Power to the People

By Vijay V. Vaitheeswaran*

Editor's note: Vijay Vaitheeswaran has been selected to receive the 2005 IAEE Journalism Award. In 2003 he published the book, *Power to the People: How the coming Energy Revolution Will Transform an Industry, Charge Our Lives and Maybe Even Save the Planet.* We are pleased to excerpt a portion of the book here.

Introduction: The Coming Energy Revolution

This book is about the future of our planet. The needlessly filthy and inefficient way we use energy is the single most destructive thing we do to the environment. Whether it is the burning of coal in industrial power plants or the felling of tropical forests, our appetite for energy which is essential to modern life seems insatiable. With enough clean energy, most environmental problems not just air pollution or global warming but also chemical waste and recycling and water scarcity can be tackled, and future economic growth can be made much more sustainable.

The problem is that change comes slowly in the energy realm. Old ways of thinking have encouraged monopolies, shielded polluters, and stifled innovation. That has burdened the rich world with an energy system locked into outmoded technologies such as America's many coal plants that are dirty and inefficient. That's bad enough, but now it seems that giants of the developing world, like China and India, may follow the same path as their economies surge over the next couple of decades. If they do, then many millions of unfortunates will die needlessly from the resultant pollution as will the world's hopes of curbing the carbon emissions that are fueling global warming. That is why this is the key question: Can we move beyond today's dirty energy system to one that is cleaner, smarter, and altogether more sustainable?

Absolutely. Though cries of shortage and crisis are often heard these days in the energy world, there is actually more reason for hope than there has been in decades. This book argues that there are three powerful trends going on below the radar that promise to rewrite the rules of the energy game: the global move toward the liberalization of energy markets, the growing popular appeal of environmentalism, and the recent surge of technological innovation in areas such as hydrogen fuel cells. Taken together, they could lead to an energy system that meets the needs and desires of future generations while still tackling serious problems like global warming and local air pollution. If this clean energy revolution is really going to take off, though, we must first be ready to think the unthinkable: we must end our addiction to oil. Ironically, it may happen for reasons entirely unrelated to concerns about the environment and human health.

The problem is economic and political as much as ecological. Consider a simple question: How much is a barrel of oil worth? You might think that the price would be whatever the market will bear. Yet the price of oil is influenced less by the free interplay of supply and demand than by the whims of the Organization of Petroleum Exporting Countries (OPEC)—the ill-disciplined cartel led by Saudi Arabia. Small wonder, then, that the oil price has yo-yoed, from around $20 a barrel for much of the 1990s down to $10 in 1998 to more than $30 a barrel in early 2003.

If you could ask Osama bin Laden that same question, though, you would get a very precise figure: $144. Several years ago, before the al Qaeda terrorist group carried out its attacks on America, bin Laden made some curious comments on energy economics. In that little-noticed diatribe, he accused the United States of the biggest theft in history for using its military presence in Saudi Arabia to keep oil prices down. He calculated that this hostile takeover of his country's patrimony added up to some $36 trillion in lost revenues and, he insisted, America now owes each and every Muslim in the world around $30,000. And counting.

That chilling calculation points to the nightmare scenario that keeps energy security experts up at night: a hostile regime seizes the oil fields of the Middle East and either raises prices sky-high or cuts off oil supplies altogether. Before September 11, scenario planners reassured themselves that if this ever happened, America would just send in its troops to quash the troublemakers and ensure safe passage for the oil supplies. After all, that was the main outcome of the Gulf War, when the coalition led by the elder George Bush booted Saddam Hussein out of the oil fields of Kuwait. And when George W. Bush began to prepare for an invasion of Iraq a decade later, even those who agreed that Saddam Hussein should be ousted took note of the fact that Iraq happens to have a bit of oil: the largest reserves in the world, in fact, after Saudi Arabia.

America's military supremacy is now unchallenged. Even so, the attacks of September 11 revealed the limits of American power in at least one realm: they have exposed the vulnerability of the global energy system to a postmodern oil shock. Today we have to consider the possibility that revolutionaries or terrorists could possess nuclear weapons and might use them on American troops or the oil wells. Such an outcome could precipitate a global economic and political crisis of the sort never seen before. The good news is that such a scenario is extremely unlikely, even in light of recent events. The bad news is that it might still happen, and not even America's mighty military can prevent it. Even short of such an extreme outcome, though, the monopoly grip that petroleum has on the world's transport infrastructure might result in an energy crisis sometime over the next few decades.

