ESTIMATING THE STATE AND REGIONAL BENEFITS OF THE MINING AND USE OF ILLINOIS BASIN COALS

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ESTIMATING THE STATE AND REGIONAL BENEFITS OF THE MINING AND USE OF ILLINOIS BASIN COALS

A. MOTIVATION

The coming economic problems for coal caused by the apparently inevitable passage of some form of CO_2 control legislation makes it important for policy makers to have a clear idea of what is at risk in our region when such legislation goes into effect.

As this report makes clear, the economic impact of the mining of Illinois Basin coal alone vastly understates the value to the region of the activity, because much of the region's coal is used within the region to generate electricity. If all the coal mined was simply exported, the value of the mining to the three-state region would be a bit over $7 billion, including the effect of the regional mining multipliers. The value, taking into account the use of that coal within the region to generate electricity, is almost three times that - $18.2 billion, taking into account the electricity multipliers for the coal so used.

This figure does not include the impact on the region of the likely loss of our region's electricity cost advantage relative to other states, as the electricity-intensive industries choose to locate elsewhere. In a previous study, the over-representation of electricity intensive industries in Indiana, certainly due in part to Indiana's lower electricity prices, was estimated to be in the neighborhood of $13 billion [1]. How much of this total would leave with the disappearance of Indiana's electricity cost advantage is unclear, since other factors enter into industry location decisions besides electricity costs.

This does not mean that if regional coal production disappeared, the loss to the three-state economy would permanently be $18.2 billion. Certainly other industries would eventually move in and employ the miners put out of work, and other sources of coal outside the area would be found to replace the local coals at regional power generating stations. What it does represent is the current contribution to the three-state economy of coal and coal use to generate electricity within the region. As such, it can be used by coal advocates as they compete for the attention of government officials interested in the promotion of the region's growth.

To put these numbers in perspective, the average value of the corn produced in the three-state region including the impact of the crop multiplier (see the Methodology section below) for the 2006 and

2007 growing seasons was a bit over $26 billion [2]; the same value for soybean production was $13 billion[1] [3].

B. METHODOLOGY - INDIVIDUAL STATE TOTALS

The methodology starts with estimates of coal production in the region in 2007, the base year chosen for the study. All Illinois, Indiana, and Western Kentucky coal production data are taken from EIA 2007 data contained in their table "Domestic Coal Distribution 2007 by Origin State - Total" [5]. The same table presents the tonnage used within the state by utilities, industrial users, and the tonnage exported to other states by state destination.

B.1 THE VALUE OF COAL EXPORTED FROM THE STATE

Each state's exports [6] were multiplied by an estimate of the revenue per ton for that state, taken from EIA 2007 data contained in their table "Average Open Market Price of Coal by State and Coal Rank, 2007" [7]. The open market average was assumed to be representative of the price of coal exports, since 83%, 90%, and near 100% of Illinois, Indiana, and Kentucky coal sales is open market.

These export values were then multiplied by each state's coal mining multiplier value, as contained in BEA RIMS II Multiplier Table 2.5, "Total Multipliers for Output, 2006" [8]. (2007 data were not available at the time of the study.) These multipliers estimate the total economic impact of additional production in a given sector of a regional economy, taking into account that the production of a commodity gives rise to a second round of spending within the region by those receiving income from the production, which in turn gives rise to a third round of spending within the region by those that sell to those whose incomes arise directly from production, and so forth. These multiplier values take into account the additional money spent within the economy only. Thus, if all those associated with coal mining activity in Indiana lived across the river in Kentucky and spent all their incomes there, the Indiana multiplier would be 1.0 - only the initial contribution adds value in Indiana.

In fact, the state multipliers for mining are in the range of 1.9 to 2.1.

[1] These numbers do not reflect the value added by further corn and soybean processing within the states; roughly 50% of Indiana corn production is used within the state - 20% for animal feed, and 30% for further conversion to corn products, such as sweeteners and ethanol; the remainder is exported [4].

B.2 THE VALUE OF COAL USED TO GENERATE ELECTRICITY WITHIN THE STATE

The value of the coal converted to electricity within each state is calculated in a conceptually similar fashion. The calculation has four steps.

First, the amount of electricity generated by the use of such coals is calculated first by converting the coal tonnage used to generate electricity [9] into energy by using the 11,800 btu/lb average energy content for Illinois Basin Coal used by the EIA in their "Coal News and Markets" reports [10].

