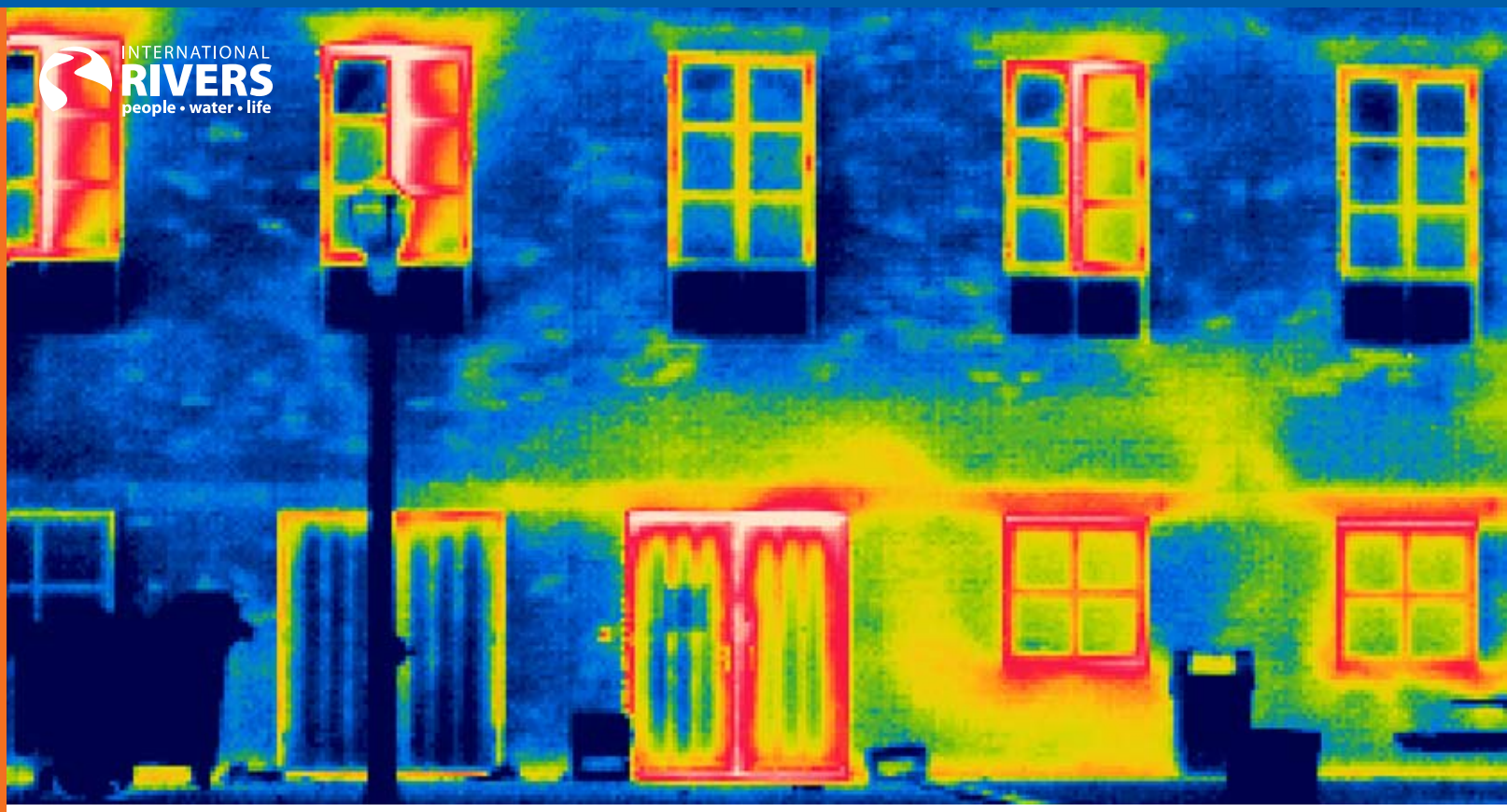

This infrared image shows heat leaking from a building. Photo: Thermotest

The Power of Negawatts

EFFICIENCY: THE GREENEST ELECTRICITY SOURCE

Reducing the impact of our use of energy is one of the key technical, political, and even moral challenges facing human society in this century. While our sources of energy have to be made cleaner, our first priority must be to use energy more efficiently. Efficiency measures are cheaper, cleaner and faster to install than any other energy option. And we lose nothing in the bargain – the point of efficiency is to allow us the same levels of productivity or comfort, but with less power.

