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

CO_2 and Indiana's Infrastructure: Turning Problems into a Resource

"Coal, Steel, and the Industrial Economy"
COAL BRIEFING
Purdue Calumet, Hammond, Indiana

Marty W. Irwin, Director
Indiana Center for Coal Technology Research

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Are We Using Too Much Energy?

	Population	Energy	GDP	Energy/GDP 1000Btu/$
USA	6%	25%	33%	.758
ROW	94%	75%	67%	1.12

Do the Math

US population consumes 5.26 times the energy of the average person in the rest of the World;

But we produce 7.7 times the goods and services of the Rest Of the World.

The USA only 67% of the energy per unit of GDP as does the rest of the world.

We are the model of energy efficiency (only **Japan** and **Lichtenstein** are better).

Per capita energy is of no value to measure, to reduce your per capita consumption you need only add population.

It is what you do with the energy that matters.

33% of the world has never used a telephone:

40% of China population have no electricity or indoor plumbing:

50% of the population of the world is on a subsistence economy:

How do you compare the energy us of a Bushman in the Kalahari trying to feed his family with a Hoosier farmer who uses his 255 acres to feeds 150 people?

Its not how much you use, it is what you do with it.

How Important is Manufacturing to Indiana? Manufacturing as % of Indiana's GDP

	1997 GDP	2006 GDP
Durable Goods	**18.1%**	**20.5%**
Non-Durable Goods	**10.2%**	**10.0%**
Total Manufacturing	**28.3%**	**30.5%**

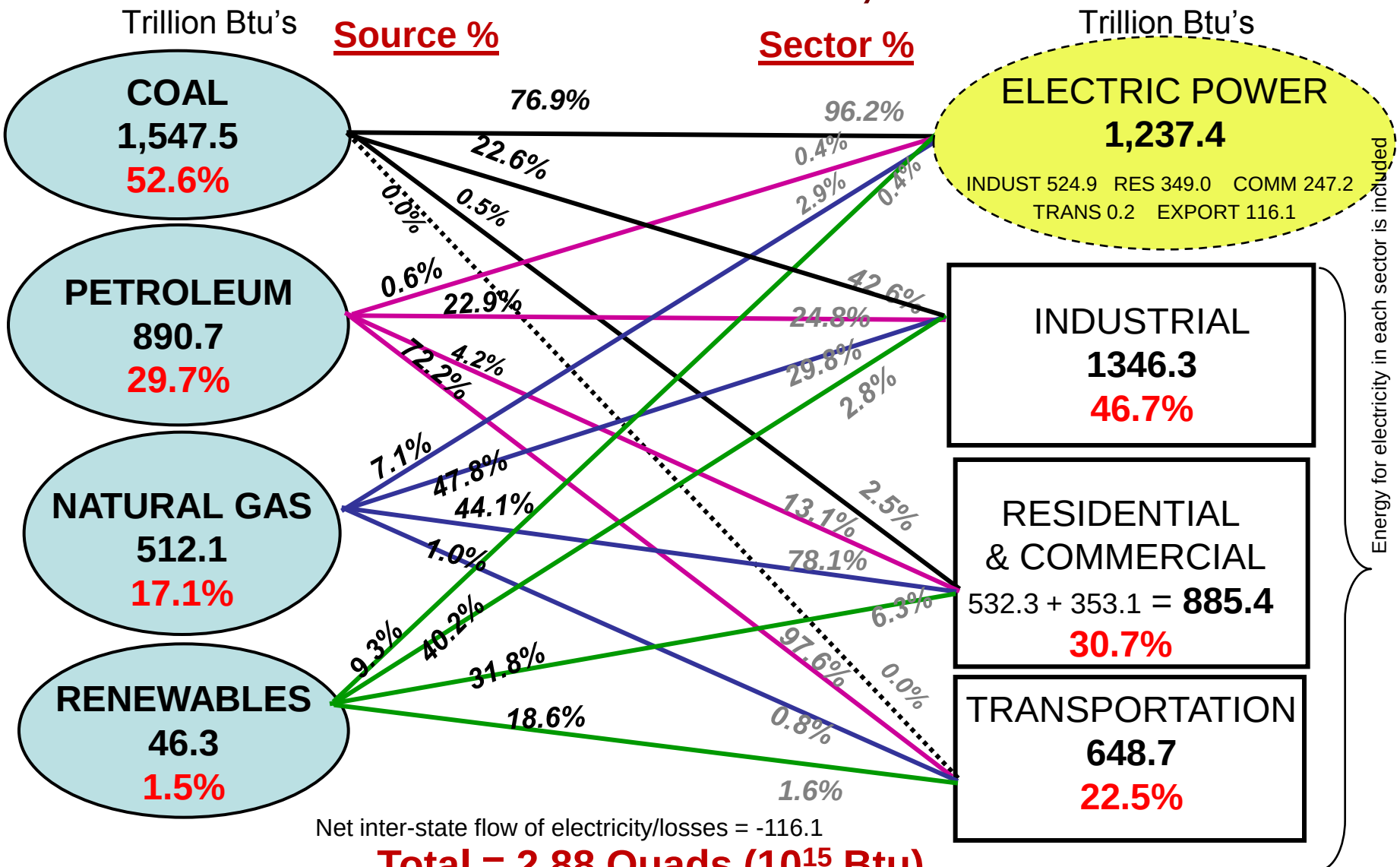
- In 1997 Indiana's 18.1% durable goods as part of GDP was the highest in the nation. (2006 Indiana ranked 3rd)
- 2006 Total Manufacturing of 30.5% is highest in the nation.
- Your CO_2 Footprint is large if you live in Indiana because we are a Manufacturing State: CO_2 and Energy use measurements do not account for where the final product is consumed.