Second, the btu values so obtained are divided by 10,067 btu/kwh, the average heat rate of pulverized coal units using such coal in Indiana, taken from FERC forms 1 and 767 to obtain the kwh generated from the coals [10]. Thus, Indiana unit heat rates are assumed to be representative of all units in the region burning Illinois Basin Coals, since Illinois Basin coals do not differ that much across state lines with regard to the coal characteristics that influence such heat rates.

Third, the kwh total is multiplied by the average retail price of electricity in each state as reported in the EIA Table "Average Retail Price for Bundled and Unbundled Consumers by Sector, Census Division, and State" for 2007 [11], to obtain the dollar value of the electricity generated from the use of coal mined in the state.

Finally, this total dollar value is multiplied by each state's utility sector multiplier [8] to obtain the contribution of the generation to the state's economy.

B.3 THE VALUE OF COAL USED TO IN THE STATE INDUSTRIAL SECTOR

The overwhelming majority of the coal used in non-utility sectors is used to generate or co-generate electricity, according to Indiana studies. Thus, the same method is used in the Industrial sector to value such coal use [12] as is used in the utility sector, except the retail price is not the average for all sectors, but each state's industrial sector retail price. The logic of this approach is that if the industrial sector did not generate its own electricity, it would have to purchase it from the utilities, and it is this avoided cost that is used as the basis for the analysis. Since a very small amount of coal - about 6% of the total - is used by the Industrial sector, this simplification is appropriate.

C. METHODOLOGY - COMBINED THREE STATE IMPACT

While the approach used is the same as the approach used to calculate the impact of coal on each state individually, the data used differs in two substantial ways.

First, exports from the region are less than the sum of each state's exports because a substantial amount of coal exported by each state is sent to other states within the region. For instance, two-thirds of the coal exported by Indiana goes to Illinois. Fortunately, the EIA data indicate the destination of coal shipments from states, so the correction is an easy one to make.

Second, the regional multipliers are greater than each state's multipliers, since there is less "leakage" from the three states than from any individual state. For instance, the utility multiplier for Indiana is 1.49, while it is 1.63 for the region as a whole.

Otherwise, the calculations are identical, and, as expected, the regional impact is 17% higher than the sum of the three states' individual impact totals.

D. RESULTS OF THE ANALYSIS

D.1 INDIANA ALONE

As Figure 1 shows, Indiana mined 34.8 million tons of coal in 2007.

Figure 1. Indiana Coal Production

Indiana mined 34.8 million tons of coal in 2007. Of this:

(a) 2.94 million tons were exported at an average price of $28.79/ton, a total export value of $84.8 million. Applying the Indiana coal mining multiplier of 1.959, the total amount of economic activity arising from the mining of this coal was $166 million.

(b) 29.8 million tons were converted into electricity in Indiana, resulting in the generation of an estimated 70e9 kwh, and sales of $4,541 million. Applying the Indiana utility multiplier of 1.49, the total amount of economic activity arising from the use of coal was $6,766 million.

(c) 2 million tons were used by Indiana industry, the bulk to generate or co-generate electricity. Using the same factors as in (b) above, except using the industrial rate to value the electricity, the total avoided cost was $232 million, and the total including the multiplier was $347 million.

Of this, 2.94 million tons were exported to other states at an average price of $28.79 per ton, assuming the Indiana average price per ton for exports was equal to the state average open market price, a reasonable assumption since 83% of export sales in Indiana were open market sales, according to the EIA. Thus, the estimated value of Indiana exports to other states would be $84.8 million. Using

the BEA mining multiplier of 1.959 for Indiana, this means an estimated $166 million of economic activity in Indiana can be attributed to the mining and export of Indiana coal.

An additional 29.8 million tons were converted to electricity by Indiana utilities. Using the EIA average btu/lb for Illinois Basin Coals of 11,800 btu/lb, this tonnage is equal to a total energy content of 7e14 btu. To calculate the amount of electricity generated by this energy, the total needs to be divided by the average heat rate in btu/kwh for generators burning coal in Indiana, 10,067 btu/kwh, taken from FERC forms 1 and 767. This division results in an estimate of 70e9 kwh generated by Indiana coals in Indiana. Multiplying this by the average retail price/kwh for electricity in Indiana, this corresponds to an estimate of $4,541 million for the sale of electricity in Indiana generated by Indiana coals. Using the BEA utility multiplier of 1.49 for Indiana, this means an estimated $6,766 million of economic activity in Indiana can be attributed to the mining and use of Indiana coals to generate electricity in the state.

