



Indiana Center for Coal Technology Research
Located in the Energy Center at Discovery Park, Purdue University

NOW IS THE TIME INDIANA IS THE PLACE

July 15, 2008
Indiana State Department of Agriculture

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Indiana Center for Coal Technology Research

Indiana Primary Energy Consumption Source & Sector, 2004

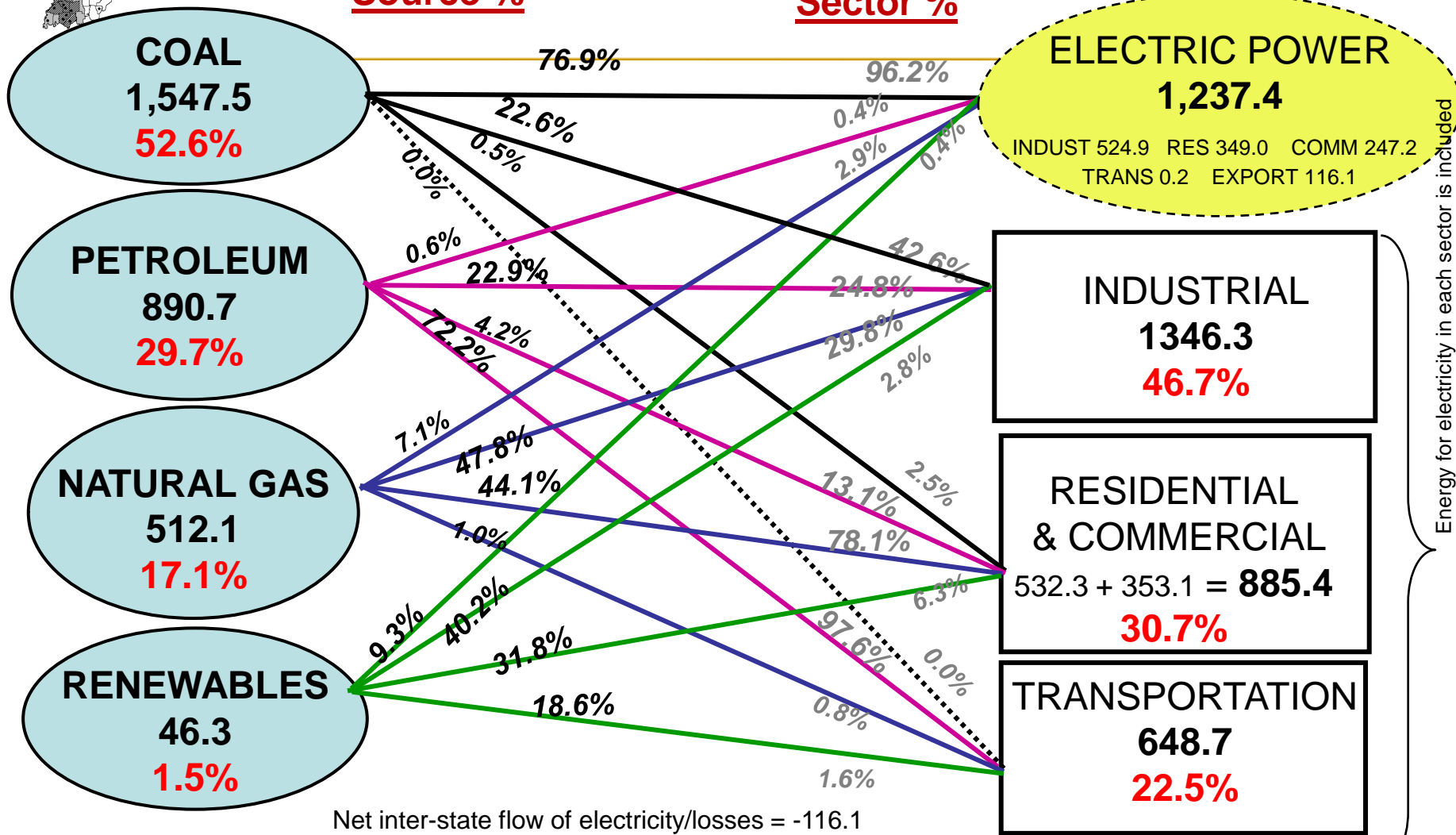


Trillion Btu's

Source %

Sector %

Trillion Btu's



Total = 2.88 Quads (10^{15} Btu)

Energy for electricity in each sector is included



How Important is Manufacturing to Indiana?

Manufacturing as % of Indiana's GDP

	<u>1997 GDP</u>	<u>2006 GDP</u>
Durable Goods	18.1%	20.5%
Non-Durable Goods	10.2%	10.0%
Total Manufacturing	28.3%	30.5%

- In 1997 Indiana's 18.1% durable goods as part of GDP was the highest in the nation. (2006 Indiana ranked 3rd).
- 2006 Total Manufacturing of 30.5% is highest in the nation.
- Investment in Biotech and Service and Alternate Energy has not changed the fact that:

Indiana is a manufacturing state

Indiana's industrial sector provides about 1/3 of the state GDP & consumes nearly 1/2 of total energy



Who uses coal in Indiana?

When you use Electricity you use Coal.

- When you allocate the coal used to make electricity to the electricity user:

Coal consumed in Indiana

Sector	% of total	Million Tons Used
• Industrial	55.2%	38.8
• Residential	21.7%	15.3
• Commercial	15.8%	11.1
• <u>Export</u>	<u>7.3%</u>	<u>5.1</u>
• Total	100.0%	70.3



Econ: 666

Demand Increases as Price Increases

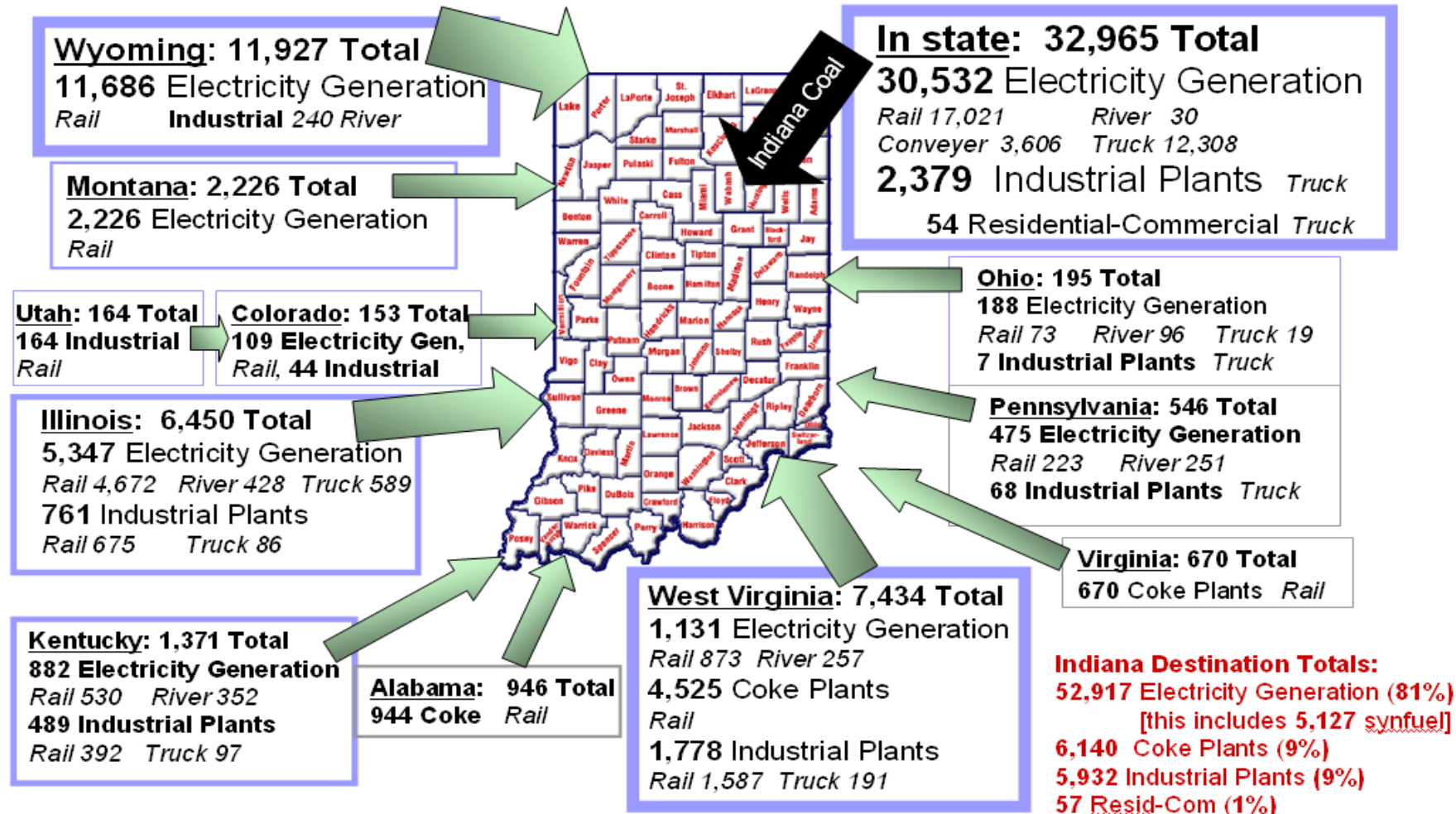
- From 1995 to 2006 :
- Coal price per MMBTU increased **21.1%**
Demand increased 14.0%
- N G price per MMBTU increased **250.5%**
Demand increased 26.7%
- Petroleum price per gallon **107.5%**
Demand increased 14.9%
- Electricity in Indiana price increased **23.5%**
Demand increased 21.3%



