Electricity-Generating Alternatives in Arkansas: An Economic Analysis

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I. SUMMARY OF FINDINGS

The Southwestern Electric Power Company (SWEPCo), which provides electricity to about 450,000 customers in the Arkansas-Louisiana-Texas region has projected that the demand for electric energy will grow by as much as 1,600 megawatts (MW) by 2011. Arkansans soon must choose between two alternatives for accommodating this growth.

One alternative involves generating electricity by burning coal. SWEPCo, a subsidiary of American Electric Power, seeks to build one 600-MW, coal-fired generator near Texarkana, Arkansas, in Hempstead County, by 2011. Its preliminary estimate of the total cost is $1.3 billion. The coal for the generator would be shipped in by rail from Wyoming.

The other alternative does not involve burning coal. Instead, it entails investing in energy efficiency, so that energy savings could be used to meet new demands, and in new generators powered by wind, biomass, and other renewable resources.

The choice between the two alternatives will have important economic consequences for Arkansas' workers, families, landowners, and businesses. This report describes the tradeoffs, focusing on these four areas:

Environmental Consequences. The generator proposed by SWEPCo would annually

emit:	2,628 tons of sulfur dioxide
	1,840 tons of nitrogen oxides
	3,942 tons of carbon monoxide
	920 tons of particulate matter
	381 pounds of mercury
	5,280,000 tons of carbon dioxide
and consume:	9,700 acre-feet of water per year

The pollutants, water use, and operation of the generator would have important environmental consequences:

- Increased illness, injury and premature deaths
- More frequent and severe droughts
- Reduced visibility
- Harm to sensitive, threatened, or endangered species
- Change in soils, water, flora, fauna
- Boom-bust economic and social change
- Degradation of recreational opportunities
- Industrialization of forested lands
- Change in climate
- Harm to crops and livestock
- Increased toxicity of fish
- Increased dust
- Growth in population and traffic
- Disposal of waste products
- Noise and light pollution
- Exposure to hazardous inputs

Impacts on Jobs. Investments in energy efficiency and renewable resources have the potential to create more jobs in Arkansas than investments in coal-fired generators. A review of recent research compared the average number of jobs created over their operational lifetimes by different types of generating facilities. It found that, after adjusting for differences in their operating characteristics, a coal-fired generator creates, on average, 1.01 jobs per MW of capacity, whereas a solar (photovoltaic) generator creates 7.41 to 10.56 jobs and a wind-powered generator creates 0.71 to 2.79 jobs. Other evidence indicates that the long-run job creation for operations and maintenance by the energy-efficiency/renewable-resources alternatives likely would be 2 to 10 times the job creation by the coal-fired alternative. Moreover, by degrading the

environment, the emissions from coal-fired generators probably would have an adverse impact on many jobs in the surrounding communities.

Costs to Ratepayers. Investments in energy efficiency and renewable resources probably would meet Arkansas' future demands for electricity at a significantly lower cost to ratepayers than investments in coal-fired generators. There are substantial opportunities to increase the efficiency of existing electricity uses, with the saved electricity available to meet new demands at a cost of about $0.02 to $0.03 per kilowatt-hour (kWh). If additional generating capacity is needed, electricity from wind and biomass resources is expected to cost consumers $0.05 to $0.06 per kWh, about the same as coal-fired electricity, under base-case scenarios.

Economic Risks. Every strategy for meeting Arkansas' future demand for electricity embodies some risk, but a decision to rely on new coal-fired generators would create extraordinary risks for ratepayers, shareholders, families, landowners, and businesses. Ratepayers and shareholders would face considerable risk that the cost of coal-fired electricity would outstrip the developers' preliminary estimates. This risk would arise from several factors: construction costs have been growing as much as 40 percent per year at generators being built elsewhere, coal prices have been and likely will be highly volatile, and actions by state and local governments indicate utilities burning coal soon will incur additional costs for their emissions of carbon dioxide. There is some probability that the increase in costs would render a coal-fired generator obsolete, so that ratepayers and/or shareholders would have to swallow the costs of the unproductive plant and equipment and the accelerated costs of decommissioning the facility.

Residents of the area surrounding a coal-fired generator would face multiple risks. Its emissions and operation would increase the incidence of illness and premature death, adversely affect crops and livestock, diminish the quantity and/or quality of water resources, impair amenities that contribute to the quality of life for those who live in the area, and lower property values.

Everyone would bear risks of the emissions' contributions to climate change, which may include higher incidence of severe hurricanes and other storms, flooding, extinctions of species, wildfires, spread of insects and diseases, and numerous other undesirable outcomes.

A decision to implement the energy-efficiency/renewable-resources alternative would avoid most of these risks. This alternative would not consume coal or other fuel to generate electricity, so there would be no risk that the future cost of electricity would jump to cover rising fuel costs. It would have minor emissions of carbon dioxide relative to those from coal-fired generators so there would be no or little risk that the cost of electricity would jump to cover carbon dioxide costs. It would produce minimal or no emissions to harm human health, crops and livestock, or the ecosystem, to degrade visibility, or to adversely affect water supplies, property values, and the amenities that contribute to economic growth.

The information readily available up to now has told only part of the economic story regarding the coal-fired generator SWEPCo proposes to build in Arkansas. Before they can make fully-informed decisions regarding these proposals, Arkansans must have the results

from a broader analysis. Such an analysis must comprehensively examine the environmental consequences, impacts on jobs, economic costs and benefits, and economic risks. It must compare the proposed coal-fired generator against an alternative that would rely on energy efficiency and electricity from renewable resources. This report takes the first steps toward this goal. It demonstrates that the energy-efficiency/renewable-resources alternative is the better choice, for it would have fewer adverse environmental consequences, create more jobs, impose smaller costs on Arkansans, and be accompanied by lower economic risk.

ECONorthwest prepared this report for the Sierra Club. ECONorthwest is the oldest and largest economic consulting firm in the Pacific Northwest. Ernie Niemi, Cleo Neculae, and Sarah Reich, economists with ECONorthwest, prepared this report, with assistance from numerous individuals, agencies, and organizations, who helped us acquire and interpret information regarding the alternatives' potential economic effects. Responsibility for the content of this report, however, rests solely with ECONorthwest.

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II. BACKGROUND

The Southwestern Electric Power Company (SWEPCo), which provides electricity to about 450,000 customers in the Arkansas-Louisiana-Texas region, has projected that the demand for electric energy will grow by as much as 1,600 megawatts (MW) by 2011.[1] Two major pathways have been proposed for satisfying this increase in demand. One entails building a new coal-fired generator. The other calls for a more diversified set of clean-energy actions, with investments in energy efficiency and new generators powered by wind, biomass, and other renewable sources of energy.

This report describes and compares the potential economic consequences associated with these two pathways. Specifically, it examines the tradeoffs between them in terms of:

Impacts on jobs. We compare: (1) the impacts on energy-related employment opportunities, and (2) the impacts on jobs arising from environmental and other effects that would alter the spending patterns of Arkansans and visitors.

Economic costs. We compare the direct costs of implementing the coal option with the energy-efficiency/renewable-resources alternative. We also account for the spillover costs nearby residents would bear, for example, as coal-fired pollutants increase the levels of illness and premature death.

Economic risk. We describe differences between the coal option and the energy-efficiency/renewable-resources option in terms of risks that might lead to increases in costs and/or to jumps in future electricity rates.

To facilitate the analysis of the coal-fired alternative, we focus on SWEPCo's proposed John W. Turk, Jr. Power Plant (the Hempstead plant). The Hempstead plant has been proposed by SWEPCo and its parent company, American Electric Power, to generate electricity 15 miles northeast of the town of Texarkana, in Hempstead County, as shown in Figure 1. Its 600-MW generator would use "ultra-supercritical" combustion technology, that would burn pulverized coal from Wyoming's Powder River Basin to create high-pressure steam to drive a turbine.[2] The proposal also includes rail improvements, transmission improvements, and the development of a solid waste landfill on-site to accept the ash and other types of waste the project is expected to generate.

The proposed development would be built on a 2,800-acre tract of land in southwest Arkansas, about 10 miles east of the Texas-Arkansas border, and 35 miles north of the Louisiana-Arkansas border. It would use about 9,700 acre-feet of water per year from a local lake, delivered to the site via the Little River, for cooling and other purposes. Construction of the project would begin in 2008, with the generator expected to begin operation by the summer of 2011, at a cost of at least $1.3 billion.

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[1] Southwestern Electric Power Company. 2006. *Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the construction, ownership, operation and maintenance of a coal-fired baseload generating facility in Hempstead County, Arkansas.* Filed with the Arkansas Public Service Commission. Docket No. 06-154-U. December 8.

[2] For the company's description of the project, *see* http://www.swepco.com/news/hempstead/default.asp.

According to SWEPCo, its objective in building the Hempstead plant is to "bring much needed generation to the Arkansas-Louisiana-Texas area," and make "upgrades to the transmission system." SWEPCo also sees an important ancillary benefit from the proposed project, in that the Hempstead plant would increase jobs, incomes, population, property values, and tax revenues to support local services, boosting "regional economic development efforts in southwest Arkansas as well as north Texas along the I-30 corridor."[3]

Figure 1. Proposed Location of the Hempstead Plant

Source: Southwestern Electric Power Company

[3] Southwestern Electric Power Company. 2006. *See* footnote 1.

III. THE POTENTIAL ECONOMIC AND ENVIRONMENTAL CONSEQUENCES OF DEVELOPING AND OPERATING THE HEMPSTEAD POWER PLANT

In the following paragraphs we describe the Hempstead plant's potential economic consequences, recognizing that some of these would be positive and others negative. Our presentation proceeds in this order:

A. Potential Positive Economic Consequences

B. Potential Negative Economic Consequences (Summary)

C. Potential Negative Impacts on Jobs

D. Potential Negative Consequences: Excessive Costs

E. Potential Negative Consequences: Increased Risks

A. POTENTIAL POSITIVE ECONOMIC CONSEQUENCES

The preceding section's description of the proposed Hempstead plant, which we drew largely from materials prepared by SWEPCo, identifies anticipated positive consequences in these three areas:

- **Generating capacity and electric energy.** The generator would have a capacity of 600 MW and is expected to be a baseload resource, operating for extended periods of time, but with occasional shutdowns for maintenance or other reasons.
- **Positive impact on jobs.** SWEPCo has stated that, at its peak, the construction phase of the plant would create about 1,400 jobs.[4] Operation of the generator and related on-going activities would provide permanent employment for 110 workers. Studies of other major industrial facilities indicate that most, perhaps nearly all, of these jobs probably would be filled by workers from outside the local area.[5] This so-called in-migration effect has been shown to dramatically reduce the potential employment benefits from economic development. In some cases as many as 8 out of 10 jobs created by new development go to workers who otherwise would have lived elsewhere.[6] Studies have also shown that large new facilities in an area do not tend to increase the overall number of local jobs to the extent predicted by their developers. One of the most comprehensive studies on the effect of new facilities on employment found that, on average, jobs provided by new firms are offset by job

[4] Southwestern Electric Power Company. 2007. "John W. Turk, Jr. Power Plant Generation Site Quick Facts." Retrieved October 10, 2007, from http://www.swepco.com/news/hempstead/docs/hempsteadfactsheet092407.pdf

[5] Bartik, T.J. 1993. "Who Benefits from Local Job Growth: Migrants or the Original Residents?" *Regional Studies* 27 (4): 297-311.