"The only by-product of energy efficiency is wealth," trumpets *The Economist*. According to the McKinsey Global Institute, a global energy-efficiency drive would be profitable, unlike most other measures needed to halt climate change. The US government, for example, has reaped a 40-to-1 return on its efficiency investments.

Up to three-quarters of the electricity used in the US today could be saved with efficiency measures, and these measures will cost less to implement than the electricity itself. Developing countries, which will account for 80% of global energy demand growth up to 2020, could cut their demand by more than half using existing technologies to improve energy efficiency, according to the McKinsey Institute. "This would leave energy consumption some 22% lower than it would otherwise have been – an abatement equivalent to the entire energy consumption of China today," the institute states.

CHEAP AT HALF THE COST

It has been called "the only cheap power left," and indeed, nothing compares. Many efficiency improvements are priced at 1-3¢ per kilowatt-hour – about one-fifth the cost of electricity generated from new coal and natural gas-fired plants. (Large hydro is more variable, but generally runs

between 4-10¢/kWh, not including "externalized" costs such as environmental and social damages.)

Efficiency is not only cheaper than all other options, it also leads to growth in jobs and personal income. By reducing energy bills, it frees up money that can be spent elsewhere. The result is a shift away from the relatively low labor-intensive energy sector to parts of the economy that employ more workers per dollar invested. It also creates growth in green-collar jobs such as building-weatherization specialists and energy auditors.

Efficiency also offers less scope for corruption and patronage than large energy supply projects. The "downside" is that the lack of potential for kickbacks can pose a political obstacle to the adoption of efficiency improvements over new supply projects.

Art Rosenfeld, the father of California's energy-efficiency movement, has stated, "I believe the world needs only half as many new power plants as it thinks it does." One of the world's most energy-efficient economies, California uses just 58% of the electricity used by other US states – and it made money getting to that level of efficiency. (See box opposite.)

"Energy efficiency itself creates jobs, simply because of the household spending it takes out of the carbon-supply chain and puts into espresso drinks and haircuts. California's energy-reduction programs generated 1.5 million jobs, worth $45 billion in payroll, between 1972 and 2006."

- David Roland-Holst, a resource economist at the University of California at Berkeley, and author of "Energy Efficiency, Innovation, and Job Creation in California"

Many governments have adopted innovative policies to improve energy efficiency. A few examples from around the world:

■ A number of US states have adopted utility pricing that separates a utility's ability to make money from the amount of electricity that it sells (called "decoupling"). Very small rate increases may be needed since less energy is being sold, but in the US experience, decoupling has not resulted in any significant rate increases, and has led to more stable electricity prices.

■ The US government offers a tax credit to makers of extremely efficient appliances. Several states give rebates, income-tax credits or sales-tax exemptions to anyone who buys them. Japan's Top Runner Program is one of the few that regulates rather than rewards efficiency; it uses the most efficient appliances on the market today to set efficiency standards for the next generation of appliances. This program has helped Japan boost the efficiency of refrigerators by 55%, air conditioners by close to 68%, and computers by 99%.

■ Retrofitting existing buildings with better insulation and more-efficient appliances can cut energy use by 20-50%. Many governments have adopted building codes that dictate minimum levels of efficiency. The Indian government's 2007 energy conservation code, for example, is aimed at cutting energy consumption in commercial buildings by 25-40%.

■ Lighting is an area where energy savings can be huge, and relatively easy to achieve. Just switching to compact fluorescent (CFL) bulbs can reduce electricity used for lighting by 75%, for example. In 2008 the Chinese government gave substantial subsidies for makers of CFLs. Brazil offers rebates on CFLs, with the result that Brazilians have installed more than 48 million efficient bulbs. Namibia, Ghana and Uganda have all achieved significant energy savings by distributing free CFLs. Ireland, Switzerland, Cuba, and Venezuela are just a few of the many governments to have begun to phase out or ban incandescent light bulbs.