2006 Coal Destination: Indiana

69 MTons Consumption, 35 MTons Production

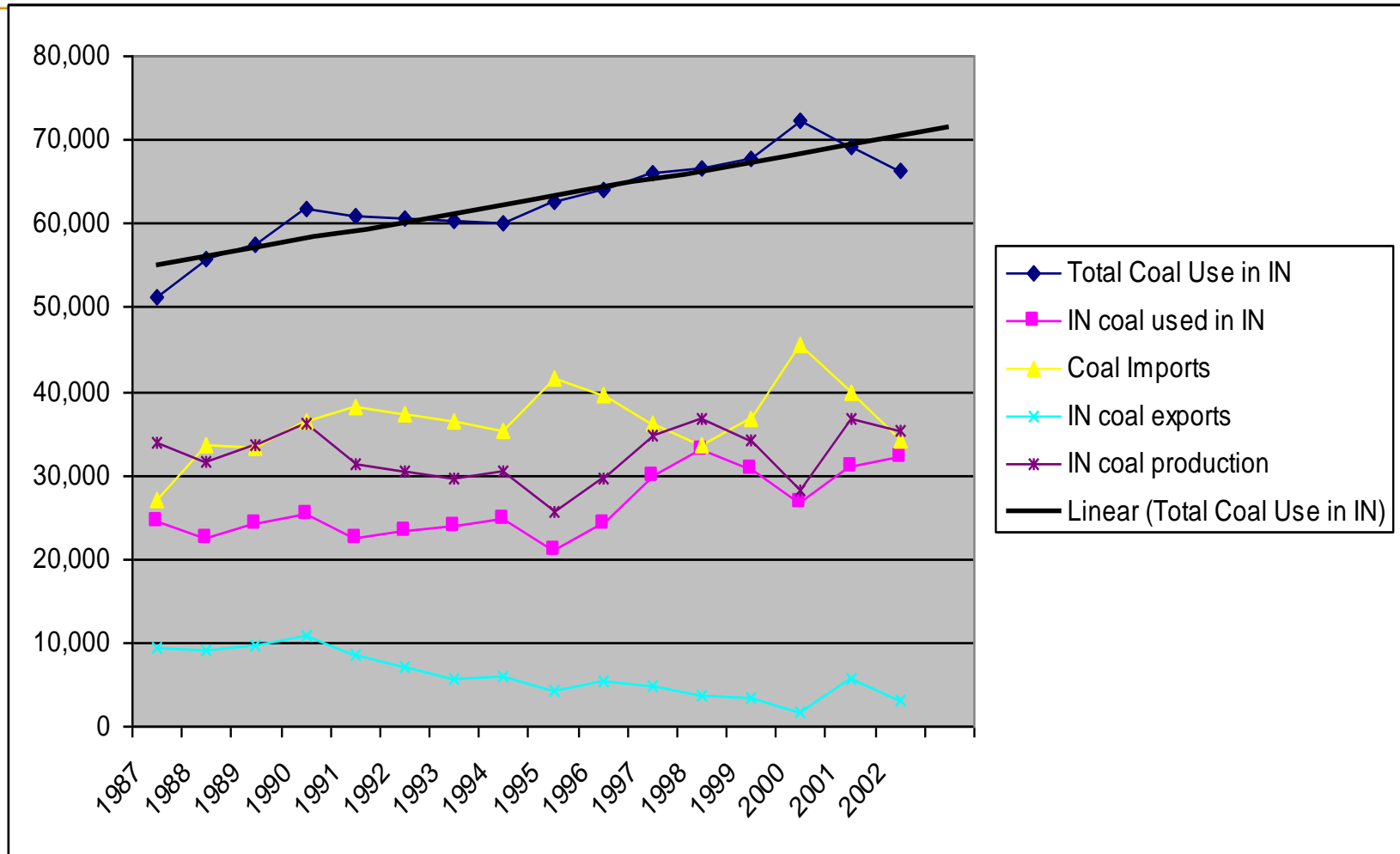
— State Total Consumption of 65,046 (Thousand short tons) & Methods of Transportation





COAL USE TREND

Indiana coal consumption growing much faster than Indiana coal production





The Real Problem We are not ready

The Energy Workforce of the Future

- All energy industries face issues
 - Coal miners are retiring; average age 51
 - Technologies are changing
 - Boilermakers are offshore
 - Nuclear welders do not exist
 - Stigma of a vocational technical education
 - Power generation industry – average age 50
 - Employs 1 million nationwide
 - ½ workforce retirement in 5-10 years
 - 62% of managers are 50 and older
 - 61% of line superintendents are 50 and older
 - 43% of foremen are 50 and older



