05 and '06 program costs, respectively.[26]

Availability

Texas' demand for electricity has grown along with its population, which in recent years increased at nearly twice the national rate. Both the population and electricity demand are projected to continue their strong growth in the coming decade. These projections have prompted increased interest in trimming the growth in demand through energy efficiency programs.

Another impetus to using energy more efficiently is the rise in energy prices, due in part to the sharp increase in power plant construction costs. According to Cambridge Energy Research Associates (CERA), those costs are up 27 percent in the year preceding February 2008, 19 percent in the latter

Exhibit 23-2

Energy Efficiency Program Costs and Savings

Summary – 2005 Energy Efficiency Program

Expenditures	Customer Energy Cost Savings		Demand Savings (MW)		Annual Energy Savings (MWh)
$78,929,907	initial year – 2005	$53 million	goal	142.17	496,890
	ten-yr project life	$290 million	achievement	180.75	

Summary – 2006 Energy Efficiency Program

Expenditures	Customer Energy Cost Savings		Demand Savings (MW)		Annual Energy Savings (MWh)
$58,376,786	initial year – 2006	$19.64 million	goal	128.30	357,000
	ten-yr project life	$90.3 million	achievement	161.68	

Source: Public Utility Commission of Texas.

six months alone. For utilities, the comparative costs for efficiency programs to save electricity and building new generation capacity increasingly favor efficiency.[27]

In January 2007, Optimal Energy, an energy efficiency consulting firm, released a report, commissioned by the nonprofit groups Natural Resources Defense Council and Ceres, called *Power to Save: An Alternative Path to Meet Electric Needs in Texas*.[28] In March 2007, the American Council for an Energy-Efficient Economy (ACEEE) released *Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas' Growing Electricity Needs*. Both reports examined the potential savings from efficiency programs in the residential and commercial sectors, as well as from other energy saving techniques such as "demand response," which refers to strategies for cutting energy use at the time of peak demand. For example, utilities can offer incentives to customers in exchange for allowing them to cycle off residential appliances or air conditioning systems for brief amounts of time. Demand response also can employ pricing tools such as time-of-use rates, critical peak pricing or real-time pricing, all of which require customers to pay more for power during peak demand periods.[29]

Programs that vary the cost of electricity to consumers depending on when it is used, like the time-of-day pricing for cell phone use, require the ability to gather new information. Not only do the consumers need to know about the different costs associated with their usage patterns, but the electric company must have the data on when and how much power each customer is using at any time. This information is gathered by advanced electrical meters often called "smart meters" (see sidebar).

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According to *Power to Save*, "ambitious" energy efficiency efforts could eliminate more than three quarters of the projected growth in demand for electricity over the next 15 years with the costs of implementing the efficiency programs being "substantially" lower than new supplies of electricity. The report found that the residential sector accounts for the largest amount of potential efficiency savings, followed by the commercial sector and then industrial uses. It also stated that:

> …[an additional] 20,000 megawatts of potential combined heat and power (CHP) capacity exists in Texas. Combined heat and power refers to the generation of both electricity and useful heat energy, usually by an industrial energy consumer for use at their own facility. This reduces the consumer's need to purchase power from a utility.

Power to Save estimated that demand response programs could further reduce Texas' peak demand by 3,200 megawatts.[30] Lowering peak demand carries a large benefit because maintaining adequate capacity for peak usage, as well as actually generating the electricity to meet that level of demand, are both very costly.

The *Power to Save* report recommended that Texas:

- increase its EEPS from 10 percent to at least 50 percent and preferably to 75 percent, which would cover at least half of the predicted load growth;
- increase its overall investment in energy efficiency programs;
- raise efficiency standards for appliances such as swimming pool pumps and DVD players;
- update residential and commercial building codes to increase energy efficiency by 15 percent;
- require utilities "to invest in all cost-effective efficiency resources;"
- eliminate disincentives for these investments through changes in the regulatory structure;
- allow utilities flexibility in design and delivery of efficiency programs; and
- require PUC to review and update the state's efficiency potential savings, goals and programs every two years.[31]

Although the *Power to Save* recommendations addressed energy efficiency only, the report also estimated gains from demand response and CHP in its total potential savings (**Exhibit 23-3**).