[6] Bartik, T.J. 2003. *Local Economic Development Policies.* Upjohn Institute Staff Working Paper No. 03-91. January. Retrieved October 29, 2007, from http://www.upjohninstitute.org/publications/wp/03-91.pdf

losses in the same region, and, under some circumstances, the job loses can outweigh the job gains.[7]

SWEPCo initially estimated that the total annual payroll for the jobs created by the Hempstead plant would be $12 million. However, in testimony before the Arkansas Public Service Commission, SWEPCo adjusted downward its own estimates of these employment benefits, reducing them to $9 million.[8]

- **Decreased risk.** SWEPCo has justified its decision to develop a coal-fired generator in part because it has compared this alternative against generators that would be fueled by natural gas. SWEPCo chose the coal option at the advice of its risk-analysis consultants, who concluded that a mixed portfolio of coal and natural gas is preferable to one that relies solely on gas.[9]

B. POTENTIAL NEGATIVE ECONOMIC CONSEQUENCES (SUMMARY)

The proposed Hempstead plant would have negative as well as positive economic consequences. The negative consequences fall into three categories:

- **Negative impacts on jobs.** Pollution from the burning of coal would degrade the surrounding environment and diminish the ability of nearby communities to derive jobs and income from the area's natural-resource amenities, such as the Millwood Lake and the region's hunting and fishing opportunities. It also would preclude Arkansas' economy from creating a greater number of new job opportunities via alternative sources of energy.
- **Costs.** Electricity from the proposed coal-fired generator would be costly. The $1.3 billion construction costs estimated by SWEPCo is just the beginning, and by SWEPCo's own admission, is an underestimate.[10] Utilities building coal-fired generators elsewhere are finding that construction costs are growing at unexpected high rates. In addition, national initiatives to rein in the emission of carbon dioxide could significantly increase the cost of burning coal. Moreover, the direct costs of developing and operating the coal-fired generator constitute only a portion of the total costs. The generator's emission of pollutants and other factors would lead to spillover costs which would materialize through increases in the incidence of human illness and premature death, diminished production of crops and livestock, reduced visibility, changes in the region's ecosystem, and contributions to global climate change.

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[7] Edmiston, K.D. 2004. "The Net Effects of Large Plant Locations and Expansions on County Employment." Journal of Regional Science 44(2): 289-319. *See also* K.D. Edmiston. 2007. "The Role of Small and Large Businesses in Economic Development." Federal Reserve Bank of Kansas City Economic Review 92 (2): 73-97.

[8] McCellon-Allen, V. *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas.* Docket No. 06-154-U, pp. 2712-2713.

[9] Weaver, S.C. 2007. "Redacted Supplemental Testimony on Behalf of Southwestern Electric Power Company." Before the Arkansas Public Service Commission. March 22.

[10] McCellon-Allen, V. 2006. "Direct Testimony on Behalf of Southwestern Electric Power Company." *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas.* Docket No. 06-154-U. December.

- **Increased risks.** A commitment now to burn coal to generate electricity over the next several decades would generate considerable risk for ratepayers, investors, local communities, and Arkansas' overall economy. Some of this risk stems from the generator's large size. Once it is built, a substantial portion of the state's economy will be handcuffed for several decades to the plant's technology and cost structure, subject to potential rises in the price of coal and unable to take advantage of newer, cheaper technologies that emerge in the future. Or, alternatively, the new technologies would render them obsolete. Perhaps more important, there is a high likelihood that utilities burning coal soon will have to bear liability for their substantial emissions of carbon dioxide and contributions to climate change. If the utilities are successful in passing this liability to their customers, then Arkansas' households and businesses could be paying markedly higher rates.

Below we describe these negative economic consequences in detail.

C. POTENTIAL NEGATIVE IMPACTS ON JOBS

The construction and operation of the proposed Hempstead plant would create some new jobs, as described above. These increases in the demand for labor directly related to the development and operation of the generator would, however, be offset by negative impacts elsewhere in the economy. These negative impacts would materialize through three mechanisms: (a) costs imposed on households, landowners, businesses, and visitors; (b) forgone development of energy alternatives capable of producing even greater numbers of jobs; and (c) higher than necessary electricity prices.

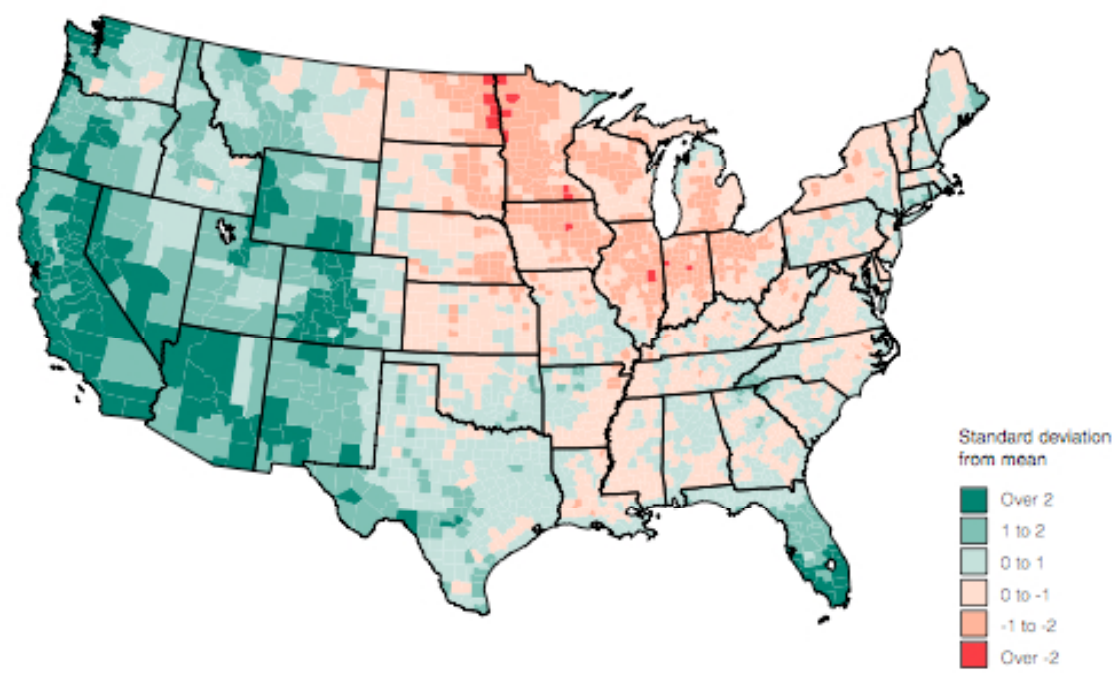
1. NEGATIVE IMPACTS ON JOBS FROM THE COSTS IMPOSED ON OTHERS

Later in this report, we describe evidence indicating that development and operation of the coal-fired generator would impose substantial costs on workers, families, landowners, businesses and visitors. These costs would materialize through multiple mechanisms:

Increased illness, injury and premature deaths
More frequent and severe droughts
Reduced visibility
Harm to sensitive, threatened, or endangered species
Change in soils, water, flora, fauna
Boom-bust economic and social change
Degradation of recreational opportunities
Industrialization of forested lands
Change in climate
Harm to crops and livestock
Increased toxicity of fish
Increased dust
Growth in population and traffic
Disposal of waste products
Noise and light pollution
Exposure to hazardous inputs

Most of these potential negative impacts on jobs are readily understood. One type of impact, that is especially important, relates to the potential effects of the generator's emissions on water resources, recreational opportunities, visibility, and other natural-resource amenities. Economists have long recognized that, on average, areas with abundant, robust natural-resource amenities experience faster growth in population and jobs, their families have higher levels of income and education, and they attract a higher concentration of

Figure 2. The Surrounding Area's Natural-Resource Amenities (shown in green) that Correlate with Growth in Jobs and Incomes



Source: McGranahan, D.A. 1999. *Natural Amenities Drive Rural Population Change*. Agricultural Economic Report No. 781. U.S. Department of Agriculture, Economic Research Service, Food and Rural Economics Division. September. Retrieved January 24, 2006, from http://www.ers.usda.gov/Publications/AER781/.

entrepreneurs.[11] Figure 2 illustrates one representation of natural-resource amenities that have been shown to be associated with changes in population and jobs. The map shows that the areas surrounding the proposed plant have amenities that positively impact jobs and income in the area.

Emissions for the proposed coal-fired generator would diminish the attractiveness of some or all of these natural-resource amenities and, hence, reduce the ability of the local community to capitalize on these amenities as a future source of economic growth. For example, reductions in visibility and increased air pollution would diminish the attractiveness of the Millwood Lake and other natural areas, and reduce the number of people taking advantage of the area's hunting, fishing, sight-seeing, and wildlife-watching opportunities. Changes in the quantity or quality of the area's water resources could diminish their ability to attract boaters and fishers. The impact on fishers would be magnified insofar as mercury emissions from the generator would contaminate the area's fish, further diminishing the allure of fishing in the area.

The potential impact on the regional and statewide economy could be significant. Research has shown that natural-resource and other amenities account for about one-half of

[11] *See*, Niemi, E., C. Neculae, and T. Raterman. 2006. *Natural-Resource Amenities and Nebraska's Economy: Current Connection, Challenges, and Possibilities*. July. Retrieved October 30, 2007, from http://www.ngpc.state.ne.us/admin/NiemeReport.pdf.

interstate differences in job growth.[12] These findings indicate that the residents of Hempstead County and Arkansas face a tradeoff. By accepting, even subsidizing, development of the coal-fired plant they can gain some additional jobs. At the same time, however, pollution from the generator and other effects, such as consumption of large amounts of water, probably would diminish the area's natural-resource amenities. Hence, its ability to realize growth in jobs and economic activity associated with these amenities will be impaired.

2. FORGONE JOBS IN OTHER ENERGY SECTORS

By proceeding with coal-fired generators, rather than investments in energy efficiency and renewable energy, Arkansas' utilities would forgo the jobs and other economic impacts associated with energy efficiency and renewable resources. The ability of the efficiency and renewable-energy sectors to create jobs was recently highlighted by these statements, from a recent assessment of the job-creation potential of the photovoltaic industry:

> Research has shown that renewable energy generates more jobs in its construction and manufacturing sectors, per megawatt of installed power capacity, than does fossil fuel generation. [footnote omitted] Specifically for PV [photovoltaic] generation, **far more jobs are produced constructing PV facilities than are produced by the construction and operation of coal and natural gas-fired plants.**[13] [bold emphasis added]

Other evidence supports a parallel conclusion for energy efficiency and generators powered by renewable resources other than solar radiation. The net effect: there probably will be fewer energy-related jobs with the coal-fired generator than without it. Stated differently: to maximize energy-related jobs, Arkansans should pursue a strategy that focuses on investments in energy efficiency and generating electricity from wind and other renewable resources. We further discuss and document this conclusion below, in our description of an alternative to coal-fired generators.

D. POTENTIAL NEGATIVE CONSEQUENCES: EXCESSIVE COSTS

The total costs of electricity from the Hempstead plant will be the sum of the direct costs and the spillover costs:

Total Costs = Direct Costs + Spillover Costs

The direct costs are those that would be borne by SWEPCo and its parent company, AEP, and, hence, by their shareholders or ratepayers. The spillover costs are those that would be borne by others.[14]

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[12] Partridge, M. and D. Rickman. 2003. "The Waxing and Waning of Regional Economies: the Chicken-Egg Question of Jobs Versus People." *Journal of Urban Economics* 53: 76-97.

[13] Kellison, B., E. Evans, K. Houlihan, M. Hoffman, M. Kuhn, J. Serface, and T. Pham. 2007. *Opportunity on the Horizon: Photovoltaics in Texas*. University of Texas at Austin, Innovation, Creativity & Capital Institute. June. Retrieved October 30, 2007, from http://www.utexas.edu/ati/cei/documents/TexasSolarOpportunity2007.pdf.

[14] Economists often use another term, negative externalities, to describe spillover costs. This term arises because the costs impinge on people, firms, and communities that are outside, or external to those who make the decisions that yield the costs.

1. DIRECT COSTS OF COAL-FIRED ELECTRICITY

SWEPCo has estimated that the construction of the Hempstead plant will cost $1.34 billion, including $75 million "contingency for unforeseen scope and unanticipated escalation during the construction period."[15] In testimony before the Arkansas Public Service Commission, however, SWEPCo's president clarified that the total cost of the facility would actually be higher, around $1.75 billion.[16] Evidence from the industry suggests that costs could be considerably higher, as construction costs for other coal-fired plants in the U.S. have been rising by as much as 40 percent per year.[17] In this case, $75 million set aside by SWEPCo for contingency may be a gross underestimate.

