Chapter Eight

Three Strategies to Increase Energy Efficiency

By Howard Geller

Three Strategies to Increase Energy Efficiency

Increasing the energy efficiency of buildings, appliances, lights, factories, and vehicles is America's least costly and cleanest source of energy. And the opportunity is huge! A 2010 study by the National Academy of Sciences found that a smart energy efficiency strategy could reduce energy waste in the U.S. by 17–20 percent by 2020 and by a total of 25–31 percent by 2030 (NAS 2010). Full deployment of cost-effective, energy-efficient technologies in buildings alone could eliminate the need for any new power plants in the U.S. through 2030.

Even with the investments needed to install energy-efficient technologies, it costs far less to save energy than it does to create it from new resources of any type. According to the National Academy of Sciences, the average cost of buildings' electricity savings resulting from installing efficiency technologies is less than half the cost of creating any type of new power generation source. In fact, a recent review of utility-sponsored energy efficiency programs found benefit-cost ratios of about 2.6:1 on average (Friedrich et al. 2009).

The fundamental cost-effectiveness of improving the energy efficiency of appliances, buildings, factories, and vehicles underlies its potential contribution to enhancing our nation's competitiveness. The United States is farther behind than many other countries in its level of energy efficiency. For example, a study of industrial energy efficiency potential worldwide found that the U.S. chemical and petrochemical industry could improve its energy efficiency by 30 percent, compared with similar improvement potential of just 10 percent in Japan and Germany, 17 percent in Brazil, and 20.5 percent in China (IEA 2007). Likewise, U.S. paper/pulp and cement manufacturers are less energy-efficient on average than are manufacturers in other nations (IEA 2007).

This chapter presents three key strategies for increasing energy efficiency and thereby enhancing the competitiveness of American businesses and government:

- Increase energy efficiency within the federal government
- Update appliance and equipment efficiency standards
- Expand utility energy efficiency programs

There has been considerable action already in all three areas, but much more can and should be done.

Strategy One: Increase Energy Efficiency within the Federal Government

The federal government is the nation's single largest energy consumer, using 1.6 quadrillion BTUs of energy, or about 1.5 percent of national energy

use, as of FY 2007, the most recent year for which data are available (FEMP 2010). The cost to the federal government for energy purchases in FY 2007 was $17.1 billion. About 64 percent of this energy is used by military and civilian vehicles, while the remaining 36 percent is consumed in roughly 500,000 federal buildings and facilities.

The government has taken significant action to increase energy efficiency and reduce energy waste over the past 25 years. Overall federal energy use decreased by 16 percent between 1985 and 2007. Primary energy use per square foot of floor area in federal buildings decreased by 10 percent during 2003–2007 alone. And, as of 2007, the federal government invested $640 million per year in energy efficiency projects, either directly or through agreements with energy service companies (ESCOs). Numerous policies and programs have helped to achieve these savings, including energy intensity reduction targets for federal buildings, fleet petroleum use reduction targets, facilitation of third-party energy efficiency project financing through performance contracting with ESCOs, and training and technical assistance provided through the Federal Energy Management Program. At the present time, federal law requires a 30-percent reduction in the energy intensity of federal buildings between FY 2003 and FY 2015 as well as a 20-percent reduction in vehicle petroleum use between FY 2005 and FY 2015.

There is still tremendous potential to increase energy efficiency and reduce energy use in federal buildings (Loper, Harris, and Capanna 2008). An investment of roughly $1.3 billion per year is needed to meet the 2015 building energy intensity reduction requirement goals (ASE 2009). Funding for energy efficiency projects within federal agencies was expanded through the American Recovery and Reinvestment Act (ARRA), but additional funding will be needed once ARRA funding runs out. Other actions that could be taken include stronger energy efficiency standards for new and renovated federal buildings, requiring federal agencies to purchase energy-efficient products and enforcing these requirements, and expanding the scope of energy savings performance contracts. Some of these actions are included in legislation pending in the 112th Congress, such as S. 1000, the Energy Savings and Industrial Competitiveness Act of 2011, and S. 963, the Reducing Federal Energy Dollars Act of 2011.

