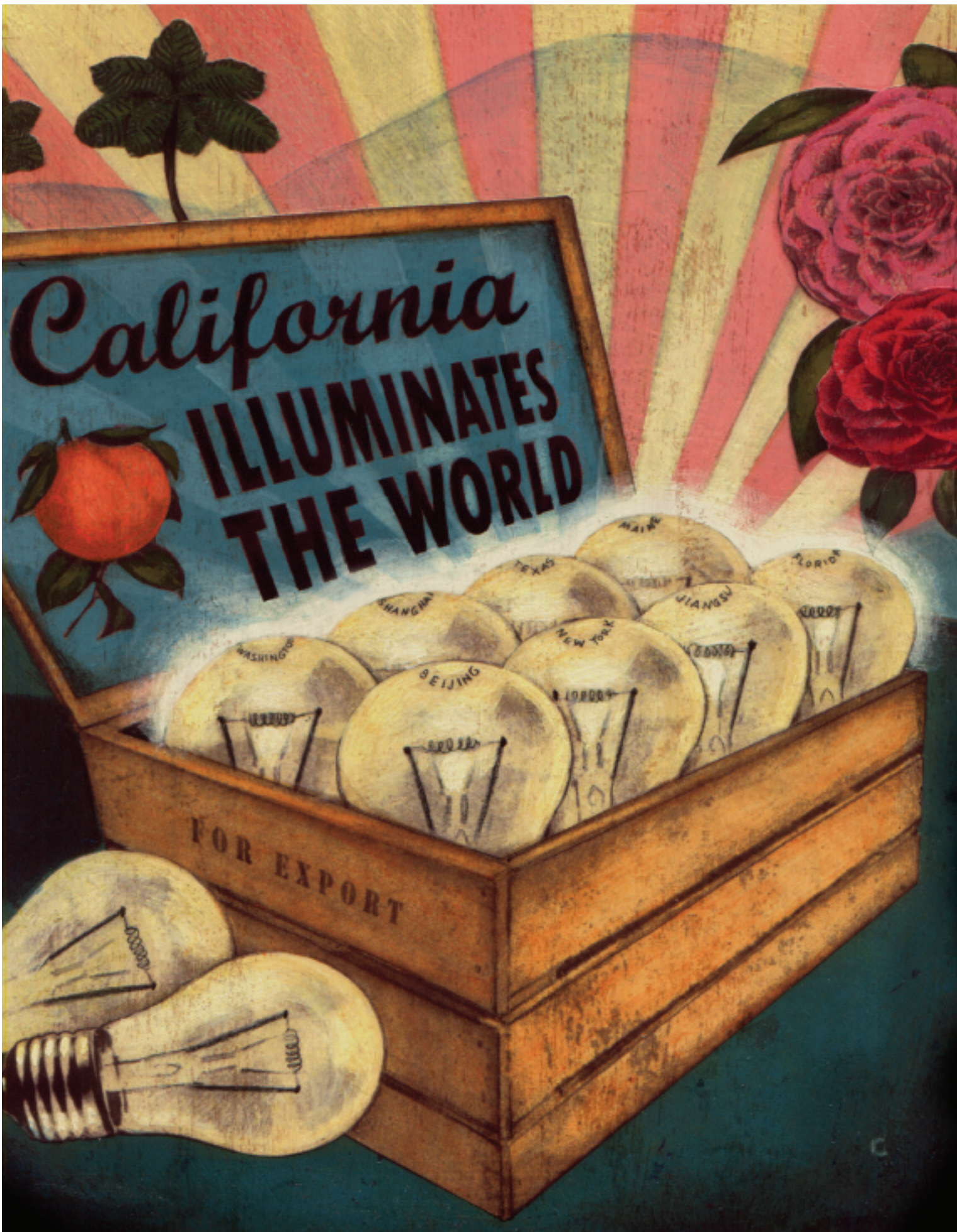
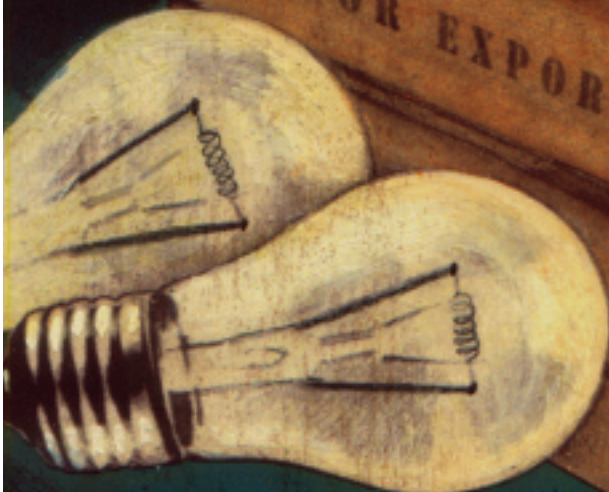


