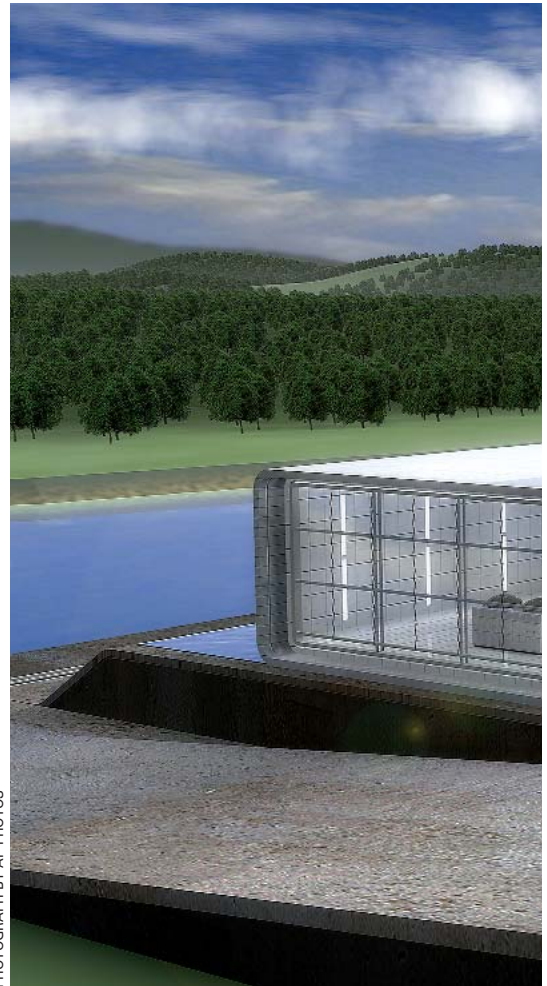


COMING FULL CIRCLE ON CARBON

By **Peter Nye**

Electric co-ops are already showing the world how to capture carbon dioxide emissions produced by burning fossil fuels and then returning the gas to where it came from—deep underground. Success in applying this technology to coal-fired power plants could very well determine if electric utilities can “keep the lights on” in coming years.