■ Electricity drawn by appliances in "standby" mode (when they are not actively on but still running electric circuitry or internal clocks) currently accounts for 5-10% of total residential electricity use in developed countries. The International Energy Association (IEA) estimates that standby power is responsible for roughly 1% of global CO_2 emissions, and growing. New technologies could reduce standby power by up to 90% with no loss in features customers want, the IEA states. At least 20 governments are working on improved standards and labeling to reduce standby power. The IEA is pressing for a global standard, since these products are designed, manufactured, and traded globally.

■ Japan set energy-efficiency targets for the countries' biggest industries beginning in the 1990s, and today its industries are among the most efficient in the world. For example, Japan's steel industry now uses a third less energy than it did 30 years ago. "If the global steel industry adopted Japanese conservation measures, it could reduce carbon emissions by some 300 million tons a year," reports the *New York Times*.

The California Model

California is a world leader in energy efficiency. In the past three decades, electricity per capita has stayed flat in California while it has risen 60% in the rest of the country.

The state wasn't always a paragon of smart energy regulations. In 1974, 75% of California's electricity came from oil, and it had plans to build 20 nuclear plants up and down the coast. An oil embargo and public protests against nuclear power pushed the state's energy planners into a corner. California's efficiencies come from three key changes: better energy policies, a shift away from energy-intensive businesses fueling the California economy, and higher energy prices. "We've saved $16 billion a year in electricity, with a net savings of about $1,000 per family per year," notes John Wilson, formerly of the California Energy Commission. Put another way, every dollar invested by California's utilities in efficiency measures has generated more than two dollars in savings for customers. The state mandates energy efficiency as the default first-choice to meet energy needs before new supply can be considered.

Half the state's savings are due to building and appliance standards, which are revised upward every three years. "We were told the 1993 standards couldn't be done, and today we're meeting a standard that is 20% more efficient than that one," Wilson says. "I think we'll get to zero-net-energy buildings in 10 years." The state's refrigerator standards alone have saved 40,000 megawatts of electricity – equivalent to about 80 typical coal plants.

California undertook a broad menu of common sense measures: better insulation, energy-efficient lighting and heating and cooling systems. But some of its savings came from unexpected places. The state found that the average residential air duct leaked 20-30% of the heated and cooled air it carried, so it required leakage rates below 6%. The state found that about 15% of outdoor lighting was directed up, illuminating the sky rather than streets and parking lots, so it required new fixtures that directed 94% of the light downward. Flat roofs on commercial buildings are required to be white, to reflect the sun and reduce air-conditioning demand.

But one of the state's most important policy changes was to remove profits from energy sales. California first decoupled sales and profits for gas in 1978 and for electricity in 1982. After a disastrous run with deregulation during which utility rates were no longer regulated, thus undermining many efficiency programs, the state reversed course. In 2007, the state adopted a scheme called "decoupling plus," which aims to make investments in energy efficiency more profitable for utilities than new power stations would be. Fees to finance energy-saving measures are added to each bill, and utilities spend the money in pursuit of targets set by the California Public Utilities Commission. The commission then calculates the savings from these investments, compared with the cost of new power plants. If a utility achieves between 85% and 100% of the target, it can keep 9% of these savings. If it exceeds the target, it gets 12%, more than it would earn from building new infrastructure. Between 65% and 85% it does not earn any return at all, and below 65% it pays a fine for every kilowatt-hour by which it has fallen short.

Insulating buildings can bring significant energy savings. In the US, buildings account for 70% of electricity consumption.

While California is one of the world's most efficient economies, there is still room for improvement (Western Europe is even more efficient, for example), and the state is striving to achieve as much new electricity savings by 2020 as it has in the past three decades.

"If all Americans had the same per capita electricity demand as Californians currently do, we would cut electricity consumption 40%, without raising American electric bills."

- Joseph Romm, director of the Center for Energy and Climate Solutions and former assistant secretary of the US Department of Energy.