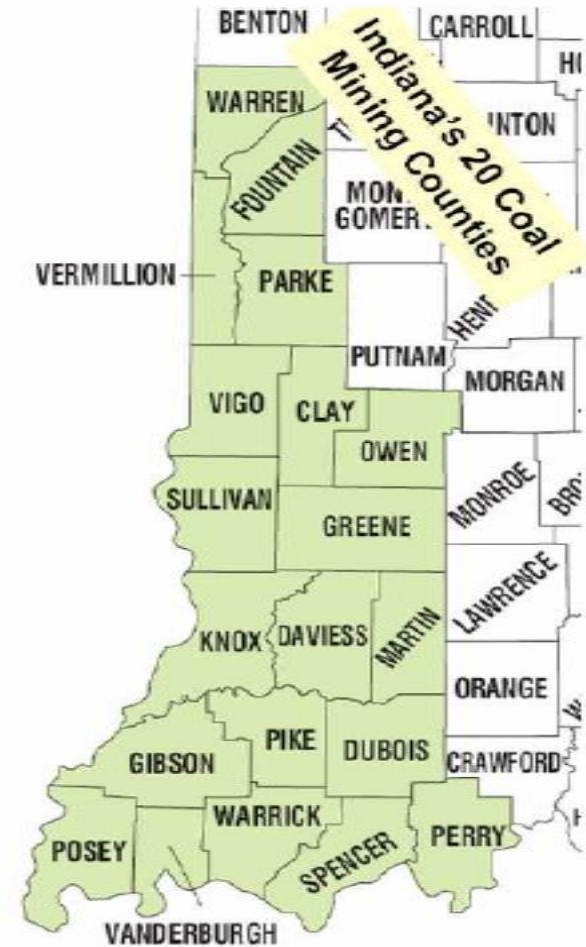
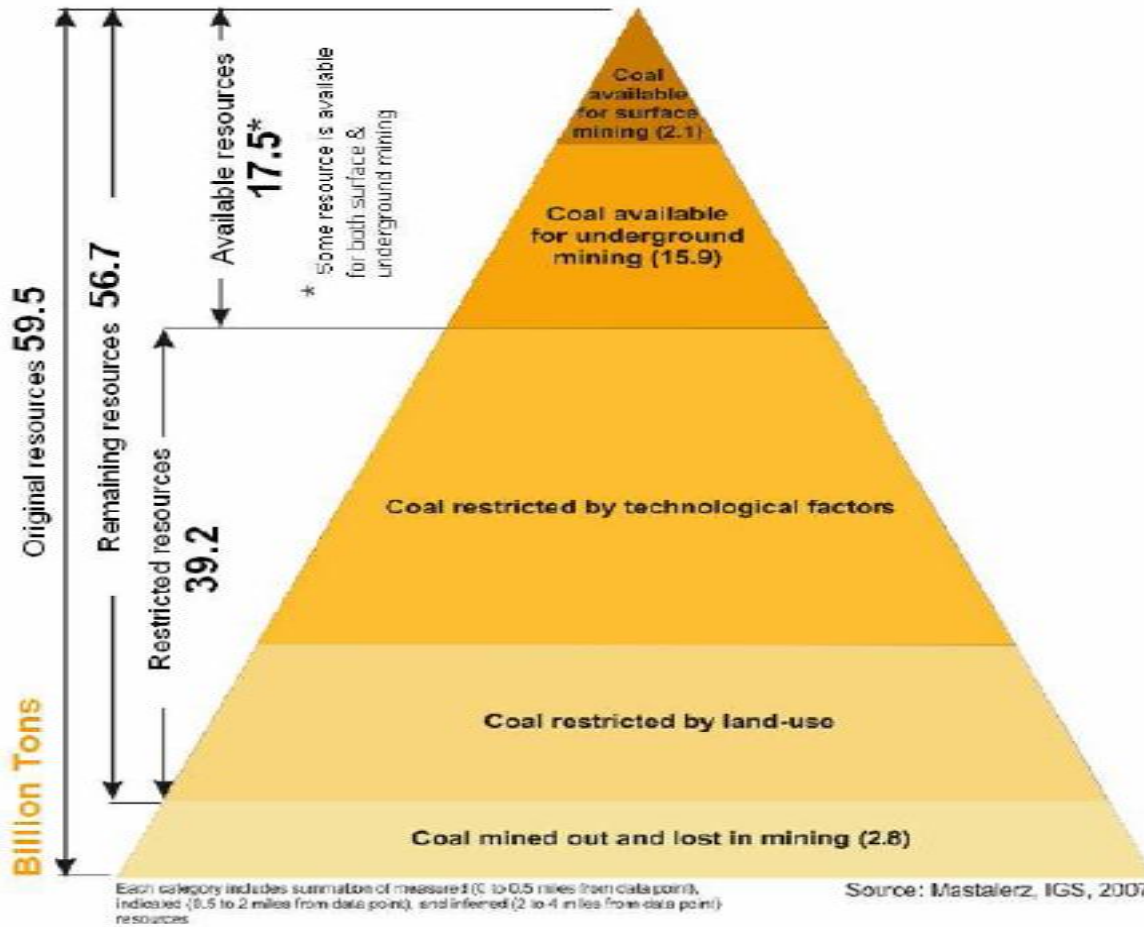
southern states energy board





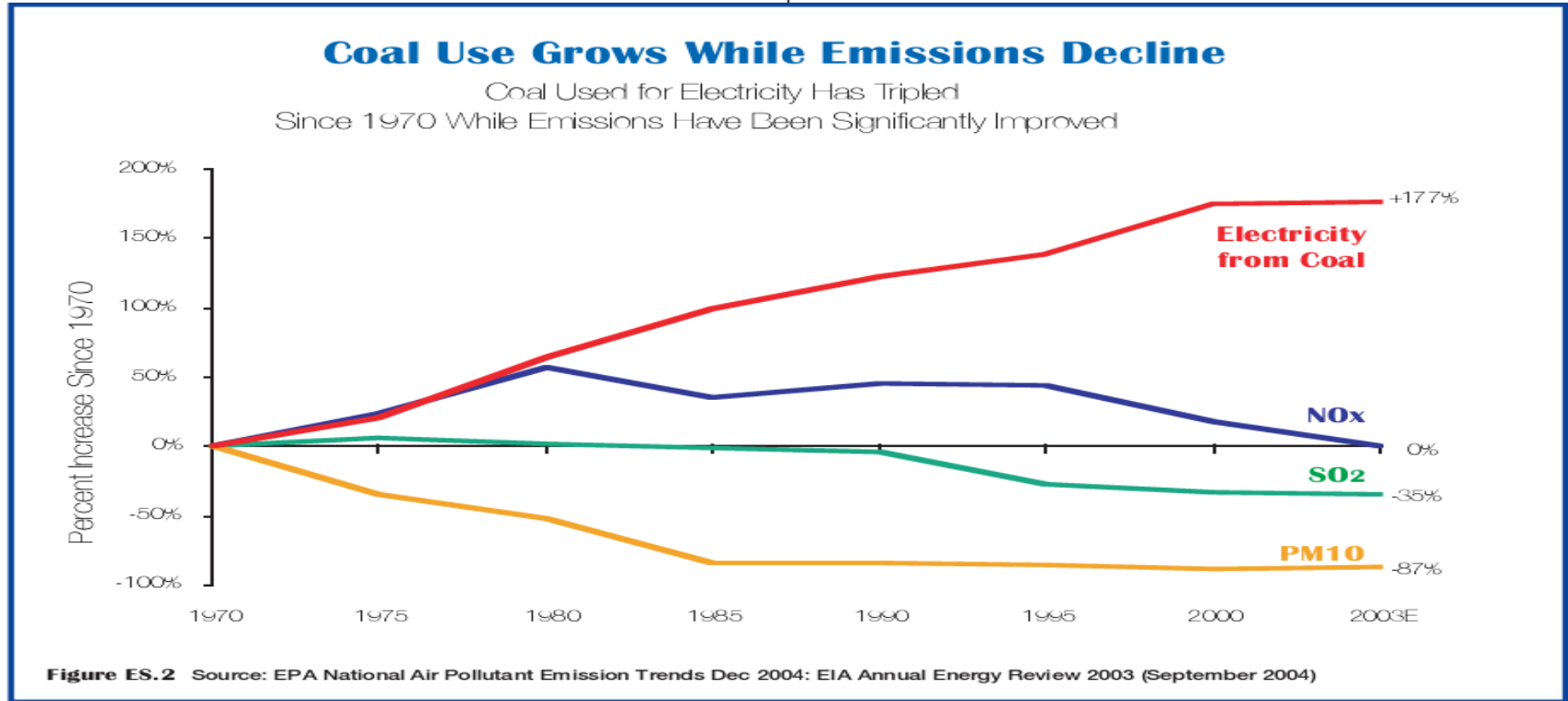
Why Coal?

Because that is what we have in Indiana, and lots of it





Coal Answer to the emissions problem? Increasing the use of electricity focuses the emissions issue back to the Utility, rent pollution control when you buy electricity