PHOTOGRAPH BY AP PHOTOS

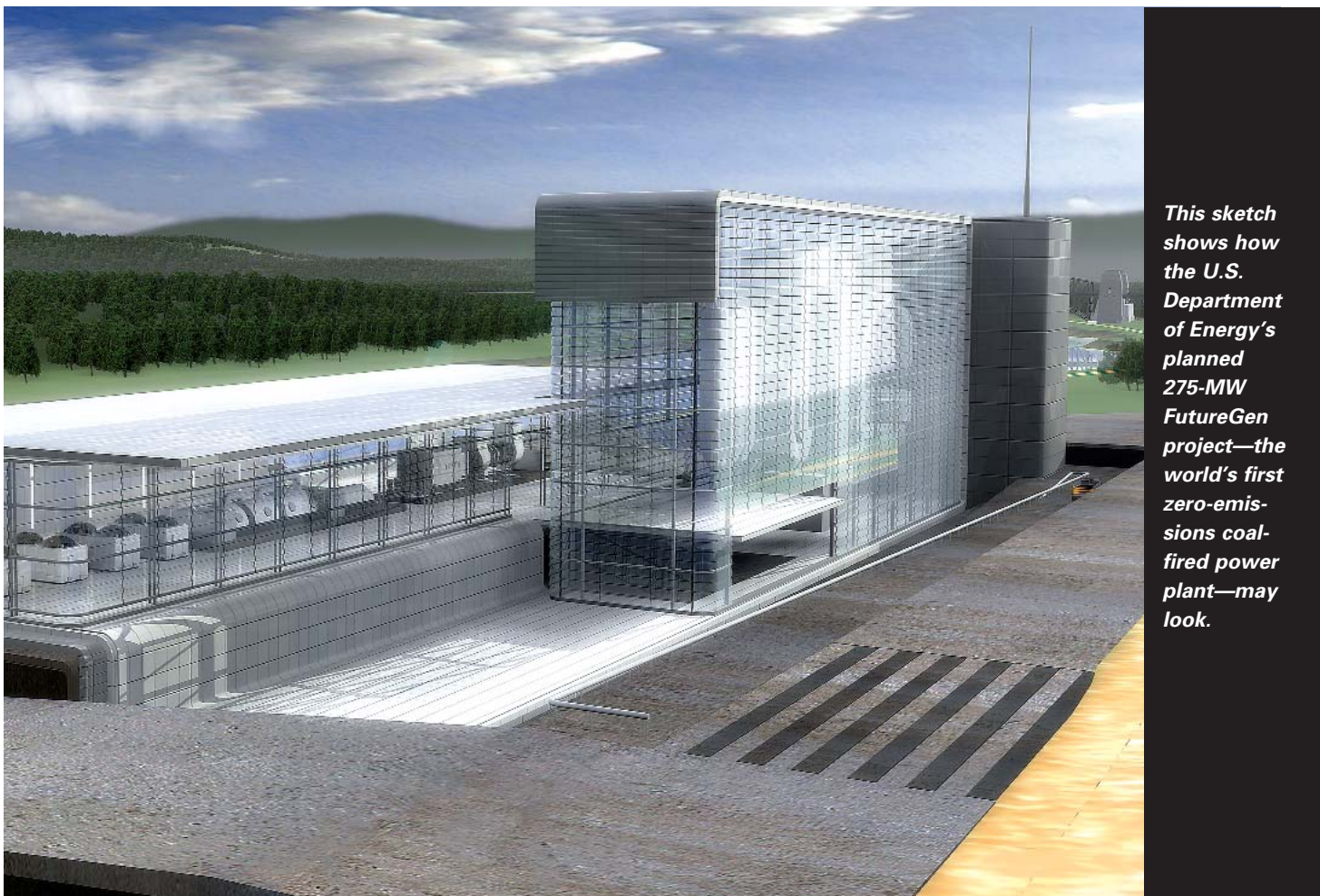


Since 2000, the Great Plains Synfuels Plant near Beulah, N.D., has shipped 8,700 tons of compressed carbon dioxide daily via a 205-mile-long pipeline buried four

feet underground to oil fields in Weyburn, Saskatchewan. There, two oil companies inject the colorless, odorless gas several thousand feet down into depleted wells to bring more crude to the surface. In turn, the carbon dioxide gets entombed permanently.

“Technicians say that carbon dioxide improves viscosity—it acts sort of like a solvent so that more crude oil can be recovered,” explains Daryl Hill, media relations supervisor for the synfuels plant’s owner, Basin Electric Power Cooperative, a Bismarck, N.D.-based generation and transmission (G&T) co-op that supplies wholesale power to 125 member co-ops in nine states. “We’re told that the carbon dioxide injections boost oil production 60 percent and will increase life of those oil fields by 25 to 30 years.”

To date, more than 10 million tons of



This sketch shows how the U.S. Department of Energy's planned 275-MW FutureGen project—the world's first zero-emissions coal-fired power plant—may look.

carbon dioxide from the co-op-owned facility, which turns coal into synthetic natural gas, have been captured and removed.

“As the only coal-based commercial-scale plant in the world that sends carbon dioxide through pipelines for storage underground, our synfuels plant has drawn global media,” Hill adds. “We have been visited by reporters from the BBC in London, FOX News, Tokyo Broadcasting, Canada’s edition of *National Geographic*, National Public Radio, The History Channel’s *Modern Marvels* program, and even the Natural Resources Defense Council. It appears we are operating the largest carbon dioxide sequestration project in the world.”

Keeping coal viable

Coal-fired power plants, which generate roughly 50 percent of the nation’s electricity, produce more than 2 billion tons of carbon dioxide a year—approximately 34 percent of all U.S. man-made carbon dioxide output (the largest single source)—and about 40 percent of all greenhouse gas emissions from human activ-

ity. Overall, coal accounts for 80 percent of the power generated by G&Ts and 62 percent of all electric co-op power requirements.

As electric utilities with coal-burning power stations scramble for ways to meet electricity demand while curbing emissions of greenhouse gases, primarily carbon dioxide, blamed for contributing to global climate change, one solution has come to the forefront: separating carbon dioxide that normally goes up a smokestack, compressing it, pumping it down into spent oil and natural gas wells, saline reservoirs, or inaccessible coal seams, and keeping it there forever—a process called carbon capture and storage (CCS). In the study *Electricity Technology in a Carbon-Constrained Future*, released earlier this year, the Electric Power Research Institute (EPRI), a non-profit utility-sponsored consortium based in Palo Alto, Calif., whose members include electric co-ops, spelled out how electric utilities could play a role in helping the United States’ energy industry slash 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. The biggest cuts, EPRI noted, would come from adding CCS technologies to new coal-fired power plants coming on-line after 2020.

