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LP [Local governments around the globe are coming up with some of the most innovative ways to cut energy use. There are lessons here for places of all sizes.]

Ann Arbor, Mich., and Beijing, China, have precious little in common. But the modest college town and sprawling national capital do share one trait: They're part of a world-wide movement by cities to rein in their runaway energy use.

TD Ann Arbor is replacing the bulbs in its street lamps with light-emitting diodes that use much less power. Beijing is closing or relocating cement kilns, coal mines and chemical plants dating back to the era of Chairman Mao.

Elsewhere around the world, cities are embarking on all sorts of innovative programs to try to corral the amount of energy they consume. Chicago is planting rooftop gardens to cool down its municipal buildings. New York is working with a private company to harness the power of tidal currents in the city's East River. Amsterdam is using cold lake water to help air-condition homes.

"We have the beginnings of a mass movement among municipal leaders," says Ralph Cavanagh, energy-program co-director for the Natural Resources Defense Council, an environmental group based in New York.

For cities, the motivation is twofold. All the hand-wringing over climate change has prompted more cities to do their part to contain greenhouse-**gas** emissions that most scientists believe are causing global warming. In the U.S., more than 700 mayors have signed an agreement to try to follow the Kyoto Protocol's goal of reducing greenhouse-**gas** emissions -- even though the Senate has rejected the treaty.

The other major motivation for cities: energy costs, which have more than doubled since 2000. Strapped for cash, municipalities are scrambling to save as much money on energy use as they can.

Although city governments themselves use a fraction of energy consumed in a municipality, industry experts say they play a crucial leadership role in getting others to conserve.

"If city government does not show leadership by its use of renewable energy and energy-efficiency solutions, it is hard to have credibility with its constituents in being a good steward of the environment," says John Berger, chief executive officer of Standard Renewable Energy, a Houston-based provider of solar, wind and other alternative energies.

Here's a look at the innovative programs nine cities around the world are using to keep their energy consumption -- and their skyrocketing bills -- under control.

CHICAGO

LET YOUR GARDEN GROW

About eight years ago, the Windy City began overhauling 15 million square feet of its municipal

buildings to make them use less power. On many of the buildings, city officials decided to put in a novel feature: rooftop gardens.

The first was planted atop the 11-story Chicago City Hall, a nearly century-old landmark where the temperature on the roof -- as on many other downtown buildings -- would soar to as high as 160 degrees on hot days. Gardens can keep a roof as much as 70 degrees cooler, city officials say, because all the greenery reflects heat while providing shade. Consequently, less energy is needed to keep a building cool.

The City Hall garden, completed in 2001, covers about 20,000 square feet of the roof, using more than 100 hardy species that can withstand Chicago's fierce winds and temperature extremes. The savings were felt immediately, with the annual power bill for the building falling by 11%, or almost \$10,000, city officials estimate.

Since then, the city has expanded the green-roof program dramatically. Now 4 million square feet of municipal and private rooftops either have a roof garden or are in the process of getting one, says Suzanne Malec-McKenna, Chicago's commissioner of the environment. In so doing, Ms. Malec-McKenna says, the city has made sure to use lightweight, permeable soils to keep the rooftops from becoming too overloaded. Waterproof membranes are also fitted below the garden to keep rain runoff and other water from leaking into the building.

A different kind of problem cropped up on the City Hall roof soon after it was finished. "We had a grasshopper invasion," Ms. Malec-McKenna says. "But thankfully the birds got them."

-- Jim Carlton

ANN ARBOR, MICH.

LIGHTING THE WAY

Officials in this town of 115,000 near Detroit took a close look at their \$5 million-a-year municipal electrical bill two years ago and realized they were shelling out \$1.5 million -- or roughly a third of the total -- just for street lights. Then they realized they could save substantially by simply swapping standard bulbs for a newer technology: light-emitting diodes, or LEDs.

Unlike standard lights that use heated, incandescent bulbs, LED light is cooler and is produced by a semiconductor. The bulbs last as long as 10 years, or five times longer than traditional lights, while using about half as much energy, Ann Arbor officials say.

