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US energy savings: Opportunities and challenges

There is great potential to reduce energy consumption and minimize its total cost by using existing technologies—and without changing the everyday habits of consumers.

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The specter of more expensive energy, along with concerns about its availability and environmental impact, has renewed interest in finding more efficient ways to use it. For executives, this shift could bring not only new challenges, including stringent regulations, but also new business opportunities. And for society as a whole, the potential savings are huge: more than $1 trillion in the United States alone.

Many people focus on opportunities that require high-tech new systems or on conservation efforts that reduce the benefits from energy. Yet there is great potential to reduce its consumption and minimize its total cost by using existing technologies—and without changing everyday habits. So why haven't these prospects been realized already? Four fundamental barriers stand out. Energy efficiency typically requires large upfront investments to achieve savings that accrue later. In addition, it has low mindshare, and opportunities are fragmented across billions of devices in more than 100 million locations. Finally, the organizations that would be primarily responsible for implementing energy efficiency find it hard to measure, which makes them less motivated to act.

Realizing the full range of savings may require a comprehensive energy policy,[1] but regardless individuals and companies alike must become more aware of the importance and profitability of change.[2] This article therefore focuses on the broad range of opportunities and challenges our research has uncovered in three key sectors.

The residential sector

Let's start with the residential sector, which accounts for 35 percent of the end use potential for energy savings. The incremental investment to make 129 million US homes—and the appliances, devices, and climate control systems in those homes—more energy efficient would be $229 billion, providing present-value savings of $395 billion. Upgrading building shells and heating and cooling equipment, mostly in existing homes, represents the largest opportunity (71 percent). The rest would come from upgrading devices and appliances.

Homes

We divided US homes into three clusters—existing homes of low-income people, existing homes of other Americans, and new homes (those built after January 1, 2009). At all income levels, energy-efficiency upgrades to shells of existing homes (for example, through insulating basements and sealing air leaks) offer the largest opportunities. Similar savings could be achieved in new homes at half the cost, but few such homes will be in place by 2020.

[1]For more information, see the full report, *Unlocking energy efficiency in the US economy*, available free of charge on mckinsey.com.

[2]Sheila M. J. Bonini, Greg Hintz, and Lenny T. Mendonca, "Addressing consumer concerns about climate change," mckinseyquarterly.com, March 2008.

Still, the barriers are significant. Homeowners typically know little about their energy consumption or how to reduce it and end up underestimating savings from retrofits. They may also move before recouping the upgrade's cost—a barrier that undermines 40 to 55 percent of these opportunities. And for most families, allocating funds for such money-saving measures is difficult: core spending absorbs 90 percent of average household budgets, so a "typical" retrofit costing $1,500 absorbs 30 percent of annual discretionary spending. If the expense isn't a deal breaker, homeowners face high transaction costs researching upgrades and finding suitable contractors. Poorly installed and operated equipment—some reports conclude that contractors install 90 percent of it suboptimally—can hike air-conditioning and heating costs by 30 percent.

Nonetheless, solutions have recently emerged. In New York, the Long Island Green Homes program, an innovative approach to financing, provides capital for upgrades. Monthly repayments smaller than the savings they generate are paid through utility bills or property taxes, so the beneficiaries—future owners or current tenants—bear the costs. Even so, while product labeling and voluntary standards have been effective for new homes and may work for existing ones, full penetration will take years. Energy-efficiency improvements could also be mandated—say, when houses are sold or renovated. Since the 1980s, the mandatory Residential Energy Conservation Ordinance (RECO) in Berkeley, California, has prompted upgrades to about 500 homes annually at a typical cost (to home sellers) of $400 to $1,300. Austin, Texas, by contrast, requires home assessments, not improvements. Realizing such solutions on a national scale represents a business opportunity for investors and business leaders.

Devices, small and major appliances, and lighting

Although smaller devices and appliances, notably TVs and PCs, offer only 19 percent of the 2020 residential opportunity, capturing it would require just $3.4 billion in incremental capital, with possible present-value savings of $65 billion. Neither consumers nor manufacturers think much about these devices' energy consumption, since it doesn't loom large on electric bills. In fact, an existing energy-saving feature of PCs—the low-power standby mode—is enabled in only 15 percent of home office computers. The power that devices consume on standby can account for up to 90 percent of the total energy used, so a general standard makes sense. Voluntary standards could be developed faster than mandatory ones and might smooth the way.