California
**ILLUMINATES
THE WORLD**



FOR EXPORT





Imagine that the electricity system in a country with an economy as big as France's was teetering on the brink of collapse. Limited blackouts already plagued several major cities. A few hotter-than-normal summer days could trigger a general power failure. Recovery might take weeks. The country would be plunged into economic recession and millions of citizens would be threatened with heat stroke, food shortages, and dehydration and disease from lack of running water.

It didn't happen in France, but it almost happened to the world's sixth-largest economy, California, in 2000 and 2001. What spared the most populous state in the union from social and economic upheaval was a crash

THE GOLDEN STATE'S PIONEERING EFFICIENCY PLAN COULD HELP SOLVE THE WORLD'S ENERGY CRISIS

campaign to conserve electricity. The state-led mobilization, with full cooperation from California's financially buffeted electric utilities, succeeded magnificently. "For a while," says Kateri Callahan, president of the Alliance to Save Energy, a nonprofit coalition of businesses, governments, and public-interest groups, "California had the lowest per-capita energy consumption of any industrialized country in the world."

When the crisis hit, California was already among the most frugal states in the country in terms of per-capita energy use. Thanks to a sustained era of progress from the 1970s through the early 1990s, the average resident of the Golden State used 40 percent less electricity than the average American. But California fell off its pedestal in the late nineties as a result of its flubbed first attempt at utility deregulation. Efficiency programs floundered for years. A new breed of private energy brokers like Enron thrived while traditional utility companies like Pacific Gas & Electric went bankrupt.

Since 2001, California has bounced back, fashioning a new framework of utility regulations that places greater emphasis on efficiency than ever before. Through 2008, utility companies plan to spend \$2 billion—a record for any state—to help Californians save energy. The investment will yield a net gain of \$3 billion in economic benefits for the state by reducing utility bills. "This efficiency campaign will avoid the need to build three large power plants," says Brian Prusnek, a senior staff member at the California Public Utilities Commission. "In terms of greenhouse gas emissions, that's the equivalent of taking 650,000 cars off the road. How many other investments yield a 50 percent financial return and reduce pollution?"

Leading-edge policies and technologies that encourage efficiency have long been a California export, right along with merlot, movies, and semiconductors. Energy policy makers in other states as well as in the federal government look to California's energy-conservation measures the same way political analysts view the New Hampshire presidential primary—as a