The ACEEE study proposed a series of nine "effective and politically viable" policies, two-thirds of them concerning energy efficiency, to reduce energy consumption and demand growth over the next 15 years. Some of these proposals echo and expand upon the recommendations in *Power to Save*, such as expanding utility energy efficiency programs; setting additional standards for electric appliances and equipment; and drafting more stringent building codes (as studied by Texas A&M per legislative direction). In addition, the report proposes initiating an advanced energy efficiency training program for architects, engineers and builders of new homes and commercial buildings; an expanded LoanSTAR

Smart meters are actually electrical meters combined with wireless or radio communication devices that allow for much more detailed information to be exchanged between electricity providers and consumers. The initial type of advanced meters simply allow one-way communication, enabling remote meter-reading. Now, meters capable of two-way communication offer the possibility of a greater exchange of data. These meters, when combined with data management systems such as billing or information storage, create the opportunity for electricity to be sold at prices that vary throughout the day, rather than in month-long chunks at one price. In that case, retail electricity providers (REPs) can charge their customers prices that more closely reflect the REPs' costs to obtain the electricity (which vary according to the load, or demand, on the system). And, with the information that the meters gather, electricity consumers can see how much power they are using any particular time, what the cost of that electricity is and what effect conservation efforts, such as raising the thermostat a couple of degrees, can have on their costs.

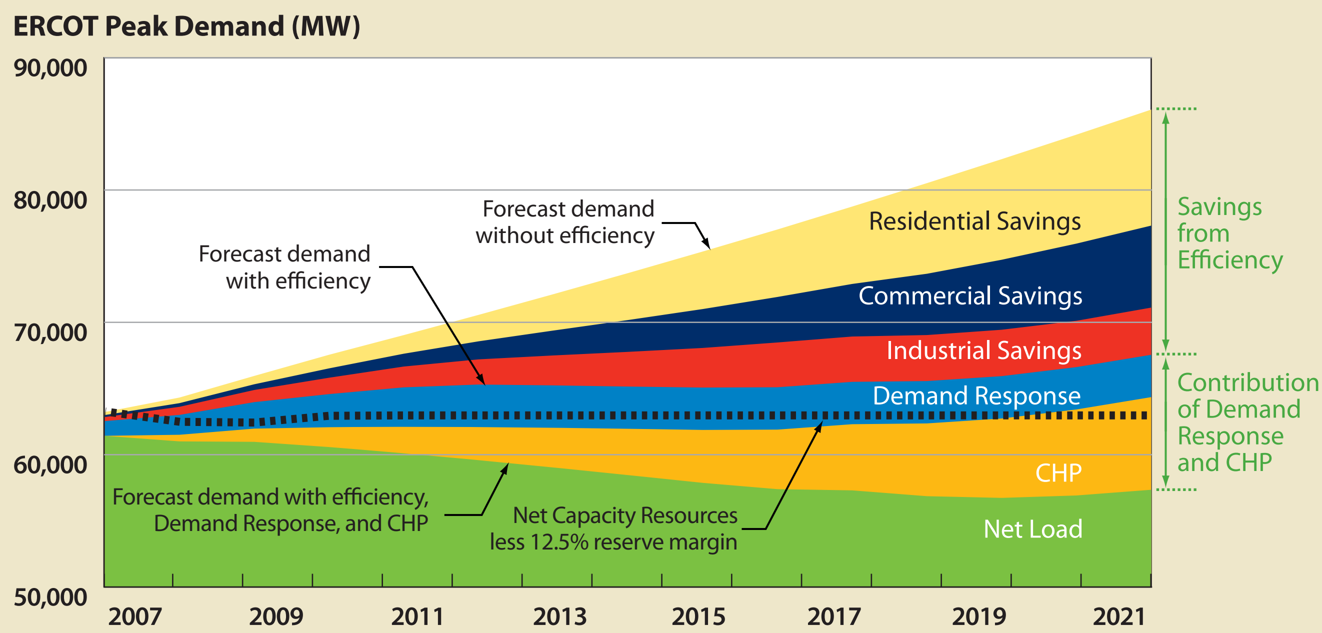
REPs also can use the advanced meters to better monitor the distribution system for problems like outages. The information about customers' usage patterns and how (or whether) they respond to different prices can help the utilities manage the system and add to demand predictability. The meters are the major first step in building what is called the "smart grid," which, like the meters, will enable greater capacity for data collection and fine-tuned control of the flow of electricity over the grid.

