



Illinois
Department of Commerce
& Economic Opportunity

Bruce Rauner, Governor

OFFICE OF COAL DEVELOPMENT

FISCAL 2014 ANNUAL REPORT

DEPARTMENT OF COMMERCE AND ECONOMIC OPPORTUNITY



ILLINOIS COAL
Discover the Power

“Did you know that Illinois coal powers millions of homes, factories and industrial plants all over the United States? It is true! Illinois coal makes many things possible.

“The first and most important impact of coal in Illinois is that it keeps the economy strong. It has been estimated that approximately one coal mining job creates five more non-mining jobs.”

*From “The Power of Coal in Illinois,”
an essay by Zahra Vasi, 7th grade,
Century Junior High, Orland Park, IL*



<u>INSIDE</u>	<u>PAGE</u>
<i>Introduction</i>	<i>1</i>
<i>Capital Project Grants.....</i>	<i>3</i>
<i>Coal News in Review.....</i>	<i>5</i>
<i>Coal Awareness Program</i>	<i>7</i>
<i>Overall Market Growth</i>	<i>9</i>
<i>Export Potential</i>	<i>13</i>
<i>Addressing Greenhouse Gas</i>	<i>16</i>
<i>Coal Science Advances.....</i>	<i>17</i>

Coal in Illinois

Coal underlies all but the northernmost counties in Illinois. It currently is mined in central and southern Illinois. In the past 10 years some \$10 billion has been invested in new Illinois coal projects. As the market for coal in general has slumped in recent years, Illinois has been a noteworthy exception. In fact, coal-related projects have been one of the largest areas of new investment in Illinois during the past decade.

By the numbers, the value of the coal produced in Illinois in calendar 2013 approached \$3.1 billion, and tonnage set a modern record of nearly 58 million short tons in 2014. Coal-fueled electricity from Illinois represents over \$7.4 billion in retail power sales.

The Illinois coal industry is currently employing approximately 5,000 miners with an average salary of \$85,000 a year. This is higher than both the U.S. and Illinois median household incomes. However, previous environmental regulations (see later sections) have resulted in coal production declining from 62 million tons in 1990 to a low of 31 million tons in 2003, with a loss of 6,500 direct jobs during this time period.

Economic Powerhouse

The state's vast coal reserves remain a major reason that Illinois has been a leader in energy production within the United States for more than 20 years. The state has the largest recoverable bituminous coal reserves in the U.S. Sometimes referenced as "steam coal," for its use in the electric power industry, this is a "reserve base" larger than all but six *countries* in the world; it is sufficient to produce all of America's electricity for 100 years, or Illinois' power needs for 600 years, at current consumption rates.

Underground room-and-pillar and long wall mines account for 52.7 million tons of production. Surface mines yield about 5.3 million tons. Partly due to coal, Illinois is the largest electricity exporter in the Midwest and one of the largest in the United States. Nearly 45% of Illinois' energy comes from coal-burning plants within the state. The market share has been on the rise, though the majority of Illinois coal plants continue to burn low-sulfur, low-cost coal from the Powder River Basin of Wyoming.

While Illinois ranks seventh nationally in coal output, Wyoming is the industry leader in virtually all categories. That state's sub-bituminous coal resources total over 1.4 trillion tons in seams ranging in thickness from five feet to a staggering 200 feet. Total deposits are more than 165 billion tons of recoverable coal.