The LED technology has been around for decades, and the lights have become common in computer indicators and traffic lights. But until about two years ago, LEDs weren't practical for street-lighting purposes because it was difficult for them to produce white light, says Govi Rao, chairman of Lighting Science Group Corp., a New York-based LED provider.

In 2005, Ann Arbor tried out one technique for making white light: blending red, green and blue beams. City officials installed some of the makeshift lights in the City Hall parking lot. "They looked like they were cobbled in somebody's garage," recalls David Konkle, energy coordinator for the city.

Then manufacturers came to the rescue, developing aesthetically pleasing white bulbs by coating blue LEDs with phosphor. City officials spent \$15,000 to install the new lights on a few streets downtown and in a residential neighborhood.

One of the few complaints was from a resident who said the new lighting no longer illuminated his home on the street; LEDs shine light directionally and are typically pointed down at the ground, unlike incandescent bulbs, which cast a glow all around. "We told him we're not in the business of lighting his home," Mr. Konkle says.

Most other people liked the new LEDs, and the city recently obtained a \$630,000 grant from the Ann Arbor Downtown Development Authority to replace all 1,046 of the street lights downtown. The city estimates that replacing the downtown street lights alone will save more than \$100,000 in reduced power costs annually as well as 294 tons of carbon-dioxide emissions -- equivalent to the carbon dioxide that about 35 homes generate annually from electricity use.

After that, Mr. Konkle says, the rest of the city's lights will be replaced as the technology develops and prices drop. City officials say they could cut their light bill by as much as \$700,000 a year by replacing all of the 7,000 or so streetlights in town.

-- Jim Carlton

PALM DESERT, CALIF.

A COMMUNITY EFFORT

In 2005, Jim Ferguson, then the mayor of this desert city, was traveling across Northern Europe to investigate the region's energy-saving programs. A host of California leaders and **utility** executives were along on the fact-finding trip, but for Mr. Ferguson the energy problem hit home particularly hard: Power bills in Palm Desert had skyrocketed to as much as \$1,000 for residents in hot summer months.

As the cruise ship made its way across the Baltic Sea, Mr. Ferguson recalls turning to some California **utility** executives and saying: "If you can save us money, then do it."

With the gauntlet laid down, two local utilities, Edison International's Southern California Edison Co. and Sempra Energy's Southern California **Gas** Co., formed a partnership with the city and a nonprofit for help. The Energy Coalition, of Irvine, Calif., helps cities and utilities work together to reduce energy consumption. Together, the partners devised a plan that would help slash Palm Desert's energy consumption by 30% by 2011 -- and achieve as much as \$40 million in annual energy savings.

The plan is one of the most audacious arrangements devised for a U.S. city, since the cuts weren't just coming from municipal operations but from the city of 50,000 as a whole. Adding to the challenge: Palm Desert is a fast-growing resort community with 30,000 homes, 22 golf courses and more than a dozen hotels -- and it's situated in one of the hottest climates in the U.S., with summertime temperatures approaching 120 degrees. That means a lot of power for a lot of air conditioners.

Under the partnership, the utilities obtained \$14 million in grants from the California Public Utilities Commission earmarked for use in Palm Desert to finance one of the nation's most aggressive incentive programs for homes and businesses to replace outmoded, energy-guzzling gizmos with energy-saving ones.

Unsurprisingly, air conditioners are one of the biggest parts of the plan. It can cost as much as \$1,200 a month for the four or so hottest months of the year to keep older models humming in a three-bedroom home. Palm Desert now gives residents rebates of up to \$1,400 per system when they buy new, energy-efficient air-conditioning setups, which can run between \$5,000 and \$9,000. Since the new air conditioners can save as much as half the power of the older ones, city officials say, they pay for themselves in four to six years. Last year, 493 new systems were installed under the program.

