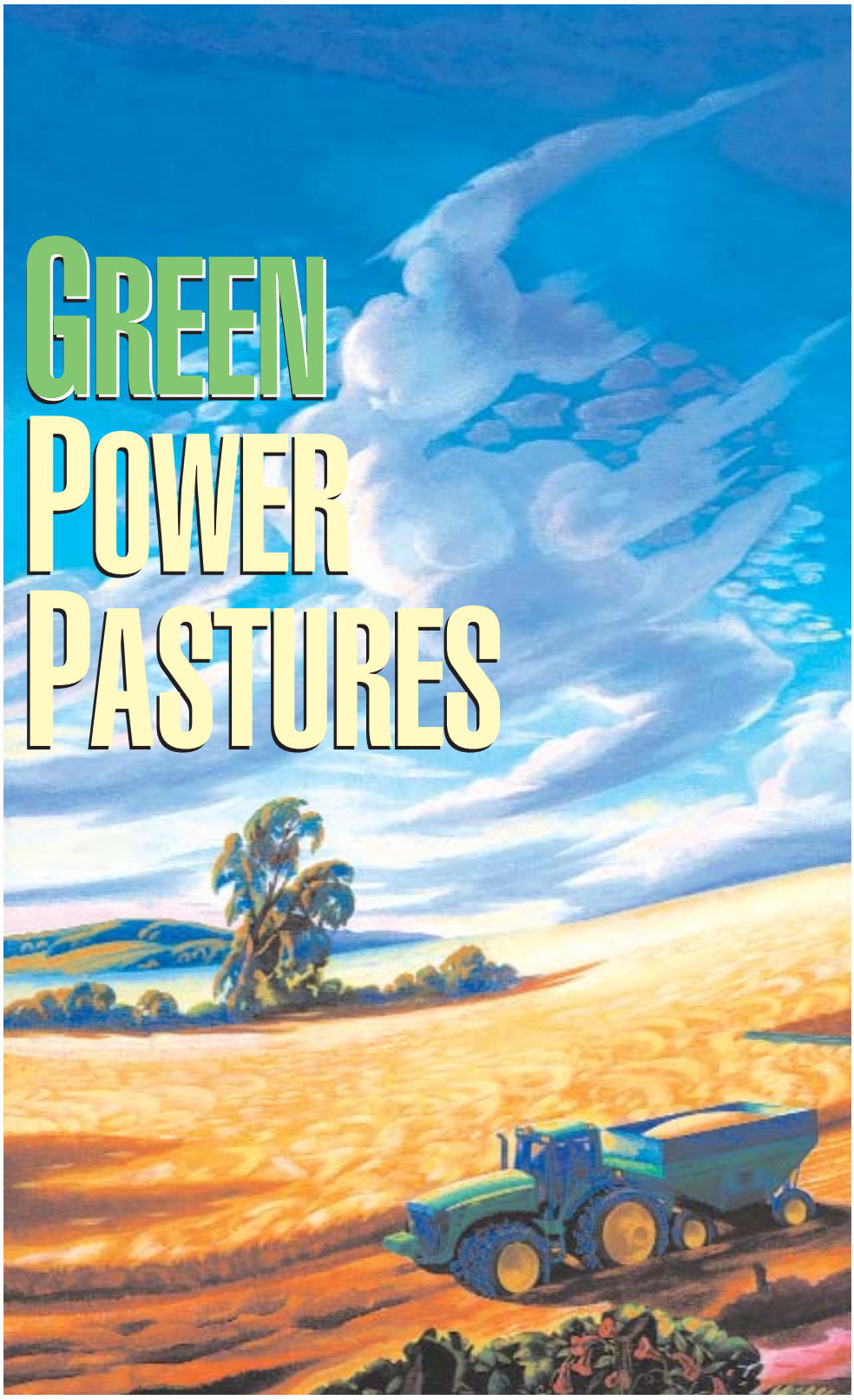
SOWING GREEN POWER PASTURES

Being closely connected to the communities they serve and committed to securing our nation's energy future, electric co-ops continue adding renewable resources to their power supply portfolios as a way to slash carbon dioxide emissions and meet growing consumer needs



By **Peter Nye**

For decades, consumer-owned electric co-ops have blazed trails when it comes to developing renewable energy. Today, more than 80 percent of the nation's 900-plus electric co-ops supply electricity produced by wind, solar, hydro, biomass (including landfill gas, livestock waste, timber byproducts, and crop residue), and other "earth-friendly" sources.