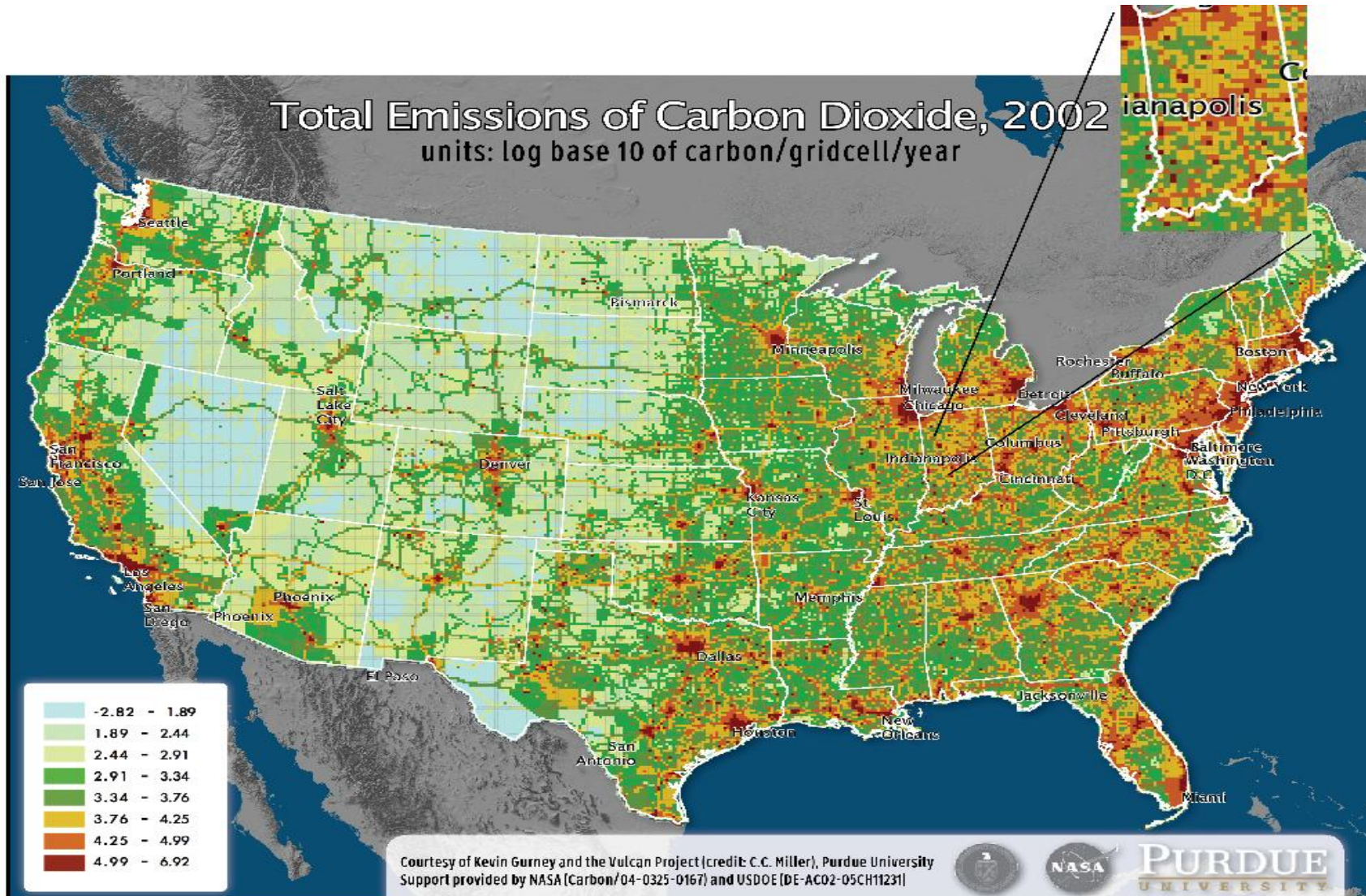
Unintended consequences of spending Billions on Pollution Control:

Nitrogen based fertilizer applications increase 44.4% from 1983 to 2004

Australian Scientist has proposed putting SO_x in the atmosphere to reduce global warming

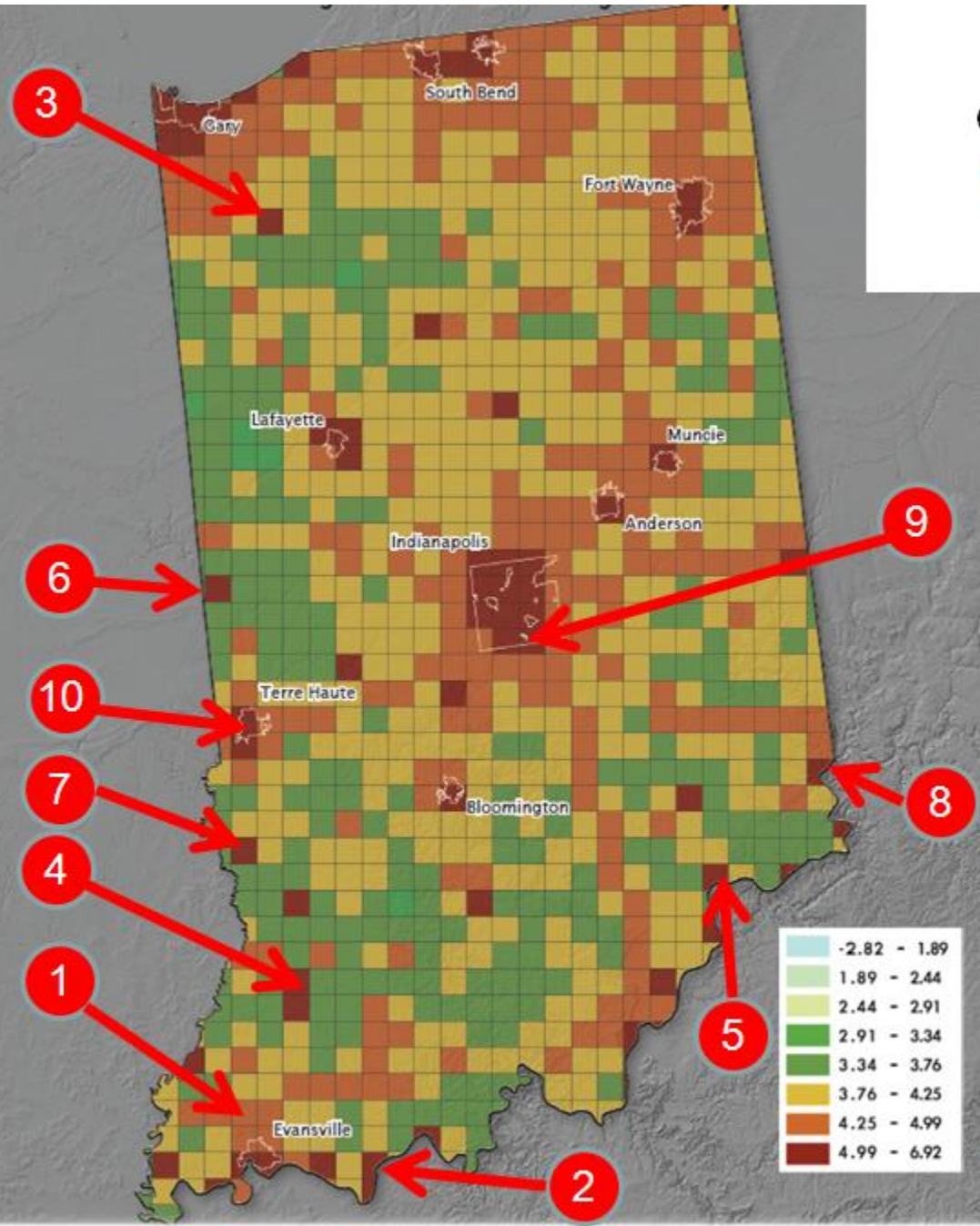
**IS GLOBAL WARMING THE RESULT OF INCRERASING THE CO2 EMISSIONS OR THE
REDUCTION OF SOX?**

A High- Resolution, Interactive Map of U.S. CO₂ Emissions from Fossil Fuels



Total Emissions of Carbon Dioxide 2002

(units: *log base 10 of carbon/gridcell/year*)



Indiana's Big 10 Power Stations:

1	Gibson	3,131 MW
2	Rockport	2,600
3	Schahfer	1,780
4	Petersburg	1,672
5	Clifty Creek	1,209
6	Cayuga	1,096
7	Merom	1,000
8	Tanners Ck	980
9	Harding St	924
10	Wabash River	918

