



**FINAL**

## **2003 Topics**

- Wind
- Coal Bed Natural Gas
- Hydrogen
- Energy Infrastructure

**REPORT**

## **2004 Topics**

- Coal Workforce Development
- Economic & Homeland Security
- Coal Utilization
- National Coal Issues





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# The Energy Roadmap Workshop Series

## About the Series

On February 14, 2001, then-Governor Bob Wise signed Executive Order Number 5-01 creating the Energy Task Force whose charter was to outline a 20-year roadmap for West Virginia to play a leadership role in energy. The task force, headed by Patrick Esposito, Ph.D., of Morgantown, included recommendations for workshops to further evaluate specific opportunities. The West Virginia Development Office (WVDO) noted these recommendations and worked with West Virginia University's National Research Center for Coal and Energy (WVU NRCCE) and the College of Business and Economics (CB&E) to sponsor and coordinate four workshops in 2003 about **wind, coal bed natural gas, hydrogen, and energy infrastructure**. Subsequently, the West Virginia Coal Forum approached the Development Office about continuing the series with a special emphasis on coal-related issues. As a result, four workshops on coal were conducted during 2004 focusing on **coal workforce development, economic impact of coal, coal utilization technologies, and national trends for coal**.

Each workshop had a program committee responsible for outlining the objectives and presentations for the workshop. Consequently, the objectives and format of each workshop were tailored to that particular workshop consistent with the desires of the individual program committees. The WVU NRCCE executed the details of each event except for the wind workshop which was executed by the WVU CB&E.

The 2003 wind workshop was conducted at Canaan Valley Resort. The remaining 2003 workshops were held at the Stonewall Resort in Roanoke, West Virginia. The 2004 series was conducted at sites around the state to foster participation by those in regions that were most affected by the particular issue.

The Energy Task Force Report and information from these eight workshops is provided in the website maintained by the WVU NRCCE:  
<http://www.WVEnergyRoadmapWorkshops.org>.

## About this Report

This report includes a summary of recommendations by participants and observations by experts and a reporting of each of the workshops. This report was compiled by Trina Karolchik Wafle, associate director of the National Research Center for Coal and Energy at West Virginia University.

## Recommendations and Observations Summary

At the eight workshops focusing on West Virginia's role as an energy leader, various participants and experts developed a variety of recommendations and offered observations about coal and energy. Those recommendations and observations are encapsulated below.

- The state should foster continued interaction of the various stakeholders in the development of **wind** energy in West Virginia.
- New legislation should be written which resolves the remaining issues regarding **coal bed natural gas** development and ownership which were not resolved in the decision handed down by the West Virginia Supreme Court in November 2003.
- The state should write comprehensive Rules and Regulations for **coal bed natural gas development** and place regulatory responsibility within one state agency thereby streamline permitting and reporting.
- The state should evaluate the costs and benefits of providing incentives for **coal bed methane** development such as tax incentives and credits covering drilling, production, gas clean up, and transportation.
- The existing coal and oil and gas data bases at the West Virginia Geological Survey should be modified to accommodate additional data related to **coal bed natural gas** development and production.
- The state should provide matching funds for a Government/Industry/Academic **Coal Bed Natural Gas** Research Consortium charged with developing a research plan for coal bed natural gas drilling, completion, production, water use and disposal, enhanced coal bed natural gas production technology, carbon dioxide injection, gathering, compression and transmission, and developing the necessary infrastructure.
- The state should commission a report with recommendations regarding the type of infrastructure needed to promote and support **coal bed natural gas** and the costs and benefits which would result from such investments.
- The state should examine its current regulatory and tax environment to remove barriers in the existing industries—coal, chemical, natural gas, electricity—that would be vital to the **hydrogen** economy and to establish a regulatory environment that would promote the adoption of hydrogen-based production, distribution, and manufacturing facilities and the associated carbon sequestration capabilities.
- The state should work tirelessly to ensure that the U.S. Department of Energy's FutureGen plant is located in West Virginia for example, by locating appropriate sites. FutureGen is a federal **hydrogen** initiative which incorporates electricity and hydrogen production from coal with carbon sequestration to prevent global climate change. FutureGen will be based on Integrated Gasification Combined Cycle, or IGCC, technology.
- The state should position itself to be able to quickly permit carbon sequestration sites, a key component of the U.S. Department of Energy's FutureGen **hydrogen** program.

- The state should facilitate creation of a public-private partnership specifically focusing on **hydrogen** production and transportation capabilities given that hydrogen can be produced from coal.
- The state should establish an educational outreach program for stakeholders, for K-12, and for the public to disseminate information about **hydrogen**.
- The state should create tax incentives to stimulate small business energy research and development in regard to **hydrogen**.
- The state should establish an energy research and development fund that would allow both public and private entities, including industry and academia, to access state research funds that could be used to cost-share federal research programs in regard to **hydrogen**.
- The state should charge an appropriate state agency with developing a full-fledged **hydrogen** roadmap for the state.
- The governor should convene a forum of federal regulators, state regulators, and industry representatives to address the issue of capital investment incentives for the development of **natural gas infrastructure**. Suggestions for capital formation included that the Public Service Commission (PSC) should ensure that authorized rates of return for regulated utilities are sufficient to encourage infrastructure investment and that the PSC should designate local distribution companies (LDC's) as suppliers of last resort.
- The legislature should provide a severance tax credit for fees to be paid by producers to transmission or pipeline firms to finance the **natural gas infrastructure**.
- The state should establish **natural gas infrastructure** corridors.
- The state should collaborate with the National Energy Technology Laboratory (NETL) in Morgantown, WV to engage in educational activities regarding the economic importance of **energy infrastructure**.
- The state should engage in proactive siting of **energy infrastructure** and electricity generation projects.
- The state should improve and streamline the project approval and **infrastructure** permitting process by facilitating interagency cooperation and collaboration.
- The state should collect meteorological data which would facilitate **energy infrastructure** project development process.
- The state should conduct tabletop **energy infrastructure** security exercises.
- The state should support **energy infrastructure** security modeling and assessment.
- The state should apply (or provide application incentives for) new **energy infrastructure** security technologies as they become available.
- The state should support research and development for **energy infrastructure** security programs.
- Key **coal workforce** issues identified were: a need to educate and update the public about the new realities of mining and using coal—cleaner, safer, highly automated, well-

paying; a need for young, trained workers with solid academic skills such as math and English, especially given the fact that the average worker is 50+ years old; a need to shift from traditional manual labor skills to knowledge-based skills among the workforce; and the need for a vision for training within the industry.

- **Homeland security** could be a common ground for industry and labor to approach the environmental community to open avenues between competing groups to move forward.
- More than one group or organization is needed to put together a plan to position West Virginia as a leader in energy as it relates to **homeland security**, perhaps through the Vision Shared process. See [www.visionshared.com](http://www.visionshared.com).
- Once first responders are adequately addressed, the federal government will likely fund “second tier” activities looking at longer term **homeland security** issues. West Virginia needs to position itself to benefit from such federal funding building on its energy capabilities.
- The state’s political leaders need to be educated about **homeland security** opportunities to develop the will and position the state to take advantage of its energy resources for securing the homeland.
- In regard to **coal utilization**, coal to transportation liquids and carbon management were cited as being the most important topics presented.
- Advances in mining technology allow mining in thinner seams, improved processing plants that offer multiple clean coal products are replacing less efficient plants, and newer combustions technologies such as fluidized bed and pressurized fluidized bed combustion all enhance **coal utilization**.
- The Coal Utilization Research Council has developed a roadmap for **coal utilization** for the nation that calls for a \$10.7 billion, 15-year research program leading to cost competitive, near-zero emission coal-based plants. See [www.coal.org](http://www.coal.org).
- Research into advanced coal-fired power generation technologies targets 99% removal of sulfur dioxide, less than .01 pounds per million Btu of nitrogen oxides emissions, removal of 95% of mercury, use of 100% of coal ash, and increasing plant efficiency from 40% to 60% all by 2020 thus enhancing **coal utilization**.
- Fossil fuels will continue to be the preferred option for transportation fuels; **coal utilization** as coal-derived liquids are compatible with today’s gasoline-based storage and delivery system and can make petroleum-based fuels cleaner.
- A **coal utilization** expert reported that sixty coal-to-liquids plants built two to three per year until 2030 would produce 2 million barrels per day of liquids and generate 30 gigawatts of power at a capital cost of \$136 billion.
- A 5,000 barrel per day coal-to-oil power facility is under development in Gilberton, PA, and developers are interested in West Virginia as a site for a future facility to promote **coal utilization**.
- Carbon management will be essential for continued **coal utilization**: coal seams have the potential to store between 200 and 300 gigatons of carbon, depleted oil wells and deep

saline formations have the potential to store another 1,900 gigatons of carbon. On an annual basis, the worldwide carbon emissions are 6.5 gigatons per year.

- An emerging voluntary program called CO-OP has been launched by a West Virginia company to promote carbon management in the energy industry.
- Integrated Gasification Combined Cycle technology, or IGCC, offers one **coal utilization** option that boasts high-efficiency, near zero-emissions electricity and chemicals production.
- On a case-by-case basis, coal ash can be utilized to remediate environmental impacts of mining enhancing **coal utilization** by providing productive uses of coal combustion byproducts.
- “Eco Parks” may help promote **coal utilization** by siting energy developers with energy users as in the case in the Greenbriar Co-Generation Project. West Virginia is rich in energy intensive manufacturers who would benefit from such a concept.
- The West Virginia Development Office has been working with others to identify target sites for FutureGen to promote **coal utilization**.
- Looking forward, the **national coal trends** are changing: bankruptcies are winding down; customers anticipate higher prices; new mines are opening in the East; old mines are reopening; expect \$70 and \$80 per short ton f.o.b. for metallurgical coal; electricity demand will rise; natural gas prices will rise; mining productivity will rise; emissions caps may shift demand to western coals; industrial coal demand and coal exports may decline while coal imports rise.
- Coal severance tax revenues are rising consistent with international and **national coal trends** for increased demand and higher prices, contributing to about 2.5% increase in general revenue funds; coal severance tax supports local communities’ finances, the state general revenue fund, and infrastructure improvements for water and sewer.
- **Nationally coal** contributes \$163 to \$659 billion in increased economic activity, \$40 to \$224 billion in household earnings, and 800,000 to 6.4 million additional jobs.
- **National coal trends** show coal-based electricity has nearly tripled while emissions of health-related pollutants have been reduced by one-third since 1970.
- Key **national coal** environmental challenges include mining with minimal environmental footprint, and addressing mercury emissions and climate change.
- Lack of environmental controls in China on the burning of coal will likely swamp any environmental improvements seen in the United States.
- The largest U.S. generator of electricity, AEP, uses coal for 70% of its generation today and is moving toward 90% coal-fired power production.
- The absence or constraint of available electricity is a basic reason for the world’s poverty—the most important of the energies at the beginning seems to be electric power. Coal is 70% of the world’s proven resources of fossil fuels and is widely dispersed around the world and can play a pivotal role in attacking poverty since available electricity is a key building block for economic development.

# The 2003 Workshop Series

## Wind Workshop

(Full report prepared by Patrick Mann of WVU CB&E is available at [www.EnergyRoadmapWorkshops.org](http://www.EnergyRoadmapWorkshops.org))

The program committee included Patrick Mann, professor in the WVU College of Business and Economics and Jeff Herholdt, manager of Energy Efficiency Programs at the West Virginia Development Office. The Wind Energy Workshop was conducted September 23 and 24, 2003 at the Canaan Valley Resort and Conference Center, in Davis, West Virginia. Approximately 100 people attended. Participants included developers, academics, economic development representatives, public utility representatives, environmentalists, and interested members of the public.

Topics discussed included the future of wind energy in the United States, a technical update on wind energy, an update on wind energy projects in West Virginia, energy transmission and interconnection, environmental issues in wind energy, new wind energy technologies, the environmental benefits of wind energy, wind energy financing, wind energy manufacturing in West Virginia, and the future of wind energy development in West Virginia.

The workshop concluded with a tour of the FPL Mountaineer Wind Energy Center. The outcome of the wind energy workshop was the continued interaction of the various stakeholders in the development of wind energy as well as providing an update on wind energy development in West Virginia.

Seven of the workshop presentations can be found at:  
[http://www.eere.energy.gov/windpoweringamerica/wkshp\\_2003\\_wv.html](http://www.eere.energy.gov/windpoweringamerica/wkshp_2003_wv.html)

## Coal Bed Natural Gas Workshop

(Full report prepared by Douglas G. Patchen of WVU NRCCE is available at [www.EnergyRoadmapWorkshops.org](http://www.EnergyRoadmapWorkshops.org))

The program committee included **Douglas Patchen** (chair), Petroleum Technology Transfer Council at WVU NRCCE, **Jeff Herholdt**, West Virginia Development Office Energy Efficiency Programs, **Tom Lane**, Bowles Rice McDavid Graff & Love, **Clint Hurt**, Clint Hurt and Associates, **Charlie Bryer**, National Energy Technology Laboratory, and **Patrick Esposito Sr.**, Augusta Systems.

The event was held October 29, 2003 at the Stonewall Resort in Roanoke, WV and was attended by more than 160 people, making it the largest of all the workshops.

The program committee had two main goals. One was to identify issues with coal bed natural gas (CBNG) that are perceived as impediments to the development of this resource in West Virginia, and the second was to identify steps that the West Virginia can take to remove these perceived road blocks.

To achieve these goals, the program committee brought together a diverse group of people who represented coal operators, gas producers, land companies, transmission companies, state regulatory officials, and lawyers.