"Renewable energy makes up about

NRECA Director Don R. McQuitty, CEO of NW Electric Power Cooperative in Cameron, Mo., commissioned this painting, **Harvesting the Wind**, *by artist Bryan Haynes. Painted in the fluid style of Missouri native son Thomas Hart Benton, famous for his bucolic images, the work was presented to Springfield, Mo.-based Associated Electric Cooperative for display in the generation and transmission co-op's headquarters lobby.*

11 percent of all co-op kilowatt-hour sales—nearly three times the amount marketed by the nation's investor-owned utilities," points out Kirk Johnson, NRECA vice president of environmental policy.

This pioneering co-op investment—made for economic, environmental, and community development reasons as well as to meet strong, 4-percent average annual load growth—now has begun to pay dividends on other fronts. Nationwide, legislators—scrambling to find ways to curb emissions of carbon dioxide, a greenhouse gas blamed as the main contributor to global climate change—have focused attention on coal-fired power plants. Coal facilities, which generate roughly 50 percent of the nation's electricity, account for approximately 34 per-

cent of U.S. man-made carbon dioxide output (the largest single source) and about 40 percent of all greenhouse gas emissions from human activity.

To reduce reliance on coal, more than half of all states have enacted renewable portfolio standards (RPS) that require investor-owned utilities, competitive electric generation suppliers, and, in some cases, electric co-ops to add increasing amounts of green power to their generation mixes. Congress may also impose a sweeping RPS on the rest—an energy bill passed by the U.S. House in August included a 15 percent RPS mandate, although the measure exempted electric co-ops.

"Curbing carbon dioxide and other greenhouse gas emissions must include a mix of clean coal, nuclear, natural gas, and renewable generation sources," declares NRECA CEO Glenn English. "There is no single magic bullet. But electric co-ops, serving areas linked to resources like wind and biomass, are naturally positioned to take maximum advantage of clean power options."

Embarking on a new "green wave," two dozen co-ops in 20 states recently received a total of $270 million in Clean Renewable Energy Bonds (CREBs) from the U.S. Treasury to develop renewable energy projects involving wind, geothermal, closed-loop biomass (trees grown expressly for electricity production), open-loop biomass (sawdust, tree trimmings, farm byproducts, animal waste, landfill gas), small hydropower (less than 25 MW), and solar systems. CREBs, created in the federal Energy Policy Act of 2005, provide not-for-profit electric co-ops with a way to level the "green power financing playing field" with investor-owned utilities, which can qualify for investment tax credits to support solar energy and a 1.9 cents per kilowatt-hour production tax credit to "sprout" other renewable sources.

"These bonds act as interest-free loans, and demand for the program is strong," stresses Susan Pettit, NRECA senior principal for legislative affairs. "Electric co-ops have submitted more than $500 million in applications since CREBs were first authorized."