Note: Impact of urban
transportation



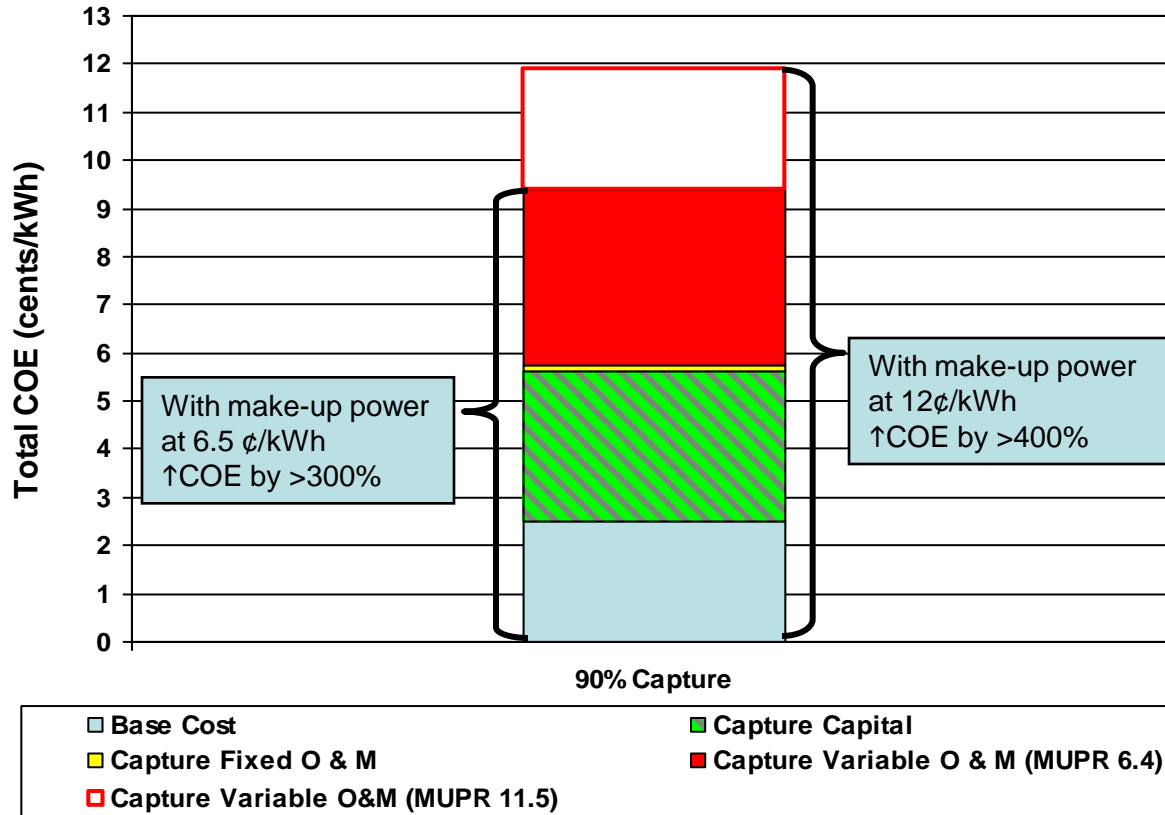
The Big CO2 Issue; We Don't Know What We Think We Know

- 1) How Much CO2 is **produced** Naturally?
- 2) How Much CO2 is **produced** by Human Activity?
- 3) How Much CO2 is **consumed** by the Earth Naturally?
 - A) If #1 + #2 is > than #3 then CO2 Density will **Increase**.
 - B) If #1 + #2 is < than #3 then CO2 Density will **Decrease**.
 - C) If #1 is > #3 then CO2 Density will **Increase** regardless of what we do with Human Produced CO2
- 4) What is the Current Level of CO2 Density?
Estimated at 380ppm, (ranges from <100ppm in upper Canada to > 500ppm in Amazon Rain Forest).
- 5) What is the Optimal Level of CO2 Density?
- 6) How Much Human Made CO2 Needs to be **Reduced** to Reach the Optimal Density Level? (Assuming that 3B is accurate).
- 7) What is the cost of reducing CO2 Human Made Emissions by 90% in by 2050? Current estimates is \$ 5,000,000,000,000 .

**The problem with CO2 legislation:
WE DO NOT KNOW THE VALUE OF ANY OF THE ABOVE**



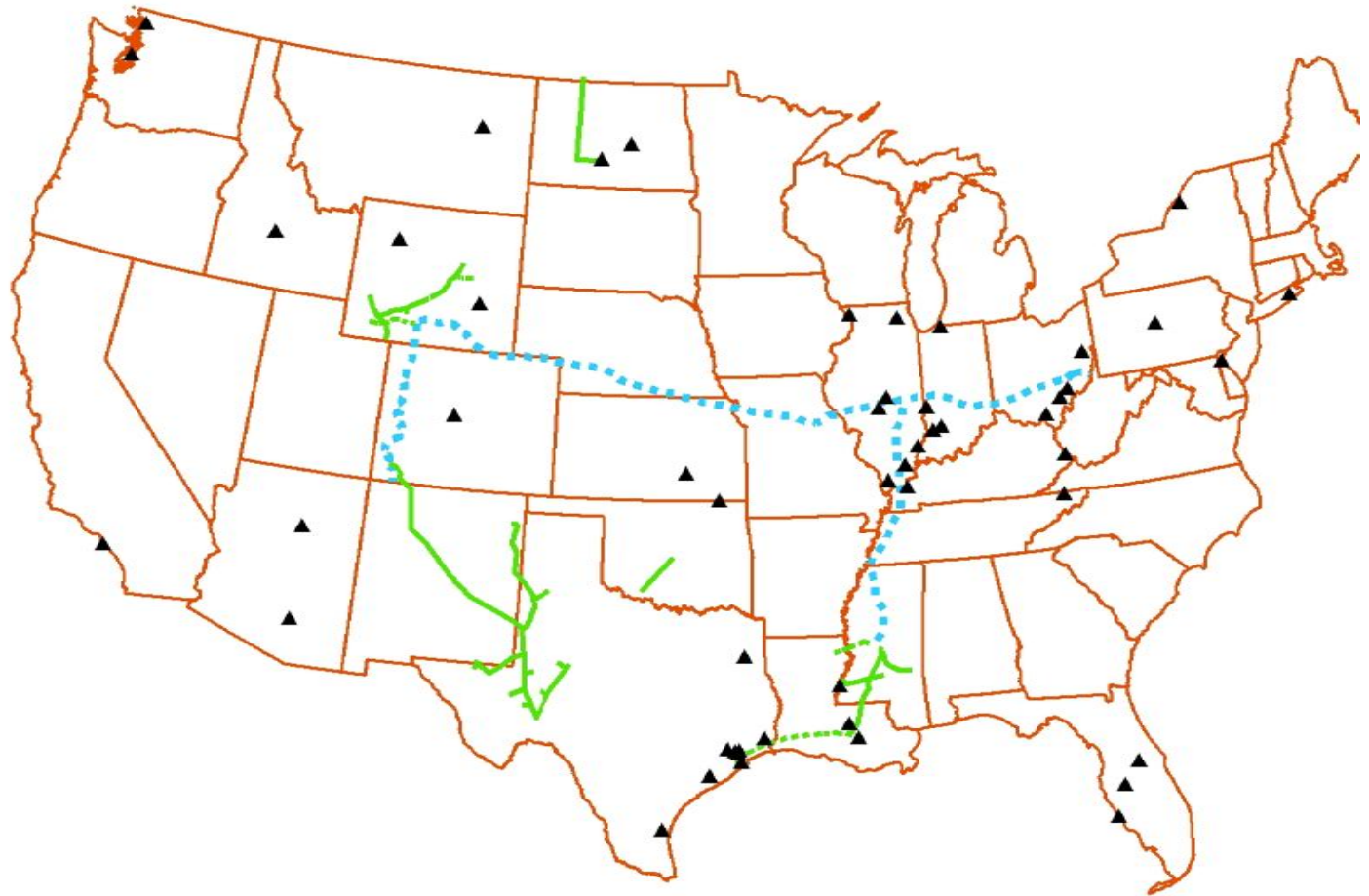
Economic Results Of CO2 Removal and Sequestration



Base power plant cost for an existing plant obtained from Energy Velocity ranged from 2 to 3 cents/kWh.
 6.5 ¢/kWh assumes make-up power from a new non-capture supercritical PC plant
 12.0 ¢/kWh assumes make-up power from a new supercritical PC plant with 90% capture



Extensions and Existing CO₂ Pipelines in Relation to Gasification Projects





What does this all mean?

Problem:

We have a need for lots of energy;
we produce stuff used elsewhere.