Smart meters capable of two-way communication for data gathering and differential pricing are more expensive than the traditional meters or even the more recent versions that can be read remotely or that allow a REP to cycle off residential electricity for a short time during highest demand. In California, where the Public Utilities Commission initiated an Advanced Metering Infrastructure project in 2005, some of the largest utilities have received approval for their plans to install millions of smart meters at a cost of billions of dollars; cost per meter ranges roughly from $150 to $350 and these costs will be passed on to the ratepayers. Some opponents to widespread installation of the meters say that the cost is too high for the consumers to offset with unproven savings, that load-shifting is not the same thing as actually conserving energy and that some types of customers, like the elderly, homebound or ill, cannot shift their energy use to avoid peak prices.[32]

In Texas, two investor-owned utilities thus far, Center Point and Oncor, are proposing to install smart meters; PUC started holding workshops in late 2007 to address how the advanced meter systems (AMS) will be implemented in the state. And Austin's municipal utility, Austin Energy, has been installing remote-reading meters since 2004 and plans to have smart meters installed throughout the rest of their system by late 2008 or early 2009. The data systems for fully utilizing the capabilities of the meters will be added over the next few years. San Antonio's municipal utility is implementing a similar program.[33]

EXHIBIT 23-3

Effect of Efficiency, Demand Response and Combined Heat and Power (CHP) on Demand Forecasts



Source: Optimal Energy.

program and fund for state and municipal facilities on the waiting list for loans to make efficiency improvements; and a market transformation initiative consisting of a series of short-term programs to educate the public on energy efficiency and offer them rebates on energy efficient products.

ACEEE asserted that if its policies (including those concerning demand response, CHP and on-site renewable energy) are implemented, "Texas can meet its summer peak demand needs without any additional coal-fired power plants or other conventional generation resources." ACEEE also says that its energy-saving policies "would meet 8% of Texas's electricity consumption in 2013 and 22% in 2023." The report notes that of its projected savings, 30 percent would come from utility efficiency programs; 30 percent from improved CHP policies; and 22 percent from appliance standards and building-related programs (the remainder would come from on-site renewables).[34] It should be noted that there is always debate among energy experts about what level of energy savings is achievable from efficiency programs and what economic costs and savings will result. The results reported from previous years' utility requirements shown above, however, indicate that savings have resulted from Texas' early EEPS. The question is which additional programs would meet their estimated goals without negative unintended consequences.

The Texas Public Policy Foundation (TPPF) released a report in January 2008 that takes issue with some of the recommendations and their estimated savings and costs in *Power to Save* specifically, along with the ACEEE report more generally. The report, entitled *Power for the Future: The Debate Over New Coal-Fired Power Plants in Texas*, casts doubt on the ability of the efficiency measures recommended in those reports to offset most of the need for new generating capacity. First, TPPF says that it is uncertain whether efficiency gained from new technology will lead to reduced electricity use, because historically consumers use more energy if their energy costs go down.

The TPPF report does agree about the need for more demand response capacity in Texas, especially in light of the amount of time it takes for new power plants to be built and come online. TPPF says that an increase in interruptible electricity supplies, whereby companies allow their power to be cut for brief times in exchange for price breaks, in particular, would help reduce the demand for new capacity. The report points out that the amount of interruptible supply available to the grid during peak demand is down by almost two-thirds since 2000.

The main reason TPPF rejects the projections of energy savings and avoided need for new plants is cost — higher prices for homes built to more stringent efficiency standards are pricing buyers out of the market, and more expensive energy-efficient appliances are causing consumers to delay replacing their older models. In addition, the report predicts that appliance manufacturers would sue the state if Texas requires higher energy efficiency standards, on the basis that the requirements would interfere with interstate commerce. And TPPF maintains that using other states as examples for Texas, as done by proponents of regulatory efficiency measures, can be misleading. California, Massachusetts, Connecticut and Vermont, states with efficiency programs mentioned in the reports discussed above, all have milder summers, less industrial expansion and, except for California, slower population growth. The report states that all four of those states have higher average electricity prices.[35] Energy use tends to decrease with higher energy prices.

The *Power to Save* and ACEEE studies were not alone in concluding that Texas can achieve significant energy savings. A January 2006 report from the Western Governors' Association (WGA), *Clean and Diversified Energy Initiative*, concluded that a "Best Practices" scenario of energy efficiency standards and programs could reduce electricity demand growth in the western states by about 75 percent over 17 years. These best practices were derived from existing programs in WGA states and the scenario assumes similar measures are implemented region-wide, with the estimated savings then proportionally applied to the other states and localities after time allowed for "ramping up" the programs.

WGA reviewed different efficiency studies and energy projections applicable to their region along with recent electricity use and price data. Many of the 19 states in the WGA region (all the states west of and including the Texas to North Dakota line) are growing fast, not only in population but also in energy use. Electricity prices have risen steeply in the western states since 2000, climbing by more than 20 percent in some states, including Texas. WGA predicted that its recommendations for efficiency best practices would reduce total electricity consumption by 20 percent by 2020, compared to a "Reference" scenario, a forecast based on the Energy Information Administration's *Annual Energy Outlook*, that includes national efficiency policies and programs.