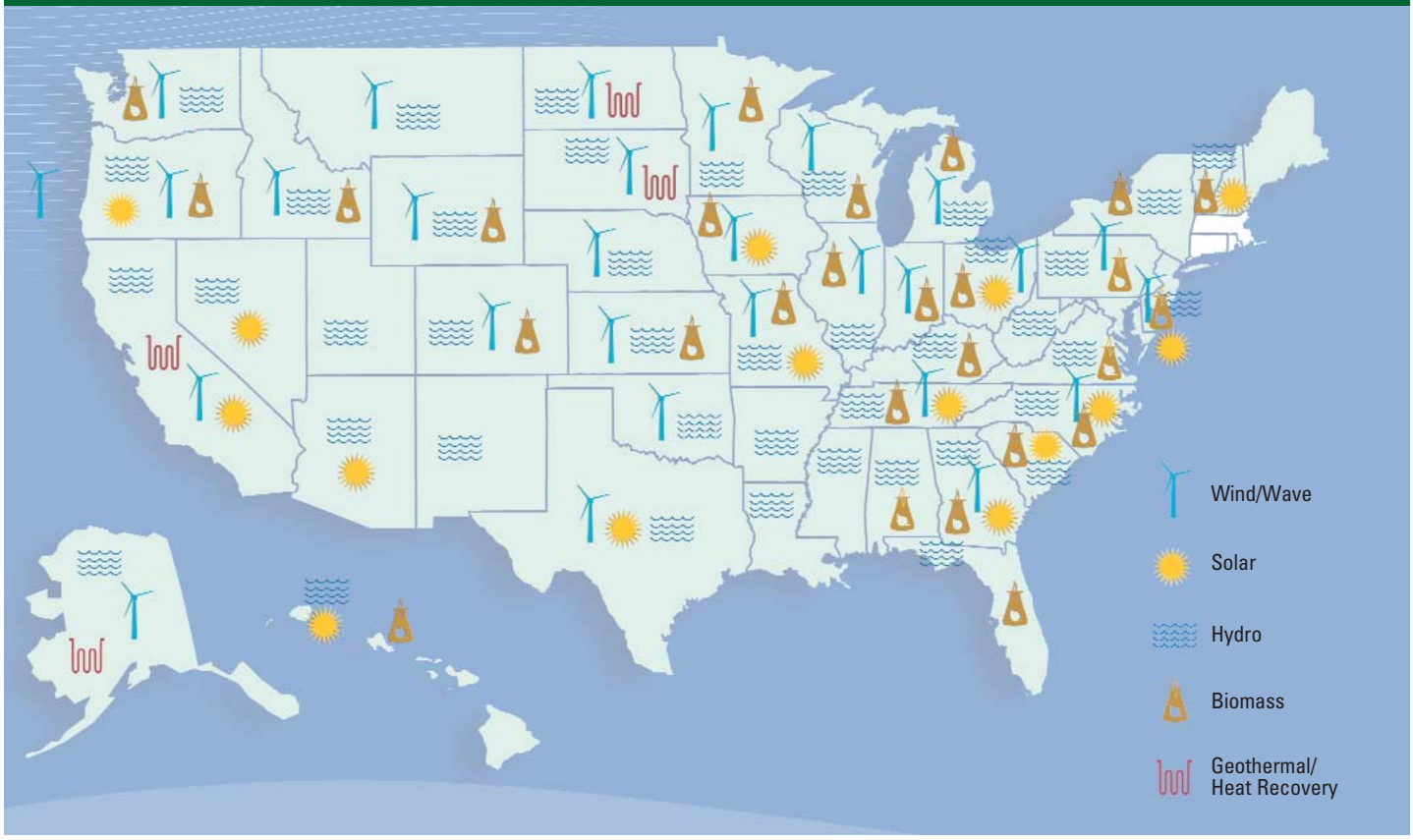
Renewables will receive an additional boost if Congress passes legislation imposing a carbon tax or creating a cap-and-trade program to lower carbon dioxide emissions, suggests Tom Key, manager of renewables with the Electric Power Research Institute (EPRI), a Palo Alto, Calif.-based non-profit consortium whose members include electric co-ops.

"Either of those actions will narrow the price difference between using renewables and coal to generate electricity," he imparts. "For example, a carbon tax of around $35 to $40 per ton would make some renewables cost-competitive with coal."

In fact, a recent U.S. Energy Information Administration (EIA) analysis of an economy-wide greenhouse gas cap-and-trade bill, S. 280, introduced by U.S. Sens. Joseph Lieberman (I-Conn.) and John McCain (R-Ariz.), found that it would push up the price of coal 129 percent by 2020 and 245 percent by 2030. In addition, it would drain about $533 billion out of the nation's economy from 2009 to 2030 while growing renewable gener-

Green Giants

(Electric co-op renewable power production, by state)



ation to between 22 percent and 29 percent of the power sector. The legislation calls for gradually shrinking U.S. greenhouse gas emissions to 2004 levels by 2012, 1990 levels by 2020, 22 percent below 1990 levels by 2030, and 60 percent below 1990 levels by 2050.

Earlier this year, EPRI released a study, *Electricity Technology in a Carbon-Constrained Future*, showing how U.S. electric utilities could reduce carbon dioxide emissions below 1990 levels within 23 years—even as they add about 40 percent more load, half of which will be generated by coal—by taking aggressive steps in seven principal areas, including vastly expanding renewable energy supplies. Leaving hydropower out of the equation, EPRI sees green power, led by wind energy, leaping from 2 percent of kilowatt-hours produced nationally today to 6.7 percent by 2030—comprising a total of 70 GW.

"While renewables by themselves are not the end-all answer to controlling carbon dioxide emissions from coal-fired power plants, they are one part of the solution," Key insists.