BY CRAIG CANINE

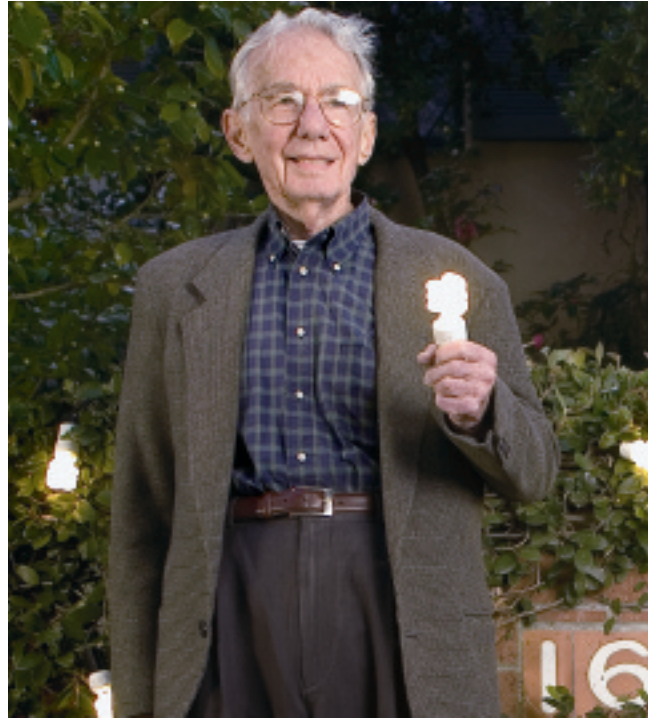
ILLUSTRATION BY CRAIG LAROTONDA



bellwether for the nation. California was, for example, the first state to adopt efficiency standards for appliances. These went into effect in 1977 and were upgraded throughout the 1980s. Florida, Massachusetts, Connecticut, New York, and other states followed California's lead, sometimes copying the California code verbatim. This shift at the state level convinced appliance manufacturers to join with efficiency advocates in lobbying for a uniform national standard, which Ronald Reagan signed into law in 1987. Thus began a process that continues to repeat itself. Since 2004 several other states have adopted at least some of California's latest standards, many of which also wound up in last year's federal energy bill. "The general pattern," says Devra Wang, a staff scientist at the Natural Resources Defense Council, "is that California adopts new standards, other states follow, and then they're adopted at the federal level."

California's efficiency standards for new buildings, introduced in 1978 and known as Title 24, have been replicated all over the world. The code governing new construction in Russia, for example, is cutting energy use by more than 40 percent, thanks to California. A similar effort now under way in China could wind up as California's most enduring global legacy (see "The California-China Syndrome," page 26). If the planet is to tackle the twin challenges of finding adequate energy resources to drive hungry economies while averting the worst consequences of climate change from burning fossil fuels, the West Coast is the place to look for leadership.

Nobody knows the power of energy efficiency better than Art Rosenfeld, who was present at the creation of the concept as we know it. Rosenfeld is a kind of human power plant—one that generates not megawatts, but "negawatts" of avoided energy consumption (to use the famous coinage of Amory Lovins, cofounder of the Rocky Mountain Institute). The type of energy that Rosenfeld thought about for the first half of his career had nothing to do with oil fields or power plants. His specialty was particle physics—the science of smashing protons and other subatomic bits of matter as a means of teasing out fundamental secrets about the



Energy stars Susan Kennedy and Art Rosenfeld display one of California's biggest contributions to efficiency: the compact fluorescent lightbulb.

universe. He was a member (and later leader) of a group headed by the Nobel Prize–winning physicist Luis Alvarez at the Radiation Laboratory at the University of California, Berkeley, now known as the Lawrence Berkeley National Laboratory (LBL).

When the OPEC oil embargo hit in October 1973, Rosenfeld did a little math. He discovered that if Americans used energy as efficiently as the Europeans or Japanese, the United States could have been exporting oil in 1973, rather than sitting in rationing lines at gas stations. The solution, he realized, was not to bend the Arab oil regimes to America's will but to end America's thralldom to them by wasting less energy.

The following summer, Rosenfeld and a few like-minded physicists organized a monthlong workshop, held at Princeton, that attracted top scientists and engineers from fields such as building design, transportation, the manufacturing sector, and gas and electric utilities. "We began looking at some things that were all sort of common sense," he recalls. "Change incandescent lights to fluorescents, make better use of skylights, put more insulation in buildings, that kind of thing. By the end of the first week, we realized that we had blundered into one of the world's largest oil and gas fields. The energy was buried, in effect, in the buildings of our cities, the vehicles on our roads, and the machines in our factories. A few of us began to suspect that the knowledge we gained during that month would change our lives."

Rosenfeld decided to spend a little more time—maybe six months—expanding on that knowledge. Sitting in a busy Silicon Valley restaurant more than 30 years later, his usual squinting smile assumes a rueful tinge: "I just vastly underestimated how long my sabbatical from particle physics would last." The six months drew out to a year, the year turned into another year. Somewhere along the way, he passed the point of no return.

Rosenfeld formed a group at LBL to create a computer program that modeled the energy performance of buildings. If you

built, say, a 3,000-square-foot house in the mountains near Lake Tahoe and put in a big north-facing picture window, how much energy would it take to heat the house in January? What if the picture window faced south—how much would that lower the heating bills? Now, plopping the same house down in the Mojave Desert town of Barstow, California. What changes would you make to minimize the need for air-conditioning? Rosenfeld's program provided much more accurate answers, and was far more user-friendly, than a previous attempt at the same kind of modeling software.