Finally, 2 million tons of coal mined in Indiana was used by Indiana industry, the bulk used to generate or co-generate electricity. Coal used for coke production by Indiana's steel industry is brought in from the southeast. Since the tonnage of coal used in this way is relatively minor, the assumption is made that the economic activity represented by this use is equal to that arising if the electricity had been purchased from Indiana utilities, rather than generated internally. Using the same factors as described in the preceding paragraph, except using the industrial, rather than the residential, commercial and industrial sector average price, this means that as estimated $347 million of economic activity can be attributed to the mining and use of Indiana coals in Indiana's industrial sector.

The total estimated amount of economic activity arising from these three uses of Indiana coal in Indiana, including the multiplier effect, is then $7,279 million, or 3% of Indiana Gross State Product [13].

This amount without the multiplier effect is $4,278 million, or 6% of Indiana GSP originating in the manufacturing, utilities, agriculture, and mining sectors [13].[2]

[2] It is not proper to express the value of economic activity including the multiplier as a percent of economic activity originating in the four sectors, since the multiplier reflect activity in sectors other than the four.

D.2 ILLINOIS ALONE

As Figure 2 shows, Illinois mined 34 million tons of coal in 2007.

Figure 2. Illinois Coal Production

Illinois mined 34 million tons of coal in 2007. Of this:

(a) 26.7 million tons were exported at an average price of $33.60/ton, a total export value of $896 million. Applying the Illinois coal mining multiplier of 2.109, the total amount of economic activity arising from the mining of this coal was $1,890 million.

(b) 4.16 million tons were converted into electricity in Illinois, resulting in the generation of 9.74e9 kwh, and sales of $824 million. Applying the Illinois utility multiplier of 1.57, the total amount of economic activity arising from the use of coal was $1,294 million.

(c) 3.3 million tons were used by Illinois industry, the bulk to generate or co-generate electricity. Using the same factors as in (b) above, except using the industrial rate, rather than the average rate, the electricity avoided cost was $467 million. Using the Illinois multiplier of 1.57, the estimated total economic activity was $733 million.

Of this, 26.7 million tons were exported to other states at an average price of $33.60 per ton, assuming the Illinois average price per ton for exports was equal to the state average open market price, a reasonable assumption since 90% of export sales in Illinois were open market sales, according to the EIA. Thus, the estimated value of Illinois exports to other states would be $896 million. Using the BEA mining multiplier of 2.109 for Illinois, this means an estimated $1,890 million of economic activity in Illinois can be attributed to the mining and export of Illinois coal.

An additional 4.16 million tons were converted to electricity by Illinois utilities. Using the EIA average btu/lb for Illinois Basin Coals of 11,800 btu/lb, this tonnage is equal to a total energy content of 0.98e14 btu. To calculate the amount of electricity generated by this energy, the total needs to be divided by the average heat rate in btu/kwh for generators burning coal in Illinois, taken to be the average for Indiana units burning Illinois Basin coal, 10,067 btu/kwh. This division results in an estimate of 9.75e9 kwh generated by Illinois coals in Illinois. Multiplying this by the average retail price/kwh for electricity in Illinois, this corresponds to an estimate of $824 million for the sale of electricity in Illinois generated by Illinois coals. Using the BEA utility multiplier of 1.57 for Illinois, this means an estimated $1,294 million of economic activity in Illinois can be attributed to the mining and use of Illinois coals to generate electricity in the state.

Finally, 3.3 million tons of coal mined in Illinois was used by Illinois industry, the bulk used to generate or co-generate electricity. Since the tonnage of coal used in this way are relatively minor, the assumption is made that the economic activity represented by this use is equal to that arising if the

electricity had been purchased from Illinois utilities, rather than generated internally. Using the same factors as described in the preceding paragraph, except using the industrial, rather than the residential, commercial and industrial sector average price, this means that as estimated $733 million of economic activity can be attributed to the mining and use of Illinois coals in Illinois's industrial sector.

The total estimated amount of economic activity arising from these three uses of Illinois coal in Illinois, including the multiplier effect, is then $3,917 million, or 0.6% of Indiana Gross State Product [13].[3]

This amount without the multiplier effect is $2,187 million, or 2.1% of Illinois GSP originating in the manufacturing, utilities, agriculture, and mining sectors [13].

D.3 WESTERN KENTUCKY ALONE

As Figure 3 shows, Western Kentucky mined 27.9 million tons of Illinois Basin coal in 2007.