Energy consumption by lighting and major appliances (such as water heaters and refrigerators) is expected to decline on an absolute basis by 3.3 percent from 2008 to 2020, mostly thanks to more efficient lighting. Further savings are possible; lighting constitutes 15 percent of this cluster's energy consumption but 82 percent of the savings potential, largely from the faster-than-mandated adoption of compact fluorescent lights (CFLs) in the near term and the subsequent spread of LED lighting as its costs decrease.

Even now, average homes could save up to $180 or more annually by switching from incandescent bulbs to CFLs, though 42 percent of consumers still distrust them. For appliances, mandatory standards have proven their value: from 1987 to 2005, they saved US consumers $30 billion in energy bills. And the voluntary labeling of many appliances through Energy Star—a joint program of the US Environmental Protection Agency (EPA) and the US Department of Energy—has saved 1,790 trillion BTUs.[3] As the experience with CFLs shows, to capture many of these opportunities manufacturers must ensure that the customer experience remains unchanged or improves.

The commercial sector

Because several commercial clusters—especially new homes and office devices—resemble their equivalents in the residential sector, we'll stress the differences. The net present value–positive upgrades would require a $125 billion investment and provide present-value savings of $290 billion. Buildings and the devices used in them offer 87 percent of the opportunity.[4]

Buildings

We divided US commercial structures among three clusters: existing private, existing government, and new private buildings. Two barriers have features specific to the private sector. The first, threatening a fifth of its potential, is the expectation of most companies that efficiency investments should pay back in one to four years—a problem for deeper retrofits. Second, energy-efficiency programs often arouse resistance because they may increase debt and divert money from revenue-enhancing projects.

Financing through public–private partnerships might solve these problems, especially in private commercial buildings: for an appropriate premium, a credit-enhancement fund that shares the default risk with lenders could direct private capital toward energy-efficiency projects. This approach has worked in other markets, particularly student loans. Similar credit insurance rates, totaling $2 billion to $4 billion, would guarantee the $73 billion in capital this cluster needs. A strong effort by banks or energy service companies (see the next paragraph) to lobby for the creation of such a fund and then to implement it would enable significant financing to flow.

The efficiency opportunity for government buildings is greatest in those of localities (counties, cities, and towns) and, secondly, of states. Unlocking it would require investments of $19 billion and $7 billion, respectively, and provide present-value savings of $36 billion and $13 billion, respectively. One barrier specific to government buildings is the fact that many states limit the use or effectiveness of performance contracting—a business model in which a third party (sometimes called an energy service company)

[3]British thermal units.

[4]Community infrastructure, such as telecom facilities, would provide the remainder.

finances and implements efficiency measures and recovers its investment by sharing in the customer's savings. As for new commercial buildings, the same observations that apply to new homes apply to them.

Office devices

People often resist focusing on their energy use because they consume it in drips and drabs. Office devices exemplify this problem: there are hundreds of categories—PCs, medical and lab equipment, cash registers, and data servers, to name just a few—and the consumption of each of these devices is usually limited. Nonetheless, they offer among the most cost-effective opportunities: present-value savings of $57 billion for an $8 billion investment.

Perhaps more odd than the failure to address small (but collectively large) opportunities is that fact that many purchasers in the commercial sector focus on acquisition rather than life cycle costs. In fact, sometimes costs of any kind seem unimportant. In data centers, where energy use could triple from 2008 to 2020, risk-averse managers overinvest in servers: 30 percent of them might consume electricity on a given day, even if only 3 percent were in use. Total-cost-of-ownership purchasing criteria could help capture much of this opportunity.

The industrial sector

The processes, support systems, and buildings of the US industrial sector not only consume more energy than the others combined but also offer the greatest NPV-positive energy-efficiency opportunity (3.65 quadrillion BTUs)—although the smallest (18 percent) as a percentage of end-use consumption. Capturing this opportunity would save $447 billion though present-value investments of $113 billion.