Eight featured speakers had been invited to share their views on CBNG potential, current activity, and key issues. Three panels were then convened to focus attention on specific issues leading into the issues identification portion of the workshop. The attendees were divided into 17 groups to solicit feedback related to ownership, landowner and regulatory issues; economic impediments and incentives; and infrastructure issues.

## Keynote Speakers

Featured speakers included:

**Patrick Esposito, Sr.** of Augusta Systems and chairman, Governor's Energy Task Force, who provided attendees with his vision of what West Virginia's coal bed natural gas industry would look like in 2020.

**Katharine Lee Avary** from the West Virginia Geological Survey who presented an overview of the resource potential and location of current coal bed natural gas development in West Virginia.

**Matt Conrad** and **Bill Vail**, both of Marshall Miller and Associates, who presented an overview of coal bed natural gas issues including resource assessment parameters, ownership and leasing, coordinating efforts with the mining estate, development options, saltwater disposal, geology, engineering, and economics.

**David Bassage**, from the West Virginia Department of Environmental Protection, who discussed coal bed natural gas as a greenhouse gas, noting that methane has a lower residence time in the atmosphere than carbon dioxide and that technology is available to capture the methane.

**Tom Lane** of Bowles Rice McDavid Graff & Love, PLLC, who chaired a session featuring **George Mason** and **James Martin**, who shared their thoughts on pooling, unitization and field rules as applied in Virginia and West Virginia. Mason, of Mason Energy Consultants Inc., discussed his experience in Virginia, with references to spacing in the Nora, Oakwood, and Roaring Fork fields. Martin, from the West Virginia Department of Environmental Protection, discussed pooling and unitization in West Virginia as set out in the act of 1994 that protected coal and the right to vent gas with mining.

## CBNG Issues Identification Panels

The Ownership, Landowner and Regulatory Issues Panel included Tom Lane of Bowles Rice McDavid Graff & Love, PLLC, **James (Marty) Martin** of the West Virginia Department of Environmental Protection, **Neal Pierce** from Robinson McElwee, and **Kevin Wall** from Natural Resource Partners.

Lane stated that in the east, gas in coal beds generally is assigned to the coal owner, whereas in the west, gas in coal beds generally is assigned to the mineral (gas) owner. Wall made brief remarks concerning the vast coal resources of the central and northern coal basins, which amount to more than 1.5 billion tons in reserve. Pierce mentioned that Virginia regulates coal bed natural gas extraction through one board, whereas in West Virginia three boards have some overview of the industry: the Shallow Gas Well Review Board, the Coal Bed Methane Review Board and the Oil and Gas Conservation Commission. Martin went into some detail regarding shallow gas well activity and coal bed methane permitting.

The Economic Impediments and Incentives Issues Panel included **Don Nestor** of Toothman Rice, **Mike Mooney** of Penn Virginia, **Claude Morgan** of CNX Gas, and **Charles Byrer** from the U.S. Department of Energy's National Energy Technology Laboratory.

Don Nestor briefly reviewed tax incentives, including the severance tax exemption, Section 29 tax credits and pending legislation in the House and Senate. Mike Mooney followed with an overview of Penn Virginia's coal bed methane operations in Virginia where gas is produced from coals at shallow depths and low reservoir pressures using horizontal drilling, but where long-term pipeline capacity is the company's primary concern.

Charles Byrer briefly reviewed various DOE-funded coal bed methane research and demonstration projects including projects in the San Juan basin, Poland, the multi-seam completion at Waynesburg College, the multi-strata, dual-completion project at the College of West Virginia, the fuel cell project at Cadiz, Ohio, and the new project in the San Juan basin in which carbon sequestration is being combined with enhanced coal bed methane production.

Claude Morgan discussed the big picture of coal bed methane production in the Appalachian basin, where 143 Mcf (million cubic feet) of gas are being produced each day from wells drilled into coal beds that produce three to five barrels a day of saltwater making them unprofitable when gas prices drop below \$4.50 per Mcf and necessitating a tax credit when prices drop below \$3.50 per Mcf.

The Infrastructure Issues Panel included **Daniel Kortum** from Dominion, **Curt Tipton** from Equitable Gas, and **Jim Crews** from Columbia Gas Transmission comprised the final panel of the workshop.

Dan Kortum discussed the significance of gas quality and capacity issues in southern West Virginia where new construction and financing are needed since there is no longer a "build it and they will come" mentality. Curt Tipton briefly summarized Equitable's infrastructure and operations, including their requirements for gas quality. Jim Crews also touched on gas quality

requirements, and then focused on new ways to increase pipeline capacity saying that long-term commitments are needed.

## Recommendations

The program committee reviewed all of the comments made by all speakers, panelists and the 17 small discussion groups during the three issues identification sessions, and made the following recommendations:

- Coal bed natural gas ownership was perceived as the main impediment to development of the coal bed natural gas resource in West Virginia. Participants took no position as to who should own the gas, just that the issue needs to be resolved to remove uncertainty. Recommendation: New legislation should be written which resolves the remaining issues regarding coal bed natural gas development and ownership which were not resolved in the decision handed down by the West Virginia Supreme Court in November 2003.
- The state should write comprehensive Rules and Regulations for coal bed natural gas development and place regulatory responsibility within one state agency. There are several regulatory agencies or boards in West Virginia, but only one in Virginia. Recommendation: Streamline the process of obtaining permits and reporting by designating one state agency to oversee all aspects of coal bed natural gas development, production and utilization.
- The state should evaluate the costs and benefits of providing incentives to develop the coal bed natural gas resources in West Virginia. These could include both tax incentives and credits, and could be broad in scope, covering the various aspects of coal bed natural gas drilling, production, gas clean up and transportation. Recommendation: The Department of Environmental Protection should issue an RFP for a report assessing the economic benefits to the state which would result from state investments in coal bed natural gas development.
- The state should establish one clearinghouse for coal bed natural gas data, preferably at the West Virginia Geological Survey who would encourage coal bed natural gas producers to submit data in a timely manner and make these data readily available. Recommendation: The existing coal and oil and gas data bases at the West Virginia Geological Survey should be modified to accommodate additional data related to coal bed natural gas development and production.
- The state should provide matching funds for a Government/Industry/Academic Coal Bed Natural Gas Research Consortium. This consortium should be charged with developing a research plan for coal bed natural gas drilling, completion, production, water use and disposal, enhanced coal bed natural gas production technology, carbon dioxide injection, gathering, compression and transmission, and developing the necessary infrastructure. The consortium should receive and approve research proposals funded by the state and industry; cost share would be required. Recommendation: A Coal Bed Natural Gas Institute should be created, supported by state, Federal and industry funds.

- The state should encourage and promote the development of the infrastructure necessary to bring coal bed natural gas to the market.  
Recommendation: The state should commission a report with recommendations regarding the type of infrastructure needed and the costs and benefits which would result from such investments.

## **Hydrogen Workshop**

(Full report prepared by Trina K. Wafle of the WVU NRCCE is available at [www.EnergyRoadmapWorkshops.org](http://www.EnergyRoadmapWorkshops.org))

The Hydrogen Workshop program planning committee included **Richard A. Bajura**, (committee chair), director, National Research Center for Coal and Energy at West Virginia University, **Patrick Esposito, Sr.**, founder and CEO, Augusta Systems, **Jeff Herholdt**, manager, West Virginia Development Office Energy Efficiency Programs, **Calvin Kent**, dean (now former), Marshall University College of Business, **Curtis V. Nakaishi**, business area coordinator at the National Energy Technology Laboratory, **Trina Karolchik Wafle**, associate director of the National Research Center for Coal and Energy at WVU, and **Tom Witt**, director, Bureau of Business and Economic Research at WVU.

The goal set by the program committee was to assess, in a preliminary fashion, West Virginia's potential for participating in the hydrogen economy. The committee derived three strategic objectives for reaching the goal, namely to:

- educate key stakeholders in the state about the status of hydrogen as the future energy carrier,
- allow the stakeholders an opportunity to network with one another to begin establishing relationships, and
- use the information and the relationship building as the foundation for future actions to be derived from the workshop recommendations.

The event was held on December 11, 2003 at Stonewall Resort. Approximately 60 people participated, representing electric utilities, the chemical, coal, natural gas, and automotive industries, economic development and research organizations, energy entrepreneurs and private investors, environmental groups, and other interested individuals.

Experts from the coal, electricity, chemical, automotive, and venture capital industries and the research community provided background for participants to use to generate ideas for a West Virginia hydrogen roadmap. Topics centered around hydrogen production and distribution issues; applications, markets, and resource issues; and federal hydrogen initiatives.

## **Keynote Speakers**

The first part of the workshop focused on educating participants about hydrogen. Featured speakers included:

**Rita A. Bajura**, then-director of U.S. DOE National Energy Technology Laboratory, spoke about the rationale for pursuing a hydrogen-based energy infrastructure and FutureGen, a federal hydrogen initiative which incorporates electricity and hydrogen production from coal with carbon sequestration to prevent global climate change.

She noted that urban pollution worries, climate change concerns, maturing fuel cell technologies, energy security priorities, and increasing political will are today's drivers for a hydrogen economy. Cost remains a barrier: hydrogen powered fuel cells cost between \$1,600 to \$4,500 per kilowatt while internal combustion engines cost about \$35 per kilowatt. Hydrogen, however, can be produced from any of a number of domestic feedstocks such as biomass, natural gas, and coal.

**Patrick Esposito, Sr.** of Augusta Systems and chair of the Governor Wise's Energy Task Force spoke about the recommendation that a hydrogen workshop be conducted.

**Jeff Withum** of CONSOL Energy Inc. discussed coal-to-hydrogen technologies and barriers such as cost.

**Bill Raney** of the West Virginia Coal Association provided background about the coal industry in West Virginia. He noted that the coal industry continues to play a major role in the West Virginia economy, as an employer and a generator of tax revenue, having contributed \$224 million to state coffers in 2002. Coal is responsible for more than \$3.5 billion to West Virginia's gross state product, nearly 13% of the total.

**John M. Maher** of the Chemical Alliance Zone provided background about the chemical industry in West Virginia.

**Robert Miller** of Air Products discussed current and emerging options for the delivery of hydrogen to end users.

**Mark Burton** of Marshall University's Center for Business and Economic Research presented outlines of a research project about the future market situation for hydrogen in West Virginia.

**Ian Sutherland** of GM Fuel Cell Activities discussed the issues associated with hydrogen-powered vehicles. He noted that the hydrogen fuel cell which powers vehicles is ten times more expensive than today's standard internal combustion engine, although he said GM is very confident that the cost will decrease significantly. He reported that GM was less confident though about technologies for storing hydrogen on board a vehicle.

**Craig Hartzell** of Azimuth presented information about the market for "personal power" devices powered by hydrogen in place of traditional batteries or generators especially in military applications. He described the intense need for small, portable, lightweight energy packs for military troops to carry to the battlefield. The soldier of the future will depend more and more on portable power to make a greater array of field-deployed warfare technology operable. As portable energy needs increase, the need for hydrogen fuel cell technology and its significantly reduced weight compared to current personal power sources becomes vital, he said.

**David Nichols** of American Electric Power discussed hydrogen powered fuel-cells for electricity production, and gasification technologies for hydrogen and electricity production. He cautioned that the cost of gasification is an issue for power production.

**Craig Schmidt** of Eastman Gasification Services Company described the operation and environmental record of the company's coal to methanol facility in Kingsport, TN that can produce hydrogen. He championed coal gasification as the primary near-term technology for making enough hydrogen to meet the nation's annual demand for transportation fuel. Gasification is gaining acceptance in the environmental community, since it is inherently lower in SO<sub>x</sub>, NO<sub>x</sub>, and particulate matter, and is potentially the lowest cost technology for mercury and carbon removal and capture.

**Michael DeRosa** of EnerTech Capital discussed the availability of capital for early stage energy companies. EnerTech Capital was one of the pioneers of venture capital investing in such technologies and he said there are substantial venture capital opportunities in this area.

**Scott Rotruck** of the West Virginia Council on Economic Development challenged the participants to think creatively during the breakout sessions. He said that the state has an excellent energy industry and research support in its academic institutions and the national laboratory so the challenge is to make sure West Virginia remains an energy leader in new era energy industries.

**Ellen Lutz**, director of the U.S. DOE Philadelphia Regional Office offered a luncheon address. She noted that West Virginia was the national leader in establishing a statewide Industries of the Future program modeled after the DOE Office of Energy Efficiency and Renewable Energy Industries of the Future initiative and therefore has the potential to be a leader in the hydrogen arena as well.

## Breakout Sessions

Upon completion of the education portion of the workshop, participants joined one of five breakout groups to facilitate networking and engage participants in early discussions about how West Virginia could play a role in the hydrogen economy. They were asked to discuss two questions:

- What and/or where are the opportunities for West Virginia (in the broadest sense)?
- What are the three key actions that West Virginia state government, executive and legislative branches, can take to position the state well to participate in the coming hydrogen economy?

Program committee members acted as facilitators for the small group discussions. Groups characterized question one as being about opportunities and question two as being about what the state can do to move the hydrogen agenda forward.

A sample of proposed opportunities included:

- a mine-mouth demonstration gasification plant to produce hydrogen;

- a simulation/modeling center of excellence to maximize the talent and capabilities of the public and private research institutions and businesses throughout West Virginia to assess various hydrogen production schemes and improvements to those schemes;
- an assessment of the role of methanol and other coal-based liquid fuels for transportation applications;
- the development of a carbon sequestration expertise to complement the gasification and hydrogen production initiative;
- positioning West Virginia as the site of choice for the FutureGen program, the Department of Energy’s proposed \$1 billion program to build a coal to hydrogen and electricity plant with near zero emissions and carbon sequestration;
- developing a state-wide industry-government-university consortium to spawn partnerships in response to federal government research and development funding opportunities;
- marketing West Virginia’s assets such as its coal, inexpensive power, and chemical industry expertise, and potential as a carbon “sink” to attract potential development firms; and
- pursuing liquid fuels from a coal gasification as an intermediary step to hydrogen.

