feature

CLOSING THE REALITY GAP ON CLIMATE CHANGE

SQUEEZING MORE OUT OF COAL

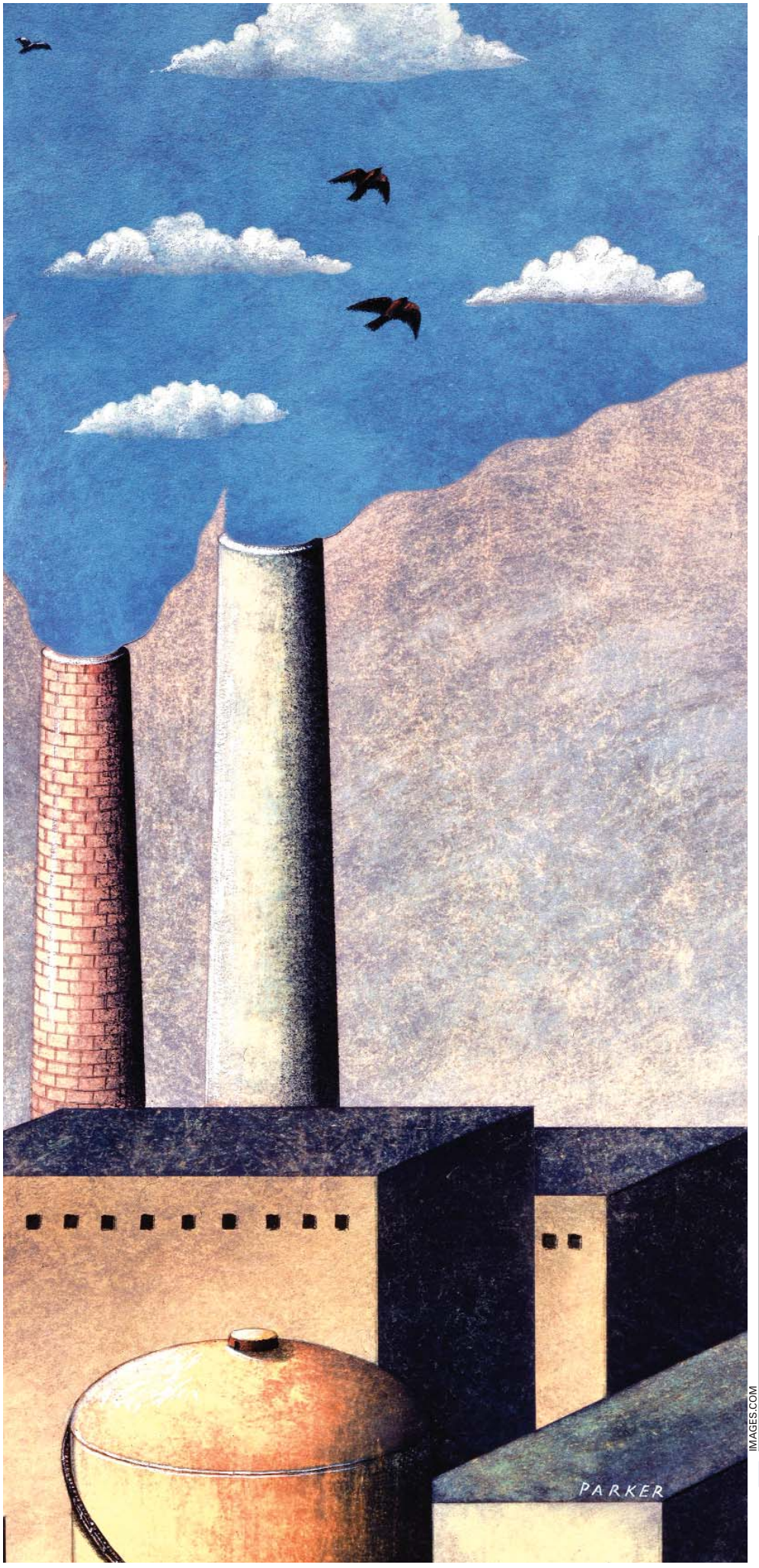
Electric co-ops are equipping coal-fired power plants with the latest pollution-control devices to clean the air, taking steps to make facilities run more efficiently, and looking at ways to reduce carbon dioxide emissions

By **Peter Nye**

According to the U.S. Energy Information Administration, "King Coal" still reigns as the least expensive and most abundant fuel used to create electricity—some 1 billion tons are burned annually. The black rock, in fact, accounts for 50 percent of the nation's and roughly 62 percent of electric co-op power supply needs.