After one full year of the program, which began in January 2007, the city has saved 27 million kilowatt-hours of power, or 12% towards its goal, says Patrick Conlon, director of energy management for Palm Desert. The effort has removed about 3,475 tons of carbon from the air -- equivalent to the carbon dioxide that 1,531 homes generate annually from electricity use. "What we are trying to do is open up [residents'] wallets and invest in energy efficiency, and that's hard to do," Mr. Conlon says. "But everybody understands dollars, and when they get a \$1,200 **electric** bill they understand that."

-- Jim Carlton

AMSTERDAM

LOOKING TO THE LAKE

In 2001, the Zuidas section of Amsterdam, south of the central city, was seeing lots of new development. As Zuidas grew, local leaders wanted to keep emissions down and help the city -- and the Netherlands as a whole -- meet Kyoto Protocol objectives. So the Dutch capital set an ambitious target: Zuidas would have to use 40% less energy than other parts of the city.

It would be a challenge. The high-density development would have big energy demands -- particularly since about 45% of the buildings would be used for businesses.

"There were lots of companies investing, making plans," says Ronald Roelen, business manager at Nuon Warmte, the subsidiary of Amsterdam-based **utility** Nuon that's responsible for Zuidas. "Amsterdam wanted to be the center of the IT world and needs a lot of electricity; the question was, how can we avoid making huge investments into electricity?"

Nuon zeroed in on air conditioning. About 37% of the total power load in Zuidas was expected to be used for cooling computer rooms and other high-tech necessities. Using a pilot project in Stockholm as a model, Nuon decided to cut down on all that power use -- by harnessing a local man-made lake, Nieuwe Meer.

The system, which came on line in August 2006, starts by removing water from about 100 feet below the surface of the lake. At that level, the temperature is usually a chilly 41 to 45 degrees. This water is pumped away and used to cool another supply of water that is then pumped into customers' buildings. There, it radiates cool air through the pipes -- much like hot-water pipes give off heat to warm a building. The lake water, meanwhile, is returned to Nieuwe Meer.

The project, which provides air conditioning for about 700,000 people in the southern part of Zuidas, saves 200,000 euros (\$292,000) a year in electricity costs and uses just one-tenth the power of conventional cooling systems, Nuon says. The **utility** provided most of the investment for the roughly 25 million euro effort, with a subsidy of 900,000 euros from the Dutch government.

Now there are plans to expand the project to the northern part of the Zuidas area. Officials also are considering a similar project for the district Amsterdam Zuidoost Lob, in the southeastern part of the city, using water from another lake.

-- Erica Herrero-Martinez

BEIJING

OUT WITH THE OLD

As part of its action plan for hosting the Olympics, Beijing targeted deep cuts in energy consumption. And it had a string of industrial relics from the city's former planned **economy** squarely in its sights.

Cement kilns, coal mines and chemical plants dating back to the era of Chairman Mao were earmarked for relocation or closure so that Beijing could lower its energy consumption per unit of gross domestic product by more than 6% annually by 2008. (That measure represents the ratio of China's total energy use, in tons of coal equivalent to its GDP, in yuan.) Part of the motivation was simple conservation of resources. China has been gobbling up coal at an enormous rate, as the nation's recent shortages -- and resulting power outages -- show.

Pollution worries were also driving Beijing's campaign; conditions were so bad that the International Olympic Committee talked of a need for contingency plans to protect athletes' health, possibly by postponing events on smoggy days.

To achieve Beijing's goals, some big employers are getting the boot. The Beijing Coking and Chemistry Plant, built in 1959, shuttered in July 2006. Last year, Beijing Huaer Co.'s chemical plant and the Beijing Organic Chemical Plant were targeted to be moved out of town within a year of the games' beginning. Scores of coal mines will be shut, and a ban was imposed on cement kilns inside the city's fifth ring road -- about 7 miles from the city proper.

The biggest challenge lay about 11 miles west of Tiananmen Square: Shougang Group's vast steelworks. A major employer in the city, the steelworks has been a source of civic pride for decades despite its inefficiency and the smoke emitted from its chimneys. Production at the plant is being wound down for the Olympics, with annual output due to halve to 4.2 million metric tons of steel during 2008. Operations will cease in 2010 and move to a new, more-efficient facility some 137 miles away at Caofeidian in Hebei province. Part of the new plant will be ready for production in October, to make up for the shrinking capacity in Beijing.