What does this mean for ratepayers? SWEPCo itself has estimated that its future customers will face increases in their energy bills of around 11 percent, or $8.51 per every 1000 kilowatt-hour consumed.[18] This increase translates into a rate increase of about $120 that the average household would have to pay every year.[19] The bottom-line costs could be considerably higher, however. It is not clear from the testimonies given by SWEPCo's officials whether these rate increases already account for transmission costs and carrying charges, which SWEPCo estimated to be around $157 million. If SWEPCo has not included them, then an 11-percent rate hike represents a lower bound of possible future increases in the energy prices SWEPCo's customers will pay. Similarly, ratepayers may have to bear significant costs to cover damages associated with coal-fired emissions of carbon dioxide or other pollutants. SWEPCo's analysis of estimated costs also does not reflect the likelihood that coal prices will be higher than forecast. This risk is significant, as reflected in the price forecasts of the Energy Information Administration (EIA). Under its reference-case set of assumptions, the EIA forecasts that the U.S. average delivered price of coal, exclusive of inflation, will increase by about 6.2 percent between 2005 and 2030. Under another set of plausible assumptions that reflect higher demand for coal, tighter environmental restriction on coal mining, and increased transportation costs, however, the agency

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[15] Kobyra, J.A. 2006. "Direct Testimony on Behalf of Southwestern Electric Power Company." Before the Arkansas Public Service Commission. December.

[16] McCellon-Allen, V. *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas.* Docket No. 06-154-U, pp. 2888-2889.

[17] Rose, J. 2006. "Direct Testimony of Judah Rose for Duke Energy Systems." North Carolina Utilities Commission, Docket No. E-7, Sub 790. Retrieved October 19, 2007, from http://dukeenergyproperties.com/pdfs/rose.pdf.

[18] McCellon-Allen, V. 2006. "Direct Testimony on Behalf of Southwestern Electric Power Company." *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas.* Docket No. 06-154-U. December.

[19] According to the Energy Information Administration, residential customers in Arkansas consumed 15.6 billion kWh in 2004. (U.S. Department of Energy, Energy Information Administration. 2007. *State Energy Consumption Estimates 1960 through 2004.* DOE/EIA-0214(2004). June. Retrieved October 24, 2007, from http://www.cpuc.ca.gov/static/aboutcpuc/commissioners/ 03grueneich/04speeches/ec5-20grueneich.pdf). Based on U.S. Census data, there are approximately 1.1 million households in Arkansas. (U.S. Census. 2007. "State and County QuickFacts: Arkansas." Retrieved October 29, 2007, from http://quickfacts.census.gov/qfd/states/05000.html). This means that the average household in Arkansas consumes an estimated 14,000 kWh per year.

forecasts that the delivered price of coal in 2030 would be 49 percent higher than under the reference-case forecast.[20]

2. SPILLOVER COSTS OF COAL-FIRED ELECTRICITY

Arkansans will disproportionately bear the spillover costs of electricity generation from the Hempstead plant. SWEPCo has estimated that about 85 percent of the power generated would be transmitted out of state, while most of the pollution and other spillover costs associated with electricity generation would occur in Arkansas.[21] Economists and others have long recognized that extensive spillover costs accompany the production, transmission, and consumption of electricity, especially when it is generated by burning coal. There are many different pathways along which spillover costs materialize; we separate them into four categories: human health, climate change, water, and other.

Human-Health-Related Spillover Costs.

Coal-fired production of electricity adversely affects human health via two major routes: accidents and exposure to harmful pollutants.

Increased accidents. The mining, transportation, and combustion of coal inevitably result in accidents that injure or kill workers as well as others. So too do the construction of coal-fired generators and ancillary facilities, the disposal of waste materials, and the decommissioning of generators and other facilities once they no longer are being used. The injuries and deaths from accidents depend on many factors, and current information does not allow us to predict with precision how many of each would occur if the coal-fired plants at Ely were built and operated. An extensive investigation into the potential spillover costs of coal-fired electricity in the early 1990s concluded, however, that the spillover costs associated with the human-health effects of accidents that accompany the shipment of coal to power plants were "of the same order of magnitude" as those that were caused by airborne pollutants.[22]

Exposure to harmful pollutants. Burning coal produces several pollutants that can cause increased incidence of disease and death among those exposed to them. The pollutants that have received the greatest attention are sulfur dioxide, nitrogen oxides, particulates, ozone, carbon monoxide, volatile organic compounds, lead, and mercury. For more than two decades economists have estimated the value of the health-related spillover costs associated with airborne emissions from coal-fired generators. In general, these studies show that the damages increase as pollutants become more concentrated and as the

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[20] U.S. Department of Energy, Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030*. Report No. DOE/EIA-0383(2007). February. Retrieved October 19, 2007, from http://www.eia.doe.gov/oiaf/aeo/index.html.

[21] Moncrief, D.R. 2006. "Direct Testimony of Donald R. Moncrief for Southwestern Electric Power Company." *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas*. Docket No. 06-154-U. December. Pg. 12.

[22] Oak Ridge National Laboratory and Resources for the Future. 1994. *Estimating Externalities of Coal Fuel Cycles*. September.

Table 1. Some of the Potential Human-Health, Spillover Costs from the Hempstead Plant

Pollutant	Tons Per Year[a]	Cost Per Unit	Total Cost
Sulfur Dioxide	2,628	$2,430[b]	$6,386,000
Nitrogen Oxides	1,840	$1,430[b]	$2,631,000
Particulate Matter[c]	920	$3,780[b]	$3,477,000
Mercury	0.173	N.A.	Unknown
Carbon Monoxide	3,942	$700[b]	$2,759,000
Volatile Organic Compounds	94.6	$1,890[b]	$180,000
Others	N.A.	N.A.	Unknown

Source: ECONorthwest

[a] Southwestern Electric Power Company. 2006. *Environmental Impact Statement: John W. Turk, Jr. Power Plant Project Hempstead County, Arkansas.* Shreveport, Louisiana. December.

[b] Matthews, H.S. and L.B. Lave. 2000. "Applications of Environmental Valuation for Determining Externality Costs." *Environmental Science and Technology* 34 (8) 1390-1395. Values converted to equivalent 2007 dollars.

[c] Particles smaller than 10 micrometers in diameter, which pose the greater health concerns than larger particles because they can pass through the nose and throat and enter the lungs.

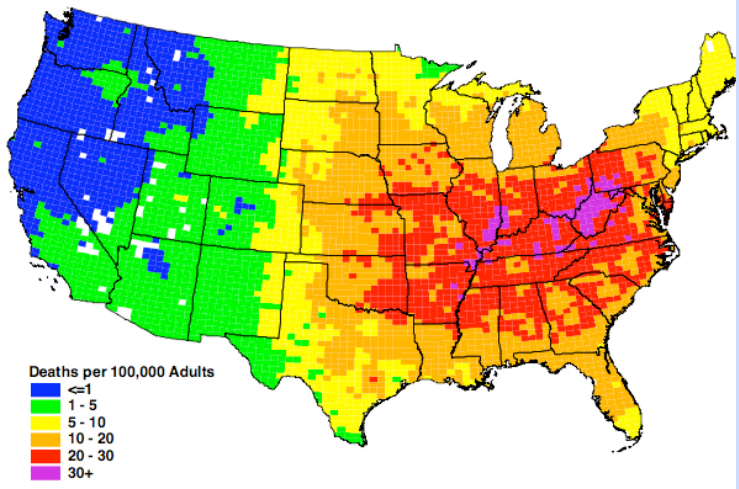
number of people exposed to the pollutants rises. We are aware of no study that directly quantifies the number of people who would be exposed to the different pollutants, at various concentrations, or calculates the potential health-related spillover costs that the residents of Arkansas and other states would bear because of the emissions from the proposed Hempstead plant. Table 1, however, provides a framework for examining these costs. The first column shows preliminary estimates of the expected annual emissions of some of the pollutants that can have an adverse impact on human health. The next column of Table 1 shows the estimated spillover cost per unit of emissions for some of the pollutants. These values come from a 2000 summary of past studies in the U.S.

Preliminary calculations show the illnesses and premature deaths caused by the potential emissions listed in Table 1 would have an economic value of about $15.4 million per year. Three factors would push the actual overall total value higher. One is population growth. In the future, when the coal-fired plant would be emitting these pollutants into the air, the population of Arkansas and the surrounding states will be larger. The greater the population exposed to the pollutants, all else equal, the higher will be the incidence of illness and premature deaths. The second factor is the value per illness and premature death. Studies completed since the 1990s indicate that this value is increasing and may be several times greater than the value that underlies the figures shown in Table 1. The third factor is the human-health effects of pollutants other than those shown in Table 1. The absence of adequate data does not mean that other pollutants, such as mercury, lead, or ozone, have no human-health spillover costs, but only that we cannot calculate them yet. Hence, the total cost is undoubtedly greater than the preliminary estimate associated with the pollutants shown in Table 1.

The people of Arkansas already experience significant adverse health effects from existing coal-fired power plants. Researchers have estimated that the small particles emitted from power plants shorten the lives of 395 Arkansans per year. Related illnesses cause residents

to have 8,327 asthma attacks and workers to miss 46,407 days of work.[23] Figure 3 illustrates the human-health effects in Arkansas of burning fossil fuels to generate electricity. The map shows a simulation, published in 2004, of the premature deaths in 2010 that would be attributable to emissions of just one pollutant, particulate matter, from power plants in the U.S. It shows 20 to 30 premature deaths per 100,000 adults for most of the state. The map does not, however, incorporate the effects of emissions from the new fossil-fuel plants proposed to be built in the state. Those emissions would raise the premature-death rates from particulate matter even further, especially for populations experiencing the greatest exposure to the pollutant.

Figure 3. Premature Mortality Risk Attributable to Particulate Matter from Power Plants, 2010



Source: Abt Associates Inc. 2004. *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios*. Clean Air Task Force, Boston, MA. June, p. 6-6. Retrieved June 15, 2007, from http://www.cleartheair.org/dirtypower/docs/abt_powerplant_whitepaper.pdf.

Another pollutant of special concern is mercury. When mercury emissions reach water bodies, they are converted to methylmercury, which, when ingested, damages the brain, nervous system, blood vessels, kidneys, and immune system. People ingest methylmercury primarily by eating contaminated fish. Methylmercury is especially dangerous for fetuses and young children, who may experience deficits in attention, language, verbal memory, spatial function, and intelligence, as well as non-neurological effects. Ingestion of methylmercury by adults is associated with increased risk of heart attack. In 2005, a group of scientists from Mount Sinai School of Medicine estimated the economic impacts associated with the loss of future productivity of children whose IQs were decreased due to contamination with methylmercury. The study found that the U.S. economy foregoes $8.7 billion annually in lost productivity. Approximately 15 percent, or $1.3 billion, is lost due to mercury emissions from American power plants.[24] Arkansans already have to contend with the risks posed by methylmercury: the state has advised against consuming fish from 260 miles of its rivers and 3,659 acres of its lakes due to mercury contamination.[25] Future emissions of mercury from the proposed coal-fired generator in Hempstead County would further contribute to environmental mercury contamination and cause economic harm in a similar manner.

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[23] Clear the Air. "Arkansas's Dirty Power Plants." citing Abt Associates. 2004. *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios.* June. Retrieved October 11, 2007, from http://cta.policy.net/regional/factsheets/factsheetARfinal.pdf.

[24] Trasande, L., P.J. Landrigan, and C. Schechter. 2005. "Public Health and Economic Consequences to Methyl Mercury Toxicity to the Developing Brain." *Environmental Health Perspectives* 113 (5): 590-596.

[25] Clear the Air. No date. "Mercury Update: Fish Consumption Advisory: Arkansas." Retrieved October 19, 2007, from http://www.cleartheair.org/relatives/17062.pdf

The total cost of the pollutants listed first in Table 1, $15.4 million, divided by the expected annual output of electricity of the Hempstead plant yields a rough estimate of the pollution-related, human-health, spillover cost per kilowatt-hour: about 0.3 cents. As we discuss above, past research has found that the accident-related costs associated with coal-fired production of electricity are of the same magnitude as the pollution-related costs. Applying this relationship in this instance indicates the overall health-related spillover costs would be about 0.6 cents per kilowatt-hour. The actual health-related spillover costs could be higher, however. By how much, it is hard to say.

Climate-Related Spillover Costs

Extensive scientific evidence leads scientists throughout the world to conclude that emissions of carbon dioxide and other gases, collectively known as greenhouse gases, are causing the atmosphere to warm and climate to change.[26] Related research shows that these changes will have both economic benefits and economic costs, but the latter will far outweigh the former.[27] The net adverse effects represent spillover costs imposed on current and future generations.