Factored into this market, most of the approximately 65 coal-fired power plants owned by generation and transmission (G&T) co-ops—comprising 8 percent of U.S. coal-based electricity production—are relatively new compared to the industry as a whole.

"G&Ts have a very successful track record of owning and operating coal-fired power plants," argues John Holt, NRECA senior principal for generation & fuel. "In general, co-op facilities tend to run more efficiently, and burn coal cleaner, than aging generating stations operated by other utilities."



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Over the next decade, G&Ts also plan to spend more than $5 billion installing state-of-the-art pollution-control devices on coal plants to cut emissions of regulated pollutants—acid rain-contributing sulfur dioxide, smog-causing nitrogen oxides, fine particulates blamed for respiratory problems, and toxic mercury that works its way into the human food chain through eating fish and seafood—by more than 150,000 tons a year. The high-tech equipment being used includes electrostatic precipitators and bag houses that remove fly ash and particulates, selective catalytic reduction (SCR) systems that slash nitrogen oxides by roughly 90 percent, and flue gas desulfurization devices, commonly called "scrubbers," that absorb up to 99 percent of sulfur dioxide and, as a "co-benefit," reduce mercury anywhere from 25 percent to 85 percent.

"You can do a lot of upgrading for less than what it takes to build a new power plant," contends Pat O'Loughlin, vice president of engineering & power supply at Buckeye Power, a G&T in Columbus, Ohio, that supplies wholesale power to 25 electric distribution co-ops across the Buckeye State and one in Michigan.

Currently, Buckeye Power is in the middle of a program to invest $800 million through 2010 to add scrubbers and SCRs on its two generating units at the coal-fired Cardinal Station along the Ohio River. The 600-MW Cardinal Unit 2 went on-line in 1967; the 630-MW Cardinal Unit 3 in 1977. Until 2004 they served as the G&T's sole generation resources.

Driving the upgrades were changes in federal clean air rules, notably the first-ever curbs on mercury emissions and additional sulfur dioxide and nitrogen oxides caps imposed on nearly all states east of the Mississippi River. To partially offset scrubber costs, Buckeye Power has entered into a contract to purchase less expensive, high-sulfur coal from a new mine under development adjacent to Cardinal Station.

"Buying coal right from the mouth of a nearby mine will decrease our transportation costs and increase plant reliability," O'Loughlin emphasizes. "We won't have to worry about

railroads upping rates to deliver low-sulfur coal from out West or the Ohio River freezing and blocking coal shipments by barge."

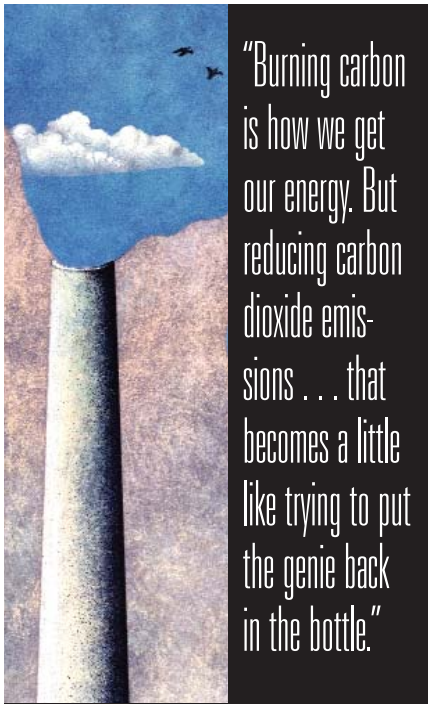
O'Loughlin expects the scrubbers to remove about 95 percent of sulfur dioxide (200,000 tons total, a net improvement of 35,000 tons) and 85 percent of mercury (a decline of about 765 pounds) emissions from the two units per year. SCRs will remove more than 90 percent of nitrogen oxides (approximately 18,000 tons) from boiler flue gas when they begin operating year round in 2009.

Carbon crunch

But pollution control could soon become even costlier. Legislation being debated by Congress would, for the first time, regulate emissions of carbon dioxide, a greenhouse gas blamed as the leading contributor to global climate change. Nationwide, coal-fired power plants make up approximately 34 percent of U.S. man-made carbon dioxide output—the largest single source—and about 40 percent of all greenhouse gas emissions from human activity.

At Minnkota Power Cooperative, a G&T in Grand Forks, N.D., Vice President for Generation Luther Kvernen sees the process of heating coal and mixing it with air to create electricity as comparable to releasing a genie.

"Burning carbon is how we get our energy," he stresses. "But reducing carbon dioxide emissions . . . that becomes a little like trying to put the genie back in the bottle."