It is important to note that in addition to the Reference and Best Practices scenarios, WGA included a "Current Activities" scenario that estimates the impact of efficiency measures enacted by 2005 within the WGA region at the state, regional, local and utility levels. (The report was commissioned in February 2005.) This scenario's estimated savings accounts for nearly half of the 20 percent cut in consumption in the Best Practices total (**Exhibit 23-4**).[36] Naturally, any efficiency programs initiated since 2005 (such as those included in Texas legislation described below) are not included in the Current Activities estimates.

The WGA report also examined the major barriers and market failures that limit or prevent greater investment in energy efficiency improvements, as does the *National Plan for Energy Efficiency*, a 2006 EPA report that said energy efficiency "remains critically underutilized in the nation's energy portfolio."[37] Barriers to achieving efficiency savings and other benefits are discussed later in this chapter.

Recent Texas Legislation

In June 2007, the Texas Legislature approved House Bill 3693, "relating to energy demand, energy load, energy efficiency incentives, energy programs, and energy performance measures," to implement some of the recommendations included in the efficiency reports discussed above. Among numerous other efficiency measures, H.B. 3693 requires electric utilities to run energy efficiency incentive programs that will "acquire additional

An increase in interruptible electricity supplies, whereby companies allow their power to be cut for brief times in exchange for price breaks, would help reduce the demand for new capacity.

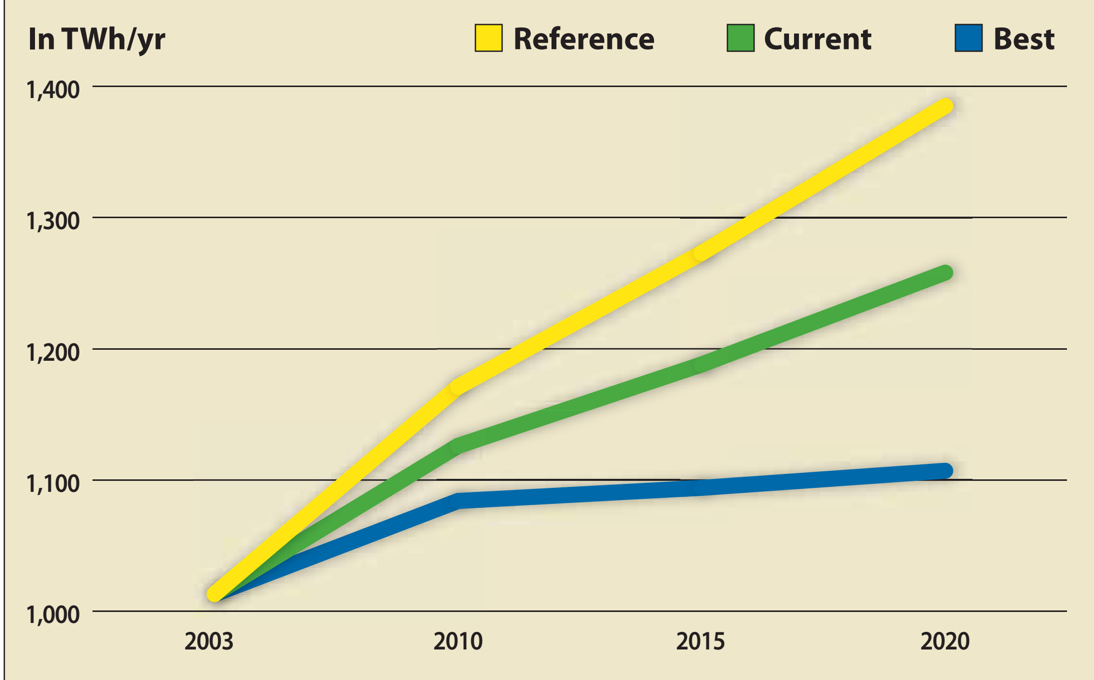
cost-effective energy efficiency equivalent to" 15 percent of annual residential and commercial demand growth by the end of 2008. This requirement, which went into effect in September of 2007, increases to 20 percent by the end of 2009. Thus, the state's energy efficiency portfolio standard is being increased from the current 10 percent to 20 percent over the course of two and one third years. This increase is undoubtedly a result of the ease with which the utilities' efficiency programs met and exceeded the energy reduction goals of the original EEPS.

It is important to note, however, that the H.B. 3693 efficiency requirements apply to residential and commercial electricity only and do not include industrial electricity use, which has been subject to the standard set forth in S.B. 7. Texas' industries account for about 30 percent of the electricity consumed in the state; the ACEEE report estimated that the industrial sector could cut that consumption by about 26 percent by adopting a set of efficiency measures ACEEE found to be cost-effective. More than 70 percent of this savings potential is due to measures that cost three cents or less per kilowatt-hour of energy saved.