Samples of the recommended state actions are to:

- facilitate creation of a public-private partnership specifically focusing on hydrogen production and transportation capabilities;
- streamline and improve the permitting and regulatory processes for plants and production; some said that the current regulatory environment did not reflect the reality of hydrogen and its potential;
- establish an educational outreach program for stakeholders, for K-12, and for the public;
- create tax incentives to stimulate small business energy research and development;
- establish an energy research and development fund that would allow both public and private entities, including industry and academia, to access state research funds; research would include technology initiatives and business assessments; funds could be used to cost-share federal research programs;
- work tirelessly to ensure that the FutureGen plant is located in West Virginia for example, by locating appropriate sites;
- charge an appropriate state agency with developing a full-fledged hydrogen roadmap for the state; and
- position the state to be able to quickly permit carbon sequestration sites.

## Recommendations

- Based on group reports and evaluations provided by individuals, there appeared to be consensus for pursuing coal-to-hydrogen through the federal FutureGen opportunity, focusing on gasification technology, with carbon sequestration to occur in coal seams or in saline formations that underlie the state.

- Also, most wanted to see the state adopt some sort of incentives to promote technology investment and deployment, through a state-supported research and development fund and through tax incentives for the private sector.
- Most wanted to see education as a focus, first targeting key stakeholders, to position the state as a leader, then targeting the workforce, from the research lab to the plant floor, and finally targeting school children, all to ensure the long-term position of the state as “the hydrogen state.”
- Finally, most wanted the state to examine its current regulatory and tax environment to remove barriers in the existing industries—coal, chemical, natural gas, electricity—that would be vital to the hydrogen economy and to establish a regulatory environment that would promote the adoption of hydrogen-based production, distribution, and manufacturing facilities and the associated carbon sequestration capabilities.

## **Energy Infrastructure Workshop**

(Full report prepared by Patrick Mann of WVU CB&E is available at [www.EnergyRoadmapWorkshops.org](http://www.EnergyRoadmapWorkshops.org))

The Energy Infrastructure Program Committee included **Patrick Mann** (chair), WVU College of Business and Economics, **Jeff Herholdt**, West Virginia Development Office Energy Efficiency Programs, **Patrick Esposito, Sr.**, Augusta Systems, **Curtis J. Nakaishi**, National Energy Technology Laboratory, **Mark Burton**, Marshall University, **Corky DeMarko**, West Virginia Oil and Natural Gas Association, **George Blankenship**, Allegheny Power, and **Tom Witt**, Bureau of Business and Economic Research at WVU.

The committee established several objectives for the workshop with the primary one being an assessment of the needs and potential of the energy infrastructure in West Virginia. Other objectives included an assessment of the present status of the energy infrastructure in West Virginia, identification of specific energy infrastructure impediments, identification of incentives for energy infrastructure development, and the examination of the process of expanding energy infrastructure.

The workshop was held at Stonewall Resort in Roanoke, West Virginia. Approximately 70 people attended. They included academics, state government agency personnel, federal government agency personnel, electric utility representatives, natural gas industry representatives, economic development representatives, and interested member of the public.

The workshop format consisted of individual presentations by electricity and natural gas representatives in the morning. This was followed in the afternoon by a regulatory presentation and a panel on energy infrastructure security. The workshop concluded with three breakout sessions focusing on electricity infrastructure, natural gas infrastructure, and energy infrastructure security.

## Keynote Speakers

**Jeff Herholdt**, manager, Energy Efficiency Program, West Virginia Development Office, described the importance of energy to the West Virginia economy.

**Patrick Esposito, Sr.** of Augusta Systems and chair of the Governor Wise's Energy Task Force spoke about the connection between the Energy Roadmap and the energy infrastructure workshop as well as the contents of the Energy Roadmap.

**George Blankenship**, a senior consultant for Allegheny Power (AP), discussed AP's infrastructure in West Virginia, the reliability of the AP system, and the causes of outages within the AP system. He listed the important electricity transmission issues as the impending Energy Policy Act and regional transmission expansion planning.

**Richard Verret**, senior vice-president of American Electric Power (AEP), provided information about AEP's infrastructure in West Virginia, planned AEP capital investment in transmission in the state, and the planned AEP 765 KV transmission line from Wyoming County into Virginia. He noted the important transmission impediments as environmental issues, mandated multi-state approvals, and mandated federal approval.

**Karl Pfirman**, president of PJM West, an electricity transmission service provider, discussed PJM and its importance to West Virginia, the advantages of being a PJM member, and the public benefits of PJM. He discussed the present PJM structure and its possible expansion into Virginia and Kentucky.

**Jim Crews**, manager of gas control, NiSource, described the Columbia Natural Gas Transmission network, the Homestead expansion project, and the elaborate process of getting natural gas to the retail market. He noted the increasing importance of liquefied natural gas (LNG) in the natural gas retail market and its negative implications for West Virginia natural gas producers.

**Dan Kortum** of business development for Dominion Transmission, discussed the problems of expanding the transmission network, transmission financing, the process of obtaining transmission project approval, and the shelved status of the Greenbrier Pipeline project. He noted that limited pipeline capacity is the single most important impediment to natural gas development in the state.

**David Ellis**, director, utilities division, West Virginia Public Service Commission (PSC), and **Earl Melton**, director, engineering division, West Virginia Public Service Commission (PSC), provided a regulatory perspective on energy transmission and related issues. Ellis discussed the Energy Policy Act and its energy infrastructure implications. Melton discussed two current proceedings at the PSC: siting rules for exempt wholesale electricity generators and net metering standards.

The final presentation was a panel on security issues regarding energy infrastructure. **Steve Viglianco**, special agent with the Federal Bureau of Investigation, discussed the role of the FBI

in protecting energy infrastructure. Staff Sergeant **Greg Young** and Sergeant **Tim Carden** of the Joint West Virginia Intelligence Fusion Center discussed the role of the West Virginia Army National Guard in protecting energy infrastructure as well as their security assessment model. **Joe Paladino**, National Energy Technology Laboratory (NETL), discussed the new Energy Infrastructure Training and Analysis Center at NETL including its objectives and potential products.

## **Natural Gas Breakout Session**

Participants in this session were asked two questions:

- What are the impediments to the expansion of the natural gas infrastructure in West Virginia?
- What actions can the state take to address these impediments?

The group identified two major impediments to expansion of the natural gas infrastructure, namely the financing and capitalization of natural gas infrastructure and the obtaining of rights-of-way in a timely and cost effective manner.

## **Electricity Breakout Session**

The attendees at the electricity infrastructure session dealt with two questions:

- What are the impediments to the expansion of the electricity infrastructure in West Virginia?
- What actions can the state take to address these impediments?

The electricity group agreed on four major impediments to the expansion of the electricity infrastructure: the lack of public education as to the economic importance of energy infrastructure; the lack of site analyses causing uncertainty regarding the number of feasible plant sites in the state; the uncertainty regarding rate of return on transmission investment, cost recovery, and site permitting; and environmental issues and litigation regarding siting of new facilities (the NIMBY, or not in my back yard, problem).

## **Infrastructure Security Breakout Session**

The attendees at the infrastructure security session dealt with two questions:

- What deficiencies exist regarding infrastructure security in West Virginia?
- What actions can the state take to address these deficiencies?

The infrastructure security group agreed on four major deficiencies regarding energy infrastructure security: infrastructure security requires applications new technology not being deployed currently, human involvement through public awareness of security issues and security checks, assessment and knowledge since infrastructure security requires knowledge of risk as well as knowledge of how to combat security threats, and a lack of strategic coordination since effective infrastructure security mandates communication and cooperation among the various units dealing with security issues.

## Recommendations

Natural gas infrastructure recommendations included that:

- The governor should convene a forum of federal regulators, state regulators, and industry representatives to address the issue of capital investment incentives for the development of energy infrastructure. Suggestions for capital formation included that the PSC should ensure that authorized rates of return for regulated utilities are sufficient to encourage infrastructure investment and that the PSC should designate local distribution companies (LDC's) as suppliers of last resort.
- The legislature should provide a severance tax credit for the proposed fees to be paid by producers to transmission or pipeline firms to finance the natural gas infrastructure.
- The state should establish infrastructure corridors.

Electricity infrastructure recommendations included that:

- The state collaborate with NETL to engage in educational activities regarding the economic importance of energy infrastructure, the economic importance of electricity generation, and the essential linkage between electricity generation and the coal industry.
- The state should engage in proactive siting of energy infrastructure and electricity generation projects.
- The state should improve and streamline the project approval and infrastructure permitting process.
- The state should facilitate interagency cooperation and collaboration in the project approval process.
- The state should collect meteorological data which would facilitate the project development process.

Infrastructure security recommendations included that:

- The state should conduct tabletop security exercises.
- The state should support security modeling and assessment.
- The state should apply (or provide application incentives for) new security technologies as they become available.
- The state should support research and development for energy security programs.

# The 2004 Workshop Series

The 2004 series came about at the request of the West Virginia Coal Forum who approached the West Virginia Development Office about doing a series focusing on coal issues.

The Coal Forum was established as a working board under the auspices of the Mine Safety and Technical Review Committee to promote the viability of the state's coal industry through facilitating public discussion of such coal related issues as the level of competitiveness and productivity of the industry, the image of the industry, miner's health and safety issues, and, identifying new markets and uses for West Virginia coal. The TRC was created by the West Virginia Legislature in 1986 with the passage of HB 2183. The forum is comprised of two chairmen: one is recommended by, and represents, the UMWA, and one is appointed to represent coal operators. Those two representatives are Fred Tucker, a retired UMWA official, and Chris Hamilton, Vice-President of the West Virginia Coal Association. Kenny Dickens, esq. is the administrator.

The Development Office enlisted the aid of the WVU National Research Center for Coal and Energy (NRCCE) for this series.

The programs were established by a core group and experts were recruited to help develop details for each workshop. The core program committee included Hamilton, Tucker, and Dickens of the Coal Forum, Jeff Herholdt of the West Virginia Development Office Energy Efficiency Programs, and Trina K. Wafle and Richard A. Bajura of the WVU NRCCE.

The group established the objectives for the series as education and issue identification. The format was altered from the original series to focus primarily on presentations with some opportunity for feedback from the audience during question and answer sessions. In particular, the Coal Forum sought public exposure for the various issues surrounding coal-related workforce development, economic impact, utilization technologies, and national trends. Each event received media attention within the region of that event.

## Workforce Development Workshop

Forty-four people registered to attend the workshop on Workforce Development which was held in Beckley, WV.

Local media attention led ultimately to the Associated Press developing a story on the issue of the aging workforce.

The program committee included **Chris Hamilton**, **Fred Tucker**, and **Kenneth Dickens** of the Coal Forum; **Trina Karolchik Wafle** and **Richard Bajura** of the WVU NRCCE; and **Jeff Herholdt** of the Energy Efficiency Programs Office and **David Lieving** of the Governor's Workforce Investment Division both in the West Virginia Development Office.

## Keynote Speakers

**Patrick Esposito, Sr.**, Augusta Systems and chair of the Governor's Energy Task Force, spoke about the Energy Task Force.

**Ken G. Woodring**, executive vice-president for Arch Coal, with introduction by **Chris Hamilton**, vice-president, West Virginia Coal Association, discussed workforce issues facing Arch Coal, citing a need for younger workers. Arch is the second largest producer in Central Appalachia, operates six mining complexes in West Virginia that produce more than 25 million tons per year, and employs about 2,000 people at its West Virginia mines. He noted that increased use of coal-fired power plants will drive near term demand for coal in the United States and that exports will also increase, saying that West Virginia currently provides 50% of all U.S. coal exports. China is a factor in this growth.

In regard to the workforce, Woodring said that West Virginia's coal industry pays over \$1 billion in annual direct wages and indirectly employs an estimated 30,000 additional workers who rely on the mining industry for all or part of their livelihoods. The average annual coal wage in 2002 was \$53,086, more than twice the state average for all workers. But the industry must address serious problem of an aging workforce. Roughly 80% of Arch's workforce is between the ages of 40-59 years old and nearly 40% of Arch's W.Va. coal miners are potentially five years or less from retirement.

Education and skill requirements are increasing all the time and a continued emphasis on quality of public school system is crucial. The industry needs a new generation of mining engineers. Trade schools also have an important role to play in providing qualified electricians, mechanics, and equipment operators. He said that the West Virginia coal industry must find ways to attract and retain the younger generations.

**David Lieving**, director of the Governor's Workforce Investment Division at the West Virginia Development Office provided comprehensive information about the WorkForce West Virginia program with its 19 full service comprehensive centers, 21 satellite centers and multiple affiliate sites. The program divides the state into seven regions, analyzes strengths and needs within that region, and develops programs as appropriate. The program offers the first functional integrated MIS system in the nation serving job seekers and employers, available at [www.workforcewv.org](http://www.workforcewv.org).

**Jerry Massie**, peer counselor/grant specialist, UMWA Career Center, discussed the peer counselor concept for the coal industry workforce. Created through a National Reserve Grant in 1998 the peer counselor concept has been used to serve 1,170 participants, 90% of whom have found employment at an average hourly wage of \$13.46. The main center is located at UMWA Career Centers, Inc., 2306 South Fayette St., Beckley, WV, 25801, (304) 253-3610 or toll free:

1-877-SWV-UMWA, with satellite offices in Chapmanville, phone (304) 855-2280, Charleston, (304) 346-0341, and Castlewood, VA (276) 762-7148.

