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Energeia

We Can See Clearer Now!!

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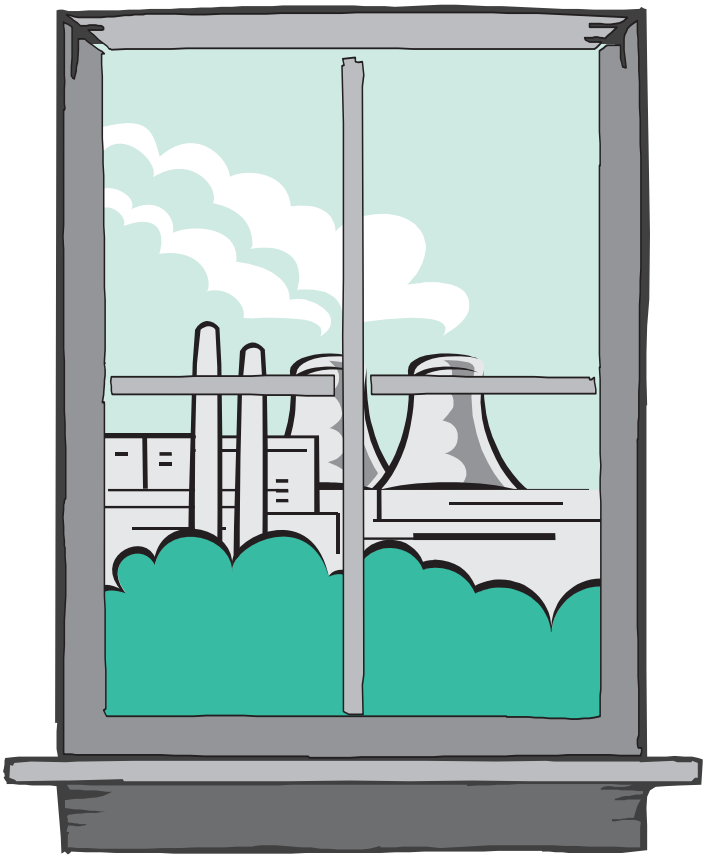
Electric utilities responded positively to the requirements of the Clean Air Act Amendments of 1990 (CAAA) by significantly reducing power plant emissions. The success of the utility industry's environmental performance is one of the best kept secrets in the nation.



CLEAN AIR ACT AMENDMENT (CAAA)

The Environmental Protection Agency (EPA), through the passage of the CAAA and its predecessors, set standards for emitted pollutants, including nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter (PM), and lead (Pb). Ozone, which is considered a non-emitted air pollutant formed by the combination of nitrogen oxides (NOx), volatile organic compounds (VOCs) and sunlight, was also included in this standard. Point sources, such as electric power plants and coke plants, were targeted for emission reductions under the act.

The EPA has collected emissions data for CO, NOx, SO_2, VOC and PM less than 10 microns (PM_{10}) by emitting source since 1970 **(Table 1)**. Based on the EPA's historical data, total U.S. emissions from all sources were reduced by 51% between 1970 and 2003. The transportation sector contributed significantly to these reductions, as have electric utilities, which reduced their emissions of the five pollutants by an aggregate of more than 33% over the same period. Even more astounding is that the utility reductions in emissions occurred during a period when coal-fueled electric generation nearly tripled from approximately 700 billion kilowatt-hours (kwh) in 1970 to 1,970 billion kwh in 2003.

It's important to maintain perspective when examining utility environmental compliance. **Figure 1** shows the electric utility contribution, for each pollutant, to total U.S. emissions. In 2003, electric utilities contributed less than 1% to the total VOC and CO emissions and almost 70% of SO_2 emissions. Since 1970, the largest contributor to national emissions has been the transportation sector. Between 1970 and 2003, the transportation sector (including both on- and off-road vehicles) was responsible for approximately 70% of all CO, NOx, SO_2, PM_{10}, VOC and Pb aggregate emissions.

SO_2 and NOx emissions are contributors to acid rain. Based on EPA data, historically coal-fueled electric utilities were the largest single emitter of SO_2 (60% to 70% of all emissions) and were a large contributor of NOx emissions (25% of all emissions). The CAAA provided a phased implementation approach with emissions caps. The primary goal of the CAAA's Acid Rain Program was:

- To decrease SO_2 emissions to 50% of 1980 levels (17.5 million tons) by 2010.
- To achieve NOx emissions reduction of 2 million tons per year below the year 2000 forecast of 8.1 million tons or 6.1 million tons per year of emissions.