But relocating Shougang's steelworks involves complex technical and political challenges -- not least the impact on more than 60,000 Beijing-based workers who may need to be relocated or change their jobs. How to split taxes from steel production between Beijing and Hebei is another issue.

Beijing hopes to absorb some of the displaced workers from the environmental drive into the city's booming service sector. Municipal officials also plan to salve civic pride by making Shougang's steelworks a memorial to the capital's industrial development -- including progress in energy efficiency -- by turning it into a tourist attraction once production ends.

The city's efforts are paying off. For years, Beijing had the highest energy consumption in China. But its efficiency drive -- equivalent to taking two 500-megawatt power plants offline each year -- has dropped Beijing behind Shanghai in terms of consumption.

-- David Winning and Sue Feng

LONDON

POWER CLOSER TO HOME

By 2025, London Mayor Ken Livingstone wants to cut London's carbon emissions 60% from their 1990 levels. His plan: move a quarter of the city's power supply to small, local energy sources and away from the national **electric** grid.

Producing electricity nearer the point of use means you don't have to use as much energy to deliver the power to customers, and less of the electricity bleeds away in transit. It also means that heat created as a byproduct of energy production can be used to warm customers' buildings. If plants are located far from customers, that heat cools down in transit.

The city has a number of projects in the works to achieve that goal. To develop them, the city's climate-change agency has teamed up with the U.K. unit of the French **utility** EDF to create London Energy Services Co., or London ESCO.

EDF Energy says the driving force behind the local-power venture will be combined heat-and-power plants, along with conventional **gas**-fired plants. As part of the effort, London ESCO says it is also considering investing in a large-scale wind farm, as well as a plant that combines power generation with both heating and cooling. The plant creates heat as a byproduct, as heat-and-power plants do, but also cool air -- which can be used in local air-conditioning systems.

The company estimates that projects already in the pipeline will be able to meet about 2% of London's energy needs. The first plant is expected to come on line as early as 2009.

Meanwhile, London ESCO is one of the three short-listed bidders for a project in the Elephant and Castle area of London. The proposed new plant will have up to 9 megawatts of capacity and will supply heat, cooling and electricity to about 6,500 local homes.

-- Erica Herrero-Martinez

ASPEN, COLO.

MORE-EFFICIENT FUN

Few cities have more at stake in global warming than this skiing mecca, whose main livelihood -- winter sports -- is directly threatened by forecasts of shrinking snow packs in the Rocky Mountain West.

So, in 2005, officials in the upscale town of 6,000 decided to adopt a plan called the Canary Initiative -- so named because the town sees itself as a canary in the environmental coal mine. The plan called for the city to dramatically ramp up its use of alternative energy and take other steps to reduce its greenhouse-**gas** emissions 80% by 2050.

A major part of the plan involves the Aspen Recreation Center, a three-story structure that houses swimming pools, an ice rink and other athletic facilities. Last August, Aspen launched a \$1.1 million retrofit of the center to cut its hefty power use. The two pools and a hot tub, for instance, got new covers so they don't lose heat at night and have to be reheated in the morning. The facility also was outfitted with energy-efficient climate-control units and timed electrical controls. For instance, vending machines now have sensors, so the lights turn on only if someone is in the room, says Tim Anderson, the city's recreation director.

Mr. Anderson says the city will benefit economically from the project, with the annual energy bill for the center dropping by nearly 40%, or \$130,000, from its usual \$350,000. The overhaul will also save 713,207 kilowatt-hours of power annually, or enough to supply 85 average Colorado homes for a year. As for carbon dioxide, the new designs will keep about 640 tons of the **gas** out of the air every year, about the same as 77 homes generate annually from electricity use.