Minnkota Power, serving 11 electric distribution co-ops and more than 115,000 consumers across 34,500 square miles in the eastern part of the Peace Garden State and northwestern Minnesota, plans to spend about $130 million to upgrade two lignite coal-fired units at its Milton R. Young Station near Center, N.D. The 250-MW Young 1, which went into commercial service in 1970, will have a new scrubber installed and be fitted with an existing chimney from its sister unit, Young 2. The 455-MW Young 2, which has been kicking out the kilowatts since 1977, will have its existing scrubber modified and receive a new chimney.

The G&T began seeking bids for the environmental improvements this summer, reports John Graves, Minnkota Power environmental manager. "Work on Young 1 should be completed by the end of 2011; we will have all of the Young 2 upgrades operational in late 2010." Annual sulfur dioxide reductions of about 19,000 tons from Young 1 and 7,000 tons from Young 2 are expected.

To reduce nitrogen oxides by 37 percent a year (3,100 tons) on Young 1 and about 40 percent (5,800 tons) on Young 2, overfired air (OFA) cyclone systems will be put in, starting with Young 2 this fall.

"Our cyclone units are somewhat unique," Graves marvels. "There are about 100 cyclone boilers that use bituminous or subbituminous coal around the country, but we're burning low-sulfur lignite coal. Temperatures in the center of the cyclone can reach 2,800 degrees to 3,000 degrees Fahrenheit, which better utilizes the coal but results in higher nitrogen oxides emissions. We will spend about $5 million for the Young 2 OFA system and about $10 million on Young 1."

Kvernen emphasizes that while present technology crimps the worst pollution emissions, it has no effect on carbon dioxide.

Mining coal info

To help generation and transmission (G&T) chief executives, managers, and engineers get the most out of existing coal-fired power plants, NRECA's Cooperative Research Network (CRN) has released three guides.

The first, *Multipollutant Strategies and Technologies*, which looks at removing sulfur dioxide, sulfur trioxide, nitrogen oxides, mercury, and particulate matter from combustion gas, includes brief technical descriptions of various emissions control technologies, cites potential removal efficiencies for each based on coal type, and provides a screening tool that calculates costs and outputs for individual G&Ts.

"The study will help G&Ts comply with clean air regulations, identify which technologies are relevant, and develop strategies to reduce emissions with incremental improvements to existing equipment," explains Tom Lovas, CRN program coordinator for generation, fuels & environment.

The second guide, *Mercury Monitoring Simplified*, offers intelligence on the potential value of a new, cost-effective mercury measurement technique called Quick SEM (also known as Method 324) that places small glass tubes the size of ballpoint pens in a plant's smokestack for a fixed period of time. The report provides a snapshot of mercury-emissions levels from diverse units burning a variety of coals as well as a brief account on conditions affecting mercury emissions and removal.

"For example, coal with low levels of chlorine can make mercury more difficult to get rid of," Lovas comments.

The third publication, *Integrated Gasification Combined Cycle* (IGCC), evaluates if IGCC can help G&Ts achieve their goal of providing a reliable supply of electricity at a competitive price. With electric co-op power requirements increasing nationwide due to strong 4 percent average annual load growth, G&Ts considering whether to add new baseload generation will soon have to make tough power supply choices, such as developing IGCC plants instead of facilities that burn pulverized coal, repowering existing plants with IGCC technology, or joining IGCC projects proposed by other utilities and merchant operators.

"Immediate carbon dioxide cuts will come from increases in plant efficiencies, such as turbine improvements and some component replacements."

One of the country's fastest-growing G&Ts, Seminole Electric Cooperative, headquartered in Tampa, Fla., needs to add roughly 200 MW a year in either new plant capacity or purchased power just to keep pace with consumer growth. The wholesale power supplier's 10 member distribution co-ops serve some 1.6 million consumers across 46 counties.

Seminole Electric has begun spending $300 million to upgrade existing scrubbers to achieve 95 percent removal and install new burners, SCRs, and an acid gas removal system on its two-unit, 1,300-MW coal-fired Seminole Generating Station, located along the St. Johns River 50 miles south of Jacksonville. The pollution controls are expected to eliminate 16,490 tons of sulfur dioxide and nearly 20,000 tons of nitrogen oxides per year.

The environmental upgrades started in February and are scheduled to finish in May 2009. In addition to scrubbers and SCRs, a lime injection system will be used to control sulfur trioxide, another agent affecting acid rain.

"We chose the upgrade-and-additional-controls route instead of purchasing clean air allowances in a fluctuating trading market," explains Seminole Electric Manager of Environmental Affairs Mike Roddy. "Also, upgrading our scrubbers will increase our synthetic gypsum sales [currently 550,000 tons per year] by approximately 75,000 tons." The gypsum—derived from scrubber waste—gets delivered by conveyor to a wallboard manufacturing plant located right next door.