“Much study still needs to be done on CCS,” concedes George Offen, EPRI senior technical executive. He confirms that only three plants currently remove carbon dioxide from gas production and store it underground—Sleipner West Field in Norway’s North Sea, In Salah Gas Carbon Dioxide Storage Project in central Algeria, and the Great Plains Synfuels Plant. But the Great Plains facility remains the only one where the process begins with coal.

Although technology to take carbon dioxide from flue gas in coal-burning power plants exists, “it’s just not ready for prime time,” asserts Ed Torrero, executive director of NRECA’s Cooperative Research Network (CRN). “The big worry for utilities is that if advancements in this field are slow to take root, the price of electricity from a generating station employing CCS as we know it today could easily double.”

A recent Massachusetts Institute of Technology study, *The Future of Coal: Options for a Carbon-Constrained World*, echoes Torrero's thoughts, noting that "carbon dioxide capture and sequestration is the critical enabling technology to reduce carbon dioxide emissions significantly while also allowing coal to meet the world's pressing energy needs."

"The MIT authors found that worldwide coal use will increase under any foreseeable scenario because it remains cheap and abundant, particularly in countries with growing economies like China and India," mentions Kirk Johnson, NRECA vice president of environmental policy. "The study emphasizes that coal can provide energy at a cost of \$1 to

\$2 per million Btu versus \$6 to \$12 per million Btu for oil and natural gas. It also assumes a global carbon price, or tax, of at least \$25 per ton because that's where CCS becomes economic."

Independent of whatever government policies are adopted to control carbon dioxide emissions, the MIT researchers advocate as a "priority objective" five large-scale projects that demonstrate the technical, economic, and environmental performance of technologies for capturing, transporting, and storing carbon dioxide. "The MIT report clearly shows that we need a crash program to make CCS economically and technically feasible to address climate change," Johnson stresses.

In late October, the InterAcademy Council, an international panel of 15 researchers representing 13 national academies of sci-

ence, cautioned that governments and the private sector are spending too little on CCS development. Worldwide investment in all types of energy research and development, estimated at \$9 billion, should be at least doubled, the group suggested.

On the vanguard

As they have with energy efficiency programs and renewable energy growth, electric co-ops are taking the lead in testing and deploying CCS technology. Basin Electric Power recently began seeking proposals from developers to launch a CCS demonstration project at its 900-MW coal-fired Antelope Valley Station, which sits next door to the Great Plains Syn-fuels Plant. The G&T expects to make a decision on partners shortly.

The War on Coal Hits Home

Across the nation, environmental and allied groups are waging an aggressive public relations and legal campaign to essentially "rid the world of coal-fired plants." And no segment of the utility industry has been impacted more by these efforts than electric co-ops.

In July, a federal lawsuit was filed to stop the Rural Utilities Service from financing at least seven co-op power plants that will consume coal, charging the agency with fostering "large-scale federal investment in new coal-fired power plants that will substantially increase emissions of greenhouse gases responsible for global warming." One of the loans, for \$650 million, would fund 80 percent of the 250-MW Highwood Generating Station planned by Southern Montana Electric Generation & Transmission Cooperative, a generation and transmission (G&T) co-op based in Billings, Mont. Applications for the other six disputed generating facilities could top \$5.1 billion total.

Florida, meanwhile, has seen five planned power plants—which would have generated 4,642 MW of electricity, enough power for nearly 3 million homes—scrapped in the wake of Republican Gov. Charlie Crist's crusade against coal. Two were rejected at the final step by state regulators—one of them being a 750-MW third unit planned by Seminole Electric Cooperative, a Tampa-headquartered G&T, for its 1,300-MW Seminole Generating Station, located along the St. Johns River, 50 miles south of Jacksonville. The \$2 billion new generator, scheduled to go on-line in May 2012, would employ "super critical" boiler technology that produces more megawatts from less coal, reducing carbon dioxide output.