Surprising as it may seem, the reason is not scarcity. Back in the 1970s, in the aftermath of the oil shocks of that decade, many people fretted that the energy was running out. With the arrival of the younger Bush in the White House, Americans once again heard talk of an energy crisis. Yet it's abundantly clear that there is enough oil to keep the world's motors humming for decades to come.

The real problem is not scarcity but *concentration*. The lion's share of that remaining oil -- and most of the oil that is

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cheap to extract lies under the desert sands of a small handful of countries in the Persian Gulf. Today, Saudi Arabia and its immediate neighbors sit atop nearly two-thirds of the world's proven oil reserves -- that's right, two-thirds. However, those countries are not producing oil nearly as fast as they can. As the world continues to deplete expensive, non-OPEC oil in places like the deep waters of the Gulf of Mexico and the frigid reaches of Siberia in coming years, OPEC's market share is set to increase dramatically -- and with it, the power of those Middle Eastern regimes. The potential for supply disruption by anti-Western terrorist bands like al Qaeda can therefore only grow. This threat is particularly acute for the United States, which is both the biggest oil guzzler and the de facto guarantor of oil supplies for its allies.

Unfortunately, there is no immediate solution, because there is no practical alternative to oil-fired transport. In the short term, all governments can do is buy some insurance against politically inspired supply disruptions and the panics that tend to accompany them. The way to do that is to expand dramatically their buffer stocks of petroleum, such as those stored in salt domes in Louisiana. To his credit, George Bush started to do this in 2001. Structural changes in the oil industry resulting from mega-mergers, cost-cutting, and a move to just-in-time inventories make the matter particularly urgent, because the private sector has greatly reduced its levels of stocks from the 1970s. Add to this the official neglect of government stockpiles, which are inadequate in the rich world and practically nonexistent in the developing world, and you get a world needlessly vulnerable to the next oil shock.

As for longer-term policy responses, three views typically dominate the energy debate raging around the world post September 11: *Relax*; *Keep pumping*; and *Ride your bicycle*. The first camp insists that the very premise of the argument is false and that "energy security" is a bogus notion not worth worrying about. The second camp sees the threat as real, but argues that it can be countered effectively through supply-side measures that boost non-OPEC sources of oil. The final camp argues that conservation is the only way forward. They tend to perpetuate a number of popular myths about energy:

- The oil's about to run out
- Without fossil fuels, we'd return to the Stone Age
- Windmills and warm sweaters will save the planet
- Rampant economic growth is the root cause of our environmental problems
- Clean technologies will emerge spontaneously, without the need for government action or difficult policy measures like energy taxes
- Sport-utility vehicles (SUVs) are the work of the devil

This book will explode these and other nonsensical notions, and explain why none of these three camps gets it quite right.

What, Me Worry?

Perhaps unsurprisingly, Saudi Arabia is at the forefront of the Panglossian camp. In 1999, Ali Naimi, its oil minister, gave a speech in which he vigorously challenged the notion that his country's growing market power will be a problem: "Oil is a global market . . . those who propagate the issue of supply insecurity, dangers of import dependence and perceived instability of the Arabian Gulf are ignoring realities."

He pointed out that his country intentionally maintains a cushion of excess capacity to counter any supply disruption. It was his country's buffer, not any non-OPEC production, he noted, that came to the rescue when previous disruptions resulted from the Iranian revolution, the Iran-Iraq War, and the Gulf War. True, but this hardly answers the question as to what will happen if his regime is toppled by a rabidly anti-Western cabal.

Lord Browne, the boss of BP, countered such fears, observing that "however fundamentalist, a regime still needs money to look after its people." Many economists agree, insisting that oil is a "fungible" commodity that is worthless unless it gets to market. In the long term, that is doubtless true. But even short-term disruptions can wreak havoc on the world economy. For example, when the Iranian revolution booted out the shah, Iran's oil exports did in fact collapse for some time, and even years later reached only two-thirds their previous level. Just imagine the chaos if willfully irrational zealots toppled the Saudi regime -- and then decided to deny themselves oil revenues in order to punish the Great Satan.