With state and federal funding, Rosenfeld's group refined the program, and then in 1976 released it into the public domain. Originally called "Two-Zone," it is now known as DOE-2. The California Energy Commission, created in the early 1970s to conduct research and create efficiency standards (among other mandates), adopted DOE-2 as the basis for setting energy-performance standards under Title 24. The commission estimated that buildings constructed under Title 24—and, therefore, designed using the Rosenfeld/DOE program—eventually ramped up to energy savings of \$5 billion a year. Other states followed California's lead, and Rosenfeld guesses that DOE-2 is now used in the design of 15 percent to 20 percent of all new buildings in the United States. More than 40 countries, from the northern climes of Canada and Switzerland to the tropics of Singapore, Thailand, and Indonesia, have also adopted the program.

Needing a home for his new line of research, Rosenfeld and two colleagues started an energy-efficient-buildings program, which later morphed into LBL's Center for Building Science. Rosenfeld led the program from 1974 to 1994—a golden era of energy efficiency in the Golden State. During this period, the program developed a series of energy-saving gadgets that remains a kind of "greatest hits" of the field. One invention was the high-frequency ballast—a solid-state power

Rosenfeld takes a few moments to sum up the savings from the major efficiency technologies and policies that originated at LBL during his tenure. "Let's see," he muses. "The DOE-2 computer program is used in building standards that save the country, conservatively, \$10 billion a year in electricity and natural-gas costs. High-frequency ballasts for fluorescent lamps are saving the United States around \$5 billion worth of electricity a year. Low-e windows are probably saving between \$5 billion and \$10 billion a year. Then if you look at refrigerator standards, which originated with us, improvements in refrigerator efficiency since 1974 are now saving the country around \$17 billion a year."

Rosenfeld retired from Berkeley and LBL in 1994, when he was summoned to Washington to work in the Department of Energy as senior science adviser to the assistant secretary for energy efficiency and renewable energy. When the election of 2000 ended his job (and any hope for an aggressive approach to energy efficiency at the federal level), he headed back to California and started his fourth career—this time as an appointee of then-governor Gray Davis to the California Energy Commission. At the age of 79, Rosenfeld is now serving his second five-year term on the commission, having been reappointed last year by Governor Arnold Schwarzenegger.

In January 2001, when blackouts began to roll through California and Governor Davis declared a state of emergency, he turned to his cabinet secretary, Susan Kennedy, to take charge of damage control. (Although a Democrat, she now serves as chief of staff for Republican Governor Schwarzenegger—testimony to her political skills in the Sacramento trenches.) "It was the most successful statewide energy-conservation campaign ever conducted," says Ralph Cavanagh, codirector with David Goldstein

ROSENFELD'S PROGRAM DEVELOPED ENERGY-SAVING GADGETS THAT ARE A KIND OF "GREATEST HITS" IN THE FIELD

source that improves the efficiency of a standard fluorescent rod but uses 20 percent less electricity. In the hands of lamp manufacturers such as Philips, the high-frequency ballast led to the creation of the compact fluorescent lamp (CFL), a mainstay of energy-efficiency programs throughout the world. Another breakthrough was the low-emissivity, or "low-e," window—a window with a thin coating that allows visible light to pass through but captures or reflects the sun's invisible near-infrared radiation, which produces heat. Low-e coatings roughly double the energy performance of standard double-glazed windows.

In the mid-1970s, Rosenfeld and one of his graduate students, David Goldstein, uncovered some chilling facts about refrigerators: On average, they realized, the most energy-efficient refrigerators on the market cost the same as the least efficient ones. If there were a basic appliance standard that eliminated the least efficient half of the refrigerators, they told then-governor Jerry Brown, it would save 1,500 megawatts' worth of generating capacity (the equivalent of one and a half typical nuclear power stations)—and consumers would notice no difference in the price of a new fridge. The California Energy Commission quickly developed a performance standard for new refrigerators and freezers, which in 1977 helped bring about a moratorium on the building of nuclear power plants in California. National refrigerator standards, which trace their origins to California's, are today saving more than 130,000 megawatts of electrical generating capacity.

of NRDC's energy program. "And Kennedy was the field general."