The PUC established the rules for implementing H.B. 3693 in March 2008 after taking public input from interested parties. The rules exclude the utilities' industrial customers from eligibility for efficiency programs except for programs that will be completed by the end of 2008. The utilities also are allowed to add qualified industrial customers to programs that started before May 1, 2007, in order to maintain participation levels in those programs.[38] Otherwise, as the statute now stands, industrial electricity demand growth will no longer be subject to efficiency savings requirements and that sector of the savings potential will

EXHIBIT 23-4

Electricity Consumption in the Western Governors' Association States by Scenario



Source: Western Governors' Association.

not be realized unless industry initiates efficiency efforts on its own. Industrial facilities have an incentive to cut energy costs and one way to do so is to implement efficiency programs, but since they are not included in the new law, they will not have access to the financial incentives that utilities provide to their customers to meet the EEPS goals.

To counteract the effect of the disincentive on utilities for investing in efficiency programs and thus selling less electricity, PUC developed new rules to ensure that the costs of these programs can be passed on to the customers who will receive the benefit of efficiency improvements. This included the creation of an "energy efficiency cost recovery factor" so that utilities can recoup the expenditures; this factor will be monitored and, if necessary, adjusted yearly to be sure that no "over-recovery of costs" occurs.

H.B. 3693 also directs PUC to study whether further increases in these targets (to 30 percent before 2011 and 50 percent by the end of 2015) are achievable. Again, it should be noted that these percentages do not include the industrial sector's electricity consumption and demand (but do apply to electricity use in the entire state).

H.B. 3693's utility mandates apply only to investor-owned utilities (IOUs) and not to municipally owned utilities or electric cooperatives, although "munis" that sold more than 500,000 megawatt-hours (MWh) of electricity in 2005 are required to have and to report on "energy savings incentive programs." Coops must "consider adopting" such programs, and those with sales of more than 500,000 MWh in sales in 2005 must also report on the effects of their "energy efficiency activities."[39] The ACEEE report specifically mentioned the municipal and cooperative exemption from the existing EEPS requirements and recommended that "all [sectors] should contribute to meeting the state's needs."[40]

H.B. 3693 has other goals, such as reducing consumption by state agencies, higher education institutions and school districts by 5 percent each fiscal year for six years; requiring efficient lighting and vending machines; and establishing efficiency standards for new residences built with public funding assistance.[41] The bill's requirements should reduce demand growth significantly.

Another piece of legislation that passed in 2007 is H.B. 3070, creating an advisory committee to study how to rate the energy efficiency of homes, new or existing, going up for sale. The rating process would also provide information on improvements that could be made and how they would change the efficiency rating, and the rating would be included in the real estate listing for the home.

The committee is also charged with studying how to educate both homebuyers and lenders (mortgage brokers and financial institutions) on energy efficiency mortgages, in an effort to make them more available. These mortgages have monetary advantages for borrowers based on the fact that the loans on efficient homes carry less risk because the homes cost less to operate. Finally, the committee is to determine whether having information about the energy efficiency of homes be part of the real estate market is likely to lead to more efficient residences. The report is due October 1, 2008.[42]

Costs and Benefits

Efficiency improvements can be considered as investments, with upfront costs and some level of return in terms of savings or avoided costs. Research indicates that efficiency is very cost-effective. The WGA report found that most of the energy efficiency programs in its region are "saving electricity at a total cost of 2-3 cents per kWh saved." In addition, it estimates that, in WGA's 18 states, the savings in electricity costs to the residential, commercial and industrial sectors by 2020 under the Best Practices scenario would be $9 billion, $11 billion and $1 billion, respectively.[43]

Efficiency improvements can be considered as investments, with upfront costs and some level of return in terms of savings or avoided costs.

These savings are not, of course, spread evenly among the states, and two of the states merit a closer look. California holds nearly half of all the potential electricity savings from the Current Activities scenario, due to its large electricity demand and aggressive efficiency policies. Its savings under Best Practices, however, are barely over a quarter of the total because many of those practices are already California programs. Texas, on the other hand, would see its portion of the region's electricity savings rise from about 20 percent with current policies to 31 percent with adoption of the best practices, providing the largest amount of additional savings.

Transportation efficiency efforts have primarily focused on improving mileage.