Another part of the *Relax* camp of energy policy relies on free-market arguments to make its case. Libertarians argue, quite rightly, that the pain associated with previous oil shocks had more to do with foolish policy responses by Western governments meddling in the market (by imposing oil price controls, for example) than with any actual lack of supply. On one estimate, America spent some $60 billion a year during the 1990s to guard oil from the Persian Gulf, when the actual cash value of those oil imports totaled only around $10 billion a year -- a mind-boggling subsidy for fossil-fuel energy. Such folk contrast this overcautious approach with America's relaxed attitude to semiconductors: these silicon sandwiches are, after all, the backbone of the digital economy and also come chiefly from just one place (in this case, Taiwan), but America's military clearly does not guard chip plants.

All that sounds quite plausible until one considers the differences between semiconductors and petroleum: the American economy can manage fine without new semiconductors for some time, but the country would grind to a halt the minute that oil dried up. Also, semiconductor plants can be built anywhere but oil wells can go only where there is oil. The gasoline riots that brought Britain and parts of continental Europe to a standstill in late 2000 showed how quickly a modern industrial economy (even one that produces a lot of its own oil and gas, like Britain) can be crippled when its flow of oil is interrupted. That vulnerability is as good a reason as any to start weaning the world economy off petroleum.

Supply-Side Chimera

If the first camp wants you to relax, the second camp wants to get you all riled up to *Keep pumping*. To do so, these folk have tried to hijack the concerns about energy security to

support domestic energy firms. Explicitly citing the need to enhance America's "energy independence," George W. Bush tried in his early days in office to push a bill through Congress that would throw open part of the Arctic National Wildlife Refuge (ANWR) to oil drilling. Environmentalists were outraged by Bush's plan because they believed that it would inevitably spoil a pristine wilderness. Yet he redoubled his efforts after September 11, arguing that the case for Alaskan oil was only strengthened. He did not even blush when critics pointed out that the pipeline through which that oil must flow is itself more insecure than oil purchased on the global market: the pipeline has been shot at, bombed, and otherwise attacked a number of times already by drunks and delusional locals. A determined band of terrorists would probably find this vital conduit, which transports over a million barrels of oil a day to the lower forty-eight states, a nearly indefensible target.

An even bigger flaw in the Alaskan proposal was that it was based on the false premise that America could ever get close to energy independence. All the oil trapped in Alaska -- for that matter, in all protected lands in the country -- would not provide energy independence. America consumes a quarter of the world's oil but sits atop merely 3 percent of its proven reserves.

Even assuming that oil majors invest enough money to develop new fields in non-OPEC areas like the Gulf of Mexico and Russia, the "call on OPEC" will still double over the next twenty years. In order to meet the world's unchecked thirst for oil, leading energy forecasters are hoping that Saudi Arabia and its neighbors will invest the vast sums necessary to expand output dramatically. If they do not, their output will stagnate or decline, and the consumers of the world will pay the price. But if OPEC does crank out all that extra oil, as economic self-interest would seem to dictate, consumers will still suffer. That is because the cartel's grip on the world's oil market -- and therefore its ability to dictate prices -- will then grow much stronger. And Russia, which has received a lot of attention of late as a potential "anti-OPEC," simply does not have enough reserves to challenge Saudi Arabia over the long haul. Alaskan oil or not, the future of the world economy will increasingly become a gamble on Middle Eastern oil. That's surely reason enough to begin the transition away from petroleum now.

CAFE Culture

"Conservation may be a sign of personal virtue, but it is not a sufficient basis, all by itself, for a sound, comprehensive energy policy." So proclaimed Vice President Dick Cheney in April 2001. The political backlash against that speech was so great that conservation is now firmly on the American political agenda. Cheney, the most forceful of those who argued that we should keep pumping, even became the poster boy for the third camp of energy thinkers: the *Ride your bicycle* gang.

At first blush, a focus on energy conservation seems an entirely good thing for America. The United States, unlike Europe, has done little to discourage the inefficient use of fossil fuels in recent years. The country imports over 11 million barrels of oil per day. America could have reduced that greatly if it had made a serious, sustained effort at curbing oil use during the last two decades.