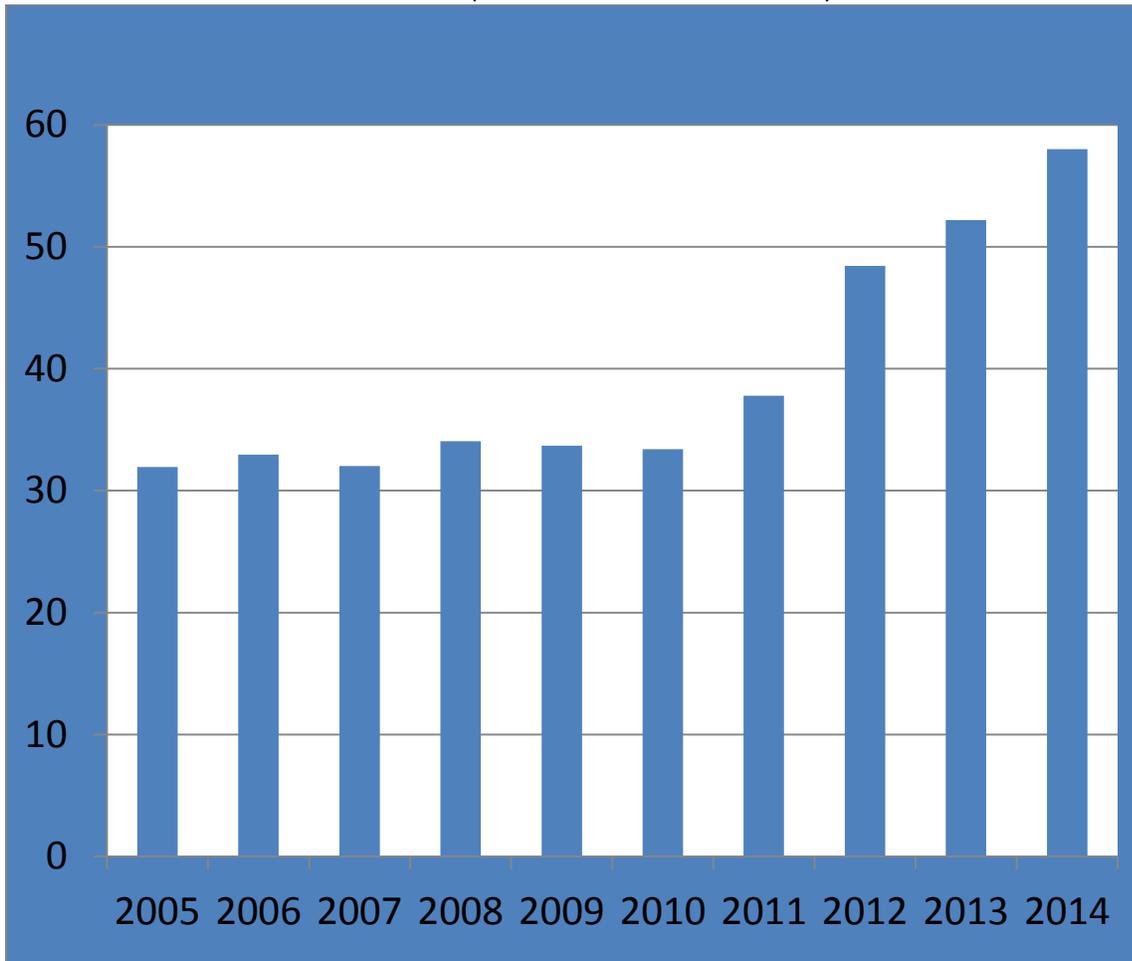
Emissions Down, Tonnage up

Historically, electricity from coal, as measured in dollars per Btu, has been more economical than other major fuels. Coal prices remain much more stable than any other fuel source. Coal power, advocates say, does not have the operational risks of nuclear energy, or the price risks of other fuels, such as oil and natural gas, which are often influenced by international policies.

While some equate coal with unwanted air emissions, coal used for electricity in the U.S. has increased by 165% since 1970. Key emission rates, for the same period, declined by 90%.

Illinois Coal Production Rising

(Calendar 2014 in million tons)



Illinois Dept. of Natural Resources

Fiscal 2014 Coal Competitiveness Program

Total Project Expenditures	\$73.6 million
State Funds Invested	\$17.6 million
Private Dollars Leveraged	\$56.0 million

Purpose:

The Fiscal Year 2014 Coal Competitiveness Program, like its predecessors, was established and funded by the General Assembly and executed through the Department of Commerce and Economic Opportunity-Office of Coal Development. Its intent is to provide financial incentives and technical support for coal miners and users to upgrade and expand operations, enhance safety and demonstrate cutting-edge clean coal technology. Many project fostered new jobs in areas of high unemployment or underemployment. In all cases, the agency was guided by a mission to make Illinois coal competitive with energy resources produced in other states.

Highlights:

- Awards to **Prairie State Energy Center** in SW IL totaling **\$3.1M** as cost sharing on five projects valued at **\$14.6M**: Among the projects are a separation system for power plant fly ash (generally a waste byproduct) from gypsum (which has a recycling value); dust control sprays and methane monitors to meet new mine safety regulations; equipment for the state’s first regional “mobile” fire suppression and mine rescue team, covering several mines in the area; safety and emergency equipment for the plant’s adjacent Lively Grove mine, including 26 security cameras, an underground fiber-optic telecom line, new warning lights and horns.
- Award to the state’s newest longwall mega-mine, built by new market entrant **White Oak Resources** in Hamilton Co., of **more than \$1.2M** as part of a **total investment of nearly \$6.5M** in underground production equipment. Also included are six new 14-passenger/personnel carriers that will increase productivity and provide an additional margin of safety in an emergency.
- Award of **\$1.36M on a \$6.8M** project at **American Coal Company’s** mining complex in Galatia, resulting in output capacity of its coal cleaning plant increasing from 2,600 to 3,000 raw tons of coal/hour.

- Turning the older Gateway Mine into a virtually new operation, mining new coal reserves, won a **\$905,000** award on projects by **Peabody Investment Corp.** to spend more than **\$26 million** upgrading the Randolph Co. mine and securing hundreds of mining jobs. Among the projects are a new 2,266-foot, two-chamber slope handling coal exiting the mine above a chamber for miners and equipment to get underground. Also included are two new ventilation shafts.
- Two awards totaling **\$360,000** on a **\$1.8M investment** to assist **American Equipment and Machine Inc.** of Centralia, a relatively new coal service company, to install electrical service, gas lines and heavy-duty overhead cranes in new shop to rebuild and repair continuous mining machinery. Also, to expand its existing longwall shield-making operations, including new concrete pads, cranes and other facilities.
- A total award of **\$1.02M** for safety and related projects at various mining facilities operated by then-**Foresight Reserves, LP.** The state funds will **leverage nearly \$4M in Foresight capital investment** in: 1) Installation of underground seals to complete mining work in the first area mined at the Mach 1 Mine, in Williamson Co., Foresight's first in Illinois; 2) Rebuilding a flexible conveyor for moving coal from active mining operations to the exit belt; 3) Providing infrastructure for an environmentally friendly plan to inject fine coal waste from the cleaning plant to mined-out underground voids, and 4) Assist in purchasing rescue chambers, underground breathing equipment and harmful-gas detectors at the Shay Mine near Carlinville in Macoupin Co.
- The coal industry's most advanced underground miner protection system was installed by **Knight Hawk Holdings** of Ava in Jackson/Perry/Randolph counties. An award of **\$351,405** shared in the cost of a **\$1.75M** Generation II automated proximity protection system that stops large underground machines before they can pin down, or otherwise injure a nearby coal miner.
- An award of **\$161,038** to **Alliance Coal Co.** for its Pattiki Mine/ White County Mine in Carlinville as cost-share in an **\$805,190** project to boost and otherwise upgrade power service underground. Work included installation of power regulators, circuit breakers, power lines and a borehole serving as conduit for the power lines going into the mine.