"Synthetic gypsum production is just one of many environmental initiatives we have pursued since voluntarily joining the U.S. Department of Energy Climate Challenge Participation Accord in 1995," Ross adds. "In addition, we've agreed to distribute more than 100,000 compact fluorescent lightbulbs to our member co-ops. To date, these efforts have reduced our carbon dioxide emissions by more than 3.3 million tons."

The G&T plans to construct a third unit at Seminole Generating Station (estimated cost: about $2 billion). The new 750-MW generator, scheduled to go on-line in May 2012 with the most advanced pollution-control equipment, will employ "super critical" boiler technology that produces more megawatts from less coal. When completed, the entire three-unit plant will emit less sulfur dioxide, nitrogen oxides, mercury, and sulfuric acid than the two existing units do now.

"Seminole Electric is also planning to proceed with a new zero-liquid discharge system that eliminates the liquid waste stream from the plant and recycles high-purity water for reuse," Roddy declares. "In the end, the only wastewater discharged into the St. Johns River will be blowdown from the closed cooling water system."

While the zero-liquid discharge setup will require about 6 MW to operate, Roddy says the loss could be mitigated by a planned carbon burnout system that reburns fly ash in a small bubbling boiler, removing any remaining carbon so the ash can be sold for use in road construction.

"The resulting waste heat from the carbon burnout system can be placed in the units' feedwater system to reduce fuel consumption," he remarks.

Hefty price tag

A recent study, *Electricity Technology in a Carbon-Constrained Future*, by the Electric Power Research Institute (EPRI), a Palo Alto, Calif.-based nonprofit consortium whose members include electric co-ops, finds that U.S. electric utilities could reduce carbon dioxide emissions below 1990 levels within 23 years—even as they add about 40 percent load, half of which will be generated by coal—by taking aggressive steps in seven principal areas, including improving the efficiency of coal-fired power plants.

At present, the nation's 618 coal-burning generating units average around 33 percent efficiency. Even so, O'Loughlin at Buckeye Power holds that "a kilowatt-hour of electricity is still more useful than a lump of coal."

"Heat is lost from boiling water to make steam and then condensing it back to water," he observes. "There are also mechanical losses from boiler circulating pumps, valves, and the spinning turbine. Finally, energy is consumed by pollution control systems. Despite these losses, power plants generate electricity—the most useful energy by any measure."

Recently, EPRI has collaborated with the Coal Utilization Research Council (CURC)—composed of the U.S. Department of Energy, as well as state, university, and business interests—to boost efficiency of coal-burning generators.

"Part of the CURC-EPRI roadmap calls for improving coal plant efficiency for new facilities to between 39 percent and 46 percent by 2020 and to 49 percent by 2030," reports John Novak, EPRI executive director of federal & industry activities.

Tony Facchiano, EPRI senior program manager for generation combustion performance, suggests several ways electric utilities can improve plant efficiency. For starters, retiring older plants and replacing them with new ones boasting the latest technology will hike efficiency levels.

"But we also need to look at improving the hardware already in place," he says. "There is a lot of potential there, such as operators of older plants measuring the fuel-to-air mixture in boilers and matching things better."

Phase one of the EPRI plan would establish basic information baselines. "We don't have a big database," Facchiano admits. "People across the electric industry are more enthusiastic now about defining the baselines to save fuel and improve plant efficiencies, which will reduce carbon dioxide emissions."

With baselines compiled, the industry could move to the next step—major improvements.

"These will involve more capital-intensive projects," Facchiano observes.

And probably sticker shock as well. EPRI estimates that returning utility carbon dioxide emissions to 1990 levels by 2030 will cost $17 billion. However, competition from China and India for copper, steel, nickel, concrete, and other raw materials has pushed that price

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co-op people

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story and individual ads and Awards of Merit for news story and "wild card." **Tom Kocecny** of Hancock-Wood Electric Cooperative, North Baltimore, earned Awards of Excellence for newsletters and electronic communications and Awards of Merit for newsletter incorporated into another publication and Web site. **Becky Engel** at Logan County Cooperative Power & Light Association, Bellefontaine, received an Award of Merit for special publications. **Nikki Vanderkooi** from Consolidated Electric Cooperative, Mount Gilead, took home an Award of Excellence for computer graphic design. **Terry Mazzone** at Lorain-Medina Rural Electric Cooperative, Wellington, got an Award of Excellence for news. **Lisa Hooker** of South Central Power Company, Lancaster, won an Award of Merit for best feature. **Tonda Meadows** at Buckeye REC received an Award of Excellence in the "wild card" category. And in addition to Crabtree—who also won an Award of Excellence and two Awards of Merit for advertising campaigns—**Jeff Brehm** and **Chris Hall** at the Ohio statewide shared an Award of Merit for best annual report. Brehm also picked up an Award of Merit for best photo, while Hall earned an Award of Excellence for computer graphic design. The statewide's Rich Warren also received an Award of Excellence for best news story.