Still, many people will always wonder how important reducing oil demand is when compared with adding supply. That is because some people's gut instinct about the nature of depletion of natural resources may be misleading. Evar Nering, a mathematician at Arizona State University, explained to readers of *The New York Times* in 2001 that the nature of exponential growth means that curbing demand is more important than adding supply: "If consumption of an energy resource is allowed to grow at a steady 5% annual rate, a full doubling of the available supply will not be as effective as reducing that growth rate by half to 2.5%. Doubling the size of the oil reserve will add at most fourteen years to the life expectancy of the resource if we continue to use it at the currently increasing rate, no matter how large it is currently. On the other hand, halving the growth of consumption will almost double the life expectancy of the supply, no matter what it is."

Using less oil is critical, but how exactly to do that? There is actually reason to think Cheney's skepticism about conservation is justified after all (though perhaps not for the reasons he had in mind): conservation may be morally appealing to the *Ride your bicycle* camp, but it could end up being a bad thing if it merely resulted in far less mobility, trade, and other things made possible by energy that enhance human welfare. In contrast, increasing energy efficiency is a very good thing -- and policies that end subsidies or other sorts of support for inefficient or dirty technologies are even better. This is particularly true given how inefficient, in energy terms, the American economy is: Europe and Japan squeeze considerably more economic output out of the energy that they use than does the United States.

One efficiency measure that is always controversial in America is the strengthening of the Corporate Average Fuel Economy (CAFE) law: raising it for cars, and closing the loophole that allows light trucks and sport-utility vehicles (SUVs) to use more gas. The automotive industry has long fought such a move, arguing that it would impose an unacceptably high cost. Yet a look at the history of CAFE suggests otherwise. The years after Jimmy Carter's presidency saw the average fuel-efficiency of America's new car fleet rise by seven miles per gallon. From 1977 to 1985, America's GDP rose by more than a quarter even as total American imports of oil fell by two-fifths; over that period, America's productivity in oil use soared. In other words, fuel-efficiency measures need not equal disaster. Even so, a far better way to encourage efficiency would be a price signal—for example, the imposition of a higher gasoline tax designed to reflect the environmental harm and energy security risks involved in using petroleum.

The car industry put on a full-court press in Washington to kill the effort to strengthen CAFE, insinuating that it would be the death of the American car industry. However, its bluff was called by a nonpartisan study done by America's

National Academy of Sciences (NAS) in 2001. That analysis debunked the industry's arguments by identifying readily available technologies that could "significantly reduce fuel consumption of new cars over the next fifteen years." The experts were certain that reductions in fuel use up to 20 percent could be achieved easily.

What's more, the NAS group left the door open for even bigger reductions if radical new technologies that are now getting close to commercialization penetrate the market. Their optimism was based on the exciting new combination of hydrogen energy and fuel-cell cars, which makes it possible for the first time to contemplate a system of personal mobility that is completely free of harmful emissions and does not rely on the iron nexus of gasoline and the internal combustion engine. If that magical technology really takes off, and it will probably take a decade or more before it hits the big time, it could signal the end of the Age of Oil -- and bring with it the death of OPEC, the collapse of Middle Eastern dictatorships, and a radical realignment of geopolitics. Because the hydrogen energy required to feed those fuel cells can be produced in all sorts of ways all over the world, and not just in the Middle East, this brave new energy world would not see any wars waged over energy resources and could never be held hostage by a future Osama bin Laden.

Impossible, you say? Not at all. In fact, this energy revolution is already well under way, as a trek to the mountaintop home of Amory Lovins reveals.

The Sage of Snowmass Speaks

If you want to catch a glimpse of our planet's future, visit the Rocky Mountain Institute (RMI). Nestled away in Old Snowmass, a quaint hamlet high in Colorado's snowcapped peaks, this curious think tank and "do tank" attracts visitors from all over the world who are interested in new ideas about energy and the environment. Upon arrival, visitors often find themselves on a tour whose highlights include a superefficient toilet and an indoor banana farm, "perhaps the world's highest," as one staffer boasted without hint of irony. Despite the elevation, the people who run this place do not really have their heads stuck in the clouds.

Amory Lovins is the intellectual force behind RMI. Like all visionaries, he gets things wrong, but he has also gotten some big things spectacularly right. In an article published in *Foreign Affairs* in the gloom after the first oil shock in the 1970s, he famously predicted that improvements in energy efficiency would lead to the decoupling of economic growth and energy use. At the time, most were convinced that America would continue to suck up more energy in lockstep with economic growth, and Lovins was widely ridiculed. Even America's Department of Energy had predicted that by the year 2000, oil prices would have skyrocketed to more than $150 a barrel in today's money. Though Americans will always complain about gasoline prices above a buck a gallon at the retail pump, the DOE's predictions were clearly wrong. America has learned to use energy more efficiently than it did in the 1970s -- though, it must be noted, still not as efficiently as Japan or Europe -- and history has vindicated Lovins.