Numerous studies and regulatory processes have estimated the spillover costs looking at either the damages expected to result from the emission of greenhouse gases or the cost of reducing emissions. A consortium of western utilities reviewed the relevant studies and concluded that, once mechanisms are in place to control greenhouse gases, utilities that emit carbon dioxide would incur a cost somewhere in the range between $9 and $70 per ton of carbon dioxide (in 2006 dollars).[28] Furthermore, the utilities found that, for states that seek to reduce their emissions of greenhouse gases commensurate with the policies and actions adopted by California, it would be reasonable to conclude that the cost would be about $40 per ton of carbon dioxide. Although, to our knowledge, SWEPCo has not estimated the cost of potential future regulation of greenhouse gases directly, it has estimated the cost of carbon capture and sequestration technologies. In testimony before the Arkansas Public Service Commission (PSC), experts for SWEPCo and the PSC indicate that employing such technologies would cost between $30 and $70 per ton of carbon dioxide.[29]

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[26] Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Summary for Policymakers.* Retrieved October 19, 2007, from http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf. Other greenhouse gases include methane and nitrous oxide.

[27] Stern, N. 2006. *The Economics of Climate Change: The Stern Review*. Cambridge, U.K.: Cambridge University Press, p. 304. Retrieved October 19, 2007, from http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm; and Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change. Summary to Policymakers.* Retrieved October 19, 2007, from http://www.ipcc.ch/SPM040507.pdf

[28] Western Regional Transmission Expansion Partnership Economic Analysis Subcommittee. 2007. *Benefit-Cost Analysis of Frontier Line Possibilities: Final Report.* April 27. Retrieved October 19, 2007, from http://www.ftloutreach.com/images/FTL_Econ_Analysis_Final_Report_4-27-07.doc.

[29] Schlissel, D. *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas.* Docket No. 06-154-U, pp. 3570-3571.

Table 2. Potential Climate-Change Costs from the Hempstead Plant

Quantity of Carbon Dioxide Emitted Per Year[a]	Value Per Short Ton	Total Annual Costs (millions)
5,280,000	$9	$47.5
5,280,000	$40	$211.2
5,280,000	$70	$369.6

Source: ECONorthwest

[a] Southwestern Electric Power Company. 2006. *Environmental Impact Statement: John W. Turk, Jr. Power Plant Project Hempstead County, Arkansas*. Shreveport, Louisiana. December.

Table 2 applies these figures to the anticipated carbon-dioxide emissions of the 600-MW plant proposed in Hempstead County. At the bottom and top of the range of costs per ton of carbon dioxide emitted, the total cost would be $48 million and $370 million per year, respectively. At $40 per ton, the annual cost would be $211 million.

These numbers illustrate the general magnitude of the costs SWEPCo would incur for its emissions at the Hempstead plant when regulations for controlling greenhouse gases come into effect (or, alternatively, if courts find they are liable for the emissions' damages). If the utilities pass the costs to their customers, then ratepayers will foot the bill. Table 3 shows the potential impact on rates, relative to their July 2007 level. We calculated the impact by dividing the potential costs of complying with regulations to limit greenhouse gases, shown in Table 2, by the expected annual electricity output of the proposed generator. Rates would jump 65 percent if the coal-fired plant were built and the utilities were to become liable for climate-change emissions at a price of $40 per ton of carbon dioxide.

We emphasize that these numbers give only a rough indication of how future efforts to limit climate change will affect electricity rates. These are uncharted waters, for the U.S. has no experience with comprehensive programs that would make utilities and others pay for the damages associated with their emissions of carbon dioxide. The actual programs may yield carbon-dioxide prices and electricity-rate increases higher or lower than those we describe above. Researchers at the University of California, for example, have found that a carbon dioxide price of $25 per ton of carbon dioxide emitted into the atmosphere would raise the price of the generated electricity by about 17 percent.[30] Other researchers conclude that a price of just $15 per ton of carbon dioxide would raise the price of coal-fired electricity by 1.6 cents per kWh, or about 22 percent of Arkansas' July 2007 rate.[31] In short, it is impossible to know now precisely what impact the regulation of greenhouse gases would have on the cost of coal-fired electricity, but it is clear that, at the price levels that many in

[30] Farrell, A.E. and D. Sperling. 2007. *A Low-Carbon Fuel Standard for California Part 1: Technical Analysis.* The University of California. May 29. Retrieved June 26, 2007, from http://www.energy.ca.gov/2007publications/UC-1000-2007-002/UC-1000-2007-002.PDF

[31] Green, K.P., S.F. Hayward, and K.A. Hassett. 2007. *Climate Change: Caps vs. Taxes*. American Enterprise Institute for Public Policy Research. June. Retrieved June 26, 2007, from http://www.aei.org/publications/pubID.26286,filter.all/pub_detail.asp.

the utility industry believes possible, the increase in electricity rates probably would exceed 15 percent.

Table 3. Potential Rate Impacts if Climate-Related Spillover Costs Are Folded into Electricity Rates

Potential Spillover Costs Per Ton of Carbon Dioxide[a]	Potential Rate Impact	
	Cents per kWh	Percent Increase[b]
$9	1.09	14.9
$40	4.73	64.6
$70	8.27	113.0

Source: ECONorthwest

[a] Range of values, and most likely value applicable to California and to other states that adopt similar goals for reducing greenhouse gases. Western Regional Transmission Expansion Partnership Economic Analysis Subcommittee.

[b] Percent of the average retail price of electricity in Arkansas in July 2007, 7.32 cents per kilowatt-hour (kWh).

Water-Related Spillover Costs

The construction and operation of the proposed coal-fired plant would impose water-related spillover costs on the citizens of Arkansas and others through several mechanisms. These costs could materialize as the utilities consume water and reduce the supply available for other uses. They also would arise as emissions from the plant intensify the probability that Arkansas and the surrounding region will experience severe drought conditions. Additional costs could appear as emissions from burning coal change the quality of water in the surrounding area and change the area's water-related ecosystems.

SWEPCo has indicated that, to operate the 600-MW generator, it would pump 3.15 billion gallons, or about 9,700 acre-feet, out of Millwood Lake, for cooling and other purposes, every year. Several studies indicate that water used to cool coal-fired and other thermoelectric generators in the U.S. has a value of about $39 per acre-foot (in 2007 dollars).[32] At this value, the water that would be used annually at the Hempstead plant would have a total value of about $378,000. If the water were like other commodities, the company would have to pay this or a similar amount to obtain it. Under current laws and regulations, however, it apparently would obtain the water for free, paying only for the costs of pumping, conveying, and disposing of the water.

About 90 percent of the water used by SWEPCo would evaporate as it is used for cooling. Thus, it would not be available for other uses. Over the next several decades, this consumption of water could become even more important economically, especially if the state and others will look to this area for water to meet municipal-industrial demands. The

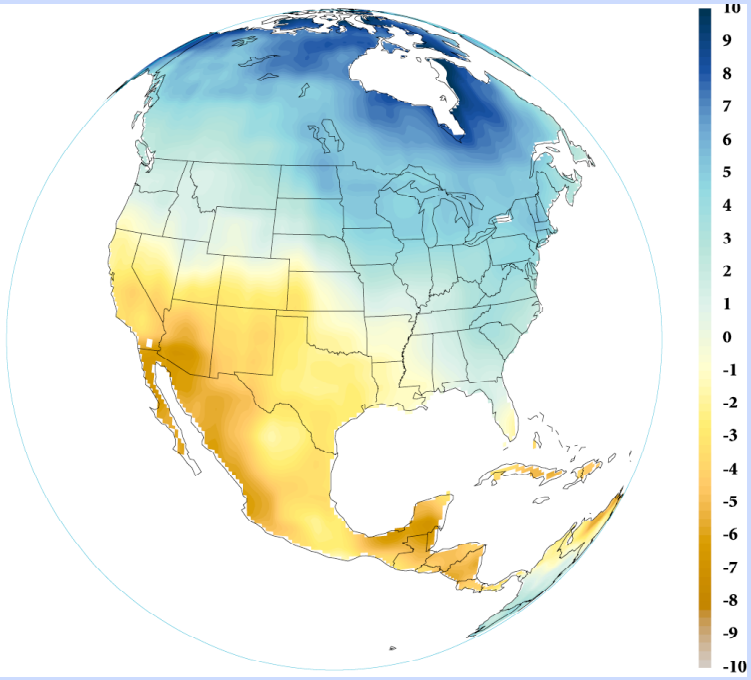
[32] Brown, T.C. 2004. *The Marginal Economic Value of Streamflow from National Forests.* Discussion Paper. U.S. Forest Service, Rocky Mountain Research Station. December 28.

amount of water that would evaporate at the plant, if available to the state's municipal-industrial water utilities, would meet the needs of about 12,300 households.

Further spillover costs would materialize insofar as pollution from the generator would intensify future droughts and/or impair the quality of water supplies. Numerous economic costs would accompany more frequent and intense droughts in the South:

- The area's farmers and ranchers would incur additional costs to secure water for their crops and livestock or, alternatively, reduce the scale of their operations.

Figure 4. Projected Change in Precipitation: the Average for 2021-2040 Minus the Average for 1950-2000, as a Percent of the 1950-2000 Average



Source: Seager, R. 2007. *An Imminent Transition to a More Arid Climate in Southwestern North America.* Lamont-Doherty Earth Observatory of Columbia University. Retrieved June 15, 2007, from http://www.ldeo.columbia.edu/res/div/ocp/drought/science.shtml.

- Generation of hydroelectricity in the southern states would decline, and consumers and businesses would incur additional costs for electricity from replacement sources.
- Wildfires would occur more frequently and across a broader landscape.
- Municipal-industrial water users, as well as rural households, would endure greater risk of future water shortages and/or incur additional costs to tap into new sources of water.
- Fish, wildlife, and plants would be stressed and significant ecological changes could occur.

Data from the National Weather Service Forecast Office show that the eastern part of the state is struggling with the consequences of severe and extreme drought.[33] Figure 4 portrays expectations, drawn from nineteen leading climate-change models, of how carbon dioxide and other gases that affect climate will affect precipitation across North America. The map shows that precipitation in Arkansas during the 2020s and 2040s is expected to be less than it has been in the last 50 years. This will add to the adversities Arkansas'

[33] National Weather Service Forecast Office. 2007. "Drought in Arkansas." Retrieved October 18, 2007, from http://www.srh.noaa.gov/lzk/html/drought.htm

agricultural producers, including those in the rice-cultivation industry, are currently experiencing due to water shortages.

Whatever the generator's impacts on future droughts, water-related spillover costs are likely to increase in the future as populations grow and additional competing demands for water emerge in the residential, recreational, agricultural, municipal, or industrial sectors.

Diminished-Amenity Costs

The Hempstead plant would impose additional costs on the natural resources in the surrounding areas and by diminishing their ability to provide goods and services. According to the Environmental Impact Statement (EIS) that SWEPCo filed with the Arkansas Public Service Commission, the proposed plant will impact approximately 44 acres of wetland and will lead to the loss of 1,600 acres of forested land. The coal-fired generator will be located 0.5 miles from Nacatoch Ravines Natural Area, 2 miles from Little River Wildlife Management Area, 3 miles from Bois d'Arc Wildlife Management Area, 11 miles from Old Washington Historic State Park, close to Nature Conservancy and Audubon Society nature preserves, and 11 miles from Millwood Lake.[34] The lake is known in the region for its pristine amenities related to fishing and bird-watching.[35] The plant and its related infrastructure, including transmission lines and railroad extensions, are likely to disrupt these natural areas with increased traffic, noise, visual obstructions, and coal-dust deposition.[36]

Summary of Spillover Costs

SWEPCo has claimed that, except for carbon dioxide, the coal-fired generator it proposes to build in Hempstead County would emit pollutants at much lower levels than those typical of older generators. This is not to say, however, that the emissions would be near zero, or that the emissions would have near zero adverse impacts on the humans, plants, animals, water, and soils exposed to them. Far from it. The evidence in the sections above demonstrates that the spillover costs of developing and operating the coal-fired generator would be substantial. Although further analysis is required to make a more precise determination, it appears that the annual spillover costs from operating the generator probably would be at least as large as the direct costs. Additional spillover costs would arise from the construction and decommissioning of the facilities associated with the proposed plant, as well as with the proposed transmission line.

Spillover costs matter. Real people, real landowners, real businesses, and real communities will bear them. Many of these costs would accrue to those who reside in or visit the affected

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[34] Southwestern Electric Power Company. 2006. *Environmental Impact Statement: John W. Turk, Jr. Power Plant Project Hempstead County, Arkansas.* Shreveport, Louisiana. December.