Blowin' in the wind

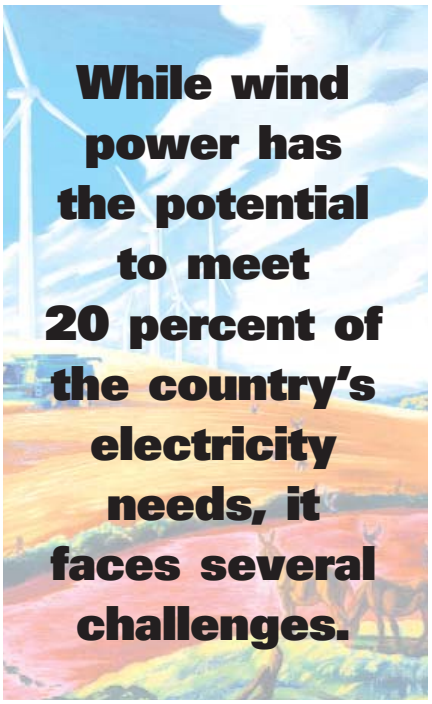
As projected by EPRI, wind power will lead the renewable parade. Currently, 150 electric co-ops either own wind turbines or buy output from wind farms, amounting to 608 MW, or about 5.2 percent, of U.S. wind generating capacity.

Not surprising, co-ops in states spanning the Upper Midwest and Great Plains—the "great American wind tunnel"—consume the most wind power: Minnesota, 209 MW; North Dakota, 138 MW; Missouri, 107 MW; Oklahoma, 74 MW; and Kansas, 50 MW. Throughout the United States, wind will kick out an estimated 31 billion kWh this year—enough to serve nearly 3 million average homes.

During the annual meeting of Kearney, Mo.-based Platte-Clay Electric Cooperative held in August, a dozen members snagged T-shirts emblazoned with vibrant-color reproductions of a new painting, *Harvesting the Wind*, depicting wind turbines lining a ridge behind a wheat field during harvest.

"The purpose of the painting is to raise awareness that we have wind energy going on the grid," explains Platte-Clay Electric CEO Mike Torres. "We hope that people seeing the T-shirts will ask about our wind power program."

Associated Electric Cooperative, a generation and transmission (G&T) co-op in Springfield, Mo., and the wholesale power



supplier to Platte-Clay Electric, agreed in 2006 to buy all of the energy (156 MW) from three wind farms under development in the northwest part of the Show Me State (see related article, page 24). The wind power will help Associated Electric's 51 member electric co-ops in Missouri, northeast Oklahoma, and southeast Iowa meet demand growth of about 2.3 percent a year, or 100 MW, equivalent to about 45,000 new homes. As a result, the U.S. Department of Energy (DOE) awarded the G&T its 2006 Wind Cooperative of the Year Award for initiative and leadership.

Alaska Village Electric Cooperative, headquartered in Anchorage, Alaska—long reliant on diesel fuel to generate electric power at its remote service locations—has installed 10 wind turbines in the villages of Selawik, 500 miles northwest of Anchorage and north of the Arctic Circle, Toksook Bay, 500 miles to the west, and Kasigluk/Nunapitchuk, 400 miles west, over the past three years. The co-op also plans to install wind turbines in Chevak and Hooper Bay, both some 500 miles west of Anchorage on the Bering Sea.

"With average diesel prices doubling since 1990 and expected to soar higher, our members consider wind turbines as one way to reduce their monthly bills," explains Amy Murphy, Alaska Village Electric public relations officer. "At the end of 2006, our average rate was 51 cents per kilowatt-hour, which is pretty high." EIA, for its part, pegs the co-op as having the highest retail electric rates in the country.

Starting late this year, Minnkota Power Cooperative, a G&T based in Grand Forks, N.D., will purchase energy from 99 MW of a 159 MW wind farm near Langdon—the biggest operation of its kind in the Peace Garden State. The wind farm, owned by FPL Energy, will produce and sell more than 350 million kWh annually to the G&T.

"We've added wind resources—now more than 10 percent of our energy requirements—in response to consumer interest and with an attractive price from FPL Energy," contends Minnkota Power President/CEO David Loer.

Corn Belt Power Cooperative, the Humboldt, Iowa-based wholesale power supplier to 11 electric co-op distribution systems in northern sections of the Hawkeye State, will purchase at least 50 MW of additional wind power on top of the 32 MW it already controls. Coupled with hydroelectric resources, Corn Belt Power's renewable energy resources will make up nearly 15 percent of its power supply portfolio.