In all, WGA claims that the net economic benefit over the 15-year period (2005-2020) would outweigh costs by 2.4 times under Current Activities and 2.5 times with Best Practices.[44] The *Power to Save* report included a cost-benefit analysis of efficiency savings that found a $4.40 return for every dollar invested.[45]

The ACEEE report calculated that the efficiency policies it recommends (not including demand response programs) would cost $29.6 billion by 2023; if incentive programs were added to ensure reaching the highest efficiency savings, the total cost would be $34.4 billion. Of this total, however, only around a quarter, or $8.6 billion from 2008 to 2023, represents public funding for incentives and program and administration costs. The remainder of the cost is paid by electricity consumers, as an investment that returns savings in energy costs. This investment would save a cumulative 672,825 million kWh. (This includes savings only from 2008 through 2023, not beyond.) The report points out that the Texas average retail electricity cost was 9.1 cents per kWh in 2005. Thus, the avoided expense of the electricity alone would be roughly $61.2 billion; if total program costs (including incentives) are subtracted, savings from avoided electricity costs alone would total $26.8 billion.[46]

This basic calculation does not take into account any of the additional economic impacts that were explored in a follow-up report from ACEEE, *The Economic Benefits of an EE/RE Strategy in Texas*. The report includes job growth (because of savings spent outside the electric utility sector, which has a low employment coefficient), lower electricity prices and reduction of air pollution (and carbon emissions) as side-effects of investments in and savings from energy efficiency and renewable energy that would benefit the Texas economy.[47]

Some analysts, however, dispute the savings projections of the various sources pushing for increased efforts for energy efficiency, and disagree with an approach that includes government mandates for reduced energy consumption and the incentives and subsidies that often accompany them. Critics point to higher consumer costs for more energy-efficient products and reduced choices that can result from regulations such as appliance efficiency standards. One analyst with the Competitive Enterprise Institute claimed that "measures enacted in the name of energy efficiency … have accomplished nothing," and asserted that "a quarter century of federal energy-efficiency mandates has increased, not decreased, total energy use." The reasoning behind this assertion is that consumers with energy efficient vehicles or appliances might tend to use them more: more driving if in a fuel-efficient car; a bigger (or second) refrigerator if it costs less to operate; or higher thermostat settings on an energy-efficient heater.[48]

Others simply believe that mandates are not the most cost-effective way to achieve higher levels of energy efficiency and can even stifle innovation. Some advocate for the power of the marketplace to provide incentives for improved efficiency without the "unintended consequences" of government regulations.[49] And there are those who believe that there is a "simple, elegant and cost-effective way" to increase energy efficiency – "make energy more expensive [through] a carbon tax."[50] These differing viewpoints about government intervention, costs of mandates, publicly funded programs, market distortions and effective means of reaching even a common goal are not unique to the issue of energy efficiency.

Transportation Efficiency

Given that 28.5 percent of the U.S.'s energy is used for the transportation of people and goods, higher efficiency in the transportation sector has the potential for significant energy savings. Road vehicles use about three-quarters of transportation-related energy, with more than 58 percent of it used by cars and light trucks.[51] This, of course, represents enormous expenditures for fuel as well as vehicle maintenance and roadway construction.

Transportation efficiency efforts have primarily focused on improving mileage — traveling more miles on each unit of fuel. Other factors come into play, however; the purpose of transportation, after all, is not to move the vehicle some distance, but rather to move its contents. The density of a vehicle's load, whether it is goods packed in a semi-trailer or passengers in a car or bus, determines its overall efficiency.

Public Transportation

Cars and light trucks accounted for 17.8 percent of all U.S. energy use in 2005, and road congestion in urban areas costs the nation billions of dollars each year in lost productivity and added fuel costs.[52]

Shipping Efficiency

Efforts to improve transportation efficiency involve many facets of modern life. Consider, for example, the packaging of goods and its effect on shipping "density" — that is, how many units fit into a shipping container.

Hewlett-Packard ships a variety of electronic equipment around the world and pays considerable attention to the way its products are packaged. The company has described examples of how that attention pays off:

> Improved packaging can…bring benefits in product transportation. For example, we reduced the weight of our standalone camera packaging from 396g/unit in 2003 to 164g/unit in 2006. The smaller size allowed us to increase the number of units per pallet from 200 to 720, which translated into less energy required to ship each item. … In 2005, HP developed the ROSe (Robust Orientation Size effect) calculator to help engineers develop packaging designs that minimize the amount and cost of materials used. ROSe also optimizes packaging for more efficient loading on pallets and trucks, based on product size, weight, the required protection level and the arrangement of the pack contents. For example, we reduced the quantity of packaging materials by 20% per unit for one category of PCs shipped from China, while increasing the number of PCs per pallet from 28 units to 40 units. The energy required to ship each unit fell by 40%.[53]

Any discussion of transportation efficiency and conservation, then, would be incomplete without considering the potential benefits of public transit.

The Texas Transportation Institute's (TTI's) *2007 Urban Mobility Report* documents some of these benefits. The report examined traffic congestion in 85 major U.S. cities and gathered traffic data for all 437 urban areas in the country. Overall, the report shows that the problems of congestion and its costs, are growing everywhere.