Strategy Two: Update Appliance and Equipment Efficiency Standards

Appliance efficiency standards were first enacted at the state level during the late 1970s and 1980s, and were subsequently adopted at the national level with the passage of the National Appliance and Energy Conservation Act in 1987. These standards led to dramatic improvements in the energy efficiency of

new refrigerators, air conditioners, clothes washers, and other products. For example, the electricity use of a typical new refrigerator produced in the U.S. declined 64 percent—from about 1,280 kWh per year in 1980 to 460 kWh per year in 2010—at the same time the average size increased and more features such as icemakers and through-the-door dispensers were added (AHAM 2011).

In 1992, minimum efficiency standards were extended to motors, heating and cooling equipment, and lighting products used by businesses and industries. Efficiency standards on other products were added in legislation enacted in 2005 and 2007. Today, energy efficiency standards created by the U.S. Congress or the Department of Energy (DOE) are in effect for about 50 different types of products. These standards have influenced the energy efficiency of hundreds of millions of products used in homes and businesses. It is estimated that national efficiency standards saved about 290 billion kWh in 2010, equal to about 7.5 percent of total U.S. electricity use (Nadel 2011). As a result, consumers and businesses spent about $32 billion less on electricity in 2010 alone. By 2020, savings from efficiency standards already adopted are expected to equal about 490 billion kWh, equal to nearly 12 percent of projected electricity use that year (Nadel 2011). By reducing electricity use to this degree, appliance and equipment efficiency standards will reduce U.S. carbon dioxide emissions by about 386 million metric tons in 2020, equivalent to removing about 74 million cars from the road (Neubauer et al. 2009).

Appliance and equipment efficiency standards create jobs and help businesses to be more competitive, in addition to saving consumers money. When consumers and businesses reduce energy purchases as a result of efficiency standards, they spend most of the savings on other goods and services that are typically more labor-intensive to produce than electricity or natural gas supply. This results in a net increase in employment in the nation. One study estimated that efficiency standards already adopted resulted in about 338,000 additional jobs and over $10 billion in increased wages in 2010 (Gold et al. 2011). Furthermore, businesses could save about $43 billion (net) from new lighting and other equipment efficiency standards that DOE was scheduled to issue between June 2009 and January 2013 (Neubauer et al. 2009). These standards should be issued on schedule and at the highest stringency levels justified under the law.

New and updated efficiency standards could cut U.S. electricity use by an additional three to five percent in 2030 if standards on currently regulated products are updated on schedule and if efficiency standards on additional products, such as televisions, are adopted. In addition, attempts to repeal or undermine consensus light bulb efficiency standards enacted in 2007 should be rejected. These standards can be met with a wide range of products, thereby saving consumers more than $10 billion per year while eliminating

Readily Available Energy Efficiency Measures

Residential Sector

- Compact fluorescent and LED lamps
- ENERGY STAR® appliances
- High efficiency heating and cooling systems
- Evaporative cooling systems in hot/dry climates
- High levels of home insulation
- ENERGY STAR® windows
- Sealing the building envelope using air infiltration reduction techniques
- Sealing heating and cooling ducts
- Programmable thermostats
- Heat pump and tankless water heaters
- ENERGY STAR® computers and other electronic devices

Commercial And Industrial Sectors

- High efficiency fluorescent lamps, ballasts, and fixtures
- High efficiency metal halide lamps
- LED lamps
- High efficiency cooling systems
- Evaporative cooling systems in hot/dry climates
- High efficiency refrigeration equipment
- High efficiency motors
- Adjustable speed motor drives
- Energy management and control systems
- Data center virtualization
- ENERGY STAR® computers and other electronic devices
- High efficiency furnaces, boilers, and water heaters
- Reflective roofing materials
- Window film and shading devices

the need for dozens of large power plants (NRDC 2011). The standards are supported by a broad coalition of lighting manufacturers, consumer groups, and environmental groups.

Strategy Three: Expand Utility Energy Efficiency Programs

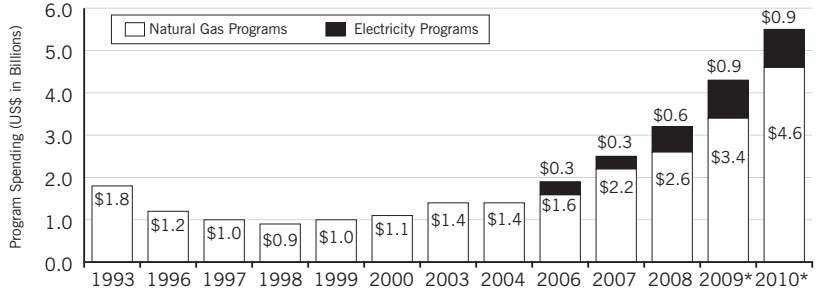
Many state legislatures or state utility regulatory commissions require electric utilities to operate energy efficiency programs, also known as demand-side management (DSM) programs. In a few states, these programs are implemented by independent entities or state agencies rather than utilities.