While most experts contend that wind power—a tested and cost-effective technology—has the potential to meet 20 percent of the country's electricity needs, it faces several challenges: transporting generation from wind farms, usually located in remote rural areas, to population centers (the three Missouri wind farms proved viable, for example, only because Cameron, Mo.-headquartered NW Electric Power Cooperative, a G&T, operated transmission lines in the area); "intermittency"—the fact that wind only blows 30 percent to 40 percent of the time, and generally not during periods of peak demand on hot, humid summer weekday afternoons; and the need for advancements in battery technology so electricity from wind farms can be stored, making it a reliable form of baseload generation.

"Wind is unreliable," cautions Floyd Robb, vice president of communications & marketing support for Basin Electric Power Cooperative, a G&T based in Bismarck, N.D. "When a heat wave hit our system in July 2006, our wind turbines were producing about 6 megawatts, even though our peak demand was 1,947 megawatts."

Basin Electric Power, serving 120 electric co-ops and about 2.5 million consumers in nine states, draws 136 MW of wind energy from purchase power agreements with two commercial wind farms in North and South

Dakota and two small projects jointly owned with sister G&Ts Central Power Electric Cooperative in Minot, N.D., and East River Electric Power Cooperative in Madison, S.D. It has also set a goal of voluntarily meeting at least 10 percent of its peak demand requirements from clean and renewable energy sources by 2010.

"We're near that number now, but as we add new generating resources, the 10 percent goal keeps moving," remarks Robb. "Our board has authorized us to build up to 300 megawatts of additional wind capacity."

Bob Gibson, senior program manager for NRECA's Cooperative Research Network (CRN), notes that the Great Plains typically see winds blow in winter during off-peak, early-morning hours. "And if the wind blows too hard, turbines have to shut down for safety."

However, electronics and software can aid grid operators handling sudden drop-offs when turbine blades slow or stop. CRN recently tested very fast transmission optimization software at East Kentucky Power Cooperative, a G&T headquartered in Winchester, Ky.

Dale Bradshaw, a CRN expert on power generation and transmission, holds that the software can evaluate the entire Eastern Interconnection of the United States in a half-second for potential transmission contingencies. Within 40 seconds, a transmission operator can collect all of the data needed to optimize performance—a major advantage in a job where critical decisions often must be made within five to 10 minutes of discovering a problem.

"The software monitors lines and equipment for thermal constraints, voltage constraints, and voltage instabilities that create transmission congestion and bottlenecks or lead to outages," Bradshaw mentions.

Underground power

According to the Massachusetts Institute of Technology, the United States possesses 100,000 MW of "enhanced geothermal capacity" that could be developed by 2050.

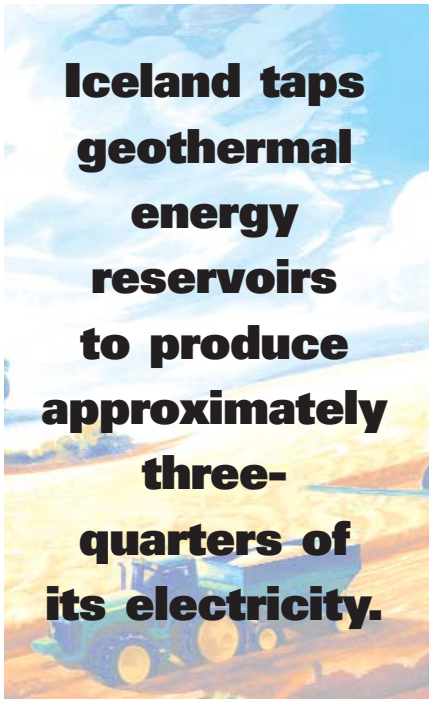
One Last Frontier State electric co-op moving toward a geothermal option, Naknek Electric Association in Naknek, located along Bristol Bay in southwest Alaska, has seen electric rates for its headquarters town of 1,000 climb toward 34.5 cents per kilowatt-hour. But that's a bargain. Twenty-five miles to the south, the 350 residents of Egegik served by the co-op pay close to 70 cents per kilowatt-hour.

Prices are sky high because both communities—like those served by Alaska Village Electric—burn diesel fuel to generate power. It's an unsustainable situation, according to Donna Vukich, Naknek Electric general manager, who feels electricity costs are crippling the Bristol Bay salmon fishery, the area's economic engine.

"Bristol Bay hosts the world's largest run of sockeye salmon—40 million to 50 million annually," she says. "But since 1997, when a summer heat wave left rivers shallow and warmed the water, millions of salmon have sought refuge deep in the Pacific Ocean. As a result, the whole region has gone into an economic spiral. People have moved away. Our school population declined from 350 kids in 1997 to 165 today."