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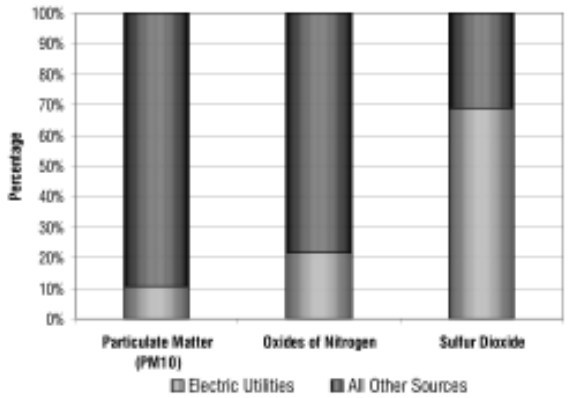
HISTORICAL EMISSIONS DATA FROM U.S. ELECTRIC UTILITIES

HISTORICAL EMISSIONS DATA FROM U.S. ELECTRIC UTILITIES	Emissions (000 tons)						Change (%)	
	1970	1980	1990	1995	2000	2003	1970 to 2003	1990 to 2003
Electric Utilities								
Carbon Monoxide	237	322	363	372	484	530	123.6	46.0
Oxides of Nitrogen	4,900	7,024	6,663	6,384	5,330	4,458	(9.0)	(33.1)
Sulfur Dioxide	17,398	17,469	15,909	12,080	11,396	10,929	(37.2)	(31.3)
VOC	30.0	45.0	47.0	44.0	61.9	55.5	85.1	18.2
Lead	0.3	0.1	0.1	0.1	0.1	0.1	(81.0)	(11.3)
PM_{10}	1,775	879	295	268	225	244	(86.3)	(17.3)
	24,340	25,739	23,277	19,148	17,497	16,217	(33.4)	(30.3)
Total All Sources	**301,524**	**267,107**	**218,182**	**188,015**	**160,248**	**147,799**	**(51.0)**	**(32.3)**

Source: EPA

Table 1.

U.S. EMISSION CONTRIBUTION OF CAAA POLLUTANTS BY SOURCE 2003



Note: Utility emissions of volatile organic compounds and carbon dioxide represent less than 1% of the total emissions of these pollutants

Figure 1.

Collectively, utilities have reduced emissions of SO_2 and NOx to 10.9 million tons and 4.5 million tons per year in 2003, respectively. The 2003 SO_2 emission levels represent 31% of the 50% reduction by 2010 required by the Acid Rain Program. NOx emission reductions in 2003 (4.5 million tons) exceeded the Program's expectations (6.1 million tons) as they have in each year since 1999.

The nearly one-third reduction in both SO_2 and NOx emissions since 1990 has coincided with a more than 24% increase in electric generation at coal-fueled power plants. The net result is a 44% reduction in SO_2 emissions per million kwh and almost a 46% decrease in NOx emission per million kwh **(Figure 2)**.

Reductions in emissions among coal-fueled generators have been made possible primarily by fuel switching, retrofit technology installation or utilization of fluidized bed combustion technology. Development of Wyoming's Powder River Basin (PRB) coalfield provided utilities with a low cost, low sulfur alternative fuel. Coal production from the PRB grew more than 100-fold from 3 million tons in 1970 to more than 360 million tons in 2003 **(Table 2)**.

After 1970, utilities began retrofitting flue gas desulfurization (FGD or scrubber) technology at some of the largest emitting stations. Through 2003 scrubbers were installed on nearly 100,000 MW of capacity at 246 coal-fueled generating stations **(Table 3)**. Approximately 44% of this scrubber capacity has been installed since 1990, amounting to 30,000 MW of coal-fueled capacity.

Since 1990, emissions of CO and VOCs by electric utilities have increased **(Table 1)**; however, electric utilities are responsible for less than 1% of these emissions and 10% of all PM_{10} emissions over the same period. Since 1985, PM_{10} emissions have been relatively consistent at around 260,000 tons per year (plus/minus 10%), nearly 86% below 1970 levels. Essentially all of the coal-fueled electric capacity utilizes some form of particulate which combats PM emissions.