Year in Illinois Coal Highlights – 2014

Compiled by Polly Wise, Michael Murphy and Office of Coal Development staff

- Boom in natural gas production begins to level off, 6 months after historic low spring 2013 prices
- The **Sierra Club** filed an appeal of the recent **Illinois Pollution Control Board** decision, giving Dynegy until 2020 to install key state-required sulfur dioxide from power plants it is acquiring from Ameren Generating Co.
- Current owner **Edison Mission Energy** is selling a total of about 4,300 MW of Illinois coal-fueled output to NRG Energy. Involved are EME's subsidiary Midwest Generation power plants at Powerton/Pekin, Joliet, Waukegan and Will County. As part of the deal, NRG agreed to spend up to \$350 million to upgrade environmental controls at the MidwestGen fleet.
- Coal revival in the Illinois Basin is proclaimed the “unexpected comeback story in the U.S. coal industry,” in the Jan. 9 **Wall Street Journal**. Coal production is **up 70% from 2010**, as 97% of the U.S. coal fleet now has sulfur removal equipment.
- Illinois coal leaders are concerned about the long-term effect on coal mine regulations after a deal between **AG Lisa Madigan** and the IL Dept. of Natural Resources “to improve transparency and public participation” in the complex, lengthy and often contentious permitting process.
- Natural gas prices, as paid for electric generation fuel, **averaged \$4.44 /MMBtu** on the spot market for 2014 and were forecast to average \$4.14 in 2015, as tracked by the authoritative Henry Hub Index. Its range during 2014 was a volatile **span from \$3.95 per MMBtu to a high of \$8.15**.
- The US House voted 229-283 on March 6 to approve the **Electricity Security and Affordability Act (H.R. 3826)**, authored by Energy and Power Subcommittee Chairs Rep. Ed Whitfield, R-Ky., and Sen. Joe Manchin, D-W.Va. If passed, the bill would effectively halt all US EPA efforts to impose CO₂ limits for both new and existing power plants. The bill will base emissions standards for new plants on the best performing technologies actually in use today.

- **Dr. Paul Chugh's** research team at **SIU Carbondale** has showcased a new longwall mining dust control laboratory -- developed with funding from OCD -- housed at **the Illinois Coal Development Park** in Carterville, IL. More than 75 representatives of the university, state and federal government agencies, mining companies and equipment vendors attended the event. The new facility simulates the working face of a longwall mine at full scale to test new safety measures that monitor and control coal mine dust.
- Illinois formulated a plan in August to meet proposed US EPA greenhouse gas (GHG) curbs under the proposed **Clean Power Plan**. Illinois planned to focus on increasing the efficiency of the state's existing generating fleet by as much as 6 percent -- and taking steps aimed at keeping mega-nuclear power operator Exelon from closing any of its nuclear power plants.
- **CONSOL**, which produces both natural gas and coal these days, has projects underway for "monetization of non-core assets," which includes the potential sale of **1 billion tons** of Illinois Basin coal reserves. CONSOL shut its last Illinois mine, Rend Lake at Sesser, in 2002.
- The U.S. Energy Information Administration reports that the nation's mining sector (activity that extracts crude oil and natural gas as well as naturally occurring mineral solids, such as coal and ores) accounts **for about 2% of gross national product**. In five mining-heavy states -- Wyoming, Alaska, West Virginia, North Dakota, and Oklahoma -- growth in the mining sector in 2014 was responsible for the state outperforming the national average in terms of economic growth.
- After extensive hearings, the Logan County Board voted 10-1 on Nov. 1 to **change zoning for 322 acres** to allow **Arch Coal's Viper** Mine to build a new coal refuse impoundment just north of its coal cleaning plant and just east of Elkhart Hill. Viper will be able to plan for waste and coal ash storage into 2017 and beyond, officials said. Arch said the mine would close otherwise.
- Coal will remain **China's** primary fuel but its share of China's **power mix is likely to decline from 72% to 64%** by 2030 as a result of the Asian nation's air pollution action plan, according to a November 2014 forecast by energy consultant Wood Mackenzie. The firm says **India will continue to get about 55% of its energy from coal**.
- A private-sector initiative to move mostly wind energy from its Plains sources to the Midwest and beyond got a major boost when the **IL Commerce Commission voted Nov. 29** to allow construction and operation of **a 121-mile power line -- the so-called Rock Island Clean Line** -- from the Quad-Cities to an area SW of Joliet. The 500-mile line begins in NW Iowa and will deliver 3,500MW/year of renewables power.

Fulfilling the Mission to Teach

The Office of Coal Development is mandated by 30 ILCS 720/2/g to operate broad-based coal awareness and education programs directed at the general population, but specifically at school-age residents of Illinois. Despite limited availability of funds, a full-bodied program was conducted in FY14.