Vukich, whose husband works as a fisherman, and the Naknek Electric board have outlined an ambitious plan to reduce retail electricity prices "by at least 70 percent" in Naknek, South Naknek, King Salmon, Egegik, 21 other villages, as well as Dillingham, the other "big town" on the bay. They propose replacing dozens of isolated diesel generators with central station geothermal power.

"We considered other renewables such as wind and hydropower," she recounts. "Wind's drawback, of course, is that it's not steady enough for baseload, and we ruled out hydro because we weren't going to mess with the tidal flow for the fish."



Before embarking on the project, Vukich toured geothermal generation plants in Nevada and California—including the world's largest complex, the 850-MW The Geysers in the Mayacamas Mountains, about 70 miles north of San Francisco—while two staffers visited Iceland to research how that island nation incorporates geothermal energy to produce approximately three-quarters of its electricity. The co-op then drilled three shallow geothermal test holes last winter near Naknek.

Seismic tests on two that "showed fairly good numbers" were set for completion this month. The next step, Vukich emphasizes, will be choosing a site with good road access and drilling deeper holes, 8,000 to 12,000 feet, to tap the geothermal reservoir. To stay on schedule, drilling rigs had to be brought up the Naknek River by the end of last month, when the ice season started.

Construction of a 25-MW geothermal power plant, 425 miles of transmission line, and 17 or 18 substations will begin next winter, with a 2009–10 completion date. The first phase will serve Naknek, Dillingham, and four or five villages.

How to cover the project's estimated price tag of $200 million? "We're looking at various avenues of financing, including Alaska state funding and federal Rural Utilities Service loans," Vukich remarks.

All of the utility planning took place with the fishery in mind. Cheaper electricity will allow canneries in Naknek to expand and add at least two more species—herring and halibut—while extending the canning season from two months to four.

Plumas-Sierra Rural Electric Cooperative in Portola, Calif., taps into geothermal power as an associate member of the Northern California Power Agency (NCPA) in Roseville. NCPA operates a pair of 110-MW-capacity power plants at The Geysers.

"In 2006, approximately 5 percent of our power mix came from geothermal energy," states Jessica Nelson, Plumas-Sierra REC manager of energy services. "We also have received approval for $31 million in CREBs to build our own wind farm."

Light bright

Every hour, enough sunlight reaches the planet to meet global energy needs for a year, according to the DOE. EPRI's Key believes that over

the coming century, solar will probably become the world's main renewable energy source.

"The trick to date has been capturing tiny packets of solar energy, called photons, to create electricity," he explains. "They have to be captured at a lower cost. Solar generation now costs about 30 cents per kilowatt-hour—four times more than wind and 15 times more than nuclear or coal."

Solar photovoltaic (PV) technology—designed for home or single-building use and familiar as distributed power sources for remote sites like irrigation pumps, telecommunications towers, and highway warning signs—has been around for decades. However, high equipment costs (a basic 4-kW PV system costs about $34,000) and several-decades payback have hindered deployment in the United States.

"PV passed the 1,000-megawatts-installed-capacity milestone only in 1999, although the amount has grown fivefold since then," says NRECA's Johnson. "Surging sales—led by California and New Jersey, the largest solar markets—have slashed PV prices about 40 percent over that time. Many G&Ts and local distribution co-ops purchase excess power generated by household PV systems owned by consumers of member co-ops."

For baseload power purposes, concentrating solar power (CSP) facilities hold promise. Shiny long parabolic troughs concentrate the sun's rays on receiver tubes; synthetic oil in the system gets pumped through heat exchangers to create steam that turns a turbine-generator. A 64-MW CSP plant with 760 parabolic concentrators spread over 350 acres went into operation in June near Boulder City, Nev.

Westminster, Colo.-based Tri-State Generation and Transmission Association, in conjunction with EPRI, national energy labs, and other utilities, has begun looking into the feasibility of constructing a CSP plant in New Mexico that will produce anywhere from 50 MW to 500 MW.

"This technology holds potential," asserts Tri-State G&T Communications Manager Jim Van Someren. "There are only four CSP plants currently in operation, one in Nevada and three in California. We expect the study to conclude by the end of the year when we will determine whether or not to move to the design and permitting phase."

Tri-State G&T also sells more than 7,500 MWh of green power a year from wind, biomass (methane digesters), and small hydro projects to its 44 distribution systems in Colorado, New Mexico, Nebraska, and Wyoming.