[35] Arkansas State Parks. 2007. "Millwood State Park." Retrieved on October 12, 2007, from http://www.arkansasstateparks.com/park-finder/articles.aspx?id=26&aid=73

[36] Heitmeyer, M.E. 2007. "Direct Testimony of Mickey E. Heitmeyer on Behalf of Hempstead County Hunting Club, Inc., Po-Boy Land Company, Inc., Cypress Bayou Corporation, Yellow Creek Corporation, Schultz Family Management Company, and Emon A. Mahony, Collectively ('Intervenors')" Before the Arkansas Public Service Commission. June.

region, through a higher incidence of accidental injuries and deaths, exposure to harmful pollutants in the air, degradation of the area's visibility, adverse impacts on the health of livestock and wildlife, changes in its ecosystem, alterations in its rural character, and consumption of water resources.

Spillover costs also matter because the utilities' ability to impose them on families, landowners, and businesses may be curtailed in the future. This is especially true for those associated with the emission of greenhouse gases, insofar as litigation may force the utilities to bear the damages caused by their emissions. Moreover, Congress and the state legislature may impose regulations aimed at restricting emissions. As utilities become responsible for damages and costs of complying with the regulations, they, and perhaps their ratepayers, will see marked jumps in the costs associated with coal-fired electricity. Additionally, utilities would see similar jumps if they become liable for the damages or incur additional regulatory costs associated with other emissions. We address these risk in the next section.

E. POTENTIAL NEGATIVE CONSEQUENCES: INCREASED RISKS

SWEPCo has justified its decision to develop a coal-fired generator in part because it has compared this alternative against generators that would be fueled by natural gas. In its assessment, SWEPCo asserts that coal prices are less likely than gas prices to jump in the future and cause marked increases in electricity rates, and it concludes this difference in risk is sufficiently important to warrant choosing coal as a source of energy from which to meet future demands for electricity over the next three or more decades.

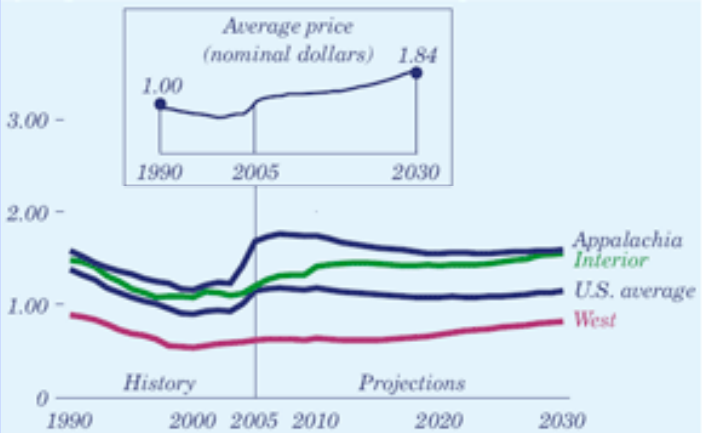
This view, however, overlooks important risks that make coal a less attractive source of energy. One of these, as we discuss above, involves the rapidly rising costs of constructing a coal-fired generator. Another arises because there is momentum building to have utilities bear the costs associated with their future emissions of carbon dioxide. In effect, this action would resemble imposing a tax on carbon-dioxide emissions. Such a tax would raise the cost of both coal and natural gas, but its impact on coal would be much larger. By one recent national analysis, a tax on carbon dioxide initially would raise the cost of coal at least 8 times more than it would raise the cost of natural gas.[37] Successful efforts to make those that burn coal liable for other spillover costs, such as the adverse impacts of airborne pollutants on human health, visibility, and the ecosystem would make the rates paid for coal-fired electricity even greater. In short, it appears that SWEPCo's comparison of the cost-risks associated with coal is incomplete. Folding in the greater spillover costs associated with coal combustion would make coal-fired generators appear more risky.

There also are significant risks associated with SWEPCo's assumption that the price of coal will be less likely to jump than the price of natural gas. The charts in Figure 5 show the current price forecast for each fuel prepared by the Energy Information Administration. The top chart shows that the price of coal mined in western states is expected to rise steadily through 2030. In contrast, the bottom chart shows the price of gas used to generate

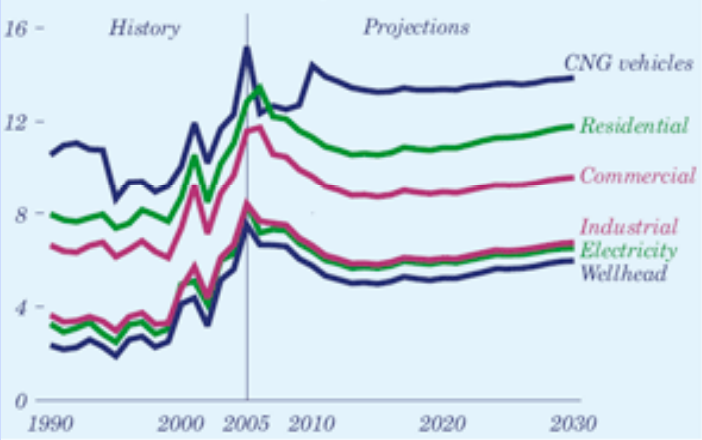
[37] Green, K.P., S.F. Hayward, and K.A. Hassett. 2007. *Climate Change: Caps vs. Taxes*. American Enterprise Institute for Public Policy Research. June. Retrieved October 19, 2007, from http://www.aei.org/publications/pubID.26286,filter.all/pub_detail.asp

Figure 5. The U.S. Department of Energy Expects the Price of Coal Will Rise Relative to the Price of Gas

Average Minemouth Price of Coal, by Region, 1990–2030 (2005 dollars per million Btu)



Natural Gas Prices by End-Use Sector, 1990–2030 (2005 dollars per thousand cubic feet)



Source: Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030.* Report No. DOE/EIA-0383(2007). February. Retrieved October 19, 2007, from http://www.eia.doe.gov/oiaf/aeo/index.html.

electricity is expected to decrease through about 2013 and then rise slowly, but remain below the current price through 2030. Moreover, the Energy Information Administration's analysis of the likelihood that prices may rise faster than expected shows that, under plausible assumptions, by 2030 the price of coal would be 49 percent higher than the reference-case forecast, whereas the price of natural gas would increase by only 27 percent.[38] Combined, these forecasts undermine the reasoning used to justify the proposal to build the Hempstead plant, for they do not show that coal-fired generators embody less risk of jumps in fuel costs than gas-fired generators. They also indicate that, with a decision to proceed with a coal-fired generator, ratepayers should expect at least continual increases, and perhaps large jumps, in the rates they pay for electricity, to cover the rising cost of coal.

[38] U.S. Department of Energy, Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030.* Report No. DOE/EIA-0383(2007). February. Retrieved October 19, 2007, from http://www.eia.doe.gov/oiaf/aeo/index.html

The EIA's findings are supported by others in the utility industry who have reached similar conclusions. In 2005, for example, three top executives from western utilities (Idaho Power, Pacific Gas and Electric Company, and PacifiCorp) co-authored a paper that looked at these and related issues and concluded:

> Utilities and regulators are recognizing the imprudence of assuming that carbon dioxide emissions will not cost anything over the long lifetime of new investments. Several utilities have begun to protect their customers and shareholders from this financial risk by integrating an estimated cost of carbon dioxide emissions into their evaluation of resource options, and selecting the overall least-cost portfolio of resources.[39]

Additional risk accompanies SWEPCo's proposal insofar as it overlooked alternatives, other than gas-fired generators, that promise to meet the region's future demands for electricity at lower expected cost and with less potential for unexpected cost increases. One of these alternatives would entail investments to increase the efficiency of the state's use of electricity and expand the generation of electricity from renewable sources of energy, such as wind and solar.

Another aspect of risk arises from the lumpiness of the financial commitment that accompanies SWEPCo's proposal. Approval of this proposal potentially would obligate ratepayers to cover its costs for several decades, even as demands for energy change in unpredictable ways, or if alternative sources of energy at lower prices should become available. An alternative approach, relying on incremental investments in energy efficiency and renewable resources would be less lumpy and, at least in concept, allow Arkansans greater flexibility in responding to future events.

The risks involved with the development of energy capacity provided by new coal-fired plants are underscored by the recent decision of investment institutions, such as Citigroup, to downgrade the coal industry across the board. In their released assessment of the coal-based companies, the Citigroup analysts named factors, such as lower earnings, infrastructure limitations, elevated stockpiles, and "anti-Coal" politics, responsible for the industry's future downturn.[40]

In sum, rather than providing ratepayers the greatest protection from risk, SWEPCo's proposal to develop a coal-fired generator probably would expose them to significantly greater risk relative to an alternative that would focus on energy efficiency and renewable resources. Based on current information, one cannot reasonably conclude that the proposed Hempstead plant is the least-risk alternative. Further analysis is required to clarify the risks it poses for ratepayers and the state's economy, as well as those of the alternatives.

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[39] Bokenkamp, K., K.H. LaFlash, V. Singh, and D.B. Wang. 2005. "Hedging Carbon Risk: Protecting Customers and Shareholders from the Financial Risk Associated with Carbon Dioxide Emissions." *The Electricity Journal* 18(6): 11–24.

[40] Citigroup Global Markets. 2007. *Coal: Missing the Window; Downgrading on Stubborn Stockpiles, Hostile Politics.* July 18.

IV. A FEASIBLE ALTERNATIVE TO COAL: ENERGY EFFICIENCY AND ELECTRICITY FROM RENEWABLE RESOURCES

Numerous researchers, agencies, and organizations have examined alternatives for meeting future demands for electricity. They have concluded that the best course is to avoid the development of new coal-fired generators and, instead, to invest in increasing energy efficiency, in developing generators powered by renewable resources, such as wind, geothermal heat, solar radiation, and biomass, and in developing new technologies, such as those that would capture and store the carbon dioxide emissions from burning coal.

Arkansas currently ranks 45th among the states in terms of the efficiency with which it consumes electricity. This ranking indicates both that it has extensive opportunities for increasing the efficiency with which electricity is used, freeing up energy to meet new demands, and that it can realize substantial economic benefits by implementing efficiency measures that other states have found beneficial.[41] Taking advantage of these opportunities would be less costly (produce net benefits) than meeting new demands with coal-fired or other generating capacity. A recent review of potential energy efficiency studies in the western United States revealed that "more aggressive, multi-year energy efficiency efforts could save consumers and businesses billions of dollars over the lifetime of the measures, with very favorable benefit-cost ratios."[42] It is likely that these findings would also apply to the potential for increased energy efficiency in Arkansas. The Arkansas Public Service Commission (PSC) apparently concurs, insofar as it earlier this year and for the first time issued rules requiring electric and gas utilities to begin programs to increase the efficiency of energy uses for residential, commercial, and industrial customers. Besides diminishing the demand for new generating capacity, increases in energy efficiency often can generate large economic savings for customers, as indicated by this experience:

> The plant-wide energy-efficiency assessment performed at the Alcoa World Alumina Arkansas Operations in Bauxite, Arkansas, identified seven opportunities to save energy and reduce costs. By implementing five of these improvements, the facility can save 15,100 million British thermal units per year (MMBtu/yr) in natural gas and 8.76 million kilowatt-hours per year (kWh/yr) in electricity. This translates into approximate annual savings of $925,300 in direct energy costs and nonfuel operating and maintenance costs. The required capital investment is estimated at $271,200. The average payback period for all five projects would be approximately 3.5 months.[43]

Arkansas also has renewable resources for generating electricity. Figure 6 depicts the generation potential for both wind and solar energy in Arkansas. Arkansas has a high potential for generating electricity from solar radiation. The U.S. Department of Energy estimates that photovoltaic arrays deployed in Arkansas could produce 4,500 to 5,500 watt-hours per square meter per day.[44] Arkansas also has some commercially viable wind

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[41] American Council for an Energy-Efficient Economy. 2007. *The State Energy Efficiency Scorecard for 2006.*

[42] Western Governors' Association, Clean and Diversified Energy Advisory Committee, Energy Efficiency Task Force. 2006. *Clean and Diversified Energy Initiative: Energy Efficiency Task Force Report*. January. Retrieved October 18, 2007, from http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-summary.pdf.

[43] U.S. Department of Energy, Industrial Technologies Program. 3002. "Alcoa World Alumina: Plant-Wide Assessment at Arkansas Operations Reveals More than $900,000 in Potential Annual Savings." *Mining Best Practices Plant-Wide Assessment Case Study*. July. Retrieved October 20, 2007, from http://www.nrel.gov/docs/fy03osti/32839.pdf.