Coal Education Conference

The Coal Education Conference, an ambitious component of the DCEO-OCD education and awareness, brought together scientists, researchers and school teachers from all parts of Illinois for a 4-day, high energy meeting June 17-20 at Rend Lake Resort and its surrounding coalfield environs. Organizers are proud of the record of having never received a negative evaluation by teacher-conference-goers.

The conference, which historically has attracted 80-100 participants, is structured to provide participants with information on the latest in coal mining technologies, regulations and safety, and, secondly, to give teachers information and materials to incorporate Illinois coal and its role in the energy portfolio into their lesson plans.

The event's lectures, tours and hands-on activities are

correlated to the Illinois Learning Standards. Topics included the formation/geology of coal, surface and underground coal mining, reclamation, permitting and regulation, mine safety, clean coal technology, generating electricity, and economics of coal. The presenters are experts in their fields and provided detailed information. The group shared hands-on coal activities they have used in their classes, and then discussed other ways to address coal in the classroom.





Conference participants toured a surface mine, an underground mine and a power plant that burns Illinois coal using clean coal technology. On each tour there was a mining/geology expert and a group facilitator. Everyone also toured the Rend Lake College Mining Training Center. The Rend Lake College mining program offers an A.A.S. degree in mining technology as well as five occupational certificates in mining.

Tom Wolf, Energy Council coordinator for the Illinois State Chamber of Commerce, was keynote speaker. After the opening night dinner, Karen Tintori, author of “Trapped: the 1909 Cherry Mine Disaster”, gave a riveting account of the tragic day that would inspire America’s first worker’s compensation laws and hasten much-needed child labor reform.

Coal Calendar Contest

Though OCD Education Coordinator Linda Dunbar provides services throughout the year, a second major effort of the education-awareness program is the annual Coal Calendar Poster and Essay contest. The contest regularly attracts hundreds of entries from throughout Illinois. Winners are selected by a panel of artists and volunteers from various coal mine operations throughout the state.



The contest is open to all Illinois 5th- through 8th-grade students. The top 13 posters on coal topics – and up to 12 essays – serve as the cover and art for each month of the forthcoming year. Several thousand of the four-color 10 X 16 calendars are printed with a funds provided by the Illinois Coal Association. In addition to small cash prizes, the winners, their parents, teachers and school principals were recognized at a spring reception at the Illinois Executive Mansion.

Illinois Basin Coal Leads Increase

Coal is typically categorized by end use. Steam or thermal coal is used in boilers to produce steam for electricity generation and in industrial applications. Historically, exports of U.S. steam coal originated primarily from Appalachia due to a combination of quality characteristics and proximity to East Coast and Great Lakes ports. This has changed as consumers have become more flexible with regard to coal quality specifications. As demographics have changed, the market has shifted away from North and South America to Europe and Asia.

In 2012, about half of U.S. steam coal exports moved through the U.S. Gulf. Almost 70% of steam coal exports through the Gulf originated from the Illinois Basin. Illinois coal has been shipped to at least 18 countries, including Canada, Mexico, Dominican Republic, and Chile in the Americas; Belgium, Denmark, Finland, France, Great Britain, Germany, Holland, Ireland, Portugal and Spain in Europe; and China, India, Pakistan, and South Korea in Asia.

The Illinois Basin consists of the coal-producing areas in Illinois, Indiana, and Western Kentucky. The growth in exports from the Illinois Basin is due to three primary factors:

- Increased ability to use Illinois Basin coal which is higher in sulfur than coals historically traded in the global market,
- Concentrated marketing efforts by producers and traders, and
- Relative competitiveness of Illinois Basin coal versus coals from other producing nations.

Top 10 Illinois Coal Users – 2013

Buyer	Tons
Prairie State Generating Co.	5,185,800
Tennessee Valley Authority	4,876,349
Dayton Power & Light	4,809,656
Duke Energy	4,006,699
No. Indiana Public Service	2,016,992
Archer Daniels Midland Milling	1,689,893
So. Carolina Public Service Co.	1,486,914
Springfield City, Water, Light & Power	1,282,522
AGC-Alcoa Power Generating Inc.	1,262,791
Georgia Power-Southern Company	1,094,661

Coal Basin Profile

Illinois Basin coal is all bituminous, sold as “steam” to the electric power sector, with an average heat content ranging from 10,000 to 12,500 Btu/pound and mostly over 2% sulfur. The Illinois Basin has experienced enormous changes over the last two decades as production declined from the peak levels experienced in 1990 of over 140 MMT to a low of 88 MMT in 2003. The decline reflected the combination of new air pollution control requirements and market penetration of Midwest states markets with low-sulfur coal from eastern Wyoming.