Figure 3. Western Kentucky Coal Production

Western Kentucky mined 27.9 million tons of coal in 2007. Of this:

(a) 10.9 million tons were exported at an average price of $32.67/ton, an export value of $354 million. Applying the Kentucky coal mining multiplier of 2.095, the total amount of economic activity arising from the mining of this coal was $742 million.

(b) 16.92 million tons were converted into electricity in Kentucky, resulting in the generation of 39.7e9 kwh, and sales of $2,317 million. Applying the Kentucky utility multiplier of 1.56, the total amount of economic activity arising from the use of coal was $3,614 million.

(c) 0.14 million tons were used by Kentucky industry, the bulk to generate or co-generate electricity. Using the same factors as in (b) above, except valuing the electricity at the average industrial rate, the avoided electricity cost was $13.8 million. Applying the multiplier results in a total economic activity amount of $21.5 million.

Of this, 10.9 million tons were exported to other states at an average price of $32.67 per ton, assuming the Western Kentucky average price per ton for exports was equal to the Western Kentucky average open market price, a reasonable assumption since near 100% of these sales were open market sales, according to the EIA. Thus, the estimated value of Western Kentucky exports to other states would be $354 million. Using the BEA mining multiplier of 2.095 for Kentucky, this means an estimated $742 million of economic activity in Kentucky can be attributed to the mining and export of Illinois Basin coal.

[3] The small percentage can be attributed to the size of the Illinois economy - over $600 billion. If Illinois were a country, it would be among the 10th largest in the world in 2000, exceeding both Mexico and India in size.

An additional 16.92 million tons were converted to electricity by Kentucky utilities. Using the EIA average btu/lb for Illinois Basin Coals of 11,800 btu/lb, this tonnage is equal to a total energy content of 4e14 btu. To calculate the amount of electricity generated by this energy, the total needs to be divided by the average heat rate in btu/kwh for generators burning coal in Western Kentucky, taken to be the average heat rate in Indiana for unit burning Illinois Basin Coals. This division results in an estimate of 39.7e9 kwh generated by Western Kentucky coals in Kentucky. Multiplying this by the average retail price/kwh for electricity in Kentucky, this corresponds to an estimate of $2,317 million for the sale of electricity in Kentucky generated by Western Kentucky coals. Using the BEA utility multiplier of 1.56 for Kentucky, this means an estimated $3,614 million of economic activity in Kentucky can be attributed to the mining and use of Western Kentucky coals to generate electricity in the state.

Finally, 0.14 million tons of coal mined in Western Kentucky was used by Kentucky industry, the bulk used to generate or co-generate electricity. Since the tonnage of coal used in this way are relatively minor, the assumption is made that the economic activity represented by this use is equal to that arising if the electricity had been purchased from Indiana utilities, rather than generated internally. Using the same factors as described in the preceding paragraph, except using the industrial, rather than the residential, commercial and industrial sector average price, this means an estimated $21.5 million of economic activity can be attributed to the mining and use of Western Kentucky coals in Kentucky's industrial sector.

The total estimated amount of economic activity arising from these three uses of Western Kentucky coal in Kentucky, including the multiplier effect, is then $4,379 million, or 2.9% of Kentucky Gross State Product [13].

This amount without the multiplier effect is $2,685 million, or 7.2% of Kentucky GSP originating in the manufacturing, utilities, agriculture, and mining sectors [13].[4]

[4] It should be noted that these numbers indicate the economic impact on the Kentucky economy of only the mining and use of Illinois Basin Coals. If the same methodology were also used to estimate the impact of the mining and use of coal in Eastern Kentucky, and the Eastern and Western totals were added together, the total contribution to the Kentucky economy with the multiplier would have been $13.5 billion, 8.9% of Kentucky GSP. The sum without the multipliers would have been $7.4 billion, 19.7% of Kentucky GSP originating in manufacturing, utilities, agriculture, and mining.

D.4 TOTAL THREE STATE PRODUCTION AND USE

As Figure 4 shows, the three states mined 96.7 million tons of Illinois Basin coal in 2007.

Figure 4. Total Three State Production and Use of Illinois Basin Coals

The three states mined 96.7 million tons of coal in 2007. Of this:

(a) 30.2 million tons were exported outside the three-state region at an average price of $33/ton. Applying the three state coal mining multiplier of 2.30, the total amount of economic activity arising from the mining of this coal was $2,292 million.

(b) 58.7 million tons were converted into electricity in the three states, resulting in the generation of 137.6e9 kwh, and sales of $8,861 million. Applying the three state utility multiplier of 1.63 (4), the total amount of economic activity arising from the use of coal was $14.4 billion.