"We are appealing the decision," says Seminole Electric Director of Projects Jim Frauen. "We met every aspect of the approval process and believe this new unit balances the critical need for additional reliable, affordable capacity with the need to safeguard the environment."

To smooth the way for project approval, Frauen relates that the G&T entered into a settlement with the Sierra Club.

"In return for them not opposing our state certification, we agreed to further lower annual emissions from all

three units [the expanded facility in total would emit less sulfur dioxide, nitrogen oxides, mercury, and sulfuric acid than the two existing units do now], continue to pursue renewable energy and carbon dioxide-reducing efforts, and purchase approximately \$200,000 worth of high-efficiency

compact fluorescent lightbulbs that our member co-ops can allocate to their consumers," he points out. "The denial of the state license was particularly disappointing because in addition to resolving all issues of concern with the Sierra Club, we also had entered into stipulations with the Florida Department of Environmental Protection and other state environmental and wildlife agencies, which concurred that all applicable standards and regulations had been satisfied."

To the west, environmental officials in Kansas—pressured by attorneys general in eight states, including California and New York, and bolstered by Democratic Gov. Kathleen Sebelius and Lt. Gov. Mark Parkinson—in October denied an air-quality permit to Sunflower Electric Power Corporation, a Hays, Kan.-based G&T, to begin construction on two 700-MW coal-burning generating units at its 360-MW Holcomb Station, located four miles south of the town of Holcomb. Tri-State Generation & Transmission Association, a G&T based in Westminster, Colo., had joined as a partner on the \$3.6 billion Holcomb Station expansion.

"I believe it would be irresponsible to ignore emerging



PHOTOGRAPH BY AP PHOTOS

Arizona Electric Power Cooperative (AEP/CO), a G&T based in Benson, Ariz., that supplies wholesale power to six distribution co-ops in the Southwest, will participate with three other Grand Canyon State utilities in the \$4 million Arizona Utilities Carbon Dioxide Storage Pilot Project sponsored by the West Coast Regional Carbon Sequestration Partnership—one of seven U.S. Department of Energy (DOE) large-scale carbon storage initiatives. The program will test carbon dioxide storage in geologic formations in 2008 and 2009, with DOE picking up 80 percent of the costs.

“This project will look only at sequestration,” remarks AEP/CO Manager of Regulatory Affairs Jim Andrew. “Plans call for drilling a well 4,500 feet down into a saline reservoir in northeastern Arizona’s Colorado Plateau

Province, injecting 2,000 tons of commercial-grade liquid carbon dioxide that’s being trucked in, and monitoring it for re-emission or leaks. It will also gauge public acceptance.”

According to the U.S. Environmental Protection Agency (EPA), Arizona power plants emitted 54 million tons of carbon dioxide in 2003. A state geological survey indicates that abandoned oil and gas fields and deep saline reservoirs could store more than 3 billion tons of carbon dioxide.

“If successful, the work may expand to evaluate the feasibility of carbon capture at the nearby Cholla Power Plant,” Andrew notes. Investor-owned utilities APS and Pacifi-Corp own the 995-MW, four-unit coal-fired facility.

CRN, for its part, may join a DOE sequestration endeavor near Gaylord, Mich.,

where 10,000 tons of carbon dioxide derived from a natural gas processing plant will be injected into deep saline formations. The carbon dioxide would be captured by an amine scrubber; a derivative of amine scrubbing technology holds promise for post-combustion carbon capture at power plants. The Michigan site features most elements of a complete sequestration system—a compression plant, an 8-mile-long supercritical pipeline, and injection and monitoring wells.

“Carbon sequestration is very expensive,” says Tom Lovas, CRN senior program manager. “With DOE partnership, CRN gains a unique opportunity that we might otherwise not have.”

CRN also continues to follow progress being made on DOE’s \$1.5 billion FutureGen



Nationwide, 24 coal-fired power plants totaling at least 20,000 MW have been scrapped in recent months, and more than three dozen have been delayed due to global warming jitters and rising construction costs.

information about the contribution of carbon dioxide and other greenhouse gases to climate change and the potential harm to our environment and health if we do nothing,” said Kansas Department of Health & Environment Secretary Roderick Bremby. The move marked

On another front, New York Attorney General Andrew Cuomo (D)—in addition to helping derail Holcomb Station—has begun investigating five major energy companies to determine if their proposals to develop coal-fired power plants present an undisclosed financial risk to investors. Cuomo has used the Martin Act—a state securities law created to investigate corruption on Wall Street—in sending subpoenas to AES Corporation, Dominion Resources, Dynegy, Peabody Energy Corporation, and Xcel Energy. In accompanying letters, Cuomo suggests that the firms could take a financial hit if federal lawmakers tighten controls on coal plants.