We have a lot of coal;

We have real issues with CO₂ ;

Regardless of whether there is any environmental basis for the concerns

We are shipping out \$1 billion a year to buy coal from other states and bring it to Indiana;

Solution:

Use Indiana's own coal in a way that would;

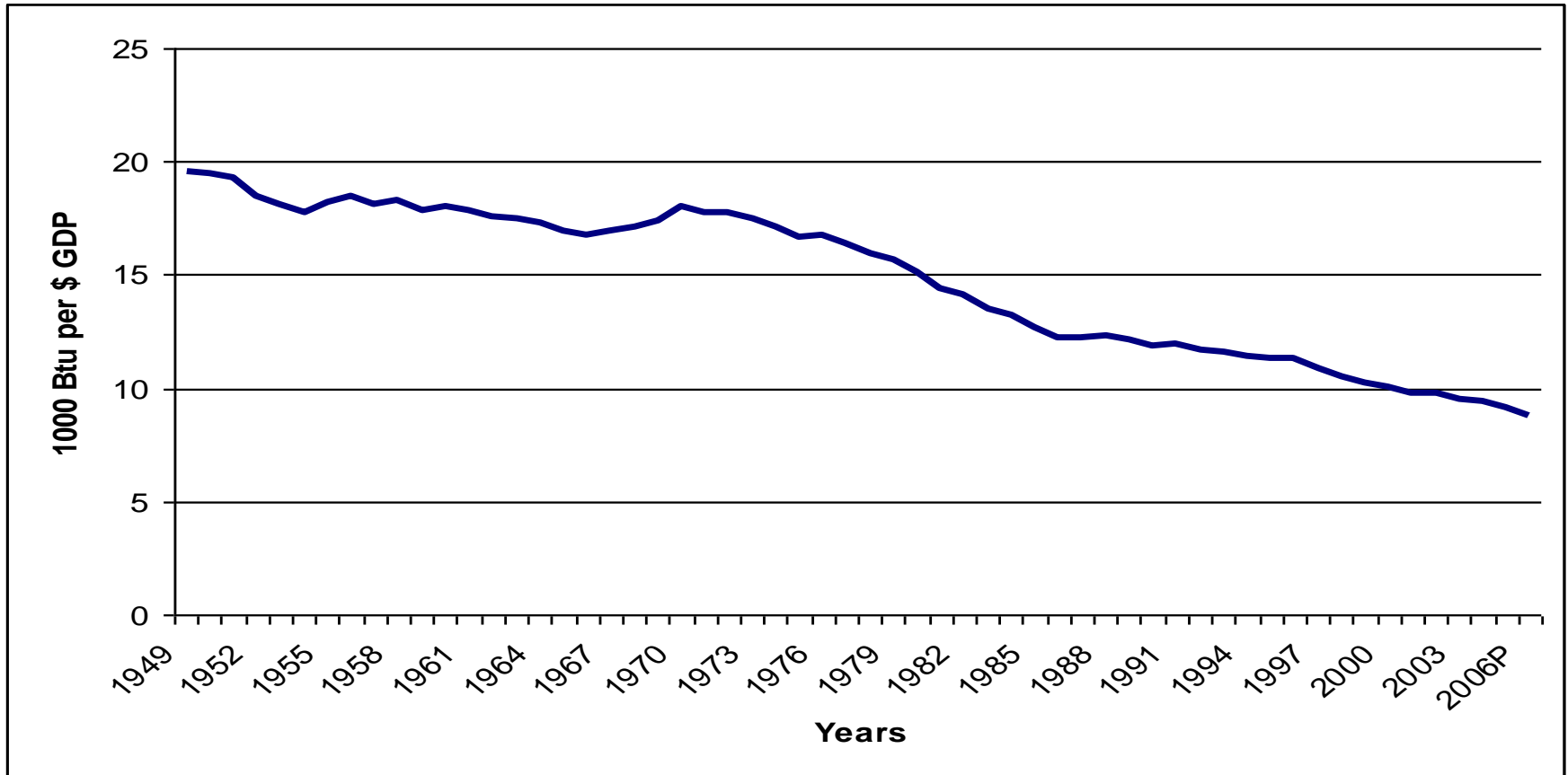
- 1) retain energy capital,
 - 2) create jobs for Hoosiers,
 - 3) Leave the environment cleaner than it is now,
 - 4) Reduce the cost of the goods manufactured in the state.
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Energy Efficiency

BTU's per Dollar GDP

50% reduction in Energy per dollar in last 50 years





Evolution of the Power plant

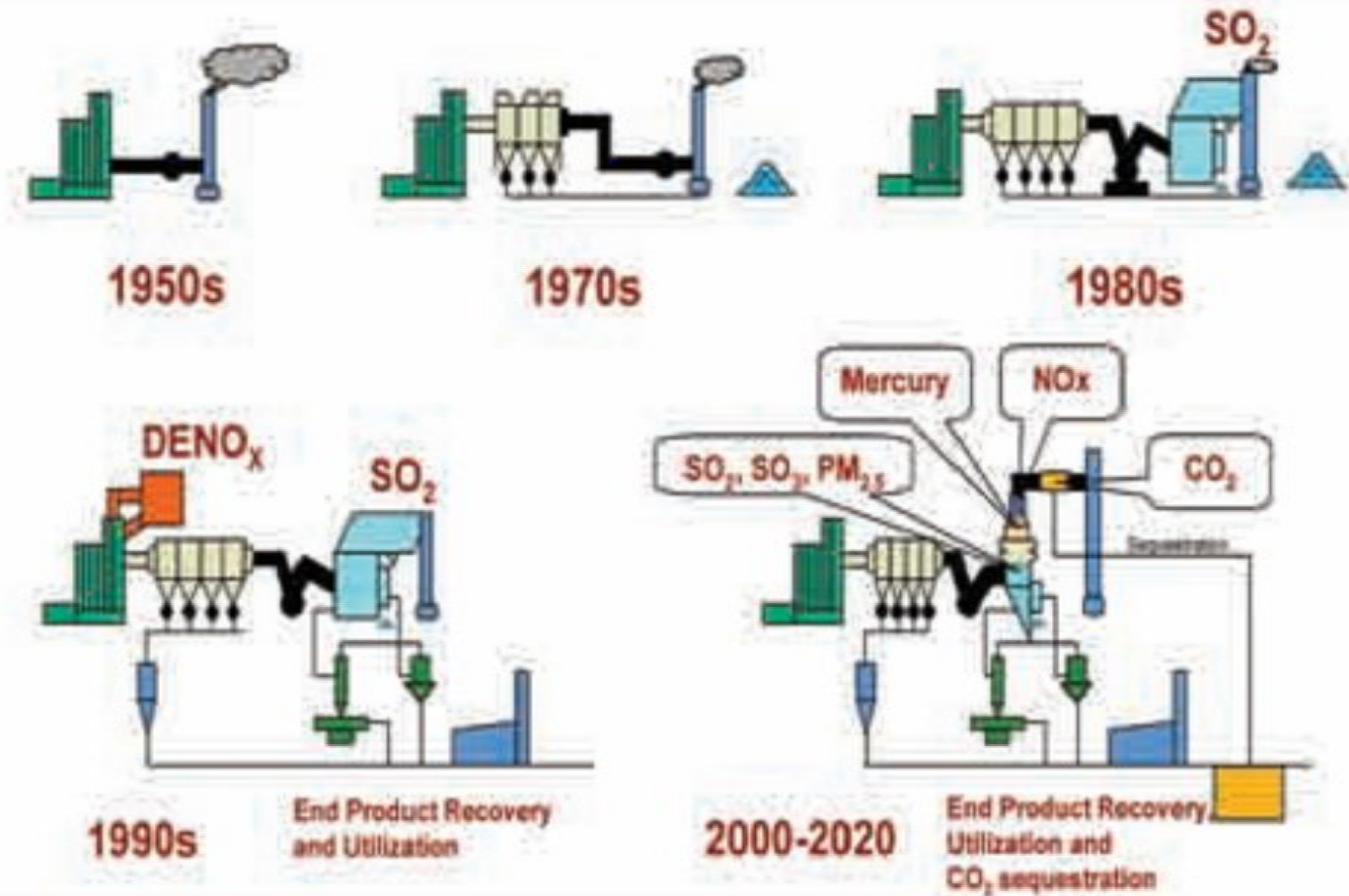
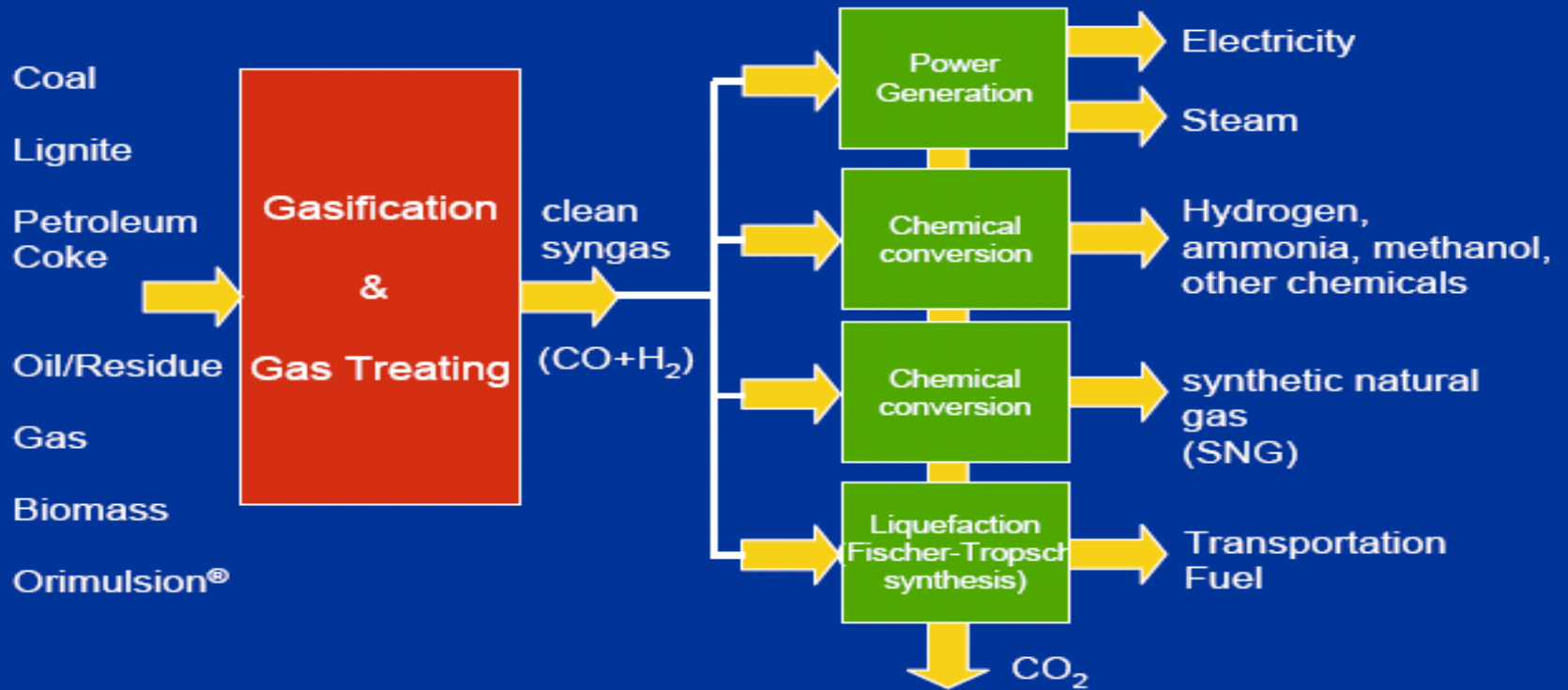