(c) 6.8 million tons were used by industry in the three states, the bulk to generate or co-generate electricity. Using the same factors as in (b) above, except using industrial electricity prices, the total amount of economic activity was $1,464 million.

Of this, 30.2 million tons were exported outside the three-state region. Note that the tonnage is 25% smaller than the sum of the three states' individual exports, since a significant amount of each state's exports went to the other states in the region. Given the tonnage weighted average price of the three states' exports is $33/ton, the estimated value of the three states' exports to other states would be $996 million. Using the BEA mining multiplier of 2.3 for the three states, this means an estimated $2,292 million of economic activity in the three-state region can be attributed to the mining and export of Illinois Basin coal.

An additional 58.7 million tons were converted to electricity by utilities in the three states. This total is 10% more than the sum of such uses in the three states individually, since much of the individual state exports are used to generate electricity within the three-state region. Using the EIA average btu/lb for Illinois Basin Coals of 11,800 btu/lb, this tonnage is equal to a total energy content of 13.85e14 btu. To calculate the amount of electricity generated by this energy, the total needs to be divided by the average heat rate in btu/kwh for generators burning coal in the region, taken to be the average in Indiana, 10,067 btu/kwh. This division results in an estimate of 137.6e9 kwh generated by the three states utilities burning Illinois Basin coals, Multiplying this by the average retail price/kwh for electricity in the three states, this corresponds to an estimate of $8,861 million for the sale of electricity in the three states generated by burning Illinois Basin coals. Using the BEA utility multiplier of 1.63 for the three states, this means an estimated $14.4 billion of economic activity in the three states can be attributed to the mining and use of Illinois Basin coals to generate electricity in the states.

Finally, 6.8 million tons of coal mined in the three-state region was used by the region's industrial sector, the bulk assumed to be used to generate or co-generate electricity. This is greater than the sum of the three states' uses for reasons discussed. Since the tonnage of coal used in this way is relatively minor, the assumption is made that the economic activity represented by this use is equal to that arising if the electricity had been purchased from the region's utilities, rather than generated internally. Using the same factors as described in the preceding paragraph, except using the industrial, rather than the residential, commercial and industrial sector average price, this means that as estimated $1,464 million of economic activity can be attributed to the mining and use of Illinois Basin coals in the region's industrial sector.

The total estimated amount of economic activity arising from these three uses of Illinois Basin coal in the region, including the multiplier effect, is then $18.2 billion, or 1.85% of the region's Gross State Product [13].

This amount without the multiplier effect is $10.7 billion, or 5.1% of the region's GSP originating in the manufacturing, utilities, agriculture, and mining sectors.

Note that the regional total with the multiplier is 17% higher than the sum of each state's individual totals because of less leakage from the region than the states, which results in higher multipliers, and the fact that within-region shipments to neighboring states' utilities are valued at their electricity value, not their export value.

E. SUMMARY

Figures 5 and 6 summarize both the production (Figure 5) and value of production (Figure 6) estimates for the three states individually and as a region.

As Figure 5 shows, Illinois Basin coal production was split roughly equally between the three states.

Figure 5. Production, Use and Flows – Illinois Basin (millions of tons)

State	Mined	Used in State	Exports	Imports	Reserves at Existing Mines
Indiana	34.8	29.8 elec 2.0 ind	2.9 (2 to IL/KY)	38.8	401
Illinois	34.0	4.1 elec 3.3 ind	26.7 (6 to TN, 4.8 to IN, 3.5 to FL, 2.1 to OH, 1.4 to MO)	54.1	1,286
W. KY	27.9	16.9 elec 0.14 ind	10.9 (6 to FL, 2 to AL, 1 to SC, 0.6 to IL/KY)	NA	513
Combined	96.7	58.7 elec 6.8 ind	30.2	NA	2,200

Both Western Kentucky and Indiana coals were used primarily to produce electricity within their states, such use amounting to 61% and 92% of production, respectively. Illinois exported 78% of its coals, primarily to Tennessee, Indiana and Florida, while Western Kentucky exported 40% of production. This raises the possibility of a "coal by wire" development strategy for both states.

Both Indiana and Illinois satisfied state demand primarily by imports from other states. Imports to Indiana and Illinois represented respectively 55% and 88% of total use within the states. Import statistics were not available for Western Kentucky, only Kentucky as a whole. Clearly, import substitution is a possible economic development strategy for both Indiana and Illinois.