Overall, 24 coal-fired power plants nationwide totaling at least 20,000 MW have been scrapped since January, and more than three dozen representing 32,000 MW, have been delayed due to global warming jitters and rising construction costs. Of 151 new coal plants announced since 2002, only 15, generating 3,700 MW, have been built. However, 22 others, comprising 12,000 MW, are currently underway. G&Ts have full or partial ownership in six of them, for 1,074 MW.

Misguided legal schemes against coal don’t make economic sense, insists NRECA CEO Glenn English. “Coal is the one indigenous form of energy we have in abundance, and we just have to find ways to burn it cleaner—but not outlaw it.”

He concludes, “Electric co-ops support new generation capacity with technology that’s available, and improving existing equipment and facilities as cost-effective options present themselves. We have an obligation to serve. If we don’t continue to build coal-fired and nuclear baseload generation, where will the electrons needed to meet a projected 40 percent increase in electricity demand by 2030 come from? Clearly, renewables and energy efficiency can’t do it all. The only other generation option is natural gas, and we’ve seen prices for that commodity triple over the past five years while pipeline capacity remains inadequate to handle greater use. The unfortunate end result from all of this could be increasing our dependency on foreign sources of energy, such as liquefied natural gas, and enormous increases in electric bills.”

—Perry Stambaugh

the first time a government body had denied an air-quality permit specifically because of concerns about carbon dioxide.

The Sunflower Electric Power project also involves plans to create a roughly \$400 million self-sustaining, carbon-neutral, integrated bioenergy center. The center—slated to include ethanol and biodiesel plants, a dairy farm, and a cow manure-fueled anaerobic digester designed to produce methane gas to operate the ethanol plant—features a reactor that grows algae in coal flue gas. The “crop” would then be refined into biofuel, dried for cattle feed and fertilizer, and harvested as feedstock for the ethanol plant.

“The bioenergy center will eventually employ 161,” reports Clare Gustin, the G&T’s vice president for member services & external affairs. “While power sale revenues from the bigger plant were expected to finance our investment, we intend to continue vigorous development and secure other partners.” Sunflower Electric Power supplies wholesale generation to six electric co-ops and 400,000 consumers in western Kansas. The G&T plans to fight Bremby’s “arbitrary and capricious” decision.

■ CLOSING THE
REALITY GAP ON
CLIMATE CHANGE

project—the world’s first zero-emissions coal-fired power plant. The prototype 275-MW FutureGen facility, which will be sited in Illinois or Texas, will couple CCS with Integrated Gasification Combined Cycle (IGCC) operation. IGCC, by turning coal into a syngas stripped of sulfur compounds, creates a more pure stream of carbon dioxide that makes carbon capture easier.

“While IGCC is interesting, it’s not ready for widespread utility operations, either,” cautions Torrero. “IGCC plants don’t have a strong track record on reliability unless they add an additional gasifier chain at a cost of at least 20 percent more.”

Only two IGCC generating plants are currently generating electricity in the United States, one of them owned by Indianapolis, Ind.-based Wabash Valley Power Association—the wholesale power supplier for 28 electric distribution co-ops in Indiana,

Illinois, Michigan, Missouri, and Ohio. The G&T purchased the synthetic gasification unit in 2005 and will complete acquisition of the 290-MW combined cycle power island by the end of this year. According to Wabash Valley Power CEO Rick Coons, the facility was one of the first in the country to demonstrate the use of gasified coal to generate electricity.

However, IGCC received a kick-start when DOE in October issued final regulations for a program, authorized in the federal Energy Policy Act of 2005, that provides 100 percent loan guarantees to build up to 16 IGCC facilities. Meanwhile, DOE and EPA are evaluating how storing carbon dioxide may affect groundwater tables.

Federal funding essential

E PRI and the Washington, D.C.-based Coal Utilization Research Council—composed of DOE as well as state, university, mining, and other business interests—argue that for electric utilities to begin adopting CCS by 2020, major

demonstration projects with coal-fired plants need to begin soon, each able to sequester more than 1 million tons of carbon dioxide per year. Legal and regulatory guidelines for CCS also need to be established.