[44] Arkansas Energy Office. No Date. *Arkansas' Solar Resource*. Retrieved October 12, 2007, from http://www.arkansasrenewableenergy.org/solar/AR_solar_resource.html

resources, concentrated along ridges located in western Arkansas. According to the American Wind Energy Association, the potential wind-power output in Arkansas is 2,460 MW, while the current installed wind-power capacity in Arkansas is only 0.1 MW.[45]

Biomass is another renewable resource that is plentiful in Arkansas. Figure 7 shows the total biomass resources available in the United States by county. The map indicates that there are substantial biomass resources available throughout much of Arkansas. According to the state's Energy Office, Arkansas' biomass resources, including forest residues, mill residues, urban wood waste, agricultural residues, and energy crops, such as poplars, willows, and switchgrass, could generate an estimated 19.8 billion kWh of electricity per year, which equals 150 percent of the state's residential electricity consumption.[46] Some of this resource is readily available for use as a fuel for generating electricity. The cheapest source is wood residue from mills and urban residues, which include chips and grindings of clean wood from construction activities, trimmings, and discarded pallets. Local governments can encourage segregation of clean wood from other forms of municipal waste to help ensure its re-use for mulch, energy, and other markets. Using clean and segregated biomass materials for electricity generation recovers their energy value while avoiding landfill disposal. Mill residues, such as sawdust, bark, and wood scraps from paper, lumber, and furniture manufacturing operations are typically very clean and can be used as fuel by a wide range of biomass energy systems. The Energy Office has estimated that Arkansas can provide 5,372,000 dry tons of wood fuels per year from these sources. The Energy Office Energy also has estimated that the state has the potential to produce 5,510,000 million dry tons of fuel per year from energy crops: fast-growing trees, such as hybrid poplars, shrubs, such as hybrid willows, and grasses, such as switchgrass. Other fuels with significant potential are logging residues (1,738,000 dry tons per year) and agricultural residues (984,000 dry tons per year).

The production and use of biomass to fuel the generation of electricity has not been feasible in the past, in part because utilities have burned coal without bearing the full costs of doing so. As pending regulations force them to bear more of the spillover costs, especially those associated with the emission of carbon dioxide, biomass fuels will become more attractive. Biomass fuels also would have economic benefits besides the displacement of coal. Burning wood residue from mills and urban areas would keep these materials from being deposited in solid-waste landfills. The production of energy crops has the potential to provide an additional, stable source of income for farmers and rural land owners.

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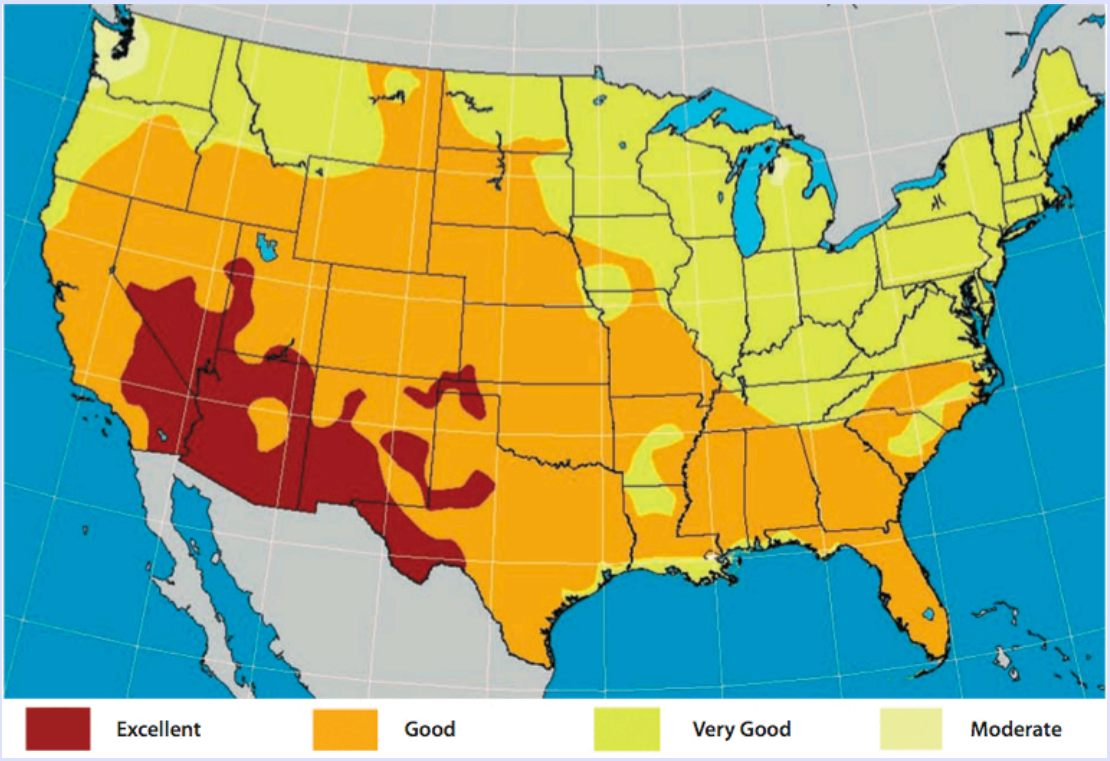
[45] American Wind Energy Association. 2007. *Arkansas Wind Energy Development.* Retrieved October 12, 2007, from http://www.awea.org/projects/arkansas.html

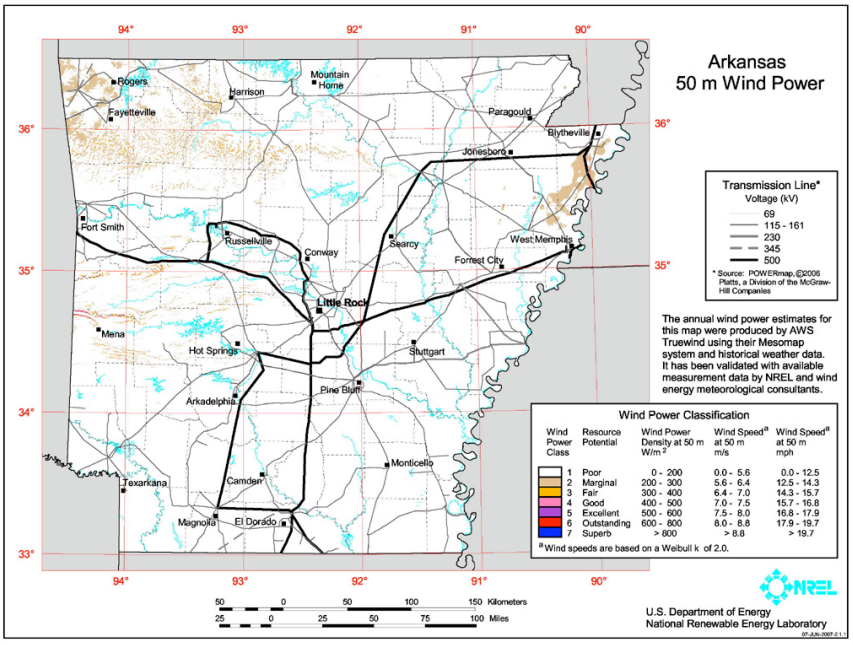
[46] Arkansas Energy Office. No date. "Arkansas Renewable Energy: Bioenergy." Retrieved October 18, 2007, from http://www.arkansasrenewableenergy.org/bioenergy/bioenergy.html

Figure 6. Arkansas Has a High Potential for Generating Electricity from Solar Energy…



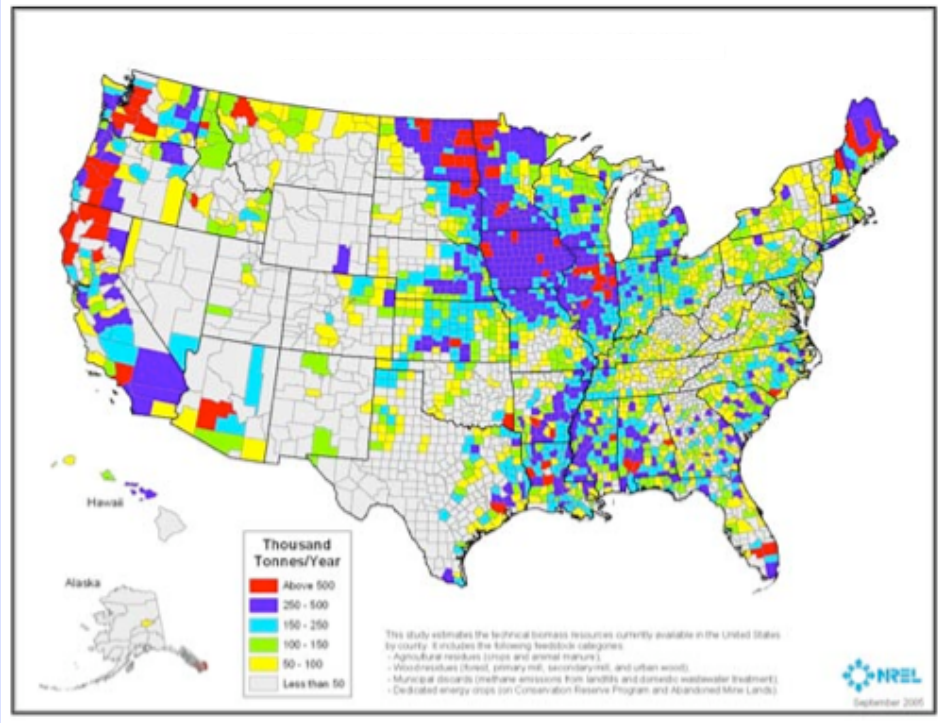
Source: Kellison, B., E. Evans, K. Houlihan, M. Hoffman, M. Kuhn, J. Serface, and T. Pham. 2007. *Opportunity on the Horizon: Photovoltaics in Texas*. University of Texas at Austin, Innovation, Creativity & Capital Institute. June. Retrieved August 12, 2007, from http://www.utexas.edu/ati/cei/documents/TexasSolarOpportunity2007.pdf. Ratings refer to photovoltaic technology.

… and from Wind Resources



Source: U.S. Department of Energy. *Arkansas Wind Resource Map*. Retrieved October 12, 2007, from http://www.eere.energy.gov/windandhydro/windpoweringamerica/images/windmaps/ar_50m_800.jpg

Figure 7. Arkansas Has Potential for Generating Electricity from Biomass



Source: Milbrandt, A.. 2005. *A Geographic Perspective on the Current Biomass Resource Availability in the United States.* Technical Report NREL/TP-560-39181. December. Retrieved October 18, 2007, from http://www.nrel.gov/docs/fy06osti/39181.pdf

In contrast to energy generated from coal, energy efficiency and electricity generated from solar radiation and wind energy would produce little or no air emissions. The combustion of biomass to generate electricity does produce air emissions, however, compared with coal, these are small impacts: biomass results in lower levels of sulfur compounds than coal, and depending on its composition, can result in lower levels of nitrogen oxides. Researchers point out that the biggest benefit of choosing biomass over coal is the reduction in carbon-dioxide emissions. Biomass utilized in a closed-loop process, in which biomass that is used to produce electricity is constantly replaced by new plant growth, is considered to be a small net emitter of carbon dioxide.[47] Additionally, energy efficiency and electricity from wind energy would use little or no water.

The feasibility of the clean-energy portfolio is further enhanced insofar as the State of Arkansas has already taken important steps to increase energy efficiency and encourage the development of renewable energy. In 2005, Arkansas partnered with the Environmental Protection Agency to develop energy-efficiency and renewable-energy projects. The EPA initiated this program with Arkansas and five other states based on its estimates that if all states were to implement cost-effective energy efficiency and clean

[47] Haq, Z. 2002. *Biomass for Electricity Generation.* U.S. Department of Energy, Energy Information Administration. Retrieved October 18, 2007, from http://www.eia.doe.gov/oiaf/analysispaper/biomass/index.html

energy policies, the expected growth rate of electricity demand could be halved by 2025.[48] In January 2007, the Arkansas Public Service Commission adopted energy-efficiency rules for electrical utilities. Implementing the clean-energy portfolio would build on the momentum created by these rules.