Regarding reserves, Illinois has almost 60% of the proven reserves at existing mines of Illinois Basin coals; Indiana has 18%; and Western Kentucky 22% [14]. The demonstrated reserves are much larger – 104, 9.4, and 19.4 billion tons in Illinois, Indiana, and Western Kentucky, respectively.

Figure 6 shows the economic consequences of the tonnage figures.

Figure 6. Value of Production and Use – Illinois Basin (millions of dollars)

State	Export w/o mult	Export w/ mult	In-state elec gen w/o mult	In-state gen w/ mult	In-state ind use w/o mult	In-state ind use w/ mult	Total w/ mult
Indiana	85	166	4,541	6,766	232	347	7,279 (3% of GSP, 7% of Mfg/Util/Ag/Min)
Illinois	896	1,890	824	1,294	467	733	3,917 (0.6% of GSP, 2% of M/U/A/M)
W KY	354	742	2,317	3,614	14	22	4,379 (2.9% of GSP, 7.2% of M/U/A/M)
Com-bined	996	2,292	8,861	14,443	898	1,464	18,202 (1.8% of GSP, 5.1% of M/U/A/M)

Columns 1 and 2 show the impact on each state individually and collectively of the export of coal to customers outside the state and region both without (Col 1) and with (Col 2) the mining multiplier effect. As noted previously, the combined impact is 18% less than the sum of the three state individual impacts because a substantial part of individual state exports go to the other states within the region.

Columns 3 and 4 show the impact of the use of coal to generate electricity individually and collectively for the three states without (Col 3) and with (Col 4) the multiplier effect.

Note that the combined effect is 19% <u>more</u> than the sum of the three effects, since the combined effect takes into account the impact of coal imported from other states within the region that is used to generate electricity.

Columns 5 and 6 repeat the impact without and with the multiplier effects for the use of coal in the industrial sector of the region.

Column 7 summarizes the economic impact on the states and the region of coal exports, the use of coal to generate electricity, and the industrial use of coal. Note that the combined impact is 17% greater than the sum of the individual impacts for reasons explained previously. Note also that although the mining and use of coal is a substantial part of the Indiana and Illinois economies, it is less so in

Illinois because of the size of the Illinois economy; Illinois' GSP is two times the sum of both the Indiana and Kentucky economies.

Finally, as the last row of the last column shows, the total regional impact of coal mining and use is estimated to be $18.2 billion, 1.8% of regional GSP, and, more importantly, 5.1% of GSP originating in manufacturing, utilities, agriculture, and mining. To put this in perspective, average 2006 and 2007 corn with the crop multiplier contributed an estimated $26 billion to the three-state economy in 2007, and soybeans $13 billion. Thus, the economic value to the region of coal use and production falls somewhere between the crop value of corn and soybeans. To be fair, the corn and soybean figures would be higher, if they included the value added to the corn by further processing within the region, as do the coal use estimates. Nonetheless, the point is that coal mining and within region coal use represents a significant amount of economic activity in the region; regional policy makers should be as alert to developments and challenges in coal markets as they are in our region's agricultural markets.

F. WHAT WOULD HAPPEN IF?

Looking into the future, two developments - one positive and one negative - could dramatically alter these estimated economic impacts of coal on the Illinois Basin region.

First, a possible bad development. While the design of CO_2 control legislation is still being debated, there appears to be a consensus that some form of CO_2 legislation - cap and trade, command and control, whatever - will be passed during the next few sessions. If the legislation is similar to the proposed Lieberman/Warner cap and trade legislation, a 2009 study commissioned by the National Association of Manufacturers and the American Council for Capital Formation estimates that the mining of coal would decrease by 37% (35 million tons) in the three states, while electricity production would decrease from 9% (Illinois) to 15-18% (Kentucky and Indiana) [15]. While many questions can be raised concerning the report and its conclusions (not the least how it is possible to have those coal output declines and yet have a 200 to 300% increase in the cost of coal also forecast by the report), there is a general consensus that Illinois Basin Coal, along with all coal, will be severely impacted by such legislation. Given that coal contains more carbon per unit of energy than other energy sources, it is inevitable that coal will be disproportionally hurt by the imposition of a tax or limit on carbon emissions. Any legislation will set in motion a sequence of events where now cheaper, less carbon-intensive energy alternatives to coal will gradually substitute for coal, and the current electricity cost advantage of states such as Illinois, Indiana and Kentucky which generate electricity from coals will disappear.