Illinois Coal Production Statistics – 2010 to June 2014

	As of June 30, 2014	2013	2012	2011	2010
Counties and Mines (MSHA)					
No. of Counties Producing Coal	14	14	14	14	14
No. of Mines Operated	22	23	24	24	21
No. of Underground Mines	13	15	15	15	14
No. of Surface Mines	8	8	9	9	7
Output of Tons (MSHA)					
All Mines	27,734,729	52,123,636	48,486,048	37,770,397	33,154,327
Underground Mines	25,211,555	46,446,547	42,836,671	32,680,425	28,286,164
Surface Mines	2,523,174	5,677,089	5,649,377	5,053,228	4,868,163
Disposition of Tonnage (EIA)					
In-state	~4,971,000	9,977,000	7,705,000	4,704,000	4,839,000
Out-of-state	~14,000,000	29,351,000	26,646,000	26,976,000	28,337,000
Exports	~8,000,000	~12,000,000	13,775,500	5,472,400	2,505,510
Employees (MSHA)					
All mines	3,965	4,049	3,777	3,636	4,111
Underground mines	3,550	3,623	3,311	3,147	3,649
Surface mines	415	426	466	489	462
Contractors					
Indirect employment					
Disposition of Tonnage (EIA)					
		(000s)	(000s)	(000s)	(000s)
Via Railroad		12,276	10,890	11,240	9,283
Via River		18,084	16,216	15,534	18,606
Via Truck		3,768	4,296	4,715	5,134
Via Conveyor, Tram		5,187	2,826	0	0

Bold face = the numbers are estimated by EIA, not yet revised; Exports are OCD calculations based on previous relationship between coal production and tons known to be domestically distributed.

MSHA = U.S. Dept. of Labor Mine Safety & Health Administration

EIA = U.S. Energy Information Administration

Over the last 10 years, Illinois' share of production has ranged between 32% and 38% of total Basin production. In 2012, 10 producers operating 22 mines accounted for all of Illinois coal production. The three largest producers, Foresight Energy, American Coal and Peabody Energy, accounted for over 70% of 2012 Illinois production. Since 2010, 10 new mines have been developed, or are in developing stages in Illinois. At full production, the announced new mines would add over 40 million tons of annual production capacity. Four of the new mines are longwall mines, each of which is expected to produce between 6.0 and 8.0 million tons per year. A coal renaissance in the Illinois Basin began in the middle of the last decade as a result of increased domestic demand. Production within the basin gradually shifted away from output from Indiana surface mines and to underground mines in Illinois, where producers have increased the use of cost-effective longwall mining.

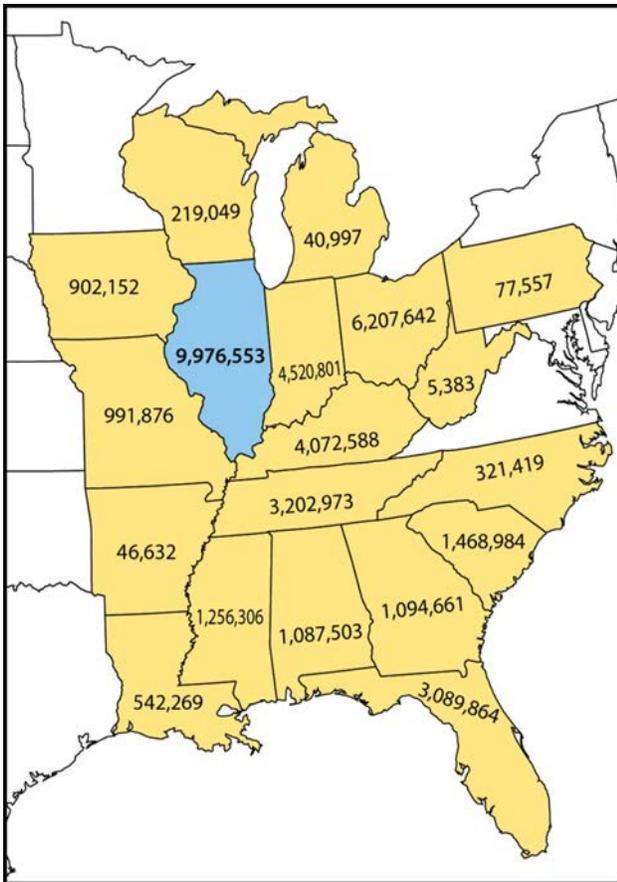
New IL Coal Mine Capacity

New Illinois Mines	Company	County	Year Opened	Type of mine	Production Capacity (million tons)
Gateway	Peabody	Randolph	2005	Underground Room and Pillar	2.5-3.0
Prairie Eagle	Knight Hawk	Perry	2006	Underground Room and Pillar	2
Wildcat Hills Underground	Peabody	Saline	2006	Underground Room and Pillar	2
Mach #1	Foresight	Williamson	2006	Underground Longwall	7.0-8.0
MaRyan	Foresight	Macoupin	2009	Underground Room and Pillar	1.5-2.0
M-Class #1	Foresight	Williamson	2010	Underground Longwall	7.0-8.0
Prairie State	Prairie State Energy	Washington	2010	Underground Room and Pillar	6.5-7.0
New Future	American Coal	Williamson	2010	Underground Longwall	5.5
Deer Run	Foresight	Montgomery	2010	Underground Longwall	8.0-9.0
White Oak	White Oak Resources	Hamilton	2011	Underground Longwall	6.5
Hawkeye	Knight Hawk	Randolph	2011	Surface	0.25
Eagle River	Eagle River Coal	Saline	2011	Surface	1.0-1.2
Viking	Foresight	Williamson	2012	Underground Longwall	7.0-8.0
Blackhawk	Knight Hawk	Randolph	2012	Surface	0.5
Gateway North	Peabody	Randolph	2014	Underground Room and Pillar	2.4

The impetus for growth also has been driven by the gradual retrofit and modernization of the nation’s coal fleet, primarily the addition on many existing power plants of so-called “scrubbers,” or flue gas desulfurization (FGD) equipment. The improved emissions controls have allowed an increasing number of Midwest and Eastern power producers to switch to Illinois Basin coal, or, in some cases, switch back to Illinois Basin coal. This domestic growth has also been augmented in recent years by the development and growth of an export market.