For some years now, the Sage of Snowmass has been making another sweeping forecast for the future of energy, and again he is sounding fanciful: "This breakthrough will be like the leap from the steam engine to the diesel locomotive, from the typewriter to the laptop computer . . . it's a really disruptive technology." He gestures toward a covered object in the center of a spacious high-tech workshop where his team of engineers has been beavering away for years. With a flourish befitting a mad scientist, he unveils his creation: the Hypercar.

After nearly a decade of work, and with the support of big industrial firms from Europe, Japan, and the United States, his outfit has developed a concept car that it believes will be the clean power plant of the future: it features electric propulsion, a 100 percent composite-plastics body, highly sophisticated electronics and software, and a radically simplified and integrated design. Most important, his roomy and stylish SUV will be powered by a stack of fuel cells.

What exactly are fuel cells? According to Lovins and others, these nifty inventions are the Next Big Thing. They are essentially big batteries that produce electricity by combining hydrogen fuel and available oxygen. They do this much more efficiently than a conventional car engine that uses gasoline. They run nearly silently. Best of all, their only by-product is harmless water vapor. They are already beginning to appear in stationary applications, such as generating power for clusters of homes and factories, and are likely to appear within a few years in portable applications: laptop computers, cellular phones, even climate-controlled bodysuits for tomorrow's soldiers.

Greens, consumers, and industrialists alike should rethink their prejudices. With fuel-cell technology, even a gargantuan Ford Expedition could sip hydrogen and emit absolutely none of the usual tailpipe gases that contribute to smog and global warming or that damage human health. There's a dream that avid consumers and righteous environmentalists might share.

But Lovins has his eye on bigger game. He is convinced that consumers will be able to use the fuel cell under the hood as a "micropower" plant that can power their homes or offices. Such cars might also be used as backup generators, or while traveling in remote areas. He sees nothing preventing consumers from plugging these electric cars into a wall socket during peak hours, when the power grid is overloaded, and selling the electricity they generate back to the utilities for a profit.

In a nutshell, Lovins thinks that some version of the Hypercar will turn the modern world upside down. It is tempting to dismiss his latest forecast as hopelessly utopian. Oddly enough, though, just days before Lovins unveiled his Hypercar on the other side of the world, another wild-haired visionary, Ferdinand Panik, had introduced a similar hyper-green power plant on wheels. At that unveiling, in Berlin, there had also been talk of revolution, and even the promise of an Energy Internet: "We can use the energy unit in this car for homes or stationary power. When linked together by smart electronics, our customers can buy and trade energy freely." Panik's boss, Jürgen Schrempp, was even more effusive: "The problem of how to ensure sufficient supply of energy

that is environmentally friendly is the key challenge of the future, and we see fuel cells as the solution."

Schrempp and Panik were not pundits or pie-in-the-sky dreamers: they were, respectively, the chairman and the chief fuel-cell expert at DaimlerChrysler, one of the biggest carmakers in the world. The company has already spent $1 billion to develop its "new electric car" (NECAR), and Panik expects the company to shell out another billion or so over the next decade to ensure its success. Daimler now expects to have its first commercial fuel-cell cars on the road by 2005, and mass-market volumes in about a decade.

Daimler is far from alone. Honda, Toyota, and GM also say their fuel-cell cars will be ready by then, and others claim they will follow. A number of car firms and oil companies have jointly opened up a hydrogen refueling station for their demonstration cars near California's capital of Sacramento. There is also a similar hydrogen station near Munich's airport. Daimler's top managers claim that in twenty years time, fuel cells will power perhaps 20 percent of all new passenger vehicles, and possibly all urban buses.

What do the stodgy old utilities think of all this airy talk? Ask Kurt Yeager, the head of the Electric Power Research Institute, which is the research body of the utility business. You might expect him to be dismissive of all this talk of micropower and Energy Internets. On the contrary, he can hardly contain his excitement: "Today's technological revolution in power is the most dramatic we have seen since Edison's day, given the spread of distributed generation, transportation using electric drives, and the convergence of electricity with gas and even telecommunications. Ultimately, this coming century will be truly the century of electricity, with the microchip as the ultimate customer."