BECOMING EFFICIENT: POLICY POINTERS

Energy savings can be found even in countries where energy use is just beginning to take off. In fact, putting efficiency measures in place now for growing economies makes economic sense, since requiring efficiencies means there will be more to share with those currently without access to electricity, and saves money to invest in other pressing needs. The McKinsey Institute estimates that developing countries could save an estimated $600 billion a year by 2020 by investing $90 billion a year in energy efficient cars, appliances and production methods. Here is a short-list of steps governments and utilities can take to improve energy efficiency:

- **Develop strong building and appliance standards** and promote the aggressive deployment of energy-efficient technologies and strategies (including those to reduce standby power). Tighten the standards regularly. To be effective, these standards should be mandatory.

- **Break the link between utility sales and revenue.** "Utility decoupling" is a necessary step to encourage utilities to pursue a path of energy efficiency over expanding supply.

- **Establish standards for utilities.** While decoupling in and of itself will not cut electricity demand, it does mean that utilities can provide incentives for conservation programs without losing revenue. Enforceable targets for energy efficiency for utilities (also known as a "portfolio standard") will ensure steady progress. Other strategies to help utilities limit the need for new power plants include energy conservation, distributed renewables (such as solar PV on large industrial buildings and homes), and tactics to manage peak demand for electricity.

- **Adjust energy prices to encourage ongoing efficiency.** While this can be politically difficult in poor countries, blanket subsidies discourage efficiency and may benefit mainly the better-off. Low-income people can be protected from higher energy prices by subsidizing basic consumption and increasing unit costs for the heaviest users.

- **Focus on the energy-intensive industries.** such as pulp and paper, steel, cement, aluminum, petroleum refining and chemicals. Adopting the most-efficient blast furnaces and boosting recycling can cut energy use in the steel industry by close to 40%. Converting China's cement industry to the most efficient dry kiln technologies, as used in Japan, could cut global energy use in the cement sector by 40%.

- **Increase awareness** among consumers, businesses, building inspectors and contractors through education campaigns, labeling of appliances, and trainings. Giving energy users feedback on how much they use and where savings can be found can lead to significant savings.

- **Don't forget the grid!** Transmission systems can be hugely wasteful. Africa's power grid, for example, loses twice as much electricity during transmission as do more modern systems, and those losses can equal 2% of GDP annually. Even the richest nations are experiencing grid-related problems. "Smart grid" technologies, which use microprocessors and software to allow information to flow back and forth to all users in the system (rather like the internet), would reduce electrical losses through the wires, give electricity customers feedback on energy use and costs so they can be active participants in managing demand, and enable a much larger expansion of renewables to the grid.

- **Create a carbon economy.** Smart regulations should be able to prevent most energy waste but cannot be expected to catch all wasteful practices. Taxing high-carbon energy sources would help encourage companies to use energy more wisely and switch to clean renewables.

None of these things are beyond our reach. In fact, energy efficiency methods are ready to be deployed now, without having to wait for any "silver bullet" technologies. All it takes is political will to get started. If you're feeling like you lack the personal will to press your political leaders to get moving on energy efficiency, just imagine this: for every appliance standard adopted or string of municipal buildings that are insulated, a river somewhere will breathe a sigh of relief and live another day to run free.

MORE RESOURCES

McKinsey's resources on efficiency are among the best. Visit their overall page to see their library: http://tinyurl.com/bx99lq. "Fueling sustainable development: The energy productivity solution" is their Oct. 2008 report on reducing energy demand in developing economies. (http://tinyurl.com/5ae9wn)

The International Energy Agency's page on energy efficiency includes information on policies, building codes, a proposal for reducing "standby power" and other good resources: http://tinyurl.com/bqwb3p

The American Council for an Energy-Efficient Economy has a library of their policy papers online, and a thorough list of links to other sites on efficiency at: http://www.aceee.org/altsites/index.htm

"Energy Efficiency, Innovation, and Job Creation in California" by David Roland-Holst, UC Berkeley, 2008. (http://tinyurl.com/6gujnf)

A complete list of California's specific plans for energy savings can be found here: http://tinyurl.com/96tpkn

More information on utility decoupling to promote energy efficiency by the Progressive States Network, 2007 (http://tinyurl.com/bv2wxx)