Most of these programs are funded through a small surcharge on electricity sales, typically two to four percent of total electric bills. The justification for these programs is that it costs much less to save a unit of electricity through utility energy efficiency programs than it does to increase electricity supply by constructing new power plants of any type. Thus, investment in energy efficiency is a utility's least expensive energy resource.

Utility and state efficiency programs provide information, technical assistance, and financial incentives to end users in order to encourage greater adoption of cost-effective energy efficiency measures. Rebates are provided for a wide range of measures ranging from energy-efficient light bulbs to heat pumps to commercial and industrial energy efficiency projects. Many programs promote ENERGY STAR® products and buildings, and support implementation of building energy codes as well as beyond-code new construction. Private businesses and the federal government are cutting energy waste, saving money, and becoming more competitive by participating in utility energy efficiency programs. For example, federal agencies invested $139 million in energy efficiency projects in FY 2007 using utility financing, and received millions more in utility rebates (FEMP 2010).

As shown in Figure 8.1, funding for electric utility energy efficiency programs nationwide increased from about $1.1 billion in 2000 to $4.6 billion in 2010 (Molina et al. 2010; CEE 2010). Preliminary estimates indicate funding increased to around $5.6 billion in 2011 (Cooper and Wood 2012). Funding for gas utility energy efficiency programs also increased dramatically in the past five years. But there is considerable variation in the commitment to—and funding for—utility energy efficiency programs among states. As of 2010, utilities in leading states were spending more than $30 per capita on electric energy efficiency programs, while utilities in over 25 lagging states were spending less than $10 per capita (Sciortino et al. 2011a).

Figure 8.1. Funding for Electric and Gas Utility Energy Efficiency Programs in the United States



Source: American Council for an Energy-Efficient Economy

"Smart Energy" Power Grids

by Michael Valocchi

Our nation's electric power infrastructure is facing unparalleled challenges on several critical fronts, including power system security, climate change, affordability, reliability, efficiency, national economy, and global competitiveness.[1] If the U.S. electrical grid were just five percent more efficient, the energy savings would equate to permanently eliminating the fuel and greenhouse gas emissions from 53 million cars.[2]

The design of our power grid system has evolved over several decades; its electrical power and information about it are distributed in one direction. It was managed much like a centrally controlled system. However, in recent years, our power grid system has been increasingly incapable of managing the dynamic network of energy supply and demand needed to meet 21st century requirements for electricity and reinforce our national competitiveness. Moving to a smart grid approach will not only substantially reduce inefficiencies but will also enable America's electric infrastructure to be more reliable, resilient, and cleaner.

The U.S. Department of Energy defines a smart grid as a class of technologies that will bring the network power lines for electrical utilities into the 21st century.[3] Smart grids rely on technologies such as remote sensors, meters, digital controls, and analytic tools to automate, monitor, and control the two-way flow of energy across operations—something that has not been technically possible until recently.[4]

By adopting these new technologies, a smart grid has many benefits that address the fronts mentioned above. The smart grid can provide:

- **Security.** It operates resiliently against physical and cyber attack through the transition away from a centralized structure that leaves our nation vulnerable to an external attack to a more decentralized system.
- **Climate-friendliness**. It reduces the U.S. carbon footprint and integrates alternate climate-friendly energy sources (wind turbines and solar panels).
- **Affordability and reliability**. It provides quality power at an affordable cost.
- **Efficiency.** It can sense pending system overloads or sense where energy is being lost and automatically reroute power through different parts of the grid to optimize performance and minimize a potential outage. It also can facilitate energy management and control within households and businesses, thereby reducing both energy use and peak demand.
- **National competitiveness**. It enables the creation of new grid-related products, services, and markets in the U.S.

The new technologies being incorporated into a smart grid are based on the use of advanced analytics that offer real-time data for informed decision-making by customers, companies, and the government. For example, they empower citizens with the information needed to monitor and manage their energy use at home. A smart grid empowers utility companies with information needed to manage delivery and balance loads that maximize performance and minimize potential outages. It also empowers the government with better information on how to best ensure safe and reliable power and preserve America's environment.

