'Conserve, conserve, conserve': A megawatt saved is better than a megawatt made

October 28 2011, by David L. Chandler

With the world's energy needs growing rapidly, can zero-carbon energy options be scaled up enough to make a significant difference? How much of a dent can these alternatives make in the world's total energy usage over the next half-century? As the MIT Energy Initiative approaches its fifth anniversary next month, this five-part series takes a broad view of the likely scalable energy candidates.

It's often overlooked in discussions of how to meet the world's growing appetite for energy, but many analysts say it's the single biggest potential contributor to meeting the world's energy needs: efficiency.

Doing more with less fuel or electricity could reduce humanity's energy demands by as much as half. No technological breakthroughs are needed for such savings, just some well-designed regulations and policies.

Improving energy efficiency is not only a good idea, says Daniel Nocera, it is "absolutely essential, at an unprecedented scale." How big a scale? According to Nocera, MIT's Henry Dreyfus Professor of Energy, what's needed, as human energy consumption grows over the next few decades, is to save an amount of power equal to today's total consumption — about 14 terawatts (trillions of watts).

But efficiency is something we already know how to achieve; we just need to figure out how to pay for it. "We know exactly what to do, but it costs money," Nocera says. Present-day systems that use fossil fuels are all energy-efficiency laggards, he says: Everything from car engines to coal-burning powerplants to oil-fired home-heating systems are, on average, only about one-third efficient.

"You need a proactive policy" to require efficiency improvements and provide incentives for their implementation, he says. With such policies, "you can go pretty fast down this road" in improving things, he says.

But some people, especially those with a vested interest in a particular energy source, often downplay the feasibility and potential importance of other solutions, says John Sterman, the Jay W. Forrester Professor of Management and Engineering Systems at MIT's Sloan School of Management. "One bias people have is toward more supply, and less toward efficiency," he says. "But efficiency is one of the biggest sources in the mix. In fact, it's number one."

But even though the importance of efficiency is well-known, implementation faces many obstacles. For example, there's the hurdle known as the landlord-tenant problem. In a nutshell, improvements in a building's energy efficiency are typically paid for by the building's owner, whereas the tenants — who often pay the utility bills — get the savings. Without regulations such as stronger building codes, financial incentives or gain-sharing mechanisms, a landlord has little motivation to make changes. With roughly a third of American homes — and many commercial buildings as well — occupied by renters, the landlord-tenant problem means tens of millions of properties are unlikely to undergo energy upgrades.

This kind of dichotomy is widespread, often in situations where it's hardly recognized. For example, Sterman says, at an institution like MIT, when a researcher has to order a new piece of equipment for a lab — say, a freezer to store samples — the freezer's cost comes out of the individual's grant, but the operating cost of the electricity comes out of building's overhead, so the incentives are inherently stacked against a more efficient, but also more expensive, purchase.

Partly because of such economic disincentives, “in the United States, we use dramatically more energy per dollar of GDP, and per person, than in other countries,” Sterman says, “and without any benefit to our quality of life.”

“If you could have the same comfort level in your home with half the energy bill, you would clearly be better off,” he adds. “And that’s technically possible.” It just requires well-known measures such as insulating the walls, installing better windows and investing in appliances that are more efficient. “Many of these have pretty short payback periods, and often your home will be more comfortable than before, as well,” Sterman says.

A missing ingredient that could drive greater efficiency is a set of standards that would make it easier for people to compare products and know what their energy savings could be. The U.S. government’s EnergyStar standards for appliances provide some of that kind of guidance. But, for example, although there has been a big recent push toward electric cars and plug-in hybrids, there are still no standards for charging stations or connectors, or ratings for different kinds of battery systems that would help people make comparisons. “None of these have been worked out, and that slows the rate of diffusion” of new technologies, Sterman says.

But some kinds of inefficiencies are not so easily reduced. For example, about two-thirds of the energy used to generate electricity using conventional steam turbines is wasted, regardless of whether the steam is heated by coal, oil, gas or nuclear fission. “You might think that’s terribly wasteful, but in fact it’s just the second law of thermodynamics,” which limits the theoretical efficiency of any process to derive work from heat, says Robert Jaffe, the Otto (1939) and Jane Morningstar

Professor of Physics, who co-teaches a class on the physics of energy. "We can't expect to do much better" in the design of such systems, he says.

Still, some of these systems are better than others: Currently, the most efficient heat-based generators are combined-cycle natural-gas plants, which use a two-stage system to squeeze the maximum energy out of the fuel, achieving overall efficiencies of around 60 percent. "Cogeneration of steam for heating, to run air conditioning or for industrial processing can make the overall efficiency even higher," Jaffe says.

That means simply making greater use of existing combined-cycle gas plants, and less use of older, much less efficient coal plants, could achieve a 20 percent reduction in overall U.S. greenhouse gas emissions without building a single new powerplant, according to a 2011 MIT study. (This takes into account the fact that not only are these plants more efficient, but natural gas also produces only about half the emissions that coal does.)

"Everyone agrees [efficiency] is the low-hanging fruit," Jaffe says. In some forms, improved efficiency can be painless, he says — such as substituting fluorescent lights, or soon, the even-better LED lights, for conventional bulbs. Other efficiency improvements may entail some costs or adjustments, such as using cars that have somewhat less power for acceleration or that cost a bit more.

The implementation of efficiency improvements is full of questions and complexities, but the basic goal — and overwhelmingly, the single most important arena for making a major dent in greenhouse emissions — is crystal clear. As Jaffe puts it: "What can be done? Conserve, conserve, conserve."

This story is republished courtesy of MIT News (web.mit.edu/newsoffice/), a popular site that covers news about MIT research, innovation and teaching.

More information: Part 1.
www.physorg.com/news/2011-10-dent.html
Part 2. www.physorg.com/news/2011-10-p … ons-electricity.html
Part 3. www.physorg.com/news/2011-10-v … ar-energy-earth.html
Part 4. www.physorg.com/news/2011-10-h … earth-atom-leaf.html

Provided by Massachusetts Institute of Technology

Citation: 'Conserve, conserve, conserve': A megawatt saved is better than a megawatt made (2011, October 28) retrieved 3 May 2024 from https://phys.org/news/2011-10-megawatt.html