Opportunities

Varied industrial processes provide 67 percent of the sector's energy-efficiency potential; energy-consuming support systems (motors, buildings, and steam systems) and the recovery of their waste heat make up the remainder.

The largest opportunity lies in energy-intensive processes (such as bleaching, in pulp and paper, and hydrocracking, in refining), which require upfront investments of $51 billion for present-value savings of $182 billion. Payback times of less than 2.5 years could be realized in about 42 percent of these projects, which involve measures such as implementing more energy-efficient processes, upgrading current ones, and improving maintenance and monitoring. Systematically recovering waste heat would improve the energy efficiency not only of processes that are energy intensive but also of processes that aren't—within industries such as foods and plastics. Such industries offer $96 billion in present-value savings for a $28 billion investment.

Energy-consuming industrial-support systems, including steam systems, motors, and buildings, could provide present-value savings of $164 billion for a $34 billion investment. Although these represent a smaller opportunity, it could be easier to pursue because boilers and the like are more standardized than industry-specific process equipment. For boilers and other steam systems, the opportunities include (again) waste-heat recovery, better-insulated distribution systems, and valve and fitting improvements. Pumps, process equipment, and other systems driven by electric motors can become more energy efficient if factories match the power of components with their load requirements. Opportunities for industrial buildings resemble those for commercial ones.

Barriers

Even in the industrial sector, energy often represents a relatively small fraction of costs, so top managers may resist serious investments. As in the commercial sector, payback times, capital constraints, and procurement can be problematic. Industrial sites, for example, generally have tight budgets, and many companies now require a one-and-a-half- to two-and-a-half-year payback, although even a two-and-a-half-year timeline cuts the sector's potential by only 46 percent. Managers may ignore attractive energy-efficiency projects because companies fear to hurt their credit ratings by raising debt. Fear also causes risk-averse plant managers to replace failing equipment with the same models rather than more up-to-date and energy-efficient ones—but inventory-carrying costs prevent many distributors from offering them anyway. And even many industrial-procurement operations focus on upfront rather than total costs.

Solutions

An energy manager properly empowered through top-management and financial support can help companies realize 8 percent of the total industrial savings identified above. In some facilities, energy managers have delivered savings of 20 to 30 percent. Increasing the penetration of the kind of corporate programs that energy managers implement is the focus of the EPA's voluntary Energy Star Partnership. The US Department of Energy's voluntary Save Energy Now initiative, which aims to reduce industrial-energy intensity by 25 percent in ten years, has already helped 2,100 US manufacturing facilities cut their energy costs. Efforts to clarify the industrial sector's energy criteria for purchasing and using equipment could save significant amounts of money, without the staff reductions typical of other cost-cutting moves.

Financial incentives can help companies allocate capital for energy-efficiency plans, lengthen payback times, and make energy-efficient products more available. Wal-Mart Stores' Company of the Future supply chain initiative, for example, offers suppliers in seven product categories not only incentives to cut their energy use and emissions but also support, such as subsidized energy audits. Direct incentives from equipment

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manufacturers and distributors, governments, or utilities would promote upgrades of process and support systems. Such upgrades are now rare because early adopters face large risks.

Within specific industries, efficiency targets or equipment standards can help boost capital allocations, lengthen payback times, create awareness among executives, and make many products more available. Voluntary agreements, for example, have induced the participants to cut their energy consumption in return for receiving financial rewards, gaining exemption from some regulations, or avoiding stricter ones. Many regulators value the flexibility and fast implementation of voluntary agreements. From 1998 to 2006, for example, one such understanding raised a Dutch chemical industry's energy efficiency by 23 percent.

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McKinsey has looked long and hard for ways to obtain an affordable, secure energy supply while controlling climate change. Energy efficiency stands out as the single most attractive and affordable component of the necessary shift in energy consumption. Although significant challenges stand in the way, solutions not only exist but can also be scaled up to a national level, which would cut the US energy bill by 23 percent and save a net $680 billion by 2020. But that isn't very far in the future, and each wasted day makes this—or any goal whatsoever—more difficult to reach.

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