She mobilized a host of dueling factions—shell-shocked utility companies, both parties in the legislature, corporations, consumer groups, the California Energy Commission and its regulatory cousin, the Public Utilities Commission—to cooperate in the fight against the common enemy of more and bigger blackouts. The state poured \$1 billion in emergency funding into a newly invigorated set of incentive programs dubbed "Flex Your Power." And Californians flexed, big-time. In short order, they replaced nearly eight million lightbulbs with CFLs in their homes. Cities and towns installed thousands of light-emitting diode (LED) traffic lights, which use less than half as much electricity as the incandescent lamps they replaced. Factories swapped out thousands of old motors for more-efficient new ones.

In utility lingo, strategies for cutting electricity demand are known as demand-side management (DSM). This "saved California from massive economic harm," Kennedy said recently. "Through DSM we were able to reduce our demand by nearly 5,000 megawatts—equivalent to the output of 10 large power plants." Nearly enough electricity, in other words, to supply the average daily needs of Los Angeles.

Not all of the savings lasted. The efficiency hardware installed during the crisis stayed in place, of course, and continued to reduce Californians' electricity bills year after year. But half of the energy savings disappeared in 2002 as the sense of urgency ebbed. What remained

were the smoking ruins of a coherent state energy policy.

The crisis, in tandem with a recession in the state's economy after the dot-com bubble burst, was Davis's Waterloo. He went down to defeat in 2003 in the first gubernatorial recall election in California history. Before leaving office, however, he appointed Susan Kennedy to the public utilities commission. She was assigned to head up all official proceedings involving energy efficiency, and brought to this task an uncanny ability to cut through hardened layers of conflicting viewpoints, find an "Aha!" solution, and then forge consensus around it.

During the early years of energy conservation in California, utility companies were compelled to run efficiency programs. They had to spend a modest percentage of their revenues to field small armies of energy auditors, hand out blankets for hot-water heaters, provide rebates for energy-efficient appliances, and offer inducements to customers to unplug and recycle those ancient second refrigerators—the beer coolers—in their garages and basements. The utilities needed prodding to do these things, because even though saving energy was beneficial to ratepayers and society in general, it was against their own financial interests. They made money by selling kilowatt-hours. The more they sold, the more they made. They had a far greater economic incentive to hand out free hair dryers (which some actually did) than to subsidize setback thermostats and CFLs for their customers.

In the 1980s, as the energy-efficiency movement gathered steam, people like Art Rosenfeld, Amory Lovins, and NRDC's Ralph Cavanagh began looking for ways to realign utilities' financial incentives so as to encourage them to invest in efficiency. The idea that gained

the most momentum was known as decoupling. Traditionally, utilities' financial health had been tied directly to increases in electricity sales. Decoupling broke this link. Here's how it works: Every few years, state regulators determine how much revenue utilities need to cover certain authorized costs. They then set electricity rates at a level that allows utilities to recover these costs, based on a forecast of sales. If actual sales are above or below this forecast, then revenues are "trued up." Over-collections are given back to consumers in the form of reduced rates, and under-collections are eliminated with modest rate increases (typically pennies a month for the average household).

In 1982 California became the first state to adopt decoupling. The utility companies liked it, because it helped stabilize their financial health. In due course, regulators in a number of other states, including Oregon, Washington, New York, and Maine, adopted decoupling mechanisms of their own.

The decoupling trend came to an abrupt halt when deregulation fever struck in the 1990s. In this new economic wonderland, utility companies sold off many of their generating assets to independent power producers. The utilities became mere middlemen, buying electricity on the wholesale spot market and reselling it to their customers. They no longer had the responsibility to plan for meeting their customers' future electricity needs by combining supply-side investments (new power plants) and demand-side investments (energy efficiency) in a diversified portfolio of resources—a process known as integrated resource planning. The invisible hand of the market would take care of all of that. Or so ran the theory.

THE CALIFORNIA-CHINA SYNDROME

CHINA'S BREAKNECK ECONOMIC GROWTH IS fueled mostly by dirty and inefficient coal-burning power plants. The consequences are painfully evident in the sulfurous pall that fouls the air and the power outages that plague China's industrial centers. It was not hard for Chinese officials to see a reflection of their own dilemma in the rolling blackouts that hit California in 2000 and 2001.