HISTORICAL NOx AND SO_2 EMISSIONS AND COAL-FIRED GENERATION

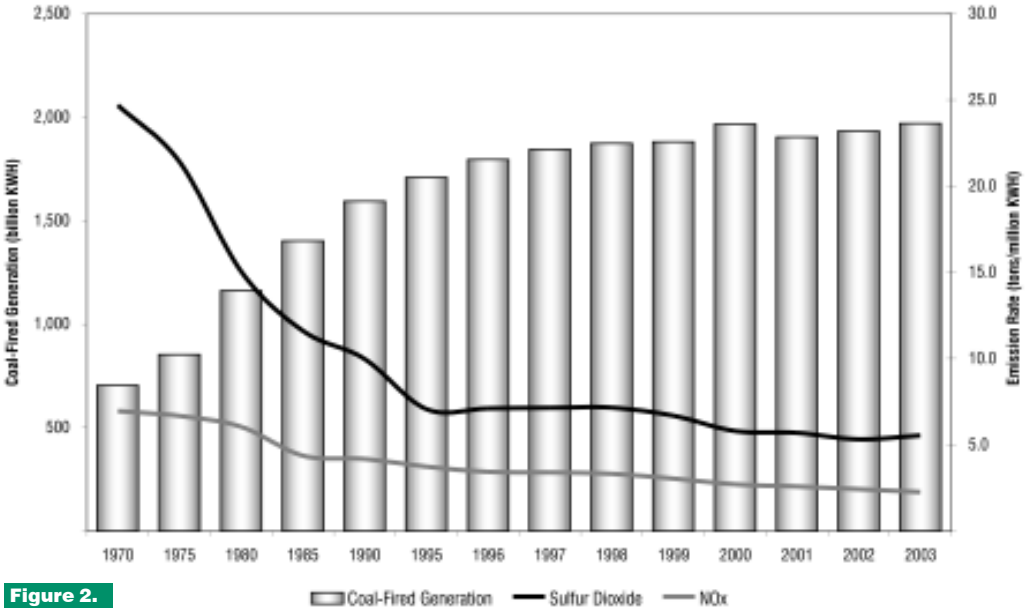


Figure 2.

CLEAR(ER) SKIES AND BEYOND

In 2002, the Bush Administration proposed new, more stringent "multi-pollutant" legislation which addressed

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GROWTH PRB COAL PRODUCTION

Year	Wyoming PRB Production (MM tons)
1970*	3
1980	68
1990	160
1995	245
2000	323
2003	363

*Estimated

Source: BOYD, MSHA

Table 2.

GROWTH OF SO_2 SCRUBBERS

Year	No. of Units	Capacity (MW)
1970	2	228
1980	69	27,790
1990	153	69,122
1995	178	84,677
2000	192	89,675
2003	246	99,567

Source: EIA

Table 3.

the emissions of SO_2, NOx and Mercury (Hg) from coal-fueled electric power plants. The Administration's "Clear Skies Act" requires emission reductions between 61% and 71% of their current levels **(Table 4)**. Sulfur dioxide reductions under Clear Skies calls for 2010 emissions to be 50% below the current CAAA standard. Reductions of this magnitude will likely require significant scrubber installations. It is ironic that environmental regulations which hindered the growth of high sulfur coal production (mostly in the Midwest) will likely spur growth of these same coals in the future.

The EPA has also proposed other Clean Air regulations to reduce SO_2, NOx and particulates at power plants. The Clean Air Interstate Rule (CAIR) would reduce SO_2 and NOx emissions below the Clear Skies limits for selected states. The program expects $PM_{2.5}$ compliance by 2015. Implementation of CAIR would be superceded by passage of Clear Skies legislation.

MERCURY

Overall man-made (anthropogenic) mercury (Hg) emissions have decreased by approximately 45%, from 220 tons in 1990 to 120 tons currently. Electric utilities (coal-fueled) are responsible for 40% (48 tons) of all U.S. Hg emissions. The Clear Skies Act emphasizes the need to reduce the level of emitted Hg. The EPA estimates that about one-third of Hg emissions are captured by generating stations through the use of existing pollution controls (scrubbers, SCRs, etc.); therefore, it is likely that as scrubbing becomes more prevalent, Hg emissions will decrease. While there are currently no commercial Hg specific control technologies available, research is ongoing to develop economically viable methods.