If the lines between the auto industry and the power industry really do begin to blur, the impact on the economy, on industry, and on all our lives could be dramatic indeed. Consider just one killer statistic: the power generation capacity found under the hoods of cars in Germany or America is ten times that of all of the nuclear, coal, and gas power plants combined in those countries. In other words, Ford Motor Company alone could add more juice to America's power grid than all of America's conventional power utilities put together. That is what makes this recent pronouncement from Bill Ford -- Ford's chairman and the great-grandson of the company's famous founder such a bombshell: "I believe fuel cells will finally end the 100-year reign of the internal combustion engine."

That is nothing short of an endorsement of Lovins's vision, and the epitaph for today's motorcar—the filthy but durable workhorse of the twentieth century.

The Quiet Revolution

This book is a survey of something really big going on in the energy world. The first section looks at one of the three powerful forces behind that change: the rise of market forces. From California to Cologne to Calcutta, governments are liberalizing their cosseted energy markets and throwing open their borders to trade in gas and electricity. For example, about half of America's states, led by California, have forged ahead with some form of electricity deregulation. Europe and Japan are also liberalizing their gas and power markets in fits and starts. Though there will be some bumps along the way, the resultant outpouring of entrepreneurship, financial capital, and innovation promises to transform today's energy world beyond recognition.

The second section of the book examines how the recent surge of environmentalism is now reshaping energy. Outrage over local air pollution, from California to China, is putting pressure on governments to explore clean power and transport. Equally important has been the concern over climate change, which will require mankind to make a slow but sure shift to a low-carbon energy system over the course of this century. Many countries now look unfavorably on fossil fuels, and encourage renewable energy. However, the recent move by George Bush to kill the UN's Kyoto treaty on climate change has led many environmentalists to despair that America will never do its fair share to combat global warming. Look beyond Bush's desire to please the energy business, however, and you find that his skepticism about Kyoto is shared by many others, who also worry how much fighting global warming will cost - and wonder if it is really worth doing whatever the price.

So is there no hope for meaningful action on global warming? Have Big Oil and the Bush Administration made a mockery of the efforts to green the energy industry? On the contrary. Today's debates over climate change are but a small taste of the broader environmental challenges to be faced by the world as it tries to meet its soaring energy needs, and a sign that Big Oil must change -- or find itself relegated to the rubbish heap of history. The most promising development on this front is the growing popularity of market-based environmentalism, which applies commonsense tools of economics like cost-benefit analysis, emissions trading, and pollution taxes to problems like climate change. By leveling the energy playing field and using carrots as well as sticks to motivate companies, governments are much likelier to nudge the market in a greener direction.

The third section of the book describes the unprecedented wave of technological innovation now upending the energy business. The deregulation of markets, when combined with rising environmental demands, is spurring the development of such promising technologies as fuel cells and microturbines. Thanks to the rise of the Internet and sophisticated command, control, and communications software, the creaky old power grid is about to leapfrog into an intelligent network worthy of being the true backbone of the digital economy.

Just a few years ago, talk of the energy sector as exciting or innovative would have inspired loud guffaws from Wall Street: after all, utilities have long been considered so safe and stable (read: boring) that they used to be called widows' and orphans' stocks. Thanks to deregulation, the rules of the game are now changing at a dizzying pace. The stock market interest in "energy technology" stocks, which even produced an Internet-style bubble in the late 1990s, is a clear sign that the broader public is waking up to the potential of fuel cells.

The happy collision of markets, environmentalism, and innovation explains the most powerful trend of all in energy today: micropower, which puts small, clean power plants close to homes and factories. That may sound unremarkable, or even like common sense, to the reader -- but in the energy business it is near heresy. It is in fact a dramatic reversal of the age-old utility practice of building giant power plants far from the end user. The most surprising aspect of the micropower revolution is that tomorrow's energy world will be based as much on silicon chips, software, and superconductors as on soot and sulfur. Dramatic advances in software and electronics offer new and more flexible ways to link parts of electricity systems together. Today's antiquated power grid, designed when power flowed from big plants to distant consumers, is being upgraded to handle tomorrow's complex, multidirectional flows (the result of micropower plants selling power into the grid as well as buying from it). It is this breakthrough that will finally make possible the intelligent homes and the Energy Internet of the squeaky-clean, not-too-distant future.