Michael Valocchi *is Energy and Utility Industry Leader, IBM Global Business Services.*

Eighteen states have adopted energy savings requirements, also known as energy efficiency resource standards, for utility and state energy efficiency programs. Massachusetts, for example, is requiring electricity providers to achieve two-percent electricity savings per year starting in 2011, while Arizona is requiring two-percent annual savings starting in 2014. Minnesota has enacted overall energy savings goals of 1.5 percent per year, with at least one percent coming from utility efficiency programs. A few states including Hawaii, Nevada, and North Carolina allow utilities to count both energy savings from efficiency programs and renewable energy generation toward meeting overall clean energy standards (Sciortino et al., 2011b).

About 18 states have adopted policies to reward utilities for promoting and investing in energy efficiency improvements by their customers. Some utilities are allowed to keep a portion of the net economic benefits produced by their energy efficiency programs; other utilities earn a bonus for meeting certain savings targets or performance goals (Hayes et al., 2011). Other states have adopted electric rate adjustment mechanisms to ensure that utilities are not penalized financially if they implement effective energy efficiency programs, as well as to prevent utilities from increasing their profits by promoting greater electricity use. This policy is known as revenue-sales decoupling (RAP 2011). Utilities in states that have adopted these policies tend to invest more in energy efficiency programs than utilities in states that have not.

Utility energy efficiency programs reduced national electricity use by about 69-terawatt-hours (TWh, or a billion kWh) in 2007, about two percent of electricity sales that year (IEE 2011). But efficiency programs in leading states such as California, Connecticut, Minnesota, Vermont, and Washington reduced electricity use by much more than the national average in percentage terms. Furthermore, energy savings have risen since 2007 because energy efficiency programs have expanded. National energy savings reached 112 TWh or about three percent of national electricity use in 2010, and are predicted to reach 125 TWh or more in 2011 (Cooper and Wood 2012). The savings as of 2010 were equivalent to the electricity use of about 10 million typical homes in one year. Furthermore, leading states or regions plan to meet the majority of their incremental energy demand over the next decade through energy efficiency improvements.

Strong utility energy efficiency programs are the result of state policies such as establishing energy savings standards or goals, performance-based financial incentives for utility shareholders, revenue-sales decoupling, and least-cost integrated resource planning. These policies should be adopted by all states in order to save households, businesses, and governments money, and enhance competitiveness throughout the economy.

The U.S. Department of Energy and the Environmental Protection Agency established a State and Local Energy Efficiency Action Network to promote

these and other policies at the state level. This network has produced a variety of blueprints, guides, and other resources for state and local officials.[5] The federal government could go further and require adoption of the policies described above as a condition for states receiving certain energy-related grants.

Dr. Howard Geller *is the Executive Director of the Southwest Energy Efficiency Project and is the former Executive Director of the American Council for an Energy-Efficient Economy.*

Notes

1. "The Smart Grid: An Introduction," prepared by Litos Strategic Communication for the U.S. Department of Energy. (http://energy.gov/oe/downloads/smart-grid-introduction-0)
2. Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy. (http://energy.gov/oe/office-electricity-delivery-and-energy-reliability)
3. "Smart Grid," Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy. (http://energy.gov/oe/technology-development/smart-grid)
4. "Smart Grid," in "A Smarter Planet," IBM. (http://www.ibm.com/smarterplanet/us/en/smart_grid/ideas/)
5. SEE Action, The State and Local Energy Efficiency Action Network. (http://www1.eere.energy.gov/seeaction)

References

Alliance To Save Energy. 2009. "Fact Sheet: Federal Energy Management." Washington, DC. September. (http://ase.org/sites/default/files/FEMP%20Fact%20Sheet%2009-21-09.pdf)

Association of Home Appliance Manufacturers. 2011. "Refrigerators: Energy Efficiency and Consumption Trends." Washington, DC.