**Kenneth Dickens, Esq.**, West Virginia Board of Coal Mine Health and Safety and current administrator for The West Virginia Coal Forum, discussed his personal experience with the workforce system transitioning from work in coal mining to law school student to his current position.

**D. Anne Cavalier**, vice-president, Institutional Advancement at West Virginia University Institute of Technology, presented work by Paul D. Melton, Sandra E. Shaw, and Paula J. Melton investigating the coal industry's future labor force needs. The study, originally conducted in 2001 with an anecdotal update performed in 2004, was done in cooperation with the West Virginia Coal Association and the Department of Commerce. Key findings of the study were that skill level requirements have increased but a post-high school education is not needed to operate equipment. Industry-related educational programs have decreased and enrollment has decreased. The workforce is aging such that a generation of experienced workers will be lost. More coal is being produced with fewer workers in part because of technological advances which have improved safety and efficiency. The coal industry struggles with regulations, public opinion, and tight profit margins. Coal mining is not valued as a viable career.

All this means that opportunities exist for the coal industry and higher education to develop cooperative programs to meet future workforce needs. More than 44% of the workers surveyed are between the ages of 41 and 50, 23.64% are between 51 and 60. Only 25% is between 21 and 40. One company president reported that the company's ability to attract and retain employees had not changed much because of increased wages and benefits that attract workers from other mining operations with lower pay, benefits, etc. Notably, this company reported that 65% of its workforce was between the ages of 21 and 40.

Cavalier noted that to attract the younger worker and to ensure adequate human resources, a company must invest adequate financial resources. Several respondents stated that training, rather than either recruitment or retention, would be the most pressing human resource issue in the next 10 years. Of the skills most in demand, seven ranked as most relevant: basic mathematics, electrical circuits, safety, heavy equipment, business management, communication skills, and supervisory skills

**Jim Dean**, director of WVU Mining Extension and Outreach discussed the WVU Mining Extension Service, which was established in 1913 with a focus on education and training. Currently seven faculty/field agents are located in Morgantown, Fayetteville, Princeton, Ansted, Daniels, and Barrackville. All agents have strong industrial experience and training background. In 2003, the program offered 169 courses to more than 3,000 people. He featured the superior high wall miner simulator used in some of the training courses.

**The Honorable Robert Kiss**, Speaker of the West Virginia House of Delegates with introduction by **Bill Raney**, president, West Virginia Coal Association spoke at lunch about the workers compensation and healthcare issues facing the state.

## Recommendations

The open forum session led to a discussion of workforce issues. Key among them was:

- a need to educate and update the public about the new realities of mining and using coal—cleaner, safer, highly automated, well-paying;
- a need for young, trained workers with solid academic skills such as math and English, especially given the fact that the average worker is 50+ years old;
- a need to shift from traditional manual labor skills to knowledge-based skills among the workforce;
- the need for a vision for training within the industry;
- the fact that China’s growing demand for energy is going to put pressure on global energy demand, including coal;and
- the shifts in the structure of the industry and labor.

## Economic and Homeland Security Workshop

Fifty-six people registered to attend the workshop on Economic and Homeland Security held in Shepherdstown, WV on July 22.

The program committee included **Richard A. Bajura**, WVU National Research Center for Coal and Energy, **Kenneth Dickens, Esq.**, West Virginia Board of Coal Mine Health and Safety, **Jeff Herholdt**, West Virginia Development Office Energy Efficiency Programs, **Chris Hamilton**, West Virginia Coal Association, **Fred Tucker**, United Mine Workers of America, and **Trina Karolchik Wafle**, WVU National Research Center for Coal and Energy.

The workshop objective was to focus on the role of coal in economic development and homeland security.

## Keynote Speakers

**Connie Holmes**, senior economist and director of International Policy, National Mining Association, introduced by **Chris Hamilton**, West Virginia Coal Forum. She provided a national and international perspective on the economics of coal.

**Patrick Esposito, Sr.**, Augusta Systems and chair of the Governor’s Energy Task Force, spoke about the Energy Task Force.

**Jeff Herholdt** chaired a panel session on coal’s impact on the West Virginia economy included:

**Bill Raney**, West Virginia Coal Association, discussed in broad terms coal’s impact on the economy and encouraged participants to become Friends of Coal.

**Tom Witt**, West Virginia University Bureau of Business and Economic Research, noted that in 1948, nearly 25% of all non-farm workers in West Virginia worked in mining. In 2003, the percentage dropped to about 2.5%. The number of mining jobs in West Virginia has

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declined from about 60,000 jobs in 1980 to about 16,000 jobs in 2002. Yet mining productivity has increased from around 1 ton per hour per miner to more than 4 tons per hour per miner over that same period of time. Where coal mining accounted for more than 16% of the gross state product in 1977, by 2002 mining represented roughly 5% of gross state product.

Central Appalachian coal typically commands the highest price, roughly \$58 per ton in July 2004, while Northern Appalachian coal is next in line at about \$45 per ton that same month. Wyoming's Powder River Basin coal ranked the least cost, selling for just over \$5 per ton. Witt said the long-term forecast update as of 2004 called for the addition of 2,000 jobs through 2005; however, long-term job outlook shows declines due to environmental and regulatory issues. The consensus forecast calls for stable production at 140 million tons/year until 2010. Thereafter, production is expected to decline to 130 million tons through 2020.

**Mark Muchow**, West Virginia Tax and Revenue Division, focused his comments on the coal severance tax. He presented a chart showing coal severance tax revenues at \$180 million for 2002. Of that amount, approximately \$15 million was designated for use by counties and municipalities. This includes even those counties in which no coal is produced, such as Berkeley, Morgan, and Jefferson counties and the municipalities of Martinsburg, Shepherdstown, Charles Town, and Ranson which received a total of approximately \$270,000 in 2002. A portion of coal severance taxes are also dispersed to the General Revenue Fund the majority of which supports K-12 education.

**Max Burnham**, of E.I. DuPont, described the company's presence in the eastern panhandle since 1953 and its close ties to the coal industry. In 1975, DuPont built its Potomac River Works to manufacture FasLoc™ used in roof bolting in underground mines to support the mine roof which allows for greater automation leading to increased productivity while also increasing safety. In 1970, more than 250 miners lost their lives in the mines, while in 2000, fewer than 25 died in mining accidents. Burnham said that DuPont has also supported Potomack Intermediate School, DuPont soccer complex, and the Bedington Volunteer Fire Department, in addition to supporting employees and pensioners in the area. He noted that during the Fasloc™ era, no layoffs have occurred and he looked forward to another 50 years in the eastern panhandle built on coal.

**Roger Lilly** of Walker Machinery provided a snapshot of a West Virginia-based company that depends on coal. Walker Machinery is a Caterpillar distributor with more than \$200 million in annual sales. Walker employs 600 people at 10 locations with an annual payroll of \$32 million, providing insurance for 1,600 employees and their family members at a cost of \$3 million per year. Walker contributes \$1 million in annual premiums to the worker's compensation fund. Walker purchases \$24 million in goods and services from other West Virginia companies. Since 1980, the coal industry has been Walker's primary customer, having earned 68% of the company's revenue from the coal industry in 2003. Other customers include light and heavy construction and industrial markets. Lilly stated that the industry needs to communicate better its compelling record of environmental performance.

**Eugene Trisko** of the Center for Energy and Economic Development and the United Mine Workers, provided a luncheon address focusing on air quality challenges facing West Virginia coal. First he outlined the big picture noting that while the U.S.'s GDP has nearly doubled since 1970, emissions of key pollutants are all down: 48% fewer carbon monoxide (CO) than in 1970, 17% fewer nitrogen oxides (NO<sub>x</sub>), 51% fewer volatile organic compounds (VOCs), 52% less sulfur dioxide (SO<sub>2</sub>), and 34% less particulate matter in the 10 micron size range (PM<sub>10</sub>).

He displayed a chart showing projections of the impact on coal production of proposed EPA Interstate Air Quality Rules to further reduce emissions: Appalachian coal production would increase from 299 million tons in 2000 to 306 million tons in 2020, western coals would increase from 475 million tons to 489 million tons, and coal from the interior would increase the most, from 131 million tons in 2000 to 229 million tons by 2020.

He noted that proposed mercury control rules add major uncertainty for the coal industry saying at the time that EPA's proposed maximum achievable control technology limits had divided the industry and that controversial emission trading alternatives ensure litigation. Trisko said that EPA recognizes that benefits of mercury controls cannot be quantified due to global mercury transport, U.S. utilities contribute 1% to the global mercury budget, and no evidence exists that the proposed reductions would reduce risks to women of child-bearing age. He warned that carbon control is the largest wild card face West Virginia and all coal producing and consuming states.

**Chris Hamilton** chaired a second panel session examined coal's role in energy security. Panelists included:

West Virginia Senator **John Unger** (D-16<sup>th</sup> district) spoke about waves of federal funding in times of war, noting that funds first are dedicated to the immediate threat, and then funds are dedicated toward searching for longer term solutions. In the case of the "war on terror" federal funds were dedicated to first responders, hospitals, and others likely to be on the front lines in terror attacks. He predicted that funding for research or other longer term security strategies are likely to follow. In light of that notion, he examined West Virginia's potential role for securing the nation's energy needs, noting that first responders and hospitals require power and the more quickly power can be restored, the more quickly the attack can be addressed. He noted that West Virginia's rural geography and abundant coal could be strengths upon which energy security strategies could be built.

**Carl Bauer** of National Energy Technology Laboratory noted several considerations affecting energy security: environmental protection, economic performance, natural disasters, human disturbances, fuel supply, fuel diversity, and national security among others. He cited International Energy Agency projections showing the projected increase in world energy production and consumption between 2002 and 2030 with developing countries producing and consuming more than twice the energy that developed nations will use.

He also presented DOE Energy Information Administration (EIA) statistics showing that the U.S. economy is becoming more energy efficient, showing an EIA analysis that indicated a

47% decline in amount of energy used per dollar generated by the economy. Electricity production in West Virginia includes: 26 coal-fired power plants with a capacity of 15,622 megawatts and another six coal-fired plants are planned with a capacity of 2,693 megawatts; nine natural gas-fired plants for a total 5,270 megawatts of capacity; 10 hydro plants for a total 388 megawatts; and 10 other types of facilities totaling 875 megawatts of power capacity.

He suggested that West Virginia leverage its coal and gas resources to export coal and electricity, maximize value of WV energy resources by increasing system efficiency, creating high-end products such as liquid fuels and hydrogen from coal, enhancing the transmission and delivery of the state's energy resources, and by applying analytical and technology development capabilities in the state (e.g. at the National Energy Technology Laboratory, the state's research universities) to build West Virginia know-how.

## Recommendations

An open forum followed. The session was conducted in a round robin manner and each participant was asked to comment. Key among the comments was:

- Homeland security could be a common ground for industry and labor to approach the environmental community to open avenues between competing groups to move forward.
- It will take more than one group or organization to put together a plan to position West Virginia as a leader. Perhaps work through the Vision Shared process to develop the plan.
- Follow up on "second tier federal funding" described by Senator John Unger. Position West Virginia to go after federal funding.
- Identify West Virginia site(s) for the U.S. DOE clean coal to hydrogen demonstration plant with carbon sequestration known as FutureGen.
- Educate and work with political leaders to develop the will and position the state to take advantage of its energy resources for homeland security.

## Coal Utilization Workshop

Sixty-four people registered for the September 22, 2004 workshop held in Morgantown, WV.

The program committee included **Richard A. Bajura**, WVU National Research Center for Coal and Energy, **Kenneth Dickens, Esq.**, West Virginia Board of Coal Mine Health and Safety, **Jeff Herholdt**, West Virginia Development Office Energy Efficiency Programs, **Chris Hamilton**, West Virginia Coal Association, **Fred Tucker**, United Mine Workers of America, and **Trina Karolchik Wafle**, WVU National Research Center for Coal and Energy.

The objective of this workshop was to present opportunities for deployment of advanced coal technologies for power generation and transportation fuels in West Virginia. Attendees at the previous two workshops indicated that the open forum portion was of least interest to them. Therefore the meeting format was altered to focus on educational presentations.

## Keynote Speakers

Three panel sessions were conducted, with 14 presenters in all plus a featured morning and luncheon speaker.

**Bart Hyita**, Vice President Coal Operations Support, CONSOL Energy Inc., introduced by **Chris Hamilton** of the West Virginia Coal Association, spoke about the latest extraction technologies being employed by CONSOL. CONSOL has the second largest domestic coal reserves with the highest Btu value and is not only the largest producer of coal from underground mines but also from underground longwall mines. He noted that improved haulage systems need to be developed to keep pace with improvements in continuous miners. Ranging arm and shearer haulage unit horsepower is increasing allowing constant advance rates as longwall faces are developed wider. Wider longwall shields minimize the number of shields required as longwall face widths are increased.

AFC Systems have increased horsepower and computer controlled drive technology. New high-horsepower longwall plows have been developed for mining in thinner coal seams. Similarly, low-profile longwall shields are also being developed for plow faces. He noted that significant time, material and effort are needed to maintain underground haulage stability. Ultimately, portions of underground haulageways will be replaced by overland conveyor belts.

He said that state-of-the-art coal processing plants are replacing, aging, less-efficient plants. New processing plants have the capability of delivering multiple clean coal product qualities. However, there remains combustible material in the waste from these plants and he described how these materials could be a source of fuel for fluidized bed combustion systems. Pressurized fluidized bed (PFB) power plants offer many environmental benefits, including coal waste reduction, excellent sulfur removal, fewer NO<sub>x</sub> emissions, lower SO<sub>2</sub> emissions, and ash as a marketable by-product.