So last fall the Chinese government invited a delegation of energy experts from California to discuss the lessons learned from the state's calamitous attempt at utility deregulation and the ensuing electrical shortages. In particular, the Chinese were eager to hear how California had recovered from its disaster by placing efficiency at the heart of its refurbished energy policies.

The delegation was led by Susan Kennedy, then the commissioner in charge of energy-efficiency matters at the California Public Utilities Commission. It included efficiency guru Art Rosenfeld; representatives from Pacific Gas & Electric, the utility company that serves most of northern California; and policy experts from the Natural Resources Defense Council.

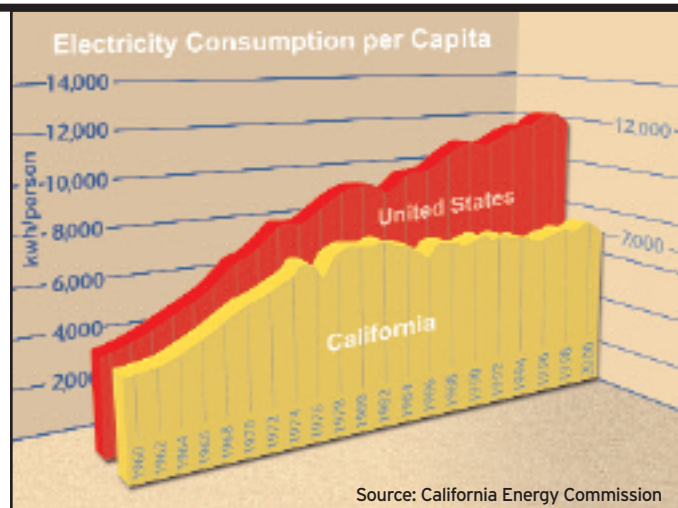
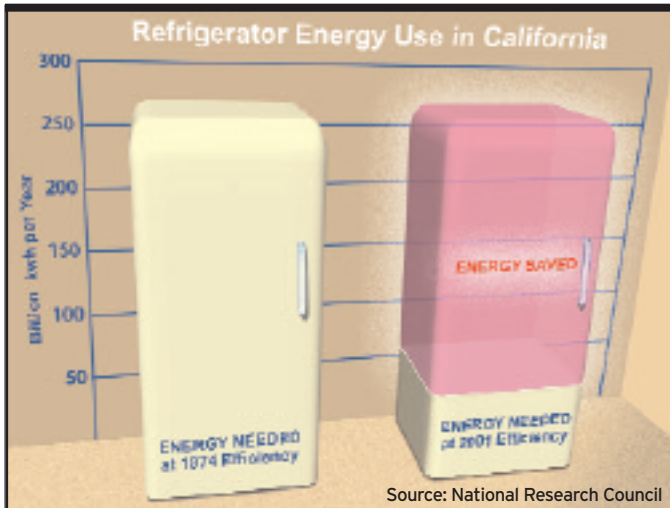
Barbara Finamore, director of NRDC's China Clean Energy Program, had already been working for several years with officials in Jiangsu Province to identify areas that would yield cost-effective energy savings. They found eight, including energy-efficient industrial motors, commercial cooling and lighting systems, and residential appliances. "Our analysis showed that investment in these eight areas could save Jiangsu the output equivalent of 17 300-megawatt power plants over the next 10 years," says Finamore. "This would meet over 8 percent of its growth in electricity demand and 15 percent of its peak demand—all at

approximately a quarter of the cost of the power from the new plants. And it would eliminate 613 million metric tons of CO₂ emissions over the 10-year period."

The California delegation described how the state had achieved large-scale energy savings by investing in essentially the same package of efficiency measures. They also explained the pioneering work of California regulators in "decoupling" utility profits from sales of electricity, so utility companies could invest in efficiency programs without harming their profitability. The visit ended with an agreement to continue the cooperative effort, with the Californians pledging to provide their counterparts in Jiangsu with extensive additional training and expertise in energy-efficiency policy, technology, program design, and implementation. California Governor Arnold Schwarzenegger went to China a month later and declared that the partnership could be "the model of U.S.-China energy cooperation in the future."