If the utilities and others are unable to move quickly enough to meet future demands through investments in energy efficiency and renewable resources, then it may be necessary to develop additional gas-fired generators or generators that burn coal but much more efficiently than, and without the carbon dioxide emissions of, those planned for the Hempstead plant. Gas-fired generators could provide capacity to quickly respond to increases in demand for electricity and, perhaps, to fill in any gaps between the development of other generating capacity. New coal-fired technologies are being developed with the intent to capture the carbon dioxide they would produce and store it underground. Some analysts have concluded that plants with these technologies and a capacity of about 300 MW may be available around 2015 and produce electricity at costs slightly more than the costs associated with the technologies proposed for development in Hempstead County.

In the following paragraphs we examine these three aspects of the potential economic consequences of the energy efficiency/renewable resources alternative:

A. Potential Economic Consequences: More Jobs

B. Potential Economic Consequences: Cost Savings

C. Potential Economic Consequences: Lower Risk

A. POTENTIAL ECONOMIC CONSEQUENCES: MORE JOBS

With a decision to implement the energy-efficiency/renewable-resource alternative, Arkansas would forgo the jobs associated with the Hempstead plant. In exchange, however, it would realize an even greater number of new job opportunities.

Research, reflected in Table 4, suggests that the job advantage for energy efficiency and renewable resources would be greater than for coal. The data in the top rows of the table come from a review of 13 independent studies of the jobs associated with different generating technologies, and show the average annual employment per unit of capacity. The unit of capacity, MWa, adjusts the so-called nameplate capacity of each technology, measured in megawatts or MW, to account for the percentage of time it would be operational. The review of the studies found the development and operation of solar (photovoltaic) generating capacity would involve 7 to 10 times more jobs than coal-fired generators. This finding is reflected by the numbers at the upper right of Table 4: jobs per adjusted megawatt (MWa) for solar (photovoltaic) total 7.41 to 10.56, whereas the total for coal is 1.01. Compared to coal-fired generators, the development and operation of both wind-powered generators and biomass-powered generators could create 30 percent fewer jobs, on the low end, or up to 280 percent more jobs, on the high end. One should note, however, that the studies show the majority of the on-going jobs created by coal-fired

[48] Arkansas Public Service Commission. 2005. *Arkansas Public Service Commission Wins Grant from EPA to Develop Energy Efficiency and Renewable Energy Projects in Arkansas.* March 9. Retrieved October 12, 2007, from http://www.arkansas.gov/psc/EPANewsRel3-05.pdf

generators are associated with the mining and other activities involved in the processing of fuel (coal) rather than with the generation of electricity, *per se*.

Table 4. Generators Powered by Renewable Resources Probably Would Produce More Jobs

Technology	Average Annual Employment over Life of Facility: Construction, Manufacturing, Installation	Average Annual Employment over Life of Facility: Operation, Maintenance, Fuel Processing	Average Annual Employment over Life of Facility: Total[a]
Jobs per MWa[b]			
Solar (Photovoltaic)	5.76 – 6.21	1.20 – 4.80	7.41 – 10.56
Wind	0.43 – 2.51	0.27	0.71 – 2.79
Biomass	0.40	0.38 – 2.44	0.78 – 2.84
Coal	0.27	0.74	1.01
Jobs for 526 MWa[c]			
Solar (Photovoltaic)	3,030 – 3,266	631 – 2,525	3,898 – 5,555
Wind	226 – 1,320	142	373 – 1,468
Biomass	210	200 – 1,283	410 – 1,494
Coal	142	389	531

Source: Kammen, D.M., K. Kapadia, and M. Fripp. 2004. *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* University of California, Berkeley, Renewable and Appropriate Energy Laboratory.

[a] Totals per MWa are reported in the study; they are not the simple sums of the numbers shown in the preceding columns.

[b] MWa equals average installed megawatts, adjusted to reflect the percentage of time a generator would produce electricity. For example, the adjusted capacity of a 1 MW solar facility operating on average 21% of the time, would be 0.21 MWa.

[c] 526 MWa = adjusted capacity of a 600 MW coal-fired generator operating at 87.6 percent of capacity.

The bottom section of Table 4 applies the per-MWa numbers to the amount of generating capacity planned for the Hempstead Plant. SWEPCo plans to install a coal-fired generator with a nameplate capacity of 600 MW, but the adjusted capacity would be 526 MWa, assuming that the generator would operate 87.6 percent of the time.[49] The bottom row of Table 4 shows the average annual employment over the life of the facility: 142 per year in construction, manufacturing, and installation; 389 in operation, maintenance, and fuel processing; and 531 total. The actual number of jobs would vary from year to year; these are the annual averages. Comparable generating capacity from solar (photovoltaic) resources would create the following levels of average annual employment: 3,030 to 3,266 per year in construction, manufacturing, and installation; 631 to 2,525 in operation, maintenance, and fuel processing; and 3,898 to 5,555 total. The comparable numbers for wind-powered

[49] McCellon-Allen, V. 2006. "Direct Testimony on Behalf of Southwestern Electric Power Company." *In the Matter of the Application of Southwestern Electric Power Company for a Certificate of Environmental Compatibility and Public Need for the Construction, Ownership, Operation, and Maintenance of a Coal-fired Baseload Generating Facility in Hempstead County, Arkansas.* Docket No. 06-154-U. December.

generation are: 226 to 1,320 jobs per year in construction, manufacturing, and installation; 142 jobs in operation, maintenance, and fuel processing; and 373 to 1,468 jobs total. The comparable numbers for biomass-powered generation are 210 jobs per year in construction, manufacturing, and installation; 200 to 1,283 jobs in operation, maintenance, fuel processing; and 410 to 1,494 jobs total.

All these employment estimates are just that: they reflect the findings of recent studies applied to an assumption that each type of generating could be built in Arkansas. The actual feasibility of individual facilities has to be determined. The actual extent to which the jobs associated with each type of facility would materialize in Arkansas also remains to be determined.

It is clear, however, that coal-fired electricity offers the lowest potential job creation and most of the long-run coal-related jobs probably would occur outside Arkansas and be associated with the mining, processing, and transportation of coal. The solar and wind technologies would have no fuel-processing jobs; all of the long-run employment would arise from operation and maintenance activities. Some of the manufacturing jobs associated with each of the technologies probably would occur elsewhere. Most, if not all, of the operation and maintenance jobs would occur in the state. There is some evidence already in Arkansas that investments in renewable energy would bring substantial jobs to the state: DMI Industries announced plans to build a new facility in Little Rock by 2008. The facility would manufacture wind-turbine blades and create more than 1,000 new jobs within five years, over 9 times the number of long-term jobs expected from the Hempstead plant.[50]

Research reported by the National Renewable Energy Laboratory gives separate insights into the potential for wind-powered generators to create jobs and incomes in Arkansas, and especially in adjacent rural communities. An analysis of existing utility-scale wind-powered generators showed they created 40 to 140 construction jobs, and 6 to 20 (average 10) permanent jobs, per 100 MW of generating capacity. Due to increased efficiencies, new generators probably would create somewhat fewer jobs than those of the past.[51] This research also shows that the development of wind-powered generators can have additional impacts on local economies. A typical wind farm in the U.S., with 100 MW of capacity, boosts property tax revenues by $500,000 to 1 million per year. When located on private land, the landowner receives lease payments of $2,500 to 3,000 per MW of capacity.

A different analysis compared the in-state economic impacts of comparably sized gas-fired, coal-fired, and wind-powered generators that might be built in Arizona, Colorado, or Michigan.[52] The author compared in-state direct spending associated with each type of facility, assuming its annual output would equal that of a reference, 270-MW gas-fired generator. She examined expenditures over a 20-year period in these categories:

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[50] "Wind Blade Manufacturer Plans Facility in Arkansas." 2007. *Composites Technology*. August. Retrieved October 12, 2007, from http://www.compositesworld.com/ct/issues/2007/August/111908

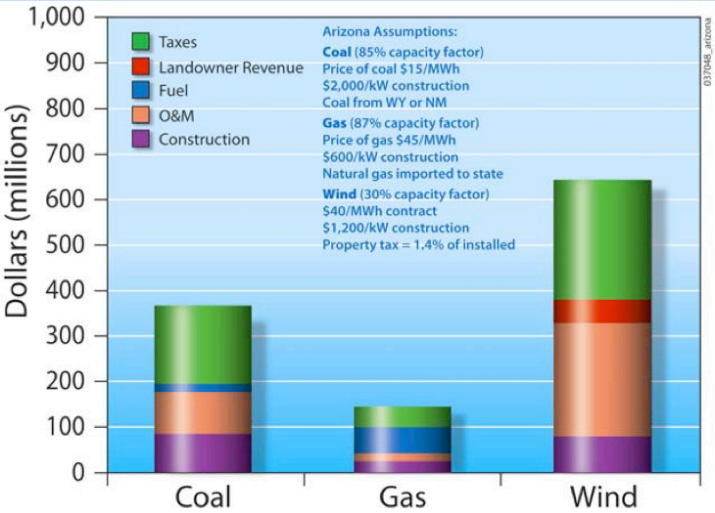
[51] Kelly, M. 2007. *Wind Energy & Economic Development*. National Renewable Energy Laboratory. June 8. Retrieved July 25, 2007, from http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/econ_dev.pdf

[52] Tegen, S. 2006. *Comparing Statewide Economic Impacts of New Generation from Wind, Coal, and Natural Gas in Arizona, Colorado, and Michigan*. NREL/TP-500-37720. National Renewable Energy Laboratory. May. Retrieved July 25, 2007, from http://www.nrel.gov/docs/fy06osti/37720.pdf.

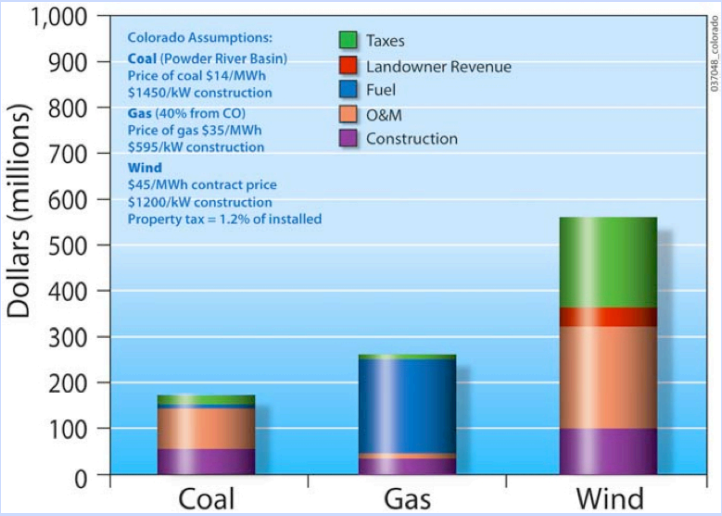
construction, operations and maintenance, fuel extraction, fuel transport, land leases, financing, and property taxes. She found that, for each of the three states, in-state expenditures associated with wind-powered generators would significantly exceed those for coal-fired generators. The higher in-state expenditures likely would result in higher in-state job creation for wind-powered relative to coal-fired generators.

Figure 8. In-State Expenditures for Comparably-Sized Coal-Fired, Gas-Fired, and Wind-Powered Generators

Arizona



Colorado



Source: Tegen, S. 2006. *Comparing Statewide Economic Impacts of New Generation from Wind, Coal, and Natural Gas in Arizona, Colorado, and Michigan.* NREL/TP-500-37720. National Renewable Energy Laboratory. May. Retrieved July 25, 2007, from http://www.nrel.gov/docs/fy06osti/37720.pdf.

Much of the potential for new wind-related jobs exists in Arkansas' western region, just north of the planned Hempstead plant. Figure 6, above, shows the state's extensive wind

resources, and indicates estimates of wind speeds at 50 meters above the ground, representing the height at which windmills would operate. The map shows wind resources ranked from Class 1 (lowest) to Class 7 (highest). The Department of Energy notes that, in general, sites with winds in Class 4 or above are potentially suitable for the development of utility-scale generators, and anticipated advancements in technology are likely to expand this range to Class 3 sites. The department's assessment of the state's wind resources concludes that some of the best sites are in the state's western region:

> The map indicates that Arkansas has wind resources can be considered for utility-scale production. The highest wind resources are found on exposed ridge crests and elevated terrain areas in the western part of the state. The best wind resource areas are concentrated on the higher elevations of the Ouachita Mountains, particularly near Mena, and the Boston Mountains of northwestern Arkansas. [53]

The actual employment impacts of the energy-efficiency/renewable-resource alternative would depend, in part, on the facility with which the state's utilities, regulators, legislature, and communities recognize and capitalize on opportunities to increase energy efficiency and develop new generating capacity using renewable resources. Some assistance toward this end already is available: the National Renewable Energy Laboratory, together with the National Association of Counties, has prepared a handbook to help county commissioners capitalize on the economic development opportunities associated with wind-powered generators, for example.[54] Similar assistance is likely to become available for other resources and energy-efficiency activities.