Figure ES-1

Evolution of Coal Fired Power Plant Emissions Capture²



Potential syngas applications





Wabash River

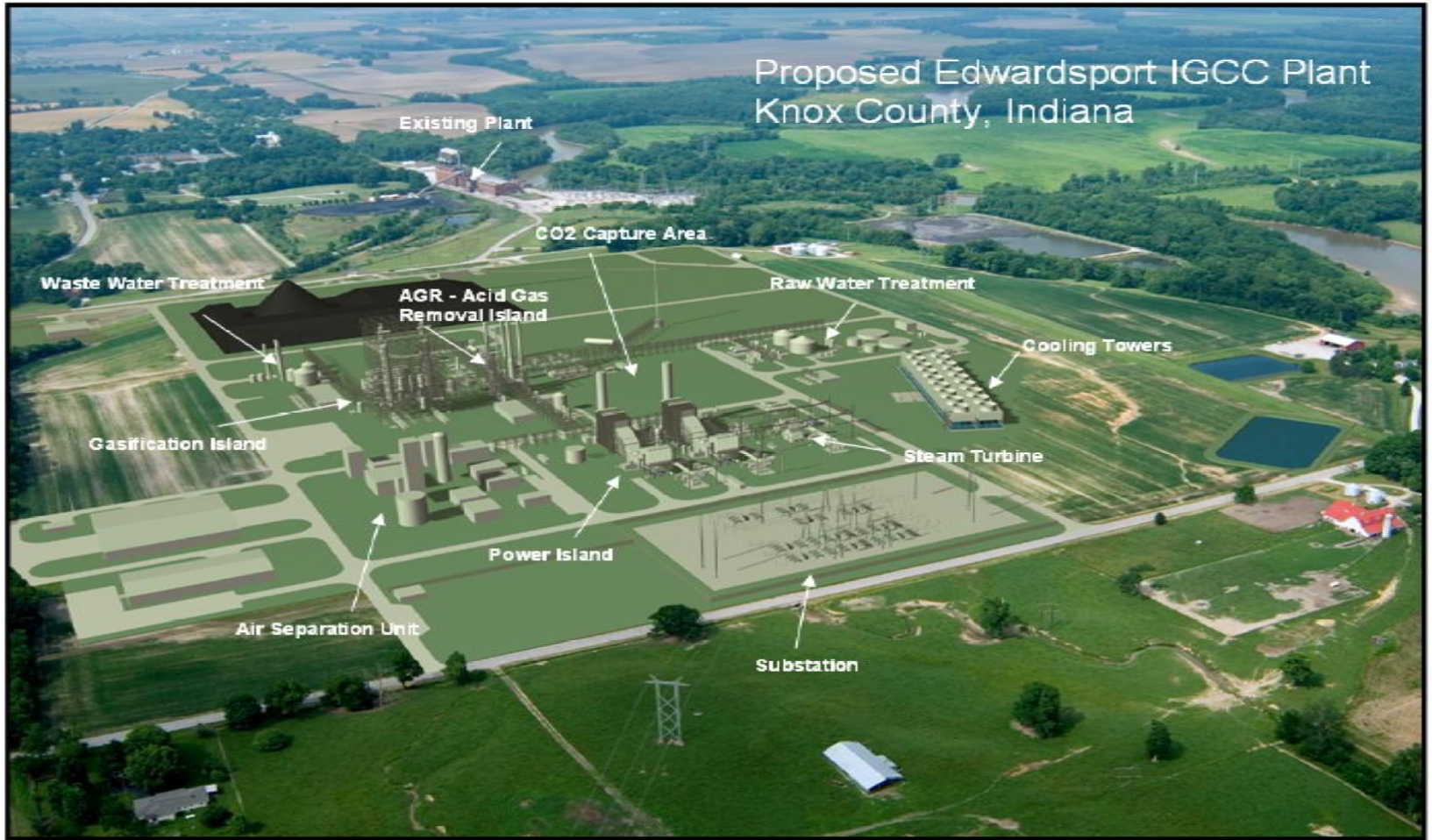
One of the Cleanest Coal Fired
Power Plants in the World