There is a public benefit to reducing Hg, but it may not be sufficient to simply seek reductions from the utility sector. EPA information indicates between 4,800 and 8,200 tons of Hg is emitted each year from all sources (including natural sources):

- All man-made Hg emissions worldwide represent only about one-third of all Hg emissions.
- The U.S. is responsible for approximately 9% of the world's man-made Hg emissions.
- U.S. power plants are responsible for 3% of the world and 30% to 40% of the U.S. man-made Hg emissions.

Natural sources and re-emission from previous activity represent approximately equal portions of the remaining worldwide Hg emissions.

CARBON DIOXIDE

By 2003, U.S. electric utility emissions of carbon dioxide (CO_2) reached 2.5 billion tons, an increase of nearly 28% above 1990 levels. Accounting for changes in electric generation from coal-fueled power plants, emission rates on a ton-per-million-kwh basis increased only 3% between 1990 and 2003.

HISTORICAL CO_2 EMISSIONS OF THE FIVE LARGEST EMITTING COUNTRIES IN 2002

	CO_2 Emissions (billion tons)	
	1993	2002
United States	5,685.2	6,337.7
China	2,877.2	3,662.3
Russia	2,080.3	1,678.0
Japan	1,141.3	1,300.1
India	766.3	1,131.2
World Total	**23,805.6**	**27,042.8**

Source: EIA International Energy Annual

Table 5.

During 2002 (latest data available) the world emitted approximately 27 billion tons of CO_2. The five largest contributing countries (China, Japan, India, Russia and the U.S.) represent approximately 52% of all CO_2 emissions **(Table 5)**. While the U.S. contributed the largest quantity of CO_2 during 2002 (6.4 billion tons), the U.S. GDP was also 40% higher than that of the other four countries combined.

The electric power industry is exploring voluntary opportunities to reduce CO_2 emissions. The Bush Administration has declined to sign the Kyoto Protocol, an international treaty mandating reductions in greenhouse gases (GHG), including CO_2. Instead, the President has decided to rely on voluntary reductions in GHG emissions per unit of GDP (GHG intensity). The goal of the program is to reduce the GHG intensity 18% by 2012. During December 2004, seven organizations signed a memorandum of understanding with the Department of Energy (DOE) to implement the plan. The group of seven (collectively known as Power Partners[SM]) include:

- American Public Power Association
- Nuclear Energy Institute
- Edison Electric Institute
- Tennessee Valley Authority
- Electric Power Supply Association
- National Rural Electric Coop Association
- Large Public Power Council

The group believes it can voluntarily reduce, primarily by carbon management, the electric power sector's GHG intensity by 3% to 5% of the 2000 to 2002 baseline level.

CLEAR SKIES ACT EMISSION LIMITS BY POLLUTANT

Pollutant	Units	2003	2008	2010	2018	Total Reduction 2003 to 2018 (%)
NOx	(MM tons)	4.4	2.1	-	1.7	61
SO_2	(MM tons)	10.6	-	4.5	3.0	71
Hg	(tons)	48	-	26	15	69

Source: EPA

Table 4.

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SUMMARY

Utilities have historically worked with the EPA and other regulating bodies to achieve environmental improvements with the greatest positive social benefit by the most economical means. Utilities have committed significant company resources to environmental policies and practices, incorporating pollution prevention measures, alternate fuel utilization, application of Best Available Treatment Economically Achievable (BATEA), and development of new technology to continually improve environmental quality.

Electricity demand in the U.S. is expected to continue to grow well into the future, and coal use is expected to continue to be the work-horse of electric generation. The U.S. remains a leader in the environmental research and implementation of new technologies for the utility industry.

A new series of challenges are facing electric utilities as they look to the future. It is no longer a question of if, but rather a question of when new limits for reductions in the EPA's emitted pollutants (i.e., Phase 3 sulfur dioxide, etc.), carbon dioxide (CO_2) and mercury (Hg) will be mandated.

While the job is not complete, electric utilities should take pride in their environmental accomplishments over the last 30 years. It is a message worthy of shouting from rooftops.

A version of this article first appeared in the American Coal Council magazine's 2005 issue.

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COMMENTARY

It's the Right Time ... Again ... for Coal

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Unrest in the Middle East underscores a precarious dependence by the U.S. on foreign oil. A natural gas shortage sends prices soaring. Legislative initiatives increase the cost of building and operating electric utility power plants.