-- Jim Carlton

NEW YORK

TAPPING THE WAVES

In December 2006, Mayor Michael Bloomberg announced an ambitious plan for New York: By 2030, the nation's largest city would cut its greenhouse-**gas** emissions by 30%. As part of the plan, Mr. Bloomberg called for 800 megawatts of new clean-energy generation, or enough to power about 640,000 homes. One company is working with the city to help reach that goal. Its unorthodox idea: harness the power of waves in New York's East River to generate electricity.

On June 11 of last year, Mr. Bloomberg helped flip the switch on an experimental tidal plant in the waterway. Since then, the five turbines submerged in 30 feet of water have been producing enough power to meet nearly a third of the electricity needs of a supermarket and parking garage on Roosevelt Island, between the New York boroughs of Manhattan and Queens. The turbines are equipped with three 16-foot diameter rotors, which spin like the blades of a windmill when the tidal currents rush through the East River at regular intervals every day.

The pilot project by Verdant Power Inc. has worked so well that officials of the New York-based start-up say they plan to seek a federal operating license later this year to install more underwater turbines. A total of 30 are on the drawing board; they would be capable of generating up to 1.5 megawatts of electricity, or enough to power about 800 homes.

City officials, who helped underwrite environmental studies for the project and have streamlined the permitting process, say as many as 300 turbines could eventually be installed in the East River, providing 10 megawatts of renewable power, or enough to power about 8,000 homes. That power, city officials say, could replace the equivalent of 68,000 barrels of oil a year.

But wave power isn't without its challenges. Regulatory barriers are so large, for example, that it can take years to get a permit to build one. Verdant Power wasn't able to get its turbines actually up and running until last year after spending five years seeking state and federal permits. The costs are also high: Verdant Power officials say the East River project has cost a total of about \$9 million, with the state of New York footing the bill for about a third of that.

So far, one fear of environmentalists isn't materializing: that blades of the turbines would hurt fish. In the East River project, Mr. Taylor says, the blades spin so slowly that fish just swim out of the way.

-- Jim Carlton

THANE, INDIA

FOLLOW THE SUN

A little-known suburb of India's financial center, Mumbai, is aspiring to become the face of the nation's renewable-energy efforts. Thane, like other Indian cities, depends on the power generated from the country's vast coal resources. And, like other cities, it's struggling to meet the growing demand of its population -- which usually means one to four hours of blackouts every day.

To cope with the problem, many Indian cities offer incentives such as property-tax rebates to get residents to install solar-water heaters. But Thane, an industrial city of about 1.5 million people, has been much more aggressive than other municipalities. Not only is it encouraging residents to take up solar power -- it is using the renewable energy extensively in its own buildings.

"We saw a big potential in energy conservation and the use of solar power in tackling the power shortage in the city and decided to make the most of it," says deputy city engineer (electrical) Sunil Pote.

The local administration started its solar drive in 2003 with a project at its main hospital. Facing a huge electricity bill, the administration decided to install solar water heaters at the facility, with a capacity of about 4,760 gallons a day. The \$40,500 or so investment made five years ago saves the hospital about \$23,500 a year in electricity costs and meets all of its hot-water needs. The energy saved is enough to power about 45 homes.

The success of the project and the savings it generated prompted the administration to move on to its other buildings. During the refitting drive, local officials installed a total of about 8,850 gallons a day of solar water-heater units.

Then the city decided to get residents in on the effort, as well. Beginning in May 2005, the

administration made it mandatory for builders to fit all new buildings with solar water heaters. "We wanted people to see the cost benefits of using solar energy, so we took a different approach," Mr. Pote says. "Before we made it mandatory, people were reluctant to use solar water heaters, as there was a misconception that they are expensive to install."

Meanwhile, to encourage existing buildings owners to install solar water heaters, the city began offering a 10% discount on property tax every year for adding the hardware.

Since the program began, 16,300 families in the city have connected to solar water heaters, Mr. Pote says. With those efforts, the city today saves enough electricity to power more than 5,000 homes. "This is still a small fraction," Mr. Pote adds. "If we can get at least 25% of the families to start using solar water heaters, we can reduce the city's total electricity consumption by almost 15%."

-- Gurdeep Singh

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