Gasification operations require more space than the original power plant





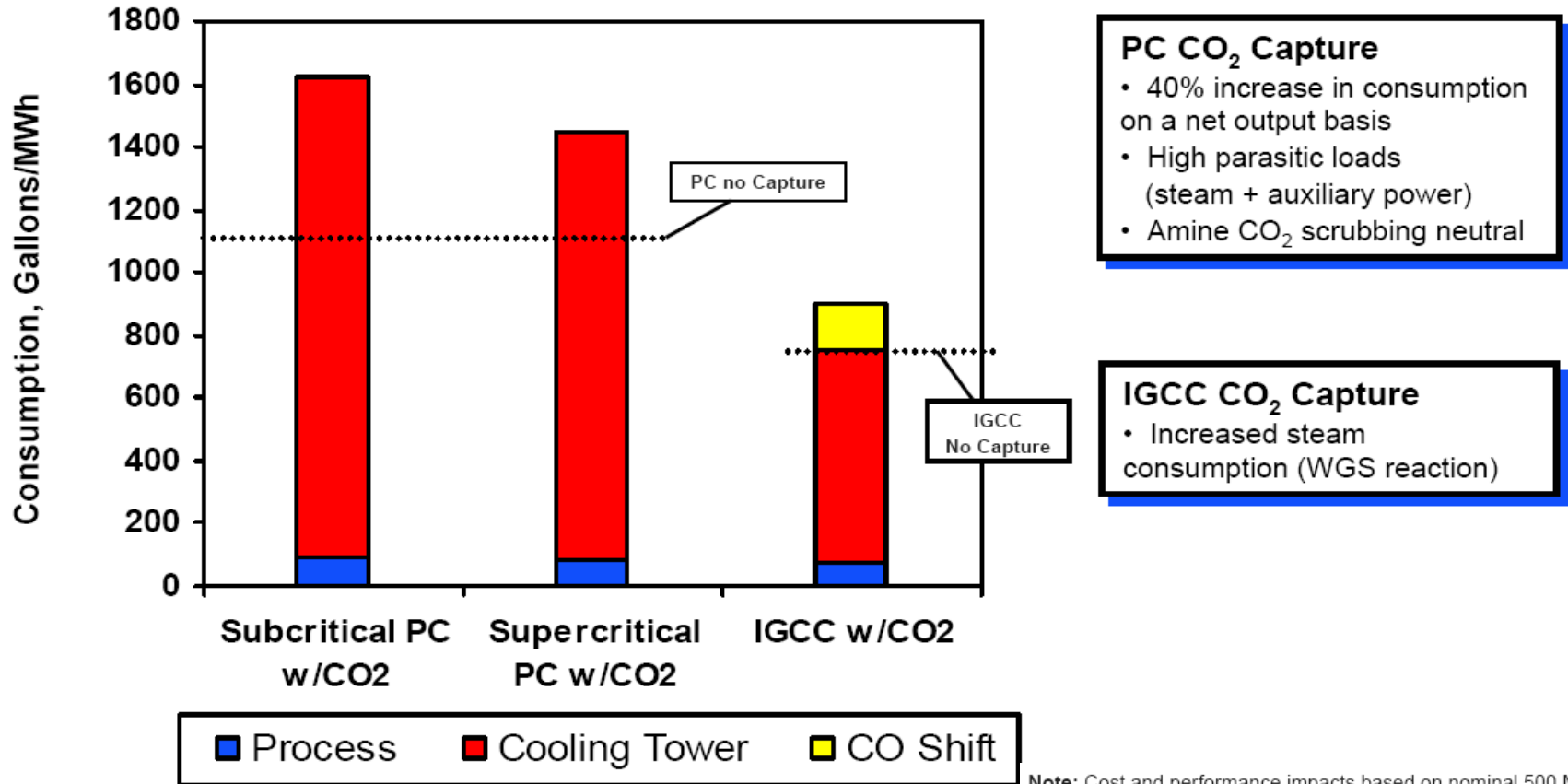
Edwardsport





Water Use by Power Plants

IGCC Consumes Less Water than PC & CO₂ Capture Increases Water Footprint



Note: Cost and performance impacts based on nominal 500 MW net output baseline plant with mechanical draft wet cooling towers



Coal Gasification Economic Impact

Edwardsport/Crane/ IN Gas, Inc.

What's in it for us?

The overall economic impact of
Adding **5.8* Million Tons of coal**
is over **\$345.6 Million per year**
483 mining jobs
1933 ancillary jobs



Producing:

800 mW of Power (690 mW net)

40 Bcf (8% of Indiana total demand)

4500-6000 Bpd/FT fuel liquids

*Edwardsport:	1.8 Million Tons
Crane:	1.0 Million Tons
Indiana Gasification, Inc:	3.0 Million Tons



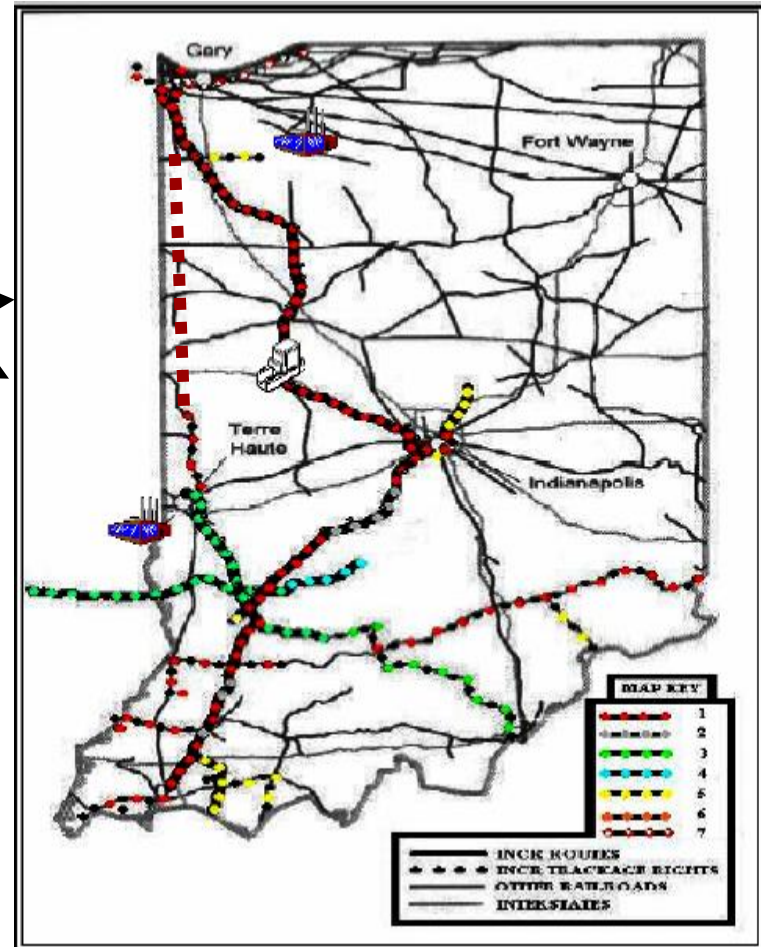
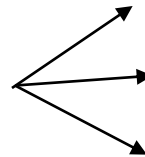
Develop an in-depth scenario involving new rail infrastructure development

Infrastructure changes including the “missing Links” will enable Indiana coal to be moved north but by-passing Terre Haute, Indianapolis and Chicago

Allows for the access of Indiana coal to the northwest region.

Connects Indiana’s North and South Ports via rail.

Increase Indiana coal export market potential





Southwest/Northwest Indiana Economic Development Plan

Future Idea Areas

Indiana Coal Production Potential:

A) Indiana coal to make coke:

reducing cost of steel production, reducing air emissions in the region 2.1 million tons

NiSource coal replacement potential 6.8 million tons

TOTAL Indiana Coal Potential 8.9 million tons

Producing 8.9 million tons of coal adds:

742 direct mine workers*

2967 Ancillary workers * employment to South West IN

Total added annual economic activity in South West Indiana \$530.3 million*

Estimated cost of the Indiana/Illinois order rail line \$ 50.0 million

B) Newport Military Base transfer to Indiana/Purdue University:

1. Biomass to Energy test site
2. Wind Energy gasification supplement site
3. Provide syngas to Cayuga making it more usable during peak demand times

***EXPANDING THE UTILIZATION OF INDIANA COALS**

Brian H. Bowen, Forrest D. Holland, F.T. Sparrow, Ronald L. Rardin, Douglas J. Gotham, Zuwei Yu, Anthony F. Black. Center for Coal Technology Research, Purdue University, 2004, page 20.



Indiana Center for Coal Technology Research Located in the Energy Center at Discovery Park, Purdue University

We welcome visits

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