These facts are all too familiar to today's energy consumers. But they weren't drawn from yesterday's newspapers. This was the state of the U.S. energy industry in the 1970s.

Called upon to help meet the nation's growing demand for energy, the U.S. coal industry responded. At the time of the Arab oil embargo, coal accounted for 17% of U.S. energy consumption. In 1993, its share was 23%. Today, it accounts for approximately one-third of our country's primary energy production and more than 50% of our electricity generation.

Over the past three decades, as the U.S. economy has become increasingly dependent on electricity to meet energy demand, coal use by electric utilities has risen 195%. Nine out of every 10 tons of coal mined in the U.S. is used by electric power plants to generate electricity. Coal consumption for electricity has more than doubled from less than 400 million tons annually in the early 1970s to over a billion tons in 2003.

The U.S. utility-coal industry has met our nation's energy challenges in the past and is poised to respond again today as the U.S. energy sector faces another significant challenge.

U.S. ENERGY CHALLENGE 2000

Throughout the 1980s and 1990s, the U.S. benefited greatly from low-cost electricity, increasingly generated using inexpensive, domestic coal. Affordable electricity helped the country achieve dramatic economic growth and improve the health and welfare of our citizens. At the same time, air quality improved with declines in coal plant emissions of sulfur dioxide, nitrogen oxide and particulate matter (as described in Frank Hilty's article in this issue.)

Over the past five years, the U.S. has experienced rolling energy shocks marked by sharp natural gas shortages and price increases, high fuel oil, heating oil and gasoline prices, and electricity blackouts. Increasing stress is being placed on the production, delivery and consumption of energy, especially electricity. These energy shocks are likely to continue and intensify.

How did we get ourselves into this predicament? During the 1990s, the U.S. reduced its energy investments, neglected to establish a comprehensive and balanced energy policy, expended excess generating reserves from low-cost nuclear plants and depleted inexpensive natural gas supplies while simultaneously fostering an over-reliance on domestic gas resources. The nation also aggressively litigated and regulated coal-based electric generation, increased its reliance on foreign energy sources and under-invested in coal generation and the nation's transmission system.

These factors now pose enormous threats to our economy and our citizens. High energy prices amount to a regressive tax, most severely affecting those least able to pay. During the last U.S. energy crisis, middle-class American faced average

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energy costs equaling 4.6% of their incomes, while low-income Americans were forced to pay 19.5% of their earnings on energy.

The increased reliance on natural gas and the rising cost of this fuel source have negatively impacted the nation's manufacturing sector. Between 2000 and 2004, the number of domestic factory jobs decreased by over 2.8 million. Most these jobs have been "outsourced" to other nations with lower energy costs.

WHY COAL? WHY NOW?

The U.S. has the largest coal reserves in the world. Coal makes up 85% of U.S. fossil fuel reserves and fuels over half of our nation's electricity generation. At current consumption rates, these coal reserves can provide a 250-year supply of domestically available fuel.

States utilizing coal for generation are rewarded by low-cost electricity. The 10 states that use the highest percentage of coal enjoy electricity rates that are 40% lower than the 10 states that use the largest percentage of other fuels.

During the 1990s, however, little new baseload generating capacity was built and in some areas of the country, demand for electricity began to exceed supply. Driven by demand for electricity, U.S. energy policy directives, readily available credit from financial lenders and the assumption that natural gas prices would remain low, the America over-invested in natural gas-fired power plants. Between 1983 and 2003, more than 140 GW of new natural gas capacity was built.

Today, because of the record-high prices for natural gas, much of this new capacity is not being used; the cost of producing electricity using natural gas is significantly higher than at coal or nuclear power plants.

Building new coal-based plants and increasing the use of coal is the solution to the natural gas shortage and price problem. Using coal for electric generation frees up limited natural gas supplies for use in higher-value applications — such as industrial, chemical and home heating — that provide jobs and tax revenues for America.

Recognizing that balancing our nation's energy needs and environmental goals is a major challenge, power generators have worked to achieve significant improvements in the environmental performance of coal-based power plants. Emissions from the existing fleet of coal plants are lower today than they were in 1970, even as power produced at these same plants has increased by 173%. The proposed Clean Air Interstate Rule (CAIR) and Clean Air Mercury Rule (CAMR) will further reduce these emissions.

Through continued research, development and deployment of new technologies, coal will continue to reliably fuel low-cost electricity that supports the economic and environmental well-being of our nation in the centuries ahead.