Bigger than the Internet

What is about to happen in the energy realm is every bit as dramatic as the telecommunications revolution of the past two decades, which, despite the recent rocky ride of telecom stocks, has brought the world such astonishing developments as cheap long-distance calls, cellular telephony, and the Internet. In fact, the coming energy revolution is quite possibly more important, for two reasons. One is that energy is the world's biggest industry, by far -- America's electricity industry alone is bigger, in terms of revenues, than the country's long-distance telephony and cellular telephony businesses combined (that calculation does not even include Big Oil, Big Coal, or Big Anything Else). All told, the global energy game is nearly a $2 trillion-a-year business.

The second reason the energy revolution is so important is, of course, the impact our energy use has on the environment. The planet's health was the theme of the famous Earth Summit organized by the United Nations in Rio de Janeiro in 1992. The world's heads of state, along with thousands of activists, lobbyists, officials, scientists, and journalists, were there to push for their pet green causes -- especially fighting global warming. After a decade of sketchy progress, the world's leaders gathered for a follow-up Earth Summit in Johannesburg, South Africa, in August 2002. Once again they sought to reconcile the demands of economic development with concerns about the environment -- and once again energy-related problems such as global warming and local air pollution were at the top of their list of concerns.

This time, though, something interesting happened. After the usual squabbles -- over whether to put the earth first or people first -- subsided, the gathered heads of state hit upon a strategy that would do both: they agreed to help the world's poorest people gain access to modern energy in ways that are environmentally sustainable. In the next couple of decades, China and India will add thousands of new power plants and many millions of new vehicles as their economies grow. The rich world should help them do so using clean technologies like renewables and micropower. If not, a window of opportunity to set the world on a clean energy footing may be lost forever. It would kill many Indians and Chinese prematurely and needlessly, and would undermine efforts to combat global warming. It may even radically alter geopolitics if the relationship between an energy-starved China and an oil-rich Saudi Arabia begins to threaten America's web of alliances in the Middle East.

The world is at a crossroads. Decisions taken in the next few years about energy in big countries like the United States will shape the investments made in energy infrastructure around the world for a generation or more. After all, coal plants and oil refineries last for decades -- and that sunk investment displaces or discourages nimbler, cleaner, and more distributed options like micropower. If we want to shift to a clean, secure, low-carbon energy system during this century, the time to start is now.

If the three camps in the energy debate remain so intransigent and shortsighted, the road ahead might prove a tortuous one. Happily, there are already signs that the dizzying pace of innovation out in the real world is bringing with it entirely new and better ways of thinking about energy that may yet render their arcane policy debates irrelevant. If micropower really takes off, then there is every reason for optimism about our planet's future. Let the revolution roll!

Announcement

9th Annual USAEE/IAEE/ASSA Meeting

Chicago, Illinois., USA January 5- 7, 2007

Session Title: Current Issues in Energy Economics and Energy Modeling

Presiding: Carol Dahl, Colorado School of Mines

Speakers: Alireza Tehrani Nejad M. and Valérie Saint-Antonin, Institut Francais du Pétrole – *Allocation of CO_2 Emissions in Petroleum Refineries to Petroleum Joint Products: A Case Study*

Lester C. Hunt, University of Surrey, and Frederick L. Joutz, George Washington University – *Modeling Underlying Trends in OECD Energy Demand: Deterministic Vs. Stochastic?*

Benjamin F. Blair and Jon P. Rezek, Mississippi State University – *The Effects of Hurricane Katrina on Price Pass – Through in Gulf Coast Gasoline Markets*

Youngho Chang and Qiyan Ong, National University of Singapore – *Consumption Efficiency and Deregulated Electricity Market*

Discussants:

Donald A. Hanson – Argonne National Laboratory

Clifton T. Jones – Stephen F. Austin State University

Young Yoo – Federal Energy Regulatory Commission

Lynne Kiesling – Northwestern University

Abstracts are posted at http://www.iaee.org/en/conferences/assa2007.aspx

The meeting is part of the Allied Social Science Association meetings (ASSA).

For program information and pre-registration forms on the larger meeting (usually available in September) go to http://www.vanderbilt.edu/AEA/anmt.htm. Also watch for the USAEE/IAEE Cocktail Party.