The growth in Illinois production is greater than the projected growth in the other parts of the Illinois Basin. As a result, Illinois’ share of total production is expected to continue to lead Basin tonnage growth. The potential increase in Illinois coal supply exceeds domestic demand. As a result, in order for this growth to be realized exports of Illinois coal need to be expanded.

Illinois Coal Sales by State of Use -- 2013



Exports Critical to Illinois Coal Growth

By Emily Medine
Energy Ventures Analysis for
Illinois Office of Coal Development

Illinois, which has the largest reserves of bituminous steam coal in the U.S., has the capability to produce significant quantities of coal in excess of domestic demand. This coal is well suited to the large and growing global coal market due to its low cost structure, access to the U.S. Gulf of Mexico (U.S. Gulf, also Gulf) for vessel loading, and the increased ability for global customers to use this quality of coal.

Illinois coal has made significant inroads into the global market in the last two years (2013-14) and, in so doing, has contributed to the increase in exports of U.S. goods. Exports of Illinois coal increased substantially between 2010 and 2012, from 2.5 million tons (Mt) in 2010 to 5.5 Mt in 2011 with preliminary estimates for 2012-13 reaching more than 13 Mt. The primary reasons for the increases were: 1) Growth in the global steam coal market; 2) marketing efforts by coal producers and traders; 3) Increased acceptance of Illinois-quality coal, and, most importantly: 4) the competitiveness of Illinois coal versus alternative sources available in the global market.

An action plan has been developed with Energy Ventures and the Illinois Department of Commerce and Economic Opportunity (DCEO) to continued export growth. It consisted of activities categorized by timing and priority. The items included in the action plan were based upon interviews with a number of current and potential Illinois coal producers, traders, and EVA's databases and analysis.

The recommendations fell into three categories:

- Those that relate to enhancing the competitiveness of Illinois coal exports,
- Those that relate to supporting smaller producers in their marketing efforts, and
- Those that relate to expanding global awareness of Illinois coal.

The competitiveness of Illinois coal is enhanced by the ability of producers to efficiently transport Illinois coal to markets throughout the world. As a result, the recommendations include:

- Selective investments to support efficiency improvements in loading coal at Illinois mines and at rail- or truck-to-barge terminals on the Mississippi and Ohio rivers,
- Financial or political support for minimized disruptions of commerce through channel improvements on the Mississippi River, and
- Investment of resources to facilitate the loading of larger vessels to be loaded in the Gulf area.

Top Coal Exporters
(MMT= million metric tons)

Indonesia	309
Australia	144
Russia	110
Colombia	75
South Africa	72
USA	34
Kazakhstan	33

Steam Coal – 2011

Source: www.worldcoal.org, EIA

Top Coal Importers
(MMT= million metric tons)

PR China	146
Japan	121
South Korea	97
India	86
Chinese Taipei	62
Germany	32
UK	27

Steam Coal – 2011

Source: www.worldcoal.org, EIA

NOTE: Metric tonnes contain 2204.6 pounds. Tons or short tons contain 2000 pounds. Most discussion of international coal is on a tonne basis; most discussion of U.S. coals is on a ton basis.

Strategic Opportunities

The selling of Illinois coal in the export market is dramatically different than marketing Illinois coal domestically. Smaller producers, and producers without export experience, face challenges regarding the identification of partner-counter-parties, handling logistics of moving coal to the typical point of sale (i.e., FOB vessel) and managing the commercial risks. Several ways in which the State of Illinois can help support producers with these matters were identified.

The efforts to expand global awareness of Illinois coal can be enhanced through increased use of State/DCEO trade representatives to educate potential buyers about the advantages of Illinois coal. A trade mission to Western Europe in 2014 also provided new contacts and business for Illinois coal producers. Finally, the state may also encourage foreign investment in Illinois coal mines by end-users such as giant TATA Power of India, particularly where such investment may lead to exports.

Global Steam Coal Market

Global steam coal trade has doubled over the last decade, growing from just under 400 million metric tonnes (MMT) in 2002 to over 800 MMT in 2012. The growth has been driven primarily by increased demand in Asia. Where China once was a net exporter of coal, the tables have turned with modernization, and China has become a net steam coal importer. Imports also have grown to South Korea, India, and other countries, underscoring the increased importance of the Pacific market.

During this period, Indonesia became the largest source of steam coal supply, growing from around 70 MMT of exports in 2002 to over 300 MMT of exports in 2012. The other major exporters of steam coal are Australia, Russia, South Africa and Colombia. Exports from the U.S. grew in 2011 and 2012 reflecting a combination of the strong global market, the weak U.S. market, and the competitiveness of U.S. coal supplies from non-traditional export sources including the Illinois Basin.

Illinois leads nation in CO₂ capture projects

FutureGen 2.0:

The project passed a major milestone and attracted national (virtually all positive) media coverage, when US DOE issued the formal **Record of Decision (ROD)** that **FutureGen 2.0** could be funded up to **\$1 billion**. While other hurdles remain to full construction funding, the ROD certifies that FutureGen 2.0's wide-ranging Environmental Impact Statement shows minimal impact would result from the project. The project received the first EPA-issued Class VI special CO₂ injection permit, the second being issued to the second phase of a US DOE-Archer Daniels Midland project in Decatur (see below).