There are two responses to this challenge. One is to fight such legislation tooth and nail, characterizing the legislation as a declaration of war against states that produce or consume large amounts of coal. The other is to consider what can be done now in the interim to minimize the impact of the legislation on our region.

The second approach seems the most prudent, given the current mood of the country that such legislation is necessary and inevitable.

Such an approach is perhaps best characterized by those in the utility industry who currently are urging that any new coal plants constructed be easily retrofitted to capture and sequester CO_2, or other actions that will minimize the cost of CO_2 rule compliance.

This brings us to the possible good news for Illinois Basin coal producers and consumers. Is there an opportunity for Basin producers to use the coming revolution in coal production and consumption to expand their regional market share, such that the region ends up with a bigger share of a smaller pie? In particular, will the economic impact of the proposed Clean Air Interstate Rules (CAIR) and CO_2 rules allow the region to recapture at least a portion of the 77 million tons of coal use in the three-state region now imported from the Powder River Basin?

The math is easy: recapture one-half of the regional market lost to Western coals, and that is enough to offset the entire projected decline in Illinois Basin coal use predicted by the ACCF/NAM study.

Is there reason to believe this is possible? The answer is a qualified yes. The reason is that a combination of CAIR and aspects of the proposed CO_2 legislation may favor the use of Illinois Basin coals in the region rather than Western coals.

Utility coal choice is a complex issue; many boilers are designed to burn a particular type of coal, and switching coals can involve some up-front expense. But such switches can happen, particularly in response to environmental legislation. One needs to look no further than the market response to the 1990 Clean Air Act Amendments and the subsequent switch to low sulfur Western coals in the three-state region, rather than install scrubbers and continue to burn high sulfur Basin Coals. Illinois Basin coal production fell from 141 million tons in 1990 to 87 million in 2000 as utilities switched to Powder River Basin coals [16].

Since recent clean air legislation rules under discussion have the effect of requiring installation of scrubbers on boilers that burn even low sulfur Western coals, “the price differential between low and high sulfur coals will diminish as coal heat content becomes the overriding factor in coal quality decisions” [17].

Will impending CO_2 legislation reinforce or counteract this trend? While it has been forecast that the delivered costs of Powder River Basin (PRB) and Illinois Basin (IB) coals will increase [15] substantially, will the forecast increases keep the relative prices of PRB and IB coals the same?

Several factors will determine the answer to this question.

(a) PRB coals have a slightly higher CO_2 production per million btu than IB coals - 212.7 lbs/mmbtu for Wyoming coal versus 203.5 for Illinois coal [18].

(b) Forecast increases in transportation costs caused by the proposed legislation will result in greater price increases in PRB than in IB coals. Transportation costs of Western coal to the Illinois Basin are probably 2/3 of the total cost, since average FOB Western coals are near $10/ton, while delivered coals in the Midwest average around $30/ton.

(c) Forecast increases in energy costs will cause IB mining costs to increase more than PRB costs, since IB coal mining, a mix of surface and underground mining, is more energy intensive than PRB coal mining, which is surface mined.

Estimating the overall impact of these factors is beyond the scope of this study. A rough estimate would be that (a) would produce a 6 -8% cost advantage for IB; (b) given that (i) transportation costs are 2/3 total delivered coal costs, (ii) half of transportation costs are fuel costs, (iii) the ACCF/NAM forecast is for gasoline prices, and by assumption, diesel prices to rise by 20% as a result of CO_2 legislation, (iv) IB coal transportation costs are negligible, then passage of the bill would produce an estimated 6% cost advantage for IB coals. The impact of (c) awaits further analysis.

G. THE IMPACT OF THE PRODUCTION OF SYNTHETIC GYPSUM FOR WALLBOARD MANUFACTURE IN THE ILLINOIS BASIN

Synthetic gypsum produced as a by-product of coal scrubbing is now a major source of gypsum for wallboard manufacturing, particularly here in the Illinois Basin. In 2008, the USGS “Mineral Commodity Summaries” reported that 12.7 million tons of gypsum were mined, while 8 millions tons of synthetic gypsum were recovered from scrubbers. According to the American Coal Ash Association, almost all of the synthetic tonnage was used to produce wallboard.