"We announced this summer that by the end of the year, we will put out a request for proposals for 50 megawatts of renewable power," Van Someren continues. "Part of this is in response to RPS legislation passed this year in both Colorado and New Mexico."

In another potential role for solar, CRN has released a report, *Solar Options to Enhance Combustion Turbines*, that evaluates the viability of cooling natural gas-fired peaking facilities using solar troughs.

"More than 140 co-ops around the country provide summertime peaking power using simple-cycle gas-turbine plants and could take advantage of renewable resources to cool them," cites CRN Executive Director Ed Torrero. "As temperatures go up, combustion turbines lose efficiency, causing reduced output and challenging the utility. A solar cooling system that combines parabolic troughs with absorption chilling could improve turbine capability and count toward a co-op's RPS share."

Meanwhile, three electric co-ops—Sulphur Springs Valley Electric Cooperative in Willcox, Ariz., Kaua'i Island Utility Cooperative in Lihue, Hawaii, and Kit Carson Electric Cooperative in Taos, N.M.—have received CREB funding for various-sized solar ventures.

Back to nature

Tapping into organic sources of electricity like crops, trees, animal waste, and garbage, G&Ts and distribution co-ops across the nation buy power from thousands of small-scale "biomass" systems operated by co-op (and occasionally non-co-op) consumers. Among the top biomass producers in co-op service territories are timber-products firms that burn sawdust, wood chips, and other waste in boilers, or large livestock operations that employ anaerobic digesters to harness methane gas from decomposing manure to spin turbine-generators.

"G&Ts and local co-ops often work with owners of these projects on issues related to system safety and interconnection and even design," says Johnson.

Some alternative energy projects using animal waste even reach baseload generation levels. Green Power Electric Membership Corporation, a partnership of 36 Georgia electric co-ops, has entered into a 15-year agreement to purchase 20 MW—enough to meet the needs of more than 15,000 homes—from the Peach State's first poultry litter-burning power plant, constructed by Earth Resources, Inc., near Carnesville, Ga., about 70 miles northeast of Atlanta.

"This adds another environmentally friendly source of energy to our stable that includes 5 megawatts of landfill gas from two facilities, 2.3 megawatts of low-impact hydro, and small PV projects at more than a dozen middle and high schools," points out Michael Whiteside, Green Power EMC president/CEO. "Since Green Power EMC was launched in October 2003, we've generated more than 100 million kilowatt-hours of renewable power."

In scattered cases, G&Ts even use farm byproducts as supplemental fuel for coal-fired power plants. Generally, such items are much more expensive than coal because of their low energy output and the additional labor required to collect, load, and transport the feedstock.

Central Electric Power Cooperative in Jefferson City, Mo., one of six G&Ts that owns Associated Electric and which supplies wholesale power to eight distribution co-ops over 22,000 square miles, last year tried burning corncobs at its 72-MW Chamois Power

Plant in Chamois, Mo. A mixture of 98 percent coal and 2 percent cobs was tested.

The actual test, however, proved disappointing because the cobs were mixed with husks, stalks, and leaves (30 percent to 40 percent of the total mass). The fodder lowered the Btu value of the cobs and didn't combust well in the plant's boilers.

"The cobs should have been around 16 percent to 20 percent moisture," indicates Tim Backes, Central Electric Power Chamois plant superintendent. "The stalks and leaves added moisture, so we couldn't prep the fuel right. We planned to burn 100 tons, but had to stop at 11 tons."

In the past, Backes has also experimented with burning sawdust, railroad ties, and even 3,400 tons of walnut shells acquired after a tornado tore the roof off a shed in southwestern Missouri where they were being stored.

"Walnut shells work real well," Backes relates. "They burn at 7,800 Btu per pound, which compares favorably with 8,800 Btu from the Powder River Basin coal we purchase. But the shells are too expensive to use on a regular basis. We pay around $25 a ton for coal, while walnut shells normally cost $300 per ton."

Household refuse also plays a power supply role for many co-ops. East Kentucky Power offers 15 MW of landfill-gas electricity to 14 member distribution systems packaged under the brand "EnviroWatts: Earth-Friendly Alternatives."

"Trash from five landfills provides the methane gas necessary to produce electricity for about 9,000 homes," reports Meredith Boyd, EnviroWatts marketing representative. "Considering that landfill gas usually escapes into the air, the process of using it to make electricity eliminates 29,881 tons of methane a year and reduces carbon dioxide emissions by 88,235 tons, the equivalent of planting 178,934 acres of trees, offsetting the use of 3,210 railcars of coal, or averting the electricity use from 1,173,335 incandescent lightbulbs."