According to TTI, the amount of fuel "wasted" due to road congestion amounted to 2.9 billion gallons in 2005. This results from the time delays on the road, which totaled 4.2 billion hours that year; together these effects cost the nation $78 billion. Without existing public transportation systems, however, it would have been worse. TTI calculates that transit travel in 2005 prevented 541 million hours of delay and saved $10.2 billion in congestion costs.

The TTI report emphasizes that there is no one solution to traffic congestion because congestion is not *one* problem. It offers a set of approaches to reducing congestion and recommends consideration of all of them, acknowledging that solutions will be different for different locations. Three of the six categories of solutions TTI recommends — adding capacity in critical corridors, providing choices and diversifying land development patterns — include potentially expanding public transportation. According to TTI, public transportation service, particularly in the most congested urban areas, provides "substantial and increasing benefits."[54]

Just as with major roads and highways, expanding existing transit systems is an expensive and time-consuming proposition and building new systems is even more so. These costs must be carefully weighed against the potential benefits. In combination with other measures, as recommended by TTI, public transportation can be an effective way to increase transportation efficiency and also reduce some of the detrimental effects of our energy-intensive ground transportation system.

Fuel Economy

The federal Corporate Average Fuel Economy standards, introduced in response to the 1973 oil crisis, are designed to reduce gasoline consumption and our dependence on foreign oil. The definition of CAFE is "the sales weighted average fuel economy, expressed in miles per gallon (mpg), of a manufacturer's fleet of passenger cars or light trucks with a gross vehicle weight rating of 8,500 lbs. or less, manufactured for sale in the United States, for any given model year."

CAFE testing is the responsibility of the U.S. Environmental Protection Agency, which provides the stickers displayed on new vehicles reporting the gas mileage that can be expected from them. The original goal for the standards, which became law in 1975, was to double the 1974 sales-weighted average fuel economy of passenger cars to 27.5 mpg by 1985. This is also the current CAFE standard for cars through the 2007 model year. Light trucks have had separate and distinct fuel standards since 1979; for the 2007 model year, the truck standard is 22.2 mpg.

If a manufacturer's fleet fails to meet the average fuel economy standard, it can be charged a penalty of $5.50 per each tenth of a mile per gallon under the standard multiplied by the number of vehicles (cars or trucks) made in that model year. Automakers are allowed, however, to offset their penalties in the previous three years or in the next three years with credits earned by exceeding the CAFE target; the credits cannot be transferred between car and truck fleets, or between manufacturers.[55]

CBO assumes a 2 percent increase in miles driven for a 10 percent improvement in average miles per gallon.

Several recent studies and reports have analyzed the effect of the CAFE standards, as well as the potential impact of raising them. In 2001, for instance, Congress asked the National Academy of Sciences to study the standards with the assistance of the U.S. Department of Transportation (DOT). The study concluded that the program "has clearly contributed to increased fuel economy of the nation's light-duty vehicle fleet," and that in their absence, gasoline use would have been "about 2.8 million barrels per day greater than it [was in 2001]." The academy recommended that the federal government continue to "ensure fuel economy levels beyond those expected to result from market forces alone," while acknowledging the "difficult trade-offs," involving costs, environmental benefits, safety, oil imports and consumer choice, that policy would require.[56]

Since that study, fuel efficiency goals have continued to generate policy proposals. A 2002 Congressional Budget Office (CBO) study weighed the potential effects of increasing the CAFE standards against two alternative policies: raising the federal gas tax and establishing a "cap and trade" system on carbon emissions from gasoline.

Under the cap and trade proposal, the government would set a limit or "cap" on the amount of carbon dioxide emissions that could be emitted by gasoline nationwide. A federal agency (probably EPA) would issue "emission allowances" for that limit. Gasoline manufacturers would receive these allowances for the emissions of the gasoline they sell, and would be able to trade, buy or sell those allowances amongst themselves.

CBO concluded that all three policy options would reduce gasoline consumption, but would produce different consequences. Specifically, CBO found that higher CAFE standards would not be as "cost-effective" as a higher gas tax or a cap and trade program because the focus on fuel economy of vehicles does not bring about gas-saving changes in driving behavior. In fact, researchers find that improved fuel efficiency can result in more miles driven; based on other research, CBO assumes a 2 percent increase in miles driven for a 10 percent improvement in average miles per gallon. CBO's definition of cost-effectiveness is "keep[ing] losses in producers' profits and consumers' welfare to a minimum for any given level of gasoline savings." This definition of cost-effectiveness does not, CBO admits, include consideration of externalities by weighing costs against additional benefits of reduced gasoline use, such as reduced pollution and carbon emissions.[57]