A panel moderated by **Jeff Herholdt** of the West Virginia Development Office Energy Efficiency Programs on technologies for energy generation from coal included:

**Richard Bajura**, director of the WVU NRCCE, who spoke about the Coal Utilization Research Council, an advocacy group for coal utilization research to improve the existing fleet of power plants and to promote future deployments of advanced technologies. The CURC developed a roadmap for research to ensure continued use of coal in an environmentally acceptable manner. Key assumptions included the use of Energy Information Administration coal power capacity forecasts as reference; roadmap time period beginning today until 2020; goals of ‘near-zero’ emission coal plants and carbon capture and sequestration capability.

Roadmap destinations represent commercially available ‘products’ that may not be yet in wide-spread use. The 2020 environmental objectives/targets represent best achievable performance—innovative, new technologies necessary to achieve new plant targets at costs competitive with alternative options having comparable environmental performance. The

roadmap also includes technology applied to existing plants to improve environmental performance and maintain competitive cost of electricity.

Critical technology needs include:

- for integrated plants—module designs, systems integration, high temperature materials, plant simulation capability, sensors and controls, intelligent plant operation (high reliability/availability, efficient and low cost operation);
- for emissions control—gas separation, combustion, multi-pollutant control, cooling system design, sensors; for advanced combustion—materials for supercritical and ultra supercritical steam for the boiler and steam turbine, CFB scale-up, O<sub>2</sub>-combustion, heat and O<sub>2</sub>-carrier concepts, sensors, and control;
- for advanced gasifier systems—gasifier design and scale-up, air separation, and solids feed; for gas cleaning—multi-pollutant control, filter materials, regenerable sorbents; for syngas utilization for power and fuels—syngas combustion, synthesis reactor design, fuel cell systems, hybrid fuel cell-turbine systems, hydrogen gas separation, hydrogen turbine, storage and infrastructure for hydrogen economy;
- for carbon capture—solid sorbents, carbon hydrates, membranes, and liquid absorption; and for carbon sequestration—direct and indirect sequestration concepts; ‘value-added’ concepts; geologic, ocean, soil ecosystem affects and modeling capability.

By carrying out the Roadmap’s proposed \$10.7 billion, 15 year research program benefits are expected to be competitive near-zero emission coal-based plants; \$100 billion projected direct economic benefit through 2020 (fuel cost, capital cost, technology export); \$500 billion to \$1 trillion additional benefit projected through 2050; and security benefits such as maintaining diversity of energy resources, retaining domestic manufacturing capabilities, and reducing dependence on imported oil.

**Robert Bedick**, program manager at the National Energy Technology Laboratory, who spoke about advanced coal-fired power generation technologies. He said performance targets for new coal-fired technologies in the year 2020 included:

- greater than 99% removal of sulfur dioxide (today, 98% of SO<sub>2</sub> is removed);
- reducing nitrogen oxide emissions from today’s 0.15 pounds per million Btu to less than 0.01 pounds per million Btu;
- removing 95% of the mercury; using 100% of the coal plant’s byproducts such as ash;
- increasing plant efficiency from 40% today to 50%- 60% by 2020;
- holding capital costs of such plants at today’s prices, roughly \$900 per kilowatt hour to sell electricity at less than \$0.03 per kilowatt hour;
- and in the case of coal-to-hydrogen power plants, producing hydrogen at \$4 per million Btu.

The goal of NETL’s research program is to enable coal-fired power generation to be as clean or cleaner than natural gas-fired power generation. Technologies include new coal gasification schemes such as one by Boeing Company that uses long life rapid mix injectors, cooled refractory liners and a carbon slurry feed system and another by Basin Electric Power Cooperative, a hybrid gasification combined cycle approach that uses a pressurized gasifier combined with an atmospheric pressure circulating fluidized bed combustor. Other

technologies include ultrasupercritical steam and two-reactor catalytic unmixed combustion. Bedick also described the DOE's FutureGen program, a coal gasification-bases system to produce power and hydrogen while capturing and storing carbon dioxide.

**John Winslow**, program manager at NETL, spoke about hydrogen and liquid fuels. To set the stage, he noted that fossil fuels will continue to be the preferred option for transportation needs while urban and regional environmental pollution concerns will grow. Demand for transportation fuels, especially ultra-clean fuels, will grow. Global climate change will continue to be an issue, requiring more efficient transportation. The U.S.'s steadily increasing reliance on imported oil (crude and finished products estimated to more than double to \$194 billion by 2025) will create pressure to diversify our fuel resources. Worldwide, the number of vehicles is expected to grow from about three-quarters of a billion in 2001 to nearly 3.5 billion by 2050, with growth in the developing countries outpacing growth in developed nations by around 2 to 1.

He noted that experts are saying higher oil prices are inevitable during the next decade. Diverse sources of fuel will be needed, with hydrogen and Fischer-Tropsch fuels being among them. Both can be derived through coal gasification. Coal-based liquid fuels can help in the transition from petroleum to hydrogen from sustainable routes, he said. Coal-derived liquids are compatible with today's gasoline based delivery and storage systems, and can provide "breathing space" until sustainable future fuels are available. Coal liquids are produced from the U.S.'s largest domestic hydrocarbon resource and can be used in existing and advanced vehicle systems.

Coal liquid make petroleum fuels cleaner, too. But the oil and coal industries will not develop coal liquids alone. Co-producing fuels and electricity is likely to be the market entry strategy since such a strategy places coal-based liquids at an equivalent oil-based value of \$30 to \$35 per barrel. The National Academy of Engineering completed a year-long study of the hydrogen economy. Key findings included that hydrogen could fundamentally transform the U.S. energy system; therefore a robust, ongoing hydrogen program is important; fossil fuels will be one of the principal sources of hydrogen for the hydrogen economy...but carbon capture and storage technologies will be required; and the United States has vast coal resources...hydrogen from coal can be inexpensive...and...coal must be a significant component of R&D aimed at making very large amounts of hydrogen.

Hurdles exist for the use of coal, among them are that integrated operations of advanced coal fuels technologies have never been demonstrated; capital and operations costs must be reduced; coal fuels facilities must show small environmental footprint as must the likely expanded coal production such facilities would promote; and the question of which industry would take the lead in commercial deployment—chemical, electric utility? Also, any public resistance to coal use must always be addressed. Wilson provided one potential scenario of deploying coal to liquids in which 60 coal-to-liquids plants built at a pace of between two and three per year until 2030 would produce 2 million barrels per day of liquids and generate 30 gigawatts of power at a capital cost of \$136 billion.

This scenario requires 32% more coal to be produced. He compared the scenario to today's oil import bill of \$120 billion and forecasted electricity demand of 50 gigawatts by 2020. Wilson said government incentives may be required for the first demonstration co-production plant because of high risk and capital. These could include: excise tax exemption, investment tax credit, accelerated depreciation, section 29 credit, cost share, price guarantees, purchase guarantees, and loan guarantees. He pointed to ethanol as a model. Coal-derived hydrogen technologies can play a major role in the transition to a sustainable hydrogen energy economy but hydrogen production, distribution, storage and end-use still face significant technical, cost, and infrastructure barriers, unlike coal liquids.

**Robert Hoppe**, chief operational officer, WMPI Pty., LLC spoke about WMPI's liquid fuels from waste coal plant. WMPI Pty., LLC, based in Gilberton, Penna., is organized to develop, own, and operate advanced coal-to-oil and power facilities. The plants will typically use waste coal or run-of-mine feedstock. The end products of these facilities are: ultra-low sulfur transportation fuels, electric power, thermal energy, and specialty products. WMPI Pty., LLC's first plant will be a 5,000 barrel per day facility built on a 75-acre site adjacent to the existing Gilberton Power Plant. This plant will utilize proven technology from major international corporations such as Uhde, Shell Global Solutions, SASOL, Linde and ChevronTexaco. Construction is slated to begin in the second quarter of 2005.

Total estimated cost of the plant is \$612 million and will take approximately three years to build. The WMPI Project will create 1,000 high paying jobs during construction, more than 150 high quality permanent jobs at the project site and approximately 600 permanent offsite jobs. Sources of funding include \$465 million in private financing – coordinated by the investment banking firm of Morgan Stanley and Co.; \$100 million in federal participation through the U.S. Department of Energy's Clean Coal Power Initiative ("CCPI"); and, \$47 million in Commonwealth of Pennsylvania participation through the Transferable Investment Tax Credit ("TITC") for coal waste removal and ultra-clean fuels. Subsequently, WMPI Pty., LLC, will develop, own and operate advanced world-scale coal to oil and power facilities in other locations. Potential future sites include West Virginia for a 5,000 to 57,000 barrels per day plant; Kentucky for a 57,000 barrels per day plant, and Illinois for a 57,000 barrels per day plant.

A second panel, also moderated by **Jeff Herholdt** of the West Virginia Development Office Energy Efficiency Programs, focused on emissions control from coal plants.

**Scott Klara**, a program manager at NETL, spoke about carbon management technologies. The two most significant greenhouses gases are carbon dioxide (81%) and methane (9%). Methane emissions from the natural gas system, coal mining, and land fills are equivalent to carbon dioxide emissions from 130 coal-fired power plants generating 500 MW of electricity. Three carbon management options exist:

- reduce carbon intensity by switching power production to nuclear energy, renewable energy, or less carbon-laden fossil fuels such as natural gas;
- increase overall energy efficiency;
- capture and store carbon dioxide in natural carbon sinks.

All three are needed. The earth has a large capacity to store carbon dioxide. Coal seams alone have the potential to store between 200 and 300 gigatons of carbon to absorb worldwide annual carbon emissions of 6.5 gigatons per year. Add in depleted oil and gas reservoirs and deep saline formations and there is the potential to store another 1,900 gigatons of carbon. But much work needs to be done to develop and test technologies for sequestration in these sinks.

Current demonstrated technologies are costly, said Klara. Sequestration research and development requires field experiments and demonstrations, development of protocols for identifying amenable storage sites, capacity evaluation studies, and a better understanding of the underlying science of carbon sequestration in relation to health, safety, and environmental risks. Klara described several ongoing projects, one being a field test in West Virginia in a saline aquifer in the Mt. Simon sandstone near New Haven. A 9,172 well has been completed in the formation. Researchers are characterizing the formation using seismic, logging and reservoir modeling techniques; developing comprehensive monitoring plan; and investigating injectivity, safety, capacity and permanence. There are no current plans for carbon injection.

Participants in the project include: Battelle, AEP, Pacific Northwest National Lab, BP, Ohio Coal Development Office, Schlumberger, Ohio Geological Survey, and WVU. He also described the DOE's Regional Carbon Sequestration Partnerships whose goal is to develop the infrastructure for wide-scale deployment of carbon sequestration. The seven regional partnerships form a nationwide network to determine technologies, regulations, and infrastructure needs for each region.

**Frank Burke**, vice-president for research for CONSOL, spoke about emissions control technologies. Nationally, he said, short, medium, and long term goals for emissions control could be described as follows: cost effective environmental control technologies enable compliance with emerging regulations in the short term; by 2015, A high-efficiency, near-zero emission power plant is designed that is sequestration ready, fuel flexible, capable of producing multiple products; and by 2020, that the first of these plants is introduced commercially.

Coal power plant performance criteria include:

- control of air emissions of sulfur dioxide, nitrogen oxides, particulate matter, and mercury;
- management of carbon dioxide;
- use of byproducts such as coal ash;
- water use and discharge; plant efficiency, reliability and availability; and
- capital and product cost.

Power generation options include pulverized coal (PC) combustion which is the predominant system in use today in which coal is burned in air to produce steam to drive turbines to make electricity; Integrated Gasification Combined Cycle (IGCC), with four units operating worldwide, in which coal is gasified in air or oxygen and the resulting gas is combusted in a gas turbine and the heat is recovered to also drive a steam turbine; and others such as atmospheric and pressurized fluidized bed combustion.

Air emissions control for pulverized coal combustion include wet flue gas desulfurization for SO<sub>2</sub> removal; combustion controls and selective catalytic reduction for NO<sub>x</sub> removal; electrostatic precipitators and fabric filters for particulate removal. Currently there are no mercury-specific technologies available for mercury control in PC plants. For IGCC plants, solvent-based acid gas cleanup (H<sub>2</sub>S) is used for sulfur dioxide control; combustion controls and selective catalytic reduction for NO<sub>x</sub> removal; slag formation and raw gas filtration for particulate control; and carbon bed or other technologies yet to be determined for mercury control. In many cases, technologies are available for emissions control. Cost will be a deciding factor, he said.

**Paul Ziemkiewicz**, director of the West Virginia Water Research Institute at the WVU NRCCE, spoke about coal combustion byproducts utilization especially in regard to mining applications. The WVWRI has extensively researched applications of in coal ash in coal mines to neutralize acid forming materials in those mines. Low permeability ashes can be used as barriers to future acid mine drainage formation and water transport, as fill material for subsidence control, and as pit filling material for surface and underground mines. Environmental issues associated with coal ash utilization include transportation of the materials and the potential for groundwater and surface water contamination.

Ziemkiewicz provided two examples of current research: the Colver Power Plant refuse site in Colver, PA where fluidized bed combustion ash from the plant is being placed on the pit floor as barrier to prevent water from reaching the acidic materials and the Longridge Mine in Preston County, WV in which ash is being injected as grout to ameliorate acid mine drainage. Data indicate that coal combustion byproducts can have positive or negative effects on groundwater depending on highly localized factors including: groundwater flow regime and chemistry and coal combustion byproduct permeability and chemistry.

**Joseph Donovan**, director of the Hydrologic Research Center at the WVU NRCCE, spoke about water management planning in the Monongahela River basin in regard to the future of mine water discharges into the river basin as mines close. His team has studied how mines flood and are flooding, where Pittsburgh seam discharges occur, how large the discharges are, which discharges are treated, what type of water chemistry may be expected, how water chemistry may change over time, approximately when and where new discharges are likely to occur. They have mapped much of the mine flooding and can project likely new occurrences of discharge.