Dennis Levering has begun his first term on the board of trustees at Consolidated Electric Cooperative, Mount Gilead, Ohio, after winning his seat during the co-op's recent annual meeting. In addition, **Richard Gearhiser** and **Don McCracken** were re-elected to the Consolidated Electric board.

REGION 5

PETERSON ON BOARD

Members of Polk-Burnett Electric Cooperative, Centuria, Wis., recently elected **Jeff Peterson** to the co-op's board of directors, where he succeeds **Robert Behling**. Incumbents re-elected at the Polk-Burnett Electric Annual Meeting were **Marlyn Bottolfson** and **Robert Thorsbakken**.

Among nearly 45,000 participants in the recent Susan G. Komen National Race for the Cure in Washington, D.C., was **Mary Roach**, director of education & training for the Iowa Association of Electric Cooperatives (statewide), Des Moines, Iowa, and a breast cancer survivor. Roach joined

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Energy efficiency

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tag 30 percent higher in just 18 months, so the total could rise even more.

Among promising innovations EPRI sees for new coal-fired power plants are circulating fluidized bed (CFB) technology, developed by the U.S. Department of Energy Clean Coal Technology Program, and Integrated Gasification Combined Cycle (IGCC). Unlike conventional generating stations that burn powdered coal at temperatures ranging from 2,200 degrees to 2,400 degrees Fahrenheit, CFB units consume crushed coal—less than three-eighths of an inch thick—at between 1,500 degrees and 1,650 degrees Fahrenheit and mix in limestone; air blown into the boiler suspends the mixture as it burns (referred to as fluidizing).

Integrated Gasification Combined Cycle (IGCC) turns coal into a syngas, stripped of sulfur compounds, which gets burned to generate electricity. In addition, the process recovers waste heat to produce even more electricity.

"IGCC results in lower emissions of sulfur dioxide, particulates, and mercury, and because it is more efficient than a normal coal-fired power plant, produces less carbon dioxide," notes NRECA's Holt. "However, 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 are currently operating in the U.S., although several others are being evaluated."

EPRI sees the largest carbon dioxide cuts coming from coal-burning plants equipped for carbon capture and sequestration, a method that collects, compresses, and stores the gas thousands of feet underground in geologic formations. The technology envisioned, still largely restricted to the laboratory, likely won't be tested commercially until 2012 when the U.S. Department of Energy's $900 million FutureGen project—the world's first zero-emissions coal-fired power plant—goes on-line at a site yet to be chosen in either Illinois or Texas. The prototype 275-MW FutureGen facility will couple carbon capture and sequestration with IGCC, since IGCC—by creating a more pure stream of carbon dioxide through gasification—makes capture easier.

"Current carbon capture and storage methods drain an estimated 20 percent to 25 percent of plant energy," cautions Facchiano.

Fortunately, electric co-ops do have experience with carbon capture and storage, although not from coal combustion—yet. The only commercial-scale operation in the United States for turning coal into synthetic natural gas, the Great Plains Synfuels Plant—owned and operated by Basin Electric Power Cooperative, a G&T based in Bismarck, N.D.—ships 8,700 tons of carbon dioxide via a 205-mile pipeline to Weyburn, Saskatchewan, for permanent entombment in old oil wells.

However, Basin Electric Power recently began seeking proposals from developers to launch a carbon capture and storage demonstration project at its 900-MW coal-fired Antelope Valley Station. In late July, Seminole Electric also joined the fray, announcing plans to capture and store carbon dioxide produced at its proposed Seminole Generating Station Unit 3.

"Given that electric co-ops over the next decade must build half again as many new power plants [roughly 14,000 MW]—a large portion of which will use coal as fuel—to keep the lights on, we feel technology remains the best way to mitigate greenhouse gas emissions and enhance energy efficiency," concludes NRECA CEO Glenn English. "As a result, the electric co-op program continues to push for increased federal investment into research and development aimed at providing workable, market-driven solutions in the areas of clean coal and carbon capture and storage." ■

This article represents the second 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 at coal-fired power plants, adding distributed generation resources, and marketing plug-in hybrid vehicles.