NOTE: *After having spent more than \$122 million, the U.S. Dept. Of Energy shelved the FutureGen project in spring 2015, citing uncertain schedules for completion of capital work.*

Sargas at Mattoon

A Swedish technology firm, **Sargas USA**, is developing a commercial scale clean coal power plant at the site of the original FutureGen 1.0 project in Mattoon. The captured CO₂ from this plant will be used for enhanced oil recovery (EOR) in the Mattoon Oil Field, and perhaps elsewhere, one the most ambitious EOR projects in the Midwest. Sargas has been working with DCEO, the IL Commerce Commission and General Assembly throughout 2014 to clarify qualification for incentives to develop new clean coal power.

Sargas intends to bid its energy to the **Illinois Power Agency (IPA)** on a competitive basis under the existing provisions of the Illinois Power Act that provides for the IPA to pursue a goal that 25% of the electricity produced in Illinois being from CCT by the year 2025. To qualify for potential electric rate subsidies, Sargas must have low harmful emissions overall, and capture 90 of the plant's CO₂ output. Some of the captured CO₂ would be sold to a third party to deploy by pumping residual crude oil from the otherwise pumped out oil fields. Proceeds from crude oil sales would reduce the cost of the plant and the risk in such an advanced technology project.

Decatur-ADM Carbon Sequestration Project

The Illinois Basin-Decatur Project at Archer Daniels Midland (ADM) neared injection of **1.0 MMT of CO₂ in October 2014**. Injection began in November 2011 into a saline reservoir and continued at a rate of 1,000 MT per day. The U.S. Dept. of Energy project's goal is to inject a total 1 MMT by the end of 2014, followed by three years of post-injection monitoring. Injection is occurring at a depth of 7,000 feet and a full environmental monitoring program in the subsurface and at the surface has shown the CO₂ reservoir and seal are performing as expected.

As part of the Decatur project, US DOE and Richland Community College co-developed what is being called the National Carbon Sequestration and Center, which utilizes real-time display of underground pressures and other measurements from monitoring of the ADM well. DCEO has provided about \$73,000 to underwrite and expand education services related to the site.

ADM has received a new class of injection well permit, Class VI to store 1.1 MMT of CO₂ each year from its ethanol process, then compress and inject the gas into the Mt. Simon Sandstone.

Illinois a Center for Coal R & D

In addition to the carbon capture mega-projects above, the state's R & D program, operated through the Illinois Clean Coal Institute (ICCI), collaborated on several important projects in FY14.

Dust Control

Perhaps the most noteworthy project was an award \$95,478 to Southern Illinois University Carbondale to create a longwall mining dust control laboratory. Objectives of this project include design, construction and start-up testing of a simulated longwall face for dust control study without the space limitations of testing in an underground setting. Second, SIUC will develop of qualitative data on interaction of different spray systems on the longwall face under realistic mining conditions. Finally, the project will identify and perform engineering control studies on at least two concepts for improved dust control around the longwall shearer.

The facility consists of a simulated full-size longwall shearer modeled after Joy Mining's Model 7LS, a standard in modern longwall operations. The lead shearer drum is equipped with bit sprays and rotates at normal operating speeds. The shearer is housed within a gantry designed to replicate a 40-ft section of the longwall face with simulated shield jacks. Five different spray systems can be tested individually or simultaneously. They include bit tip sprays on the shearer, shield sprays, the shearer clear spray bar, and sprays on the shearer chassis and ranging arm. Air velocity through the gantry is controlled by a variable frequency drive (VFD) fan and ranges between 400 and 700 fpm. The facility will be used to optimize engineering improvements around longwall mining areas prior to their field implementation.



Above: Simulated Longwall Face in SIUC Dust Control Laboratory

Coal Cleaning Breakthrough

The Department of Mining Engineering at the University of Kentucky received a **\$124,996 grant** to evaluate a two-stage, heavy media cyclone coal cleaning process that was developed in China, and has seen widespread application in that country. Conventional U.S. heavy media cyclones are fed with raw coal suspended in heavy slurry under pressure. The US process produces a significant amount of secondary coal fines that work well only with dried-down feed of coal. The remarkably different innovative cyclone technology consists of two stages: 1) a cylindrical cyclone and, 2) a specially designed conical cyclone. These are designed to perform well with the dried-down, or “non-deslimed”, with minimal secondary fines.



Above: Pilot-scale, Two-stage Heavy Media Cyclone Testing Circuit

The proposed technology can greatly simplify an Illinois coal preparation plant flow sheet. It can eliminate the need for low-efficiency gravity separators, such as spirals used for fine coal, and minimize the amount of coal fines that have to be cleaned by froth flotation. As a result, the two-stage cyclone not only improves separation efficiency, it saves on energy consumption and reduces capital and operating costs by 20-30 percent. A systematic study of the proposed technology will be performed using a pilot-scale (8-inch diameter) cyclone with 8 tons per hour capacity to investigate the effects of major process parameters on separation performance and identify optimum conditions for a typical Illinois coal mine. Magnetite consumption will be measured as part of the testing program, and compared with that used by conventional heavy media cyclones.

Improved Waste Processing

The ICCI awarded \$79,987 to a multi-disciplinary research team at **Southern Illinois University Carbondale** to investigate co-disposal of coarse waste and fine processing waste from a typical coal preparation plant. The proposed study aims to demonstrate whether combined disposal of coarse and fine coal processing waste will provide both the geotechnical stability needed to lower refuse facility liabilities, and the geochemical environment necessary to minimize sulfate discharge. The project includes demonstrating that an addition of a small amount of low-cost limestone sand will further increase refuse fill stability by lowering moisture content. At the same time, the added limestone greatly improves refuse chemistry.