State-by-state data are not reported by the ACCA; nonetheless, the Indiana Geological Survey [19] conducted a phone survey of utilities in 2008 that estimated a total of 1.2 million tons of synthetic gypsum was sold for wallboard use in 2007, or about 1 million tons after calcining. Assuming wallboard

contains 70% by weight of calcined gypsum, the rest being perlite, paper, additives and water [20], this translates into 1.4 million tons of wallboard. Since ½ inch wallboard prices were $176/ton in 2006 according to the 2006 USGS Minerals Yearbook, then the value of Indiana production is estimated to be about $250 million. Applying the BEA non-metallic mineral product manufacturing multiplier of 2.16, this means the estimated total economic value of the recovery and use of synthetic gypsum to manufacture wallboard in Indiana is around $550 million [21].

Unfortunately, such production statistics aren't available for Illinois and Kentucky. What is known from the ACCA is that 5 of the 18 plants producing wallboard from synthetic gypsum are located in the Illinois Basin states, two each in Indiana and Kentucky. Assuming the plants are all of the same size and output as Indiana, and using the Indiana calculations as a guide, this means that the value of Kentucky wallboard made from synthetic gypsum is roughly equal to that of Indiana, and Illinois half of that. In total, then, an estimated $1,350 million of economic activity is added to the three states' economies by the recovery and use of synthetic gypsum to manufacture wallboard [22].

REFERENCES

(1) Measuring the contribution of Coal to Indiana's Economy," F.T. Sparrow, CCTR Briefing, Hammond, IN, December 12, 2008

(2) National Corn Growers Association "Corn Production and Trends," 2009

(3) Soy Stats, 2007 and 2008

(4) "The Effect of Ethanol on Grain…" Frank Dooley, BioEnergy, Purdue Extension ID 329

(5) "Domestic Coal Distribution 2007 by Origin State… Total," 2007, EIA

(6) Ref (5), "Total Exported to Other States," 2007, EIA

(7) "Average Price of Coal Delivered to End Use Sector by Census Division and State, Electric Utility Plants," 2007, EIA; state utility plant average assumed to hold for exports, since 80% of exports go to the utility sector in all three states

(8) "RIMS II Multipliers (2006), Table 2.5, Total Multipliers for Output…" by Individual State, and by three-state aggregation, BEA, 2009

(9) Ref (5), "Electricity Generation within State"

(10) "Coal News and Markets," EIA, June 8, 2009, the average heat rate of generating units burning Illinois Basin coals in Indiana (FERC Forms 1 and 767)

(11) Estimate obtained by multiplying the kWh from (6) by state average retail price in "Average Retail Price for Bundled and Unbundled Consumers by Sector, Census Division, and State," EIA 2007

(12) Based on Information on the Industrial Use of Indiana Coals in Indiana

(13) "Gross Domestic Product by State-2007", BEA Regional Economic Accounts, Interactive tables, 2007

(14) "Recoverable Coal Reserves and Average Recovery Percentage by State, 2007" EIA

(15) ACCF/NAM study, "Economic Impact of the Lieberman/Warner Legislation," March 13, 2008

(16) "In the 80's and 90's, They Died Like Flies," Energy Biz, Sep/Oct 2005

(17) J.T.Boyd Company, "U.S. Coal Vision 2009"

(18) "Predicted CO_2 Emissions from Indiana Coals During Combustion," Maria Mastalerz, Agnieszka Drobniak, and Kathryn R. Shaffer, Indiana Geological Survey, presented at the CCTR Advisory Panel Meeting, Vincennes University, Vincennes IN, September 10, 2009

(19) Results of a phone survey of Indiana utilities in 2007 cited in Shaffer, N.R. and, Sadowski, R., "Indiana Limestones and Dolomites for Flue Gas Desulfurization," in press, Indiana Geological Survey

(20) "Materials Safety Data Sheet-Wallboard"

(21) Estimate obtained by assuming calcination reduces weight by 85% (assumes ¾ of water driven off during calcining, "Mineral Facts and Problems," U.S. Bureau of Mines, 1985), 70% of the weight of wallboard is calcined gypsum ("Materials Safety Data Sheet-Wallboard,") and the average price of ½ inch wallboard is $176/ton (United States Geological Survey Minerals Yearbook-Gypsum, Table 5, 2006)

(22) Estimate based on ACAA 2007 Coal Combustion Product survey which showed that 8.254 million tons of FGD gypsum were used to produce Gypsum panel Products in the US in 18 plants, 2 each in Indiana and Kentucky, and one in Illinois (Mike McDonald ACAA presentation), and then assuming all plants had the same capacity, which resulted in an estimate of 0.917 million tons produced for Indiana and Kentucky, and 0.458 million tons for Illinois. The 0.917 million ton estimate for Indiana is 20% lower than the survey estimate for Indiana reported in [(16) above