The work will not only help prevent mine blowouts in which acidic waters can rush into receiving streams with catastrophic effect, the work is helping to characterize what can be viewed as an aquifer with potential to be a valuable resource with a recharge rate of 95,000 gallons per minute or more that may be available for future uses such as in electricity production. The discharges are iron-rich but are mostly net alkaline; much of the load is treated. The water quality is not pristine but is gradually improving and will ultimately be usable and thus may be the third most productive aquifer in the region (after Great Valley karst and Ohio Valley alluvium). Donovan said the keyword for future mine-water use is

“management.” Future research must shift towards (a) continuation of monitoring, (b) developing innovative water uses.

Lunch included a speech by then West Virginia Development Office Director **David Satterfield**

A third panel chaired by **Richard Bajura** focused on opportunities for coal programs in West Virginia.

**Patrick Esposito, Sr.**, president of Augusta Systems, discussed some of the recommendations from the Governor’s Energy Task Force report relevant to coal utilization. Among them were action items to:

- promote the commercial and residential use of clean energy technologies, including distributed energy generation and renewable energy forms;
- establish public/private partnerships that benefit research institutions and commercial enterprises that engage in the commercialization of energy and environmental technologies;
- publicize and market the actions that the state has taken and will take to become an energy leader in energy and environmental technology research, development, and commercialization;
- promote greenhouse gas emissions reductions and energy efficiency initiatives.

In terms of greenhouse gas reductions, Augusta Systems has established an emerging voluntary program for greenhouse gas reduction called CO-OP. The program is designed to assist industry, government, and nongovernmental organizations in catalyzing collaborative GHG reduction and offset projects and activities, with a focus on carbon sequestration, in a way that emphasizes voluntary actions by industry. CO-OP is a web-based system that serves as a central informational resource to match potential investors with contemplated GHG reduction and offset projects. The goal is to stimulate GHG related project development.

**Carl Irwin**, co-director of the Industries of the Future-WV program at WVU NRCCE, spoke about clean coal power projects and opportunities in West Virginia. He first described the Greenbriar Co-Generation Project in Greenbrier County, WV, an 85 MW waste coal to energy plant using fluidized bed combustion technology. The plant is to be part of an “Eco Park” concept, in which turbine exhaust heat can serve industrial users such as the wood products industry for drying hardwood in a steam kiln. The plant has an integrated co-production facility to produce value-added structural bricks.

He noted that energy-intensive industries are important to West Virginia and that there is untapped synergy between the state’s energy resources and energy-intensive industries. Recently, his group has been examining the idea of energy intensive industry clusters in the New Martinsville, Ravenswood, Weirton/Moundsville areas in which to locate a high-efficiency coal gasification combined cycle plant as a source of low-cost, reliable power, heat, and chemicals for the cluster with excess power sold to the grid. Policy, legislative, and regulatory approaches to promote this idea need to be examined.

**Jeff Herholdt**, manager of Energy Efficiency Programs in the West Virginia Development Office, spoke about FutureGen opportunities for West Virginia. FutureGen is a U.S. Department of Energy program whose purposes are to validate the engineering, economics, and environmental viability of a zero-emission, fossil-based energy system that produces electricity and hydrogen from coal and integrates the capture and sequestration of carbon dioxide. FutureGen technology will be based on coal gasification integrated with combined cycle electricity generation. The ten-year, \$1 billion demonstration is projected to produce 275 MW of electricity and be a living prototype with future technology innovation incorporated such as coal liquefaction and carbon dioxide sequestration in deep unmineable coal seams, deep saline formations, or depleted oil and gas reservoirs. A FutureGen consortium has been established whose membership is open to electric utilities and coal companies.

The consortium is administered by Battelle Labs of Columbus, Ohio. The consortium will use fair and open competition to select the FutureGen host site. Members include: American Electric Power, CONSOL Energy Inc., Kennecott Energy, The North American Coal Company, Pacific Corporation, Peabody Energy, Foundation Energy, Southern Company, and TXU. FutureGen consortium members will own FutureGen siting needs include: a 100 acre site with access to potential sequestration formations, access to a coal transportation network, access to the electrical transmission grid, access to two million gallons of water a day and one million tons of coal per year, a trained workforce, and nearby markets for electricity, hydrogen, and carbon monoxide. It is anticipated that a multi-state consortium may be a requirement for the project. The Development Office has been working with others to identify potential sites.

**Marshall Miller** of Marshall Miller & Associates reported about a proposed partnership for Appalachian regional carbon sequestration incorporating Virginia Tech, WVU NRCCE, and MM&A. The program is driven by Bush administration energy policy which includes action items to reduce by 18% the greenhouse gas intensity of the U.S. economy during the next 10 years, provide \$1.3 billion for advanced energy and sequestration technology, and establish a cabinet level committee on climate change science.

The proposed partnership would study an area from eastern Kentucky north through West Virginia, eastern Ohio and western Pennsylvania focusing on coal bed methane wells in the region. Prospective coal beds for carbon sequestration include Jawbone, Tiller, and Upper, Middle, and Lower Seaboard seams in the Upper Lee Formation; the Upper and Middle Horsepen, C-seam, War Creek, Lower Horsepen, and X-seam seams in the Middle to Lower Lee Formation; and the Pocahontas No. 6,5,4, and three seams in the Pocahontas Formation. Unmineable coal seams are projected to have the capacity to store 20 billion tons of carbon. The advantage of using coal bed methane seams for carbon storage, said Miller, is the ability to use carbon dioxide to enhance coal bed methane production thus producing an income stream from the “byproduct” of carbon sequestration—methane—possibly making this form of carbon storage the least expensive.

**Ted Hapney** of the UMWA offered brief comments on labor’s perspective of opportunities for coal, focusing mainly on encouraging the industry to engage labor in ongoing discussion

about opportunities for coal. He offered a sobering commentary about the effect on people's lives of the up and down cycles of coal employment.

**Gene Coccari**, WV Division of Air Quality, WV Department of Environmental Protection spoke about air permitting requirements in West Virginia. Thirty-seven state air quality rules apply, some are incorporated by reference from federal rules. There are also other federal rules that apply to air quality. Rules are for two types of sources: major sources and minor sources which includes minor modifications to major sources. He noted that 45CSR13, or "rule 13", is a pre-construction rule; a facility must have an air permit in place to begin construction. Rule 14 (45CSR14) applies to the modification of major stationary sources of air pollution for the Prevention of Significant Deterioration (PSD).

The rule requires "best available control technology" or BACT, an impact assessment including Class I Area analysis and Class II Area analysis. Such assessments require modeling. Rule 19 pertains to sources in non-attainment areas. In West Virginia, non-attainment counties, those whose emissions exceed clean air standards, include: Berkeley, Jefferson, Wayne, Cabell, Putnam, Kanawha, Wood, Marshall, Ohio, Brooke, and Hancock. According to Rule 19, proposed emission increases must be offset by greater emissions decreases from existing sources in the area using LAER - lowest achievable emissions rate (controls).

**Trina Waffle** of the WVU National Research Center for Coal and Energy spoke about the role of academic research which she said were to discover new knowledge, advance the state of the art to improve the quality of life—special role of a land-grant university, inform decision-makers, and educate tomorrow's scientists and engineers. WVU promotes a multidisciplinary approach to address complex problems like those associated with coal utilization. She noted that WVU NRCCE works with faculty across WVU, faculty at other institutions through consortia, industry as a contractor and subcontractor, and private and public sector through advisory committees for its various programs.

## Recommendations

Feedback on the evaluations from the July 22<sup>nd</sup> workshop indicated that the round-robin format for discussion was not generally welcome since participants did not necessarily have a rapport with one another. Participants said they did not necessarily feel comfortable speaking in front of the group. Therefore organizers determined not to use that strategy for this workshop. Consequently no comments were forthcoming from the audience at the coal utilization session. Also, the workshop ran longer than advertised. A tremendous amount of information had been shared and it is quite possible that participants suffered from overload. Among those who completed evaluation forms, the coal to liquids and carbon management were cited as being the most important topics presented.

## National Coal Issues Workshop

Seventy-nine people registered to attend the workshop on National Coal Issues which was held on November 11, 2004 in Charleston, WV.

The program committee included **Richard A. Bajura**, WVU National Research Center for Coal and Energy, **Kenneth Dickens, Esq.**, West Virginia Board of Coal Mine Health and Safety, **Jeff Herholdt**, West Virginia Development Office Energy Efficiency Programs, **Chris Hamilton**, West Virginia Coal Association, **Fred Tucker**, United Mine Workers of America, and **Trina Karolchik Waffle**, WVU National Research Center for Coal and Energy.

The primary function of this workshop was to provide information to the public. No open forum was conducted. The event was organized into two panel sessions.

The first panel focused on West Virginia coal issues, was moderated by **Jeff Herholdt** of the West Virginia Development Office Energy Efficiency Programs, and included:

**Calvin Kent**, vice president for Business and Economic Research at Marshall University, who provided a perspective on energy supply and demand with an emphasis on the role of coal. Coal demand has increased significantly. But the increase in demand has not accounted for all of the supply problems that developed over the previous year and a half.

Many major buyers of coal did not replenish their depleted inventories in anticipation of lower prices. The uneven demand was exacerbated by China's unreliable trading practices in not delivering the coal on the world markets that they had indicated they would.

The very favorable exchange rate for the U.S. dollar meant an increased demand for U.S. coal in Japan and Korea, Taiwan and India as well as other countries.

EIA projections show that the western region is beating out the Appalachian region in terms of making up the difference in the markets so far as supply is concerned, with the interior region, particularly the Illinois Basin remaining particularly constant. EIA expects this projection to hold true. Eastern coal production is going to remain fairly constant, while western coal is going to make up the difference. On a per miner basis, five times more coal is produced in the Powder River Basin in the west than is produced in eastern mines.

There were an unusually large number of mine closings in 2003 which were expected to continue through 2005 mainly due to "bad geology" or reserve depletion. Several major mines suspended mining due to hazards.

Chronic low contract coal prices have driven at least six sizable bituminous producers into bankruptcy over the last couple of years. Banks and other lenders have not made new loans to mines based on the record of relatively low coal prices, increased mining costs, and the past record of some bad debts in the industry.

The demand in the international Atlantic market has been extremely strong and that has

captured some of the South American coal imports that would have otherwise gone into coastal southeastern utilities, particularly those in Florida. As a result of problems with China's deliveries of coal, Australian exports have been sent to Japan, Korea, and other places.

Kent said that environmental concerns have affected mining operations, having estimated that that the recent Goodwin decision will cut production by 10 to 40 million tons a year.

Also the shortage of skilled laborers, particularly engineers and miners who are not being replenished, is expected to be a problem.

Coal truck weight limits were not as big a problem as others made of it, he said. However, the ability to actually get the coal to the rail terminals expeditiously continues to be a problem.

Looking forward, bankruptcies appear unlikely since the best properties have been acquired by financially stable companies. Estimates are up by about \$5 a ton to \$40 to \$45 per ton depending on the type of coal. Appalachian coal is predicted to be significantly above that price.

The current market high spot prices probably do not reflect the national trend, but the backwardation that does exist in coal markets is a fairly strong indication that there are going to be better coal prices continuing at least into the foreseeable future. (Backwardation describes a market in which spot prices exceed forward prices. Typically, forward prices increase in energy markets. Backwardation in prices usually corresponds with an immediate shortage.)

New mines are opening and old mines are being refurbished and brought back on-line.

International demand is going to continue to be sufficiently high, particularly in China and in Asia where the economies are growing at double-digit rates annually.

The demand for coal for electricity is going to continue to accelerate 2.5 to 3% per year. Natural gas prices will continue to rise, which means that alternatives to natural gas are going to become more and more desirable.

Going forward, the Interstate Air Quality Rule (IAQR) will affect coal. Kent said that according to his contacts in Washington, the Bush Administration is putting most of their agenda into effect through the Interstate Air Quality Rule, which is designed to reduce NO<sub>x</sub> by 70% and SO<sub>2</sub> by 65% in 29 Midwestern and eastern states except New England. Studies indicate that \$22 worth of benefits will accrue for every \$1 of cost of the program. Standards are set for 2010 with additional standards set for 2025. Each state is will be free to design its own implementation plan to meet reduction guidelines, with a recommendation that the states regulate power plants using a cap and trade system. Existing plants would be grandfathered with credits for emissions at the 2000 level. New plants would not be given any credits at all.

As a result of the rule, a small increase in electricity prices is expected, ranging from 1.5 to 2.7% in 2001 dollars. Demand for coal will continue to increase by at least 24% over the relevant period of the forecast.

The rule does not include a provision for mandatory mercury reductions which disadvantages Central Appalachia since it is considerably easier to remove mercury from Appalachian coal than it is from western coal.

Kent believed that since Central Appalachian coal is cleaner and easier to clean, the implementation of the IAQR will lead to a healthy market for West Virginia coal.

On the whole, the market looks extremely good for coal into the future.

**Mark Muchow**, director of fiscal policy for the West Virginia Division of Tax and Revenue, spoke about coal's contributions to state finances. Governor Wise had announced that the state is estimated to have an accumulated surplus over two budget cycles, fiscal year 2004 and fiscal year 2005 of \$243 million. A significant portion was attributable to coal severance taxes which for FY2004 were expected to exceed estimates by at least \$50 million.

In the 1970s, there was a major expansion of coal severance tax revenues due to increased energy demand. Revenues peaked around 1982 at about \$190 million. Revenues have generally stayed there or retreated a little bit since then. A major collapse in energy prices in '86-'87, meant that coal prices retreated even though production rose during most of the 1980s and into the 1990s. In recent years coal has been averaging around \$30 a ton.