Consortium for Energy Efficiency. 2010. *State of the Energy Efficiency Program Industry*. Boston, MA. December. (http://www.cee1.org/files/2010%20State%20of%20the%20Efficiency%20Program%20Industry.pdf)

Cooper, A. and L. Wood. 2012. "Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures." Washington, DC: Institute for Electric Efficiency. January. (http://www.edisonfoundation.net/iee/issueBriefs/IEE_CEE2011_FINAL_update.pdf)

Friedrich, K., M. Eldridge, D. York, P. Witte, and M. Kushler. 2009. *Saving Energy Cost Effectively: A National Review of the Cost of Energy Saved Through Utility-Sector Energy Efficiency Programs.* Washington, DC: American Council for an Energy-Efficient Economy. September. (http://www.aceee.org/sites/default/files/publications/researchreports/u092.pdf)

Gold, R., S. Nadel, S. Laitner, and A. DeLaski. 2011. *Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator.* Washington, DC: American Council for an Energy-Efficient Economy. January. (http://www.aceee.org/sites/default/files/publications/researchreports/a111.pdf)

Hayes, S., S. Nadel, M. Kushler and D. York. 2011. *Carrots for Utilities: Providing Financial Returns for Utility Investments in Energy Efficiency.* Washington, DC: American Council for an Energy-Efficient Economy. January. (http://www.aceee.org/sites/default/files/publications/researchreports/u111.pdf)

International Energy Agency. 2007. *Tracking Industrial Energy Efficiency and CO_2 Emissions*. Paris, France. (http://www.iea.org/textbase/nppdf/free/2007/tracking_emissions.pdf)

Loper, J., S. Capanna, and J. Harris. 2008. *Reducing Greenhouse Gas Emissions in Federal Buildings, Facilities and Vehicles.* Washington, DC: Alliance To Save Energy. April. (http://www.climateactionproject.com/docs/PCAP_Final_FEMP_Chapter_4-18-08.pdf)

Nadel, S. 2011. Personal communication with Steve Nadel, American Council for an Energy-Efficient Economy, Washington, DC. April 11, 2011.

National Academy of Sciences. 2010. *Real Prospects for Energy Efficiency in the United States*. Washington, DC: National Research Council. (http://www.nap.edu/catalog.php?record_id=12621)

Natural Resources Defense Council. 2011. "Oppose Efforts to Roll Back Light Bulb Efficiency Standards." New York, NY. March. (http://www.nrdc.org/legislation/files/LightBulbEfficenencyRepeal.pdf)

Neubauer, M., A. Delaski, M. Demascio, and S. Nadel. 2009. *Ka-BOOM! The Power of Appliance Standards.* Washington, DC: American Council for an Energy-Efficient Economy. July. (http://www.aceee.org/sites/default/files/publications/researchreports/a091.pdf)

The Regulatory Assistance Project. 2011. "Revenue Regulation and Decoupling: A Guide to Theory and Application." Montpelier, VT. June. (http://www.raponline.org/document/download/id/902)

Rocky Mountain Power. 2011. *2010 Annual Energy Efficiency and Peak Reduction Report—Utah*. Salt Lake City, UT. September. (http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2010_UT_DSMAnnualReport_9-12-11.pdf)

Sciortino, M., M. Neubauer, S. Vaidyanathan, A. Chuttum, S. Hayes, S. Nowak, and M. Molina. 2011a. *The 2011 State Energy Efficiency Scorecard.* Washington, DC: American Council for an Energy-Efficient Economy. October. (http://www.aceee.org/sites/default/files/publications/researchreports/e115.pdf)

Sciortino, M., S. Nowak, P. Witte, D. York and M. Kushler. 2011b. *Energy Efficiency Resource Standards: A Progress Report on State Experience.* Washington, DC: American Council for an Energy-Efficient Economy. June. (http://www.aceee.org/sites/default/files/publications/researchreports/u112.pdf)

Shipley, A.M. and R.N. Elliott. 2006. *Ripe for the Picking: Have We Exhausted the Low-Hanging Fruit in the Industrial Sector.* Washington, DC: American Council for an Energy-Efficient Economy. April. (http://www.aceee.org/sites/default/files/publications/researchreports/ie061.pdf)

Sundin, D. "CEE Annual Industry Report (Preliminary Data)." Presentation at the CEE Industry Partners Meeting, Denver, CO., Oct. 4-6, 2011. (http://www.cee1.org/cee/mtg/10-11mtg/Wed_GeneralSession_Sundin.pdf)

U.S. Department of Energy, Energy Information Administration. 2011. *Monthly Energy Review*, September 2011. DOE/EIA-0035(2011/09). Washington, DC. (http://205.254.135.24/totalenergy/data/monthly/pdf/mer.pdf)

U.S. Department of Energy, Federal Energy Management Program. 2010. Fiscal Year 2007. Washington, DC. (http://www1.eere.energy.gov/femp/pdfs/annrep07.pdf)