More recently, a July 2007 report from the National Petroleum Council (NPC), noted that although the cars and trucks produced now are more "technically" efficient than those dating from the inception of the CAFE standards, this efficiency has not been used to increase fuel economy. Instead, the industry has made larger, heavier and more powerful vehicles with a number of energy-consuming features. NPC calls for a "doubling of fuel economy of new cars and light trucks by 2030 [which is] possible through the use of existing and anticipated technologies." In fact, the report recommends using increased energy efficiency to moderate demand as the first of its five U.S. energy policy strategies.[58]

On December 19, 2007, President Bush signed the Energy Independence and Security Act which requires that the CAFE standard for light-duty vehicles be increased to 35 mpg by 2020.[59]

Environmental Impact

Efficiency, as an energy resource, has a unique impact on the environment, compared to other energy sources. Efficiency is not just benign in its environmental impact; reducing energy use through efficiency has clear and, in some cases, measurable environmental benefits. Cutting air pollution is perhaps the most obvious benefit of improved efficiency in transportation and electricity use. Others include reduced carbon emissions, less transportation of fuels and reduced need for additional power plants — in sum, every form of environmental impact caused by using energy can be lessened by reducing energy use through greater efficiency.[60]

Barriers to Efficiency

The National Action Plan for Energy Efficiency notes that underinvestment in efficiency programs is due to known barriers that include:

- *market barriers,* such as the well-known "split incentive" barrier, which limits home builders' and commercial developers' motivation to invest in energy efficiency for new buildings because they will not be paying the energy bill;
- *customer barriers,* such as a lack of information on energy-saving opportunities, or a lack of funding to invest in energy efficiency; and
- *public policy barriers,* such as statutes and regulations that provide disincentives for utility support of and investment in energy efficiency.[61]

Overcoming these barriers can be difficult for policy-makers. Educating the public, including business and industry, about the environmental (and economic) benefits is an obstacle. Nonetheless, the growing concern about climate change presents an opportunity to meet that challenge.

Outlook for Texas

The state of Texas has, over the years, enjoyed some of the lowest energy prices in the nation, helping to fuel economic growth and building an industrial base with a national, even global impact. The abundance and relatively low cost of energy supplies fostered a climate where reducing energy use was not considered a priority. In today's world, with consideration of numerous factors such as higher prices, energy security and environmental and climate impacts, energy efficiency is viewed by many as an attractive and low-cost energy resource. Texas has a large, untapped reservoir of this resource available. While the actual numbers associated with

Texas Industries of the Future

One barrier to implementation of efficiency measures is the intense competition between companies within certain industries, which can act to compound a lack of access to complete information about energy-saving practices. In Texas, where industry accounts for half of all the state's energy use, the potential for savings is large. To help overcome the obstacles to information sharing, Texas Industries of the Future was established in 2001 with grant funding from the U.S. Department of Energy (DOE) through a contract with the State Energy Conservation Office.

The purpose of the Texas Industries of the Future program is to facilitate the development, demonstration and adoption of advanced technologies and adoption of best practices that reduce industrial energy usage, emissions, and associated costs, resulting in improved competitive performance. The bottom line for Texas industry is savings in energy and materials, cost-effective environmental compliance, increased productivity, reduced waste and enhanced product quality.

The state program, managed by the University of Texas at Austin, leverages the programs and tools of the DOE's Industrial Technologies Program (ITP), which focuses on energy intensive industries. These tools include access to technology resources of the national laboratories and to information and training on ITP's national Best Practices. In Texas the initial focus has been primarily on the chemical manufacturing and refining industries, as well as the forest products and biomass sectors, because these account for 86 percent of the industrial energy use in Texas.

Texas Industries of the Future brings benefits for the state, the economy and the environment. The program builds partnerships among the industry, university and government sectors to target and solve pressing technological problems within and across key industries. It also provides a forum for identifying longer-term technology issues of interest to Texas industries and positions Texas to successfully compete for national funding of technology research and demonstration and commercialization projects.

A closely related program, also from ITP, is the "Save Energy Now" program, initiated in 2006, in which experts from DOE assess industrial plant operations and identify opportunities for saving energy. There also is follow-up for these assessments to check for implementation of energy-saving practices and quantify the savings achieved. In April 2008, Texas Industries of the Future recognized a dozen "Saver" industries and three "Champion" industries in Texas that saved a total 1.1 trillion Btu of energy through the Save Energy Now program.

estimates of efficiency potential may be debatable, the fact that the potential exists is not in dispute. Texas, once again, finds itself in the enviable position of having a big energy resource to develop, given the determination to do so.

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