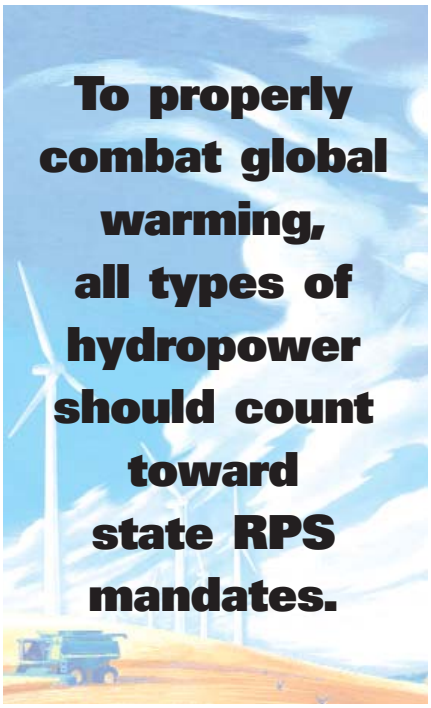
EnviroWatts sells 100-kWh blocks through participating distribution co-ops, which sign up residential consumers and commercial and industrial accounts. Each block costs $2.75 a month for a one-year commitment.

In similar fashion, consumer-members in Alabama and the Florida panhandle can purchase 100-kWh blocks of landfill-methane power for $2 each through their local electric co-op. The offering comes courtesy of a partnership between Andalusia, Ala.-based G&T Alabama Electric Cooperative and Waste Management, Inc., which operates a regional landfill near Campbelton on the Florida-Alabama border. The 4.8-MW generating plant at the landfill can power about 4,000 homes.

In Indiana—where renewable sources will provide 10 percent of the electricity used in government buildings by 2010—power will be supplied by Indianapolis-based Wabash Valley Power Association landfill-gas plants. Since 1999, Wabash Valley Power, a G&T, has steadily increased its renewable capacity through a deal with Waste Management. The wholesale power supplier to 28 electric distribution co-ops in Indiana, Illinois, Michigan, Missouri, and Ohio now owns eight landfill gas plants capable of generating 3.2 MW each, with two more under construction.

Washington Electric Cooperative in East Montpelier, Vt., produces power from the Green Mountain State's largest landfill, in Coventry, a village about 80 miles north and near the Canadian border.

"Vermont presently does not have an RPS, but mandatory renewable percentages for utilities may kick in after 2012," says Washington Electric General Manager Avram Patt. "The Coventry plant would more than meet our RPS requirement if and when we have one. We are presently selling renewable energy certificates to a company in Massachusetts that can utilize them to meet that state's RPS requirement."



Patt adds that Washington Electric built the landfill facility "because studies showed it would be better than buying energy on the open market, just based on production costs alone." CREB financing allowed the 10,000-member co-op to boost capacity at the landfill plant earlier this year to 6.4 MW, more than half of the amount needed to meet non-peak demand.

And co-op coal-fired power plants are helping produce alternative fuels, too. Sunflower Electric Power Corporation, a G&T headquartered in Hays, Kan., has begun developing an integrated bioenergy center at its 360-MW Holcomb Station site. Spokesman Steve Miller notes that the bioenergy center will include ethanol and biodiesel plants, anaerobic digester, dairy farm, and an algae reactor.

"A subsystem will utilize carbon dioxide from flue gas emissions to grow algae for use as an oil suitable for refinement into biodiesel, starch for the ethanol plant, or dried for dairy cattle feed," he says. "Scientists are currently testing various algae to determine which strain will be most effective in the bioenergy center."

Water world

Among renewable energy sources, hydropower boasts the lowest cost and greatest reliability. About 8 percent of all electric co-op power requirements are met through hydro generation—mostly from large state- and federally operated facilities. The country's four federal power marketing administrations, for example, ship hydropower to rural electric systems in 33 states, with rates paid by co-ops and public power entities covering all costs.

"Hydro is a mature technology that produces no greenhouse gas or carbon emissions," observes Ted Case, NRECA senior director of legislative affairs. "However, most RPS laws do not count electricity generated by large hydropower plants as a renewable resource. To properly combat global warming, electric co-ops believe all types of hydropower should be factored in."

Small hydro (under 25 MW), though, usually fits the RPS bill. One such co-op facility—the 21-MW, two-unit, run-of-river Raystown Hydroelectric Project, William F.

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