The tax department assumed that prices were likely to remain in that \$30 to \$32 per ton range to develop its near term revenue projections. But the overall average for the industry appears to be in the \$38 to \$40 per ton range. Year-to-date output in West Virginia is up about 5.8% as the statewide average, with a more than 17% increase in the northern part of the state. For fiscal year 2004 the department predicted total coal severance tax collections in excess of \$210 million, slightly higher than the previous peak.

For fiscal year 2005, the estimate for overall prices is \$38 to \$40 a ton range. Since a significant amount of coal is under long-term contract the price is expected to be fairly stable. As new long-term contracts are renegotiated, the price is likely to rise.

Coal and natural gas are bigger players this year (2004). More than 40% of the revenue growth in the general revenue fund for the year to date is attributable directly to the severance tax. The other major contributors to growth are corporate income business franchise tax collections and personal income tax receipts; and in each of these two latter cases, the coal industry has played a role. Mining employment was up by 2,000 increasing personal income tax collections and higher energy prices mean increased profits with increased collections from corporate income taxes.

Coal severance taxes support local government finance. In recent years, counties and municipalities received about \$15.5 million. Estimates of future expected disbursements are

as high as \$17.5 million.

The general revenue fund of the state treasury received approximately \$155 million of revenue annually in recent years, or about 5% of the general revenue fund. Because more than half of the general revenue fund supports K-12 education, one can infer that about \$75 million in coal severance taxes support education. The Department of Health and Human Services receives about 20% of the general revenue fund so that would mean about \$30 million in severance tax money would go to health and human resources.

In addition, the first \$24 million of severance tax collected each year goes to an infrastructure bond fund to fund various infrastructure projects around the state. The coal industry has contributed about 90% of that total, or around \$21.5 million per year. The \$300 million bond issued a couple of years ago supports water and sewer projects (80%) and economic development (20%). This bond has been very important, particularly in the eastern panhandle of the state. Between fiscal year '96 and fiscal year 2005, \$216 million of severance tax money has been devoted to the infrastructure bond.

The coal industry also pays a significant amount of property taxes in those counties where the industry is located. At last count, the annual property tax bill directly paid on active mines as well as reserve properties totals in excess of \$60 million a year.

**Bill Raney**, president of the West Virginia Coal Association, spoke about coal's importance to the state, the nation, and the world as a bridge to the future. West Virginia has more than 50 billion tons of coal according to the West Virginia Economic and Geological Survey, about 20 billion in seams that are greater than 2½ feet in thickness and less than 1.5 % sulfur. In 2003, nearly 150 million tons of coal at a value of a little better than \$4 billion were produced.

Raney stressed the importance of political leadership, saying that President Bush will bring stable leadership to get an energy plan that the country needs, a president who appreciates the West Virginia coal miners and the coal industry as a major player in that energy plan. Such leadership builds the coal industry's confidence for the future.

He also complimented the efforts of business and industry in helping to bring about change within the state Supreme Court, specifically acknowledging Don Blankenship for taking a bold leadership role.

Experts agree that coal will be a big part of America's energy future. Predictions are that electricity demand will increase by 45% over the next 20 years. In 2001, the United States consumed 97 quadrillion BTUs of energy. By 2025, projections are that 136 quadrillion BTU's will be needed, which is a 40% increase. Seventy-four gigawatts of generation will be constructed by 2025, which will require another 320 million tons of coal.

During the last 30 years coal use has tripled while air emissions have dropped by 84%. That trend will continue.

Twenty-two of the 25 lowest cost electric plants are coal fired.

Technology is available to gasify and liquefy coal and to make hydrogen from coal. Today's energy market supports taking those applications to the field. From a BTU standpoint, West Virginia's coal nearly equals 77% of the oil in Saudi Arabia, 77%. The energy in coal is equal to or greater than 1.5 times the natural gas content of North America, including Canada and Mexico.

West Virginia is a leading producer of underground coal in the nation. Seventy percent of the state's production is underground; 342 companies operate 513 separate mines.

Coal production represents 8% of the state's gross product. The 17,000 direct coal miners had a payroll of a billion dollars and there are 24,000 expert specialty contractors who depend on a mine operating every day somewhere in West Virginia.

West Virginia is in a once in a lifetime opportunity to mine coal that had been written off years ago as not being economical to mine.

Development of the smallest of mines costs \$10 million. In some of the state's smaller counties, that kind of economic activity is certain to have an impact.

Coal has been important to West Virginia, but the industry does have needs, he said. For example, the industry needs rail car predictability and permitting of new equipment, incentives to develop the tougher, less-accessible seams that we have and more funding for research on extractive technology. The industry also needs solid, reliable policy that encourages the use of West Virginia coal in West Virginia as well as throughout the country. West Virginia has the best coal workforce in the world, but young miners are needed. Companies are working towards bringing a new generation of coal miners on board.

If opponents of coal have their way, 52% of the lights in this country will go out and 99% of the lights in West Virginia will go out, he said. Typically, the opponents offer no alternative to coal. Wind and solar are attractive and the coal industry supports their construction and use, but these technologies are not practical for filling the electricity demand gap. For example, it is estimated that to meet the energy needs of 2010 with windmills and solar panels, 9.4 million acres of land would be required, an area equal the size of Massachusetts, Connecticut, and Rhode Island combined. So today, these options are not practical. Coal is the most reliable, abundant, and secure source of energy known today to make that electricity.

**Rita A. Bajura**, (former) director of the National Energy Technology Laboratory, spoke about new coal technologies. These facts are known:

- West Virginia produces 15% of U.S. coal.
- There are 40,000 direct West Virginia jobs in mining, contracting, coal prep, and suppliers.
- Coal produces 99% of West Virginia's electricity.
- There are 14 coal-fired power plants in West Virginia.
- Coal provides over half the nation's electricity.

- The United States has abundant coal reserves.
- Coal prices are relatively low stable prices, compared to natural gas and oil.

But coal is environmentally challenged. While contaminant emissions are down, there is tremendous public pressure to further reduce environmental emissions.

From a long-term, research perspective three key environmental challenges are: mining with a minimal environmental footprint; mercury emissions; and climate change. These last two are global issues.

In the United States mercury emissions from manmade sources equal about 120 tons per year. Coal-fired power plants produce about 40% of the manmade emissions in the United States, 48 tons per year. On a global basis, almost 5,000 metric tons per year of mercury are emitted. These emissions circulate around the globe making mercury a global issue. Much of the mercury in the rivers and lakes of this state is from this global circulation. U.S. power plants contribute just 1% of that global circulation of mercury.

Nevertheless, the “U.S. Global Mercury Assessment Report,” which was issued in February of 2003, said, “Sufficient evidence of adverse impacts exists to warrant further international action to reduce risk to human health and to the environment.” And it said, “Both immediate and long-term action should be initiated as soon as possible.” United States actions include:

- Regulation of mercury emissions from incinerators. Emissions are 95% less than they were in 1990.
- Forty-five states have issued advisories for all or part of their waters warning about the risks to pregnant women and children from consuming fish from those waters.
- Regulations limiting mercury emissions from coal-fired power plants will be issued in March 2005.
- In parallel with the regulatory process, the Department of Energy has a research program to test mercury control devices at full scale at operating power plants. NETL is testing devices at more than two dozen plants with a range of coal types and a range of pollution control equipment, scrubbers, SCRs. Those tests should be done by the end of 2007.
- NETL is also studying the mercury in the byproducts from the field tests. If all the byproducts from coal-fired power plants are determined to be hazardous waste, that could have a huge impact on the electric industry—both from the loss of revenue, and from the cost of hazardous waste disposal.

There is no vendor out there willing to offer a typical commercial guarantee such that an electric utility would buy a mercury control device.

Understanding of the fundamental mercury chemistry is an immature science. It is not scientifically valid to extrapolate what happened with incinerators to coal-fired power plants because the concentration levels are very, very different.

SO<sub>2</sub> or NO<sub>x</sub> control devices will also significantly reduce mercury emissions.

Climate change is the other key environmental challenge for coal. To address that, President Bush announced the FutureGen program in February 2003, a nearly \$1-billion, ten-year project to demonstrate that coal can be used to produce electricity and to produce hydrogen with zero emissions. Nominally, the FutureGen facility would be a 275-MW power plant, about half the size of the Fort Martin power plant in Monongalia County.

Sulfur emissions from coal are down, but sulfur is only 1 to 3% of coal's makeup. Carbon, however, is the heart of coal. To build a power plant and have near-zero carbon emissions is the equivalent of putting a man on the moon in 10 years.

U.S. carbon emissions from fossil fuel combustion in the residential, commercial, industrial, transportation, and electric utility sectors. Transportation is roughly one-third of the emissions. Large central station power plants operated by industry produce a third of the carbon emissions, and they are very likely to be the first emissions source that is regulated—if indeed the Nation decides to regulate carbon emissions.

In view of possible restrictions on carbon emissions, FutureGen technology will enable coal to continue to be an option for power generation, and the technology will enable coal to be used in the transportation sector by producing hydrogen as a substitute for gasoline. Both of these with near-zero carbon emissions.

FutureGen is based on integrated gasification combined cycle technology, or IGCC. In IGCC, coal is converted to a high-temperature synthetic gas composed mainly of carbon monoxide and hydrogen. It uses both steam and gas turbines—that's the "combined cycle"—to produce electricity. The technology is currently in its demonstration stage. Two IGCC plants operate on coal in this country. Both of them are about 10 years old. There are less than a dozen IGCC plants worldwide. IGCC offers several advantages:

- Fuel and product flexibility. The plants can use coal, bio-waste, bio-meds, or sewage sludge. They can produce electricity. They can produce hydrogen. They can produce chemicals.
- IGCC offers higher efficiency. The plants create more electricity from a ton of coal than other technologies.
- IGCC is environmentally superior for criteria pollutants.
- IGCC is carbon sequestration capable.

The current issues with IGCC include cost and reliability. An IGCC plant is a little more expensive than a conventional pulverized coal plant, and the operating reliability is lower. These issues are what the FutureGen research program is addressing.

Industry is expressing tremendous interest in commercializing IGCC technology. For the first time, electric utilities saying, "We are going to build these plants." Major architectural and engineering firms are saying, "We're going to build, design, and operate these plants with commercial guarantees."

An important aspect of FutureGen is carbon sequestration—physically capturing the carbon dioxide inside the plant and pumping it deep in the earth for permanent disposal. carbon has

been pumped into the ground for years for enhanced oil recovery; the carbon dioxide forces oil and natural gas out of the rock formations.

There are two 1-million-ton-per-year projects going on now with international groups monitoring them. DOE is one of the groups involved. One is the Weyburn Project in North Dakota and Saskatchewan in which carbon is shipped via pipeline 200 miles from the Dakota Gasification Company's synfuel plant in Beulah, North Dakota, to the Weyburn oilfield in Regina, Saskatchewan, for enhanced oil recovery. The second project is the Sleipner Project in the North Sea. Statoil, the Norwegian oil company, is running the project. Norway has a carbon tax for producing natural gas in the North Sea. Gas in the North Sea has a lot of carbon in it. Statoil is stripping out the carbon and disposing of it in a reservoir underneath the North Sea.

An industry group has announced interest in implementing the FutureGen project on behalf of the Department, and we currently are starting negotiations with this group. Five of the major coal-fired utility companies in the country and five of the major coal companies are involved. These charter members reflect one half of the U.S. coal industry and one third of U.S. coal-fired utilities.

Starting in 2010 and 2015, the nation is going to need a lot more new coal-fired power plants. A window of opportunity between now and 2015 exists, a 10-year time period for the FutureGen project to get the data needed to know what kind of plants to build, what design they should be, and how to build plants with zero emissions—if indeed that becomes a national requirement.

In the future, coal could be used to produce hydrogen for the transportation sector. There are other ways to produce hydrogen, but if only coal is used to make hydrogen, the market for coal would double.

The second panel moderated by **Chris Hamilton**, of the West Virginia Coal Association, focused on national and international issues and included the following speakers:

**Steve Miller**, president of the Center for Energy and Economic Development (CEED), discussed today's and tomorrow's challenges facing the coal industry. His comments focused on three main themes: coal is a fuel of the future; electricity from coal is affordable; about the increasingly clean environmental performance of electricity from coal.

Coal is the fuel of the future, based on the experience at CEED, but more particularly in the last five years with the Americans for Balanced Energy Choices campaign, the ABEC campaign.

The key is to have decision makers and opinion leaders recognize coal as the fuel of the future. Then these decision makers and opinion leaders will be more likely to make investments of government funds and private sector funds, and secure the public support that is necessary for industry to go forward.

CEED has done about \$1.5 million worth of public opinion research over six or seven years, including focus groups all across the country and national public opinion polls. CEED found that the public needs to know 1) that coal and electricity from coal are essential to America's economy, 2) that coal is affordable, and 3) that coal is increasingly clean.

Thirty-five years ago, electricity as part of the whole energy mix in this country was only about 20%, today it is 41% and growing. The country's economic engine is being driven more and more by electricity. There is a one-to-one correlation between economic growth in this country and the consumption of electricity. The economy will grow largely on the back of electricity consumption.

All fuel sources for electricity are going to be important.

Ten years ago, CEED performed a survey asking, "What is coal used for in America today?" The number one answer was, "I don't know." The number two answer was, "To power train locomotives." The public policy terrain is very difficult for an industry that provides more than 50% of the feedstock for the biggest commodity bought and sold in America, electricity and food being the two largest, and governors, congressman, state legislators, and local leaders that either "don't know" or believe that coal is used to power train locomotives.