“To conduct research and answer all of the questions the public has about carbon capture and storage will require spending \$800 million annually over the next 10 years—a total of \$8 billion,” Offen points out. “But without this expenditure, the cost of doing CCS with today’s technology to meet growing electric demand would cost at least \$1 trillion more than with advancements.”

In September, NRECA CEO Glenn English testified before the U.S. House Select Committee on Energy Independence and Global Warming and encouraged Congress to invest in the emerging technologies required for reducing greenhouse gases from coal plants.

“Cooperatives are at the cutting edge in demonstrating the viability of integrated CCS technology,” English stated. “Funding for federal research and development incentives is essential to full availability of CCS technology.”

Rae Cronmiller, NRECA environmental counsel, contends that the electric industry will also have to overcome regulatory hurdles to get CCS off the drawing board on a commercial scale. “There are issues involving groundwater protection, mineral rights, waste disposal, pipeline transmission eminent domain, liability in case of accidents, and federal/state jurisdiction that remain to be worked out,” he declares. “Without a comprehensive permitting system in place ahead of time, it will be difficult for CCS to achieve significant reductions in carbon dioxide emissions.”

A states’ rights clash over sequestration may materialize, too. EPA has announced plans to issue rules for underground carbon storage under the federal Safe Drinking Water Act. That may not sit well with states like North Dakota, where Gov. John Hoeven (R) recently released a carbon dioxide management plan—based on one cobbled together by the Interstate Oil & Gas Compact Commission, of which he serves as chairman—that recommends states, not the federal government, oversee vast, buried carbon dioxide storage “warehouses.” To finance state monitoring activities and provide liability protection, a fee would be levied for each ton of carbon dioxide sequestered.

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Each day, 8,700 tons of compressed carbon dioxide gas produced at the Great Plains Synfuels Plant in North Dakota are shipped through a 205-mile-long pipeline for permanent burial in Canadian oil fields. Basin Electric Power Cooperative, a generation and transmission co-op based in Bismarck, N.D., owns the synfuels facility.



PHOTOGRAPH BY BASIN ELECTRIC

Consumer costs

In a July 6 editorial, “Global Warming and Your Wallet,” the *New York Times* highlighted that “leading politicians have yet to educate their constituents [and fellow colleagues] about an unpleasant and inescapable truth: any serious effort to fight warming will require everyone to pay more for energy.”

Offen concurs. “Just building new coal-fired generators with CCS technology will boost capital costs by around 40 percent, while the tab for retrofitting plants, if possible, could run 60 percent to 80 percent of what it would take to replace a facility. In addition, CCS drains an estimated 20 percent to 30 percent of the energy from a coal plant.”

According to the EPRI carbon constraints study, all new domestic electric supplies built after 2020 would need to implement CCS for the energy sector to lower carbon dioxide emissions to 1990 levels by 2030. “By then, new generation—presumably equipped with CCS—will provide about 15 percent of all coal-derived electricity in the U.S.,” Offen estimates.

English sees the debate on climate change growing hotter. “Electric co-op consumers want something done, but they also are conscious that there is a price to pay for reducing greenhouse gas emissions like carbon dioxide,” he concludes. “But as co-ops, we have a responsibility to protect our consumer-members and an obligation to serve. We need to encourage our elected officials to ‘get climate change right,’ and to work for creating sustainable, long-term solutions based on new technology. If we can get the issue of what it will cost the consumer into public policy discussions, then we will succeed.” ■

This article represents the fifth in a series on how electric co-ops are looking out for their consumers and working to control power costs in an environmentally responsible fashion. Aimed at “closing the reality gap” on public understanding about climate change, the series examines ways electric co-ops are addressing seven Electric Power Research Institute recommendations that will allow the electric utility industry to slow, halt, and eventually decrease carbon dioxide emissions to 1990 levels by 2030 while still meeting demand for affordable, reliable electricity. The seven recommendations (some of which are still on the drawing table) are: boosting energy efficiency, improving the operating efficiency of coal-

fired power plants, investing in renewable energy, expanding nuclear power capacity, capturing and storing carbon produced by coal-fired power plants, adding distributed generation resources, and marketing plug-in hybrid vehicles.