

The Energy to Change the World

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Daniel Kammen earned a bachelor's degree in physics at Cornell and master's and doctoral degrees in physics at Harvard. Today he is a professor in both the Energy Resources Group and the Goldman School of Public Policy at UC Berkeley, where he also directs the Renewable and Appropriate Energy Laboratory (RAEL). He was a coordinating lead author for the Intergovernmental Panel on Climate Change (IPCC), which won the 2007 Nobel Peace Prize. In all these endeavors, Kammen is working to overcome a lack of basic energy resources and inefficient and unsustainable energy practices—problems that he believes may be the largest contributors to human, environmental, and global health problems today.



Defining my focus

As a post-doctoral fellow, I had the opportunity to work on energy systems in Central America, including solar ovens and wind energy. I was able to explore both on-grid and off-grid energy issues, and that's when I really began to appreciate how central energy is to human development. Access to electricity correlates with significant improvements in quality of life, schooling, and the ability to do productive work. I realized that

I could use my physics background to make a significant impact on society.

At the Renewable and Appropriate Energy Laboratory, our focus is on designing, testing, and promoting renewable and appropriate energy systems in industrialized and developing nations. Putting "appropriate" in the title was a way to ensure that we think in an interdisciplinary way about energy. Using science, engineering, and economics, we create models of renewable energy technologies and policies, from finding healthier alternatives to biomass fuels in developing countries to assessing electrical grids of entire countries.

Small energy is big

Energy can transform people's lives, but we're not likely in the near future to be able to provide it in developing areas through large traditional grids, or even mini grids. This means

utilizing electricity off-grid, through distributed individual energy services—often called nano grid or pay-as-you-go systems.

These pay-as-you-go systems work much like prepaid phones. People with little regular income can buy an inexpensive solar charger kit that allows them to power LED lights and charge their mobile phones. Then, using their mobile phones, they can pay for small amounts of energy when they need it. Many services today—from lighting to radios to television to freezers to communication towers—are increasingly powered by distributed individual off-grid products such as small amounts of solar, biomass, and wind.

It's remarkable how much you can do with very small amounts of energy. And these device-specific amounts of energy provide services that are often more reliable or tailored to the individual than bigger systems can provide, particularly with solar. People in remote areas, in homes with no electrical wiring, can charge their phones. They can have light without having to burn wood, charcoal, or kerosene. These distributed off-grid products are safer, cleaner, and cheaper. They're transforming the system.

Living in an off-grid world

The off-grid world is probably the most rapidly changing aspect of energy service, but the ability to interact between devices is also very important. If several people in an area have these small pay-as-you-go systems, are they able to integrate them? Can one connect more and more devices together to build up distributed systems that function as tiny mini grids? The availability of distributed energy systems opens the door to these possibilities.

We need to define ways to bring down the barriers that exist against distributed renewables, whether it's a matter of establishing meters or utilizing rooftops for distributed clean energy generation. It's interesting that the places where the off-grid world is doing best also have the most reliable mobile banking. Kenya, for example, has very widely used, trustworthy, and reliable mobile money commerce technology that allows people to buy small amounts of energy through their mobile phones. Small-scale energy providers receive payment directly from customers, who might otherwise have to travel long distances under difficult conditions. Having reliable mobile banking enables this whole off-grid world.



Efficiency is key

In developing countries, we're focusing on off-grid services, but in industrialized countries, the larger focus is on increasing energy efficiency. Maximizing energy efficiency is a good guiding principle, economically as well as environmentally. There are lots of things we can do to move toward energy efficiency, whether it's using mass transit and turning down the thermostat or substituting non-emitting energy sources for emitting sources. By limiting emissions that affect human health—by not putting waste into the system—you're contributing to a more efficient system.

But we also need to increase the use of solar energy at the household and business level and take advantage of new technologies that allow us to buy and sell energy directly. This so-called “net metering” would allow a business or homeowner who installs more panels on the rooftop to be able to sell their excess energy back to the utility. These are all opportunities to change the equation.

We have the energy. The amount of solar power alone that the Earth receives is thousands of times more than we need. But solar is intermittent, not just because of night and day, but because of weather conditions. Finding ways to build reliable, renewable energy systems based on variable energy sources like solar and wind requires new approaches. Then we need to figure out how to integrate efficiency and the renewables.

The politics of clean energy

We need to expand the dialogue that's begun between the U.S. and China around clean energy and carbon targets. There are now a variety of these bilateral relationships, whether it's the U.S. and India, or Indonesia and Brazil. Now we have to expand the discussion to figure out what tools we need to deploy more solar or biomass energy, for example, in these countries.

We have to find ways to put a price on greenhouse gas emissions. Ontario just announced that it is joining Quebec and California in a market set up to reduce carbon emissions. In this type of market, companies are allowed to release only so much carbon into the atmosphere each year. Those who emit less carbon than they are allowed can sell the rest of their allowances to those who are having a harder time staying within their limits. The total number of allowances per year remains the same, so we still limit the overall pollution. The system is an incentive to invest in cleaner technology. These are all potential topics for increased international cooperation and collaboration; they are all key issues if we want to see a transition to clean-air systems.

Energy: the great equalizer

One of the big questions for me is how to utilize this energy transition to address wider social issues such as inequality. The availability of distributed energy opens the door to important and interesting new ways to approach this problem. By enabling the transition to clean energy while keeping a focus on these large-scale social challenges, we can make a big social impact as well as an environmental one. It's an opportunity, but it's one that doesn't happen by itself. We need young people to help work on these challenges.

The energy landscape is wide open. There are so many ways to contribute, from laboratory science to understanding markets to social and ecological issues. Many of these things require multidisciplinary, multimodal thinking, so developing ways to work across traditional disciplines is important. People who can do that are increasingly in demand. Developing the ability to work in teams is also increasingly valuable, whether as part of a research team, a government group, the private sector, or as an academic researcher. Energy is very much about people. That's the key resource in this process. ■

For more information on careers in energy and science policy, visit Dr. Kammen's website at <http://kammen.berkeley.edu/advice.html>.