Decision makers' and opinion leaders' understanding of coal's economic role matters profoundly to jobs in this country. CEED commissioned research from Penn State University that showed that the value to the U.S. economy of using domestic coal reserves to generate electricity in the year 2010 will be between \$163 to \$659 billion in increased economic output, \$40 to \$224 billion in increased household earnings, and 800,000 to 6.4 million additional American jobs. The models used to generate the models were reviewed by economic modelers at Georgia Tech.

If coal is eliminated from the nation's energy mix, there would be a range of \$163 to \$659 billion in lost economic output for the nation, \$224 billion dollars in reduced household earnings and somewhere between 800,000 and 6.4 million additional American jobs at risk.

The value to West Virginia's economy of using domestic coal reserves to generate electricity in the year 2010 will be between \$12.6 to \$19.9 billion in increased economic output; \$3.4 to \$6.1 billion in increased household earnings; and 80,000 to 173,000 additional West Virginia jobs. For numbers for all 50 states, see CEEDnet.org.

For people who are on the lower socioeconomic end, the cost energy profoundly affects their decisions about how to conduct their daily lives. CEED research compared census data from 2000 with research that DOE does every five years to track energy consumption in this country. For people who earn \$50,000 a year or more as a family pay about 4% of their total income for energy (e.g. transportation, home heating, and cooling). For people who earn \$10,000 to \$25,000 a year, about 33% of American families, 13% of their income goes to energy. For the 10 or 11% of the families in this country that earn \$10,000 a year or more, nearly 33% of their total income goes to energy.

Since 1970, coal use has almost tripled emissions from coal are one-third lower today than in 1970. Yet, anti-coal opinion shapers run advertising and talk about how kids are being poisoned by deadly mercury from power plants and are good at distributing the kind of rhetoric that creates a public frenzy that is damaging to a reasoned policymaker in this country.

A legitimate way to deal with concerns about climate change centers around sequestration of carbon through natural processes—geological, terrestrial—and the use of technology to make electricity even more efficient than it is today. Some states are making policy around climate change. Their theory is that the United States government is failing to act. But there are some pretty significant federal programs that are in place dealing with carbon emissions. Plus the growth of other countries, particularly in the developing world, is going to dwarf the cap and trade initiatives of individual states or small groups of states.

The United States is on a trajectory towards near zero emissions from electricity generation. The only question is the slope of that path and the timeline for that path. If the slope is steeper than what is reasonable, American workers and people who live on low or fixed incomes will be hurt.

**Don Blankenship** spoke about challenges facing southern West Virginia coal production. Blankenship is president, chief executive officer, and chairman of the board of Massey Energy Company, a Fortune 1,000 company producing more than 41 million tons of coal in 2003 with a workforce of 5,000 employees. Massey Energy holds a reserve base of over 50 years worth of coal.

Blankenship used the acronym ACE to describe the near term future of coal: attitude, China, and the environment. The current price of West Virginia coal competes well but newly mandated scrubbers to remove sulfur will take away one of the advantages that West Virginia's low sulfur coal has had. Higher sulfur Illinois and Ohio coal production will increase and Wyoming's Powder River Basin coal will penetrate into eastern markets. So West Virginia coal will be very dependent on high quality metallurgical coal and industrial coal demand.

In 2008 when mandates to increase control of mercury, NO<sub>x</sub>, and SO<sub>2</sub> take effect, demand for West Virginia coal could take a dip. It's very important that the West Virginia delegation understand how they need to focus on the balance between environmental requirements from other coal producing regions in the country and ours; otherwise, West Virginia will end up disadvantaged.

Massey's attitude is to focus on job creation, low-cost electricity, and opportunity to allow thousands of West Virginians to enjoy life. Massey Energy is 5,000 employees with 15,000 family members that have a fully-funded pension plan, that have 90% of their medical bills paid, that average \$55,000 a year in income and have the highest quality of life of anyone living in southern West Virginia.

One-hundred-thousand of the 400,000 children in West Virginia today live in poverty in a

state that has a \$215 million severance tax windfall and more resources than any state in terms of opportunity in natural gas, coal and timbering, et cetera.

Blankenship questioned the wisdom of spending billions of dollars controlling 48 tons of mercury when the world is generating 5,000 to 7,000 tons of mercury.

Blankenship noted that Massey pays \$81 million a year to retire the reclamation obligations of black lung, obligations of workers' comp, other obligations that failed coal companies have left behind. Were Massey not successful in providing the \$81 million it would fall on the citizenry of the country or the state in terms of taxes in order to retire those obligations.

He said there have been 30,000 union jobs lost in this country, UMWA jobs, so attributing union job loss to Massey is a difficult task.

He said that the result of a negative attitude toward the industry is that 40% of West Virginia's children live in families who do not have full-time employment. It is hard to overcome people who have power and who have the position of being able to influence the public and being negative about an industry that is so critical to our citizenry.

As a result of that, 25% of West Virginia's children live in poverty and a child is neglected or abused every hour, is born into poverty every two hours, dies before their first birthday every two days, is killed by gunfire every three weeks and that's out of 402,000 children.

West Virginia is the only state in the United States since 1950 that's lost population. Most of that population has been lost in southern West Virginia. The lost population would be much more dramatic and more negative were it not for the growth of the Washington, D.C. bedroom communities in the eastern panhandle.

In regard to China, worldwide carbon, mercury, and particulate matter emissions will grow as a result of China which produces nearly 1.7 billion tons of coal. China has little or no control on coal use. Every dollar spent in China on environmental improvements would yield 100 times greater environmental improvement than a dollar spent in the United States. Blankenship said it is disingenuous to claim that the U.S.'s 48 tons of mercury emissions will somehow have an important role in polluting the world's environment, when the Chinese are moving from 1.7 billion tons of coal per year and increasing the number by a 200 million a year, equivalent to all Central Appalachian production with no environmental control.

**Mark Dempsey**, vice-president, External Affairs, AEP Appalachian Power, spoke about the status of the electricity infrastructure and opportunities for growth.

AEP is the largest generator of power in the country and the largest consumer of coal in the country as well. In '98 AEP was 88% coal fired is 70% coal fired today with plans to be closer to 90% production of coal-fired generation in the near term.

Environmental issues are the biggest driver of the decisions at AEP. SO<sub>2</sub> Emissions are down by approximately 50% between 1990 and 2005 with actuals between 1990 and 2002 showing

a 44% reduction. Emissions of NO<sub>x</sub> are down nearly 80% in ozone season emissions between 1990 and 2005. More than \$1 billion in capital was spent between 2001 to 2004 to address emissions. By 2005 there was approximately a 60% annual reduction in NO<sub>x</sub>. These emissions come even as demand for electricity from AEP-East coal plants has grown by about 20%. AEP announced emissions-related projects in West Virginia alone of about \$2 billion and will probably have another \$5 billion to announce soon.

AEP views the future of coal very seriously. Dempsey said that AEP is very much committed to coal, saying there is nothing to replace coal. He added that new electric generating facilities need to be built in the eastern states.

AEP announced plans to build an integrated (coal) gasification combined cycle (IGCC) unit in one of the eastern states to be on-line by 2010. Factors that come into this decision include the engineering, procurement, and construction costs per kilowatt hour. Conventional pulverized coal (PC) units cost \$1,250 per kwh, supercritical PC and circulating fluidized bed units each cost \$1,300 per kwh, natural gas combined cycle units cost \$440 per kwh, and IGCC units are estimated to cost \$1,300 per kwh. The IGCC price is yet to be tested in the marketplace with real contracts. The U.S. DOE piloted projects in the 1980s with capital costs at about \$2,500 per Kwh of generated capacity. The more companies that build IGCC plants, the more likely the price will come down.

IGCC offers fuel flexibility and shows superior efficiency using eastern bituminous coal. IGCC does not work as well with the western coal stock. IGCC has superior environmental performance, produces a suite of byproducts, and is conducive to carbon capture and disposal. Carbon capture is very big in the thinking at AEP. In IGCC coal is gasified to make syngas to be used to generate electricity using a combined cycle, burning the gas in a gas turbine and using steam off the back of the cycle to run a conventional turbine. The process also can produce a number of products such as synthetic diesel fuel. IGCC is basically a chemical plant and AEP is hopeful of attracting the chemical industry to perhaps co-locate with an IGCC facility.

No manufacturer of IGCC exists to serve the electric utility market. Recently GE purchased Chevron/Texaco's gasification unit and Bechtel is now partnering with GE. Dempsey said that they tell AEP that they are prepared to guarantee the operation of the plant. That is a big issue for AEP and will be a big issue when AEP talks to regulators about the IGCC plant.

The promise of IGCC is competitive capital costs, fuel flexibility, highest efficiency, best emissions characteristics, most carbon-friendly, coal-based technology and the technology of choice to keep the coal industry in the money.

AEP thinks strategic alliances between the electricity industry and the coal industry need to be formed going forward. Coal is getting tight in all markets. AEP thinks that central Appalachian coal is going to remain a very strong market. Part of that outlook is because production looks like it is going to continue to decline because of permitting and reserve issues.

As opposed to being replaced by Powder River Basin coal, AEP thinks the real opportunity is back with the northern Appalachian coal. The Illinois Basin is also going to see a lot of activity.

Wyoming's Powder River Basin coal is going to remain an important part of the fuel mix in general, but the western most point in the AEP system that burns Powder River Basin coal is in Indiana. AEP has a coal terminal in Indiana that brings Powder River Basin for that plant a distance of 1,900 miles over basically one track. AEP can not face the exposure of depending on much more coal on such a fragile logistics scheme.

**Richard Lawson** (retired Air Force general) spoke about coal as the U.S.'s national energy resource. Lawson is chairman of Energy, Environmental and Security Group, vice-chairman of the International Committee on Coal Research, vice-chairman of the Atlantic Council, member of the Board of Directors of the United States Energy Association, and member of the Washington Institute of Foreign Affairs and the World Energy Council.

Lawson's comments started with global energy demand, focusing on China and India. China produced about 1.7 billion tons of coal, albeit unclean. By the end of 2006, China will produce two billion tons of coal. India produces about 350 million tons of coal and will go to 650 million tons by the end of 2005. Both countries realizing they have to find energy.

By 2025 total world population is projected to grow by about 1,876 million human beings and 1,800 million of them will live in developing nations. Ninety-six percent of all population growth is going to occur in developing nations and those developing nations' economic status is less than satisfactory. The projections through 2025 are these: world population is projected to grow 77%; Central and South America up 119%; India up 122%; average of all developing nations up 129%; and China up 174%.

To illustrate the human condition, Lawson proposed a model global village with 100 residents. Seventy-eight of them come from the developing world. Fifty of the 100 live on less than \$2 a day. Fifty have limited or no access to commercial energy of any kind. Thirty of those 50 burn dung as their only source of energy. Fifty are malnourished and stalked by disease. Eighty are stacked in substandard housing. Eighty percent of the village wealth is in the hands of 16% of the villagers.

Lawson believes that the wars of the future are going to be caused by poverty. Unremitting poverty is a dominant factor in build-up the social unrest and resentment among nations, among individuals, and among groups of individuals. For terror, revolution, and war, the motive is all the same—to try and resolve by force and violence those grievances that are born out of economic and political deprivation.

To resolve this issue, the reasons for that poverty must be attacked. Lawson observed that the most basic reason for poverty is an absence or a major constraint on the amount of energy available. The most important type of energy seems to be electric power. Electricity is the essential prerequisite, the one component that causes the other components in an economy to begin to develop, a cause of causes.

So an examination of the world situation must begin with an examination of electric power.

On his trip to China, Lawson learned that China is building a new coal-fired power plant every 12 days and that there is now electricity in every single village in China, an electric light at the very least in every village. The Chinese response to questions about environmental issues was, “As soon as we solve the problems of feeding, housing and clothing, then we'll begin to work on those issues that are associated with the environment.”

China is keeping track of all the technologies associated with the environment, but right now the goal is to produce the basis and the foundation for economic growth. Coal is 70% of the world's proven resources of fossil fuels. Oil is about 17%, gas is 15%. Coal is the most widely dispersed fossil fuel. Coal is the fuel for the 21st Century because it is dispersed in such a way that it can provide the trigger for economic growth.

Energy projections from Los Alamos looking at the entire 21st Century had this to say: oil and natural gas use will fall by 86 quadrillion British Thermal Units, a decline of 20%; renewables will be up 78 quads; nuclear generation will be up 289 quads; coal worldwide will be up 431 quads; overall energy requirements will be up 712 quads, almost 140%. The numbers show that coal will be the backbone for the 21st Century. Across the board, through the end of the century, renewables will hold steady at about 8%, despite aggressive programs on many sides. Natural gas and oil will fall from their present high of about 62%, down to 23%. Nuclear generation will rise from 6% to 27 %, and coal will almost double from 24% to 42%.

In this evolution, the rise in coal demand alone may exceed the world's total energy consumption by 25 quads, the rough equivalent of more than 11 million barrels a day. And in some, about 60% of the world's new energy over the next 90 years will have to come from coal if coal is to have sufficient energy, especially electric power.

The United States is expending resources to get at pinpoints of environmental problems that could be used to go at magnitudes of problems on a worldwide basis that might have extraordinarily significant results in terms of developing allies to accomplish the following:

- 1) Development of a coal to liquid transportation fuels—work in the Department of Defense and to a lesser degree with the Department of Energy is focusing on the creation of new liquids for the defense machines from alternative sources, primarily from coal, with a renewal of efforts in the oil shale business.
- 2) Development of an “Energy Marshall Plan”—a program to identify those countries whose political leadership, whose physical characteristics, whose natural resources and whose requirements are such that the United States might be able to put together an energy framework that could begin to initiate economic activity of a sufficient quality to begin to give some hope to impoverished people. The program will be a government-primed, public sector push to develop energy structures. About 85% of those developing countries' energy plans will focus on coal.