"Even China's central government understands that California is far ahead of the U.S. federal government in matters involving energy efficiency and renewable energy," says Timothy Hui, NRDC's chief representative in Beijing, "so California is acknowledged to be the model." California's standards for the energy efficiency of new buildings, the most stringent in the world, are serving as a blueprint for code development across China.

"The Chinese are nothing if not pragmatic," Finamore says. "That's why energy efficiency makes so much sense to them. In China, gaining a megawatt of electricity by building more generating capacity costs four times as much as saving a megawatt through greater efficiency. It's a smart way to support economic growth." And spare the earth some grief in the process. —C.C.



But things didn't work out as planned. Some analysts believe that California's electricity shortages in 2000 and 2001 were the result of too little deregulation, too late. Others say the deregulatory wrecking ball swung too far. In any case, when Susan Kennedy took her seat on the utilities commission in 2003, the sense of immediate crisis had passed but the underlying damage had not been repaired. The commission was, by that point, designing and administering efficiency programs itself, since neither the utilities nor the restructured marketplace could be trusted to do the job. Funding for these programs came from a Public Goods Charge—a 1 percent tax added to utility bills. This tax generated about \$250 million annually—less than half of what California utilities had been investing in efficiency under decoupling.

Kennedy faced the task of bringing the drifting ship of efficiency policy under control. "I was extremely fortunate to know some of the best minds in the world in energy efficiency," she says. In the spring

It took nearly two years, but Kennedy finally managed to turn this vision into California law. The groundbreaking energy-efficiency campaign that the utilities commission adopted last September, with its \$2 billion of approved investments in efficiency from 2006 through 2008, brings funding beyond the historic levels unleashed by decoupling in the early 1980s and again in the early 1990s. Every dollar the utilities invest in efficiency measures will generate more than two dollars in savings for customers. That's not just hopeful speculation: \$100 million will go toward monitoring and verification to make sure the investments are producing cost-effective results. "If we're going to say energy efficiency is a dependable resource, then we've got to make sure that it's actually producing savings," Kennedy says. The new mantra of the public utilities commission is "Trust—but verify."

California's recommitment to energy efficiency is partly a return to the past, but with a significant new wrinkle. Now, when utilities

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of 2003, she invited a half-dozen experts, including Art Rosenfeld and Ralph Cavanagh, to dinner in San Francisco for a strategy session.

"It was a pivotal discussion for me," Kennedy recalls, "because we laid the groundwork for thinking big. I said, 'Tell me what is possible with energy efficiency—think about this as if funding was not a limiting factor.' The sparkle in Art Rosenfeld's eye got brighter as he talked about all the possibilities. Pouring out of this little man was decades of research and experience and passion about what is possible if we have the collective will to get it done."

"It was an experience I will never forget," Kennedy continues. "And I believe we proved that if you approach energy efficiency in a holistic, integrated way—as a tangible resource—you can achieve great things and actually save consumers and businesses tons of money."

A return to decoupling and integrated resource planning was a necessary first step, Kennedy decided. But where would the money come from to support the "think big" approach? She proposed adding another source of funding: the utilities' procurement budgets, deep reservoirs of cash that had previously been earmarked for buying wholesale blocks of power from existing power plants, or for building new ones. Added to the Public Goods Charge, this source of investment capital could at least begin to do justice to Art Rosenfeld's bag of efficiency tricks.

plan for long-term growth in electricity demand, efficiency is the resource of first resort, with renewable energy sources next in line. Utilities and regulators call this the "loading order." What it means, in Kennedy's words, is that "before our electric utilities spend a dollar to buy power in the market or build a new generation plant, they will first invest in ways to help us use energy more efficiently." If efficiency measures don't free up enough generating capacity to meet the growth in demand, the next resource in the loading order is renewable sources. Only then can utility companies turn to fossil-generated power (whether bought or built), and even then any new plants that are constructed must be no dirtier than a state-of-the-art natural-gas generating plant.

Kennedy's term on the utility commission was cut short on December 1, 2005, when Governor Schwarzenegger recruited her back to ward healing in Sacramento as his chief of staff. But the momentum from her tenure as an efficiency crusader continues. This year, California regulators are expected to hammer out stronger financial incentives for utilities to invest even more in demand-side management. If that happens, watch for yet another California trend to turbocharge energy-efficiency programs soon in a state near you. 🐾

Craig Canine is a contributing editor to OnEarth.