WHAT NEEDS TO BE DONE?

In November 2004, the National Coal Council (NCC)* presented the results of a study on opportunities to advance coal generation to the U.S. Secretary of Energy. The study identified significant impediments and offered numerous recommendations to the Department of Energy (DOE) that should be undertaken to expedite the construction of new coal-based power plants.

Environmental Regulatory Approaches. Among the impediments noted, was the likely unintended consequence of environmental regulations encouraging the retrofitting of high capital cost emissions control technologies at existing coal plants. In order to avoid the risk of stranded investments and the uncertainty of investing in new plants, power plant operators have taken steps to extend the lives of existing plants. This has made it more difficult for new plants to enter the electricity market at a price competitive with the overall cost of electricity from older coal plants, where the capital cost component of electricity is much less.

DOE can help advance the construction of new coal-based power plants by developing a clear regulatory mechanism allowing investors to recover the added costs of replacing older, less efficient power plants with new advanced facilities. Cost-recovery proposals, addressing both state and regional concerns, will be required to insure recovery of new capital investment, as well as stranded capital from un-recovered investments associated with the retirement of older plants.

Permitting. The length and redundancy of permitting requirements has created impediments to new coal plant construction. These delays result from an inefficient permitting process which can cause such significant delays that plants are cancelled. The time from project initiation to start-up is routinely extended due to permitting delays that don't result in any changes to the plant's emissions control systems. These delays result in increased costs and foster the perception of coal plants as high-risk endeavors, discouraging investment community participation.

What's needed is an integrated, flexible and streamlined approach to environmental regulations and permitting for new, advanced coal generation. Operating permits should additionally include assurances that new regulations will not change the permit for a defined, fixed period of time following the start-up of a new plant.

Clean Coal Technologies. Past incentives offered through DOE have facilitated research, development and demonstration of advanced, clean and efficient coal-based technologies, leading to significant achievements in both environmental performance and generation efficiency. DOE must ensure that proper funding is allocated to maintain a balanced portfolio in the three critical areas of Research and Development, Demonstration and Deployment.

This includes recognizing the potential for IGCC (integrated gasification combined cycle) to replace the use of natural gas in electricity generation, produce synthetic gas for poly-generation and accelerate progress of the Hydrogen Initiative. The advancement of IGCC technology would help stabilize the price of natural gas and free more of it for use in home heating and in the domestic job-saving chemicals, fuels and fertilizer industries.

In addition to IGCC, DOE must support R&D for other advanced coal-based technologies, including advanced pulverized coal and circulating fluidized bed (CFB) technologies. This, along with support for carbon capture, ultra-supercritical power plant designs and other efficiency improvements, will allow investors in coal generation to choose from a portfolio of attractive technologies.

Regional Planning. Transitional state-by-state changes in the electric

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utility industry have resulted in a lack of regional planning. This, in turn, has resulted in a short-term focus with small, incremental capacity additions – such as natural gas combined cycle plants rather than coal-based plants that provide enhanced energy security, long-term sustainability and lower overall electricity prices for our nation.

DOE must work to encourage a regional planning approach for capacity additions, including mechanisms to reward investment in efficient and environmentally superior coal-based plants that would have widespread regional benefits and transcend the individual territory of any one state or IOU (investor-owned utility).

COAL IS A VITAL U.S. RESOURCE

Coal must be utilized in the U.S. to provide an adequate measure of energy security and reliability. Coal has been and will continue to be the major fuel for U.S. electricity generation. Its use should be encouraged as an alternative feedstock for chemicals, fuels and other industries that provide jobs for U.S. citizens in the U.S. Appropriate incentives and regulatory approaches should be established to encourage coal's use in as clean a manner as possible.

The increased use of vast U.S. coal resources represents the single most effective step the U.S. can take to ensure domestic energy security, low-cost energy, reliability and sustained economic growth.

*The National Coal Council is a public policy advisory committee to the U.S. Secretary of Energy (www.nationalcoalcouncil.org). The author is a member of the NCC.

The opinions expressed in this article are those of Janet Gellici and do not necessarily represent the opinion of the American Coal Council or its member companies or of the National Coal Council.

The ACC is a trade association dedicated to advancing the development and utilization of coal as an economic, abundant, and environmentally sound fuel source (www.americancoalcouncil.org).

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