B. POTENTIAL ECONOMIC CONSEQUENCES: COST SAVINGS

Coal-fired electricity is not necessarily the lowest-cost option for Arkansas' families and businesses. The rapidly rising construction costs for coal-fired generators are whittling away at the apparent cost advantages touted by their supporters. Recent increases have raised the average (levelized) costs by more than $20 per MWh, making coal-fired generators less attractive not just with respect to energy efficiency and generators powered by renewable energy but also with respect to generators powered by natural gas.[55]

The cost advantages of energy efficiency can be substantial. An advisory committee to the Western Governors' Association, which reviewed seven major studies of the current potential for energy-efficiency investments, found it would be cheaper to reduce the demand for electricity through investments in energy efficiency, than to expand the supply of electricity through the development of coal-fired generators. From its review of existing

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[53] U.S. Department of Energy, Wind & Hydropower Technologies Program. "Arkansas Wind Resource Map." Retrieved October 12, 2007, from http://www.eere.energy.gov/windandhydro/windpoweringamerica/maps_template.asp?stateab=AR

[54] Costanti, M., and P. Beltrone. 2006. *Wind Energy Guide for County Commissioners.* National Renewable Energy Laboratory, Wind Powering America, and the National Association of Counties October 31. Retrieved October 30, 2007, from http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/county_commissioners.pdf.

[55] Chupka, W.M. and G. Basheda. 2007. *Rising Utility Construction Costs: Sources and Impacts.* The Brattle Group. September.

Table 5. Potential Direct Costs,[a] by Alternative (cents per kilowatt-hour)

Hempstead Plant (Coal)[b]	Energy Efficiency[c]	Wind[d]	Biomass[e]	Solar[e]
5 – 6	2 – 3	5 – 6	6	12-16

Source: ECONorthwest

[a] Approximate busbar costs, ignoring spillover costs.

[b] U.S. Department of Energy, Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030.* Report #:DOE/EIA-0383(2007). February. Retrieved October 19, 2007, from http://www.eia.doe.gov/oiaf/aeo/excel/figure56_data.xls.

[c] Western Governors' Association, Clean and Diversified Energy Advisory Committee, Energy Efficiency Task Force. 2006. *Clean and Diversified Energy Initiative: Energy Efficiency Task Force Report.* January. Retrieved October 19, 2007, from http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-summary.pdf.

[d] U.S. Department of Energy, Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030,* and Wiser, R. and M. Bollinger. 2007. *Annual Report on U.S. Wind Power, Installation, Cost, and Performance Trends: 2006.* U.S. Department of Energy, Energy Efficiency and Renewable Energy. May. Retrieved October 19, 2007, from http://www.nrel.gov/docs/fy07osti/41435.pdf.

[e] U.S. Department of Energy, Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030.* Report #:DOE/EIA-0383(2007). February. Retrieved October 19, 2007, from http://www.eia.doe.gov/oiaf/aeo/excel/figure62_data.xls.

energy-efficiency programs, the task force found that "**Most of the programs are saving electricity at a total cost of 2 to 3 cents per kWh saved**."[56] [bold emphasis added]

Table 5 applies this finding and shows that, to the extent that Arkansans can accomplish energy efficiency at similar rates, then the direct cost of saving energy would be about half the direct cost of generating new coal-fired electricity: 2 to 3 cents versus about 5 to 6 cents per kWh. This cost saving would total about $138 million per year, if energy efficiency could offset all of the electricity that the 600-MW generator would produce annually, operating at 87.6 percent capacity. If not, then the research underlying the other data in Table Y indicates that electricity could be generated from wind and biomass at about the same cost as electricity from coal-fired generators. (This statement ignores spillover costs which, as we demonstrate above, would be far greater for coal-fired electricity.)

The task force's findings indicate, however, that energy-efficiency programs and policies probably would not be powerful enough to nullify all requirements to build new generating capacity. Hence, some new generating capacity would be required. Electricity from new generators that rely on the sun, wind, or biomass as a source of energy might have higher direct costs than electricity from the proposed coal-fired generator in Hempstead County. Or, it might not. In the past, the direct costs of electricity from these renewable resources have been higher, but some of these costs have been offset by subsidies. The costs of electricity from renewable resources have been declining, however, at least until recently, when the demand for new facilities outstripped manufacturing capacity, and studies indicate there is a high likelihood that they will be the same as, or even lower than, the direct costs of coal-fired electricity in the foreseeable future. A review of recent analyses found that the cost of electricity from new wind-powered generators currently is about 6 to

[56] Western Governors' Association, Clean and Diversified Energy Advisory Committee, Energy Efficiency Task Force. 2006. *See* footnote 51.

9 cents per kWh, and half that amount at the best sites.[57] According to the EIA, depending on the location and availability of biomass fuel, new baseload biomass electricity plants may be competitive with new coal-fired plants.[58]

In short, these data indicate there is a high likelihood that Arkansas' ratepayers would pay significantly less to address the state's future demands for electricity not by building coal-fired generators but by investing in energy efficiency, at one-half the current cost of coal-fired electricity (ignoring spillover costs), and on generating additional electricity from renewable resources, at roughly the same cost as the current cost of coal-fired electricity. Further analysis, however, is required to develop a more detailed description of each alternative and produce a more precise comparison of their relative costs.

C. POTENTIAL ECONOMIC CONSEQUENCES: LOWER RISK

Above, we describe the economic risks that would accompany development of the coal-fired generators proposed for the Hempstead plant. Many of these risks would be borne by ratepayers. Substantial evidence indicates that electricity from coal-fired generators probably would be more expensive than estimated by SWEPCo. Recent rapid rises in the cost of developing coal-fired generators suggest that ratepayers would be responsible for costs far greater than current estimates. Once the generators are built, rate shocks could materialize if coal prices are higher than expected. They also could occur if SWEPCo were to incur significant costs for their emissions of carbon dioxide. Indeed, the company, itself, has recognized this risk:

> [A]ny legal obligation that would require us to substantially reduce our emissions beyond present levels could require extensive mitigation efforts and, in the case of CO_2 legislation, would raise uncertainty about the future viability of fossil fuels, particularly coal, as an energy source for new and existing electric generation facilities.[59]

In other words, the company is saying that anticipated regulations to curtail emissions of carbon dioxide could make coal no longer viable as a fuel from which to generate electricity, so that it would be uneconomical to construct new coal-fired generators, and/or uneconomical to maintain or operate a generator already in place. This assessment indicates there is a real probability that money spent to develop the Hempstead plant may yield no benefits at all. Instead, the proposed coal-fired generators may become obsolete, perhaps even before they are completed, leaving ratepayers and/or shareholders to swallow the costs of the unproductive plant and equipment and the accelerated costs of decommissioning the facilities. Moreover, if SWEPCo decided to maintain its coal facilities should carbon-dioxide emissions become regulated, company filings unequivocally state that it would seek recovery of expenditures for potential regulation of these emissions from customers in both regulated and deregulated jurisdictions.[60] This statement

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[57] Smith, R. 2007 "The New Math of Alternative Energy." *The Wall Street Journal*. February 23. Retrieved October 30, 2007, from http://yaleglobal.yale.edu/display.article?id=8813.

[58] U.S. Department of Energy, Energy Information Administration. 2007. *Annual Energy Outlook 2007 with Projections to 2030*. Report #:DOE/EIA-0383(2007). February. Retrieved October 19, 2007, from http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2007).pdf.

[59] American Electric Power. 2007. *Form 10-K*. Filed with the U.S. Securities and Exchange Commission, p. 34.

[60] American Electric Power. 2007. *Form 10-K*. Filed with the U.S. Securities and Exchange Commission, p. A-30.

notwithstanding, the Attorney General of New York has recognized that the risks to shareholders are substantial and asked SWEPCo's parent company for more information regarding the potential risk to shareholders. The treasurers of several states, together with the managers of some large pension funds and others also have recently requested far more detail than has been available in the past regarding the risks.

Ratepayers and shareholders are not the only ones who would bear significant risks. Residents of Hempstead County and the surrounding area would face the probability that emissions from the generators would increase the incidence of illness and premature death, adversely affect crops and livestock, diminish the quantity and/or quality of water resources, impair amenities that contribute to the quality of life for those who live in the area, and lower property values. Businesses and communities would bear risks associated with the likelihood that activity in the tourism and recreational sectors would diminish insofar as emissions from the generators would reduce the quality of life in the region.

Everyone would bear risks of the emissions' contributions to climate changes, which may include higher incidence of hurricanes, other severe storms, flooding, extinctions of species, wildfires, more frequent and intense droughts, spread of insects and diseases, and numerous other undesirable outcomes.

Implementing the energy-efficiency/renewable-resources alternative would avoid most of these risks. Evidence indicates that this alternative probably would enable Arkansas to meet future demand for electricity at a lower cost. Electricity made available from investments in energy efficiency is predicted to cost about one-half the current estimated direct cost of coal-fired electricity. The cost of electricity from renewable resources is predicted to be comparable to the current cost of coal-fired electricity (exclusive of spillover costs), but the latter likely will jump when utilities incur costs for emitting carbon dioxide.

None of this is to say that ratepayers would face no economic risks with the energy-efficiency/renewable-resources alternative. Significant hurdles would have to be overcome to develop and implement new technologies. Arkansas would not be alone in trying to overcome them, however. Other states and countries, numerous businesses, and countless communities are striving to find new ways and lower the costs of increasing energy efficiency and generating electricity from renewable resources. All this activity is likely to yield new technologies and, as they become available, Arkansas would be prepared to take advantage of them. Hence, as Arkansans weigh this alternative against coal-fired generators, they must assess the likelihood that these efforts will be successful.

For individuals, families, landowners, businesses, and communities, the tradeoffs between the two alternatives are more striking. The energy-efficiency/renewable-resources option is much less likely to adversely affect human health (though there undoubtedly will be some accidents and other undesirable outcomes). It is much less likely to have adverse impacts on crops, livestock, fish and wildlife, and the overall ecosystem. Moreover, the energy-efficiency/renewable-resources option would positively reinforce efforts to limit climate change.

V. REFLECTIONS AND CONCLUSIONS

Arkansans face important choices that will affect their pocketbooks, communities, job opportunities, and, for some, even their lives. Some have argued that building coal-fired generators is the safe choice: it is a proven technology, coal is less costly than natural gas, and, although energy efficiency and renewable-resource generators sound good, they have a short track record. In sum, they say Arkansas should choose coal, because it is less costly and less risky.

But cost and risk are tricky things to get one's arms around. Often, in situations such as this, decision-makers and the public confuse cost and risk with the availability of information, and assume that an alternative supported by large amounts of data and studies have less cost and risk than those that aren't. Or, they assume that, if something was the best alternative in the past then it must be the best in the future. Each of these approaches is akin to steering a car by looking in the rearview mirror, seeking solace by regarding a view where the terrain is familiar, rather than endure the discomfort of scrutinizing the less familiar landscape visible through the windshield. Looking backward rather than forward can have disastrous results especially at a time, such as now, when the factors that influence cost and risk are changing dramatically. Never before have utilities and ratepayers faced the prospect of becoming liable for substantial costs associated with climate change. Not for generations, perhaps millennia, has the southeast faced the prospect of climate extremes that many scientists believe has already arrived on our doorstep. Only recently has the economic outlook for communities depended more on their ability to sustain a healthy environment than on their ability to sacrifice the environment to industrial development.

If Arkansans are to manage economic costs and risks effectively as they choose between building new coal-fired generators and implementing the energy-efficiency/renewable-resources alternative, they must fully assess and weigh these and other factors, making certain they are looking ahead, not looking in the rearview mirror. We believe that, if they do so, they will conclude that a prudent strategy is to limit exposure to the significant costs and risks that accompany the development of coal-fired generators.