Research results will be used to develop innovative engineering concepts that result in cost-savings and more environmentally friendly refuse techniques. In fact, mine operators are seeking better disposal practices to greatly reduce long-term environmental liability by eliminating traditional slurry impoundment and lowering the rate of weathering of refuse materials. A series of six large-scale, field leach columns have been constructed to evaluate three experimental conditions. The first set of duplicate columns contains 100% coarse processing waste and is used as the control. The second set of duplicate columns contains 90% of coarse processing waste mixed with 10% of fine processing waste. The third set of duplicate columns contains 84% coarse processing waste, and equal amounts of fine processing waste and limestone. Results so far indicate that the coarse and fine coal blends perform the best and gives the stability needed.



Above: Demonstration Waste Disposal Columns

Emissions advances

The ICCI provided **\$175,000** to the **Illinois State Geological Survey (ISGS)** in Champaign to continue development of a patented, on-site, calcium-based sorbent production technology (Sorbent Activation Process, SAP) which removes SO_3 and HCl from coal combustion flue gases.

In the SAP technology, sorbents can be prepared at the utility site and directly injected into the flue gas, negating the purchase and stockpiling of the sorbents on-site. Coal-fired power plants using SAP technology could save an estimated 15-30%, compared to the conventional dry sorbent injection technologies cost, in the control of SO_3 and HCl emissions. The removal of SO_3 in a wet flue gas desulfurization (WFGD) process is difficult and is best captured with a sorbent in the plant's electrostatic precipitator (ESP). Substantial accumulation of chlorides in scrubber water would cause corrosion issues, and thus removal of HCl with a sorbent upstream of the WFGD is desirable. Cost estimation and engineering scale up studies charting possible cost savings will be conducted at an on-site SAP unit, installed in a 500 MW power plant burning high-chlorine, high-sulfur Illinois coal.



Above: Bench Scale SAP unit in operation with PI Hong Lu.

Greenhouse Gas Curbs

The ICCI contributed **\$150,000** to **Gas Technology Institute (GTI)** of Schaumburg as first-year cost-sharing support for a four-year program to build and test a pilot-scale CO_2 capture technology utilizing a polyether ether ketone (PEEK) membrane system. The project drew special attention by utilizing actual flue gas from Southern Company's National Carbon Capture Center (NCCC) test site at Wilsonville, AL.

The proposed pilot scale test is a continuation of the bench-scale technology development supported by ICCI through previous projects (*11/US-7, 11/US-17, and 12/US-4*). The GTI process combines advantageous features of both absorption and membrane processes to provide a cost-effective solution for CO_2 capture from flue gases.

In the process, the CO₂-laden gas passes through one side of the PEEK hollow fiber contactor (HFC), while a CO₂ selective solvent flows on the other side. The CO₂ permeates through the hollow fiber membrane and is absorbed into the solvent. The CO₂-rich solvent can be regenerated for reuse in a second module operated in a reverse manner.



GTI's HFC bench-scale system at the Midwest Generation site in Romeoville, IL.

Controlling Mercury (Hg)

The ICCI awarded **\$120,000** to **Illinois State Geological Survey** to evaluate Illinois limestone resources for mercury re-emission control for coal power plants burning Illinois high-sulfur coal. This work seeks to evaluate specific properties of limestone that may impact mercury re-emission for a specific flue gas composition and Wet Flue Gas Desulfurization (WFGD) chemistry. Eight limestone samples from power plant sites and from limestone resources near the power plants have been collected and characterized. Mercury re-emission from simulated FGD slurry prepared from limestone samples will be evaluated using a simulated flue gas representing a typical flue gas generated from burning high-sulfur Illinois coal, with and without HCl addition. The results from the experimental tests and process modeling studies will be integrated to provide useful information that will help WFGD operators select suitable limestone, and if necessary, activated carbon, to control mercury re-emission.

Simplified Coal-to-Chemicals

ICCI development funds allocated of **\$950,000** were awarded to a Southern Illinois University Carbondale (SIUC) spin-off company, **Thermaquatica Inc.**, were used to advance the commercialization objective of Oxidative Hydrothermal Dissolution (OHD), a new coal conversion technology. This entirely novel approach converts coal directly into chemicals using only water and oxygen.

The process does not go through the usual gasification route, or use expensive or proprietary catalysts. SIUC has been awarded a patent for the OHD technology, and transferred an exclusive license to the OHD technology to Thermaquatica. The project developed full engineering designs and specifications for a 5-10 lb/hour, fully continuous Process Design Unit (PDU), that will allow energy balances and economics to be better refined. Finally, the modular PDU was constructed and installed at SIUC's Small Business Incubator in Carbondale, IL. The PDU can now produce OHD chemicals at a scale necessary for evaluation and testing by potential end users and possible investors in the company.

In a separate development, **Greenpower Energy of Australia** (ASX: GPP) has signed a Memorandum of Understanding to jointly test and develop the OHD process for the conversion of coals to liquids. In return for an exclusive license on OHD in Australia and New Zealand, Greenpower will directly finance research and development OHD work by Thermaquatica.



Side view of the OHD PDU in the Thermaquatica laboratory at the SIUC Research Park.



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