Indiana is a manufacturing state

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

Source: Indiana Business Review, Spring 2008

Indiana Primary Energy Consumption Source & Sector, 2006



Net inter-state flow of electricity/losses = -116.1

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

75% of energy imported

http://www.eia.doe.gov/emeu/states/sep_use/total/pdf/use_in.pdf

http://www.eia.doe.gov/emeu/states/state.html?q_state_a=in&q_state=INDIANA

2006 COAL DESTINATION: INDIANA

Coal Destined for Indiana: 72,346 (Thousand short tons) & Methods of Transportation

Wyoming: 11,927 Total
11,686 Electricity Generation
Rail **Industrial** *240 River*

Montana: 2,226 Total
2,226 Electricity Generation
Rail

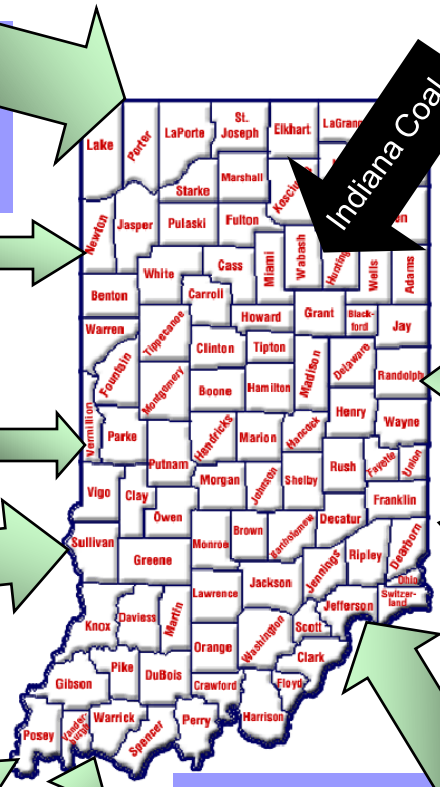
Utah: 164 Total
164 Industrial
Rail

Colorado: 153 Total
109 Electricity Gen,
Rail, **44 Industrial**

Illinois: 6,450 Total
5,347 Electricity Generation
Rail 4,672 River 428 Truck 589
761 Industrial Plants
Rail 675 Truck 86

Kentucky: 1,371 Total
882 Electricity Generation
Rail 530 River 352
489 Industrial Plants
Rail 392 Truck 97

Alabama: 946 Total
944 Coke *Rail*



In state: 32,965 Total
30,532 Electricity Generation
Rail 17,021 River 30
Conveyer 3,606 Truck 12,308
2,379 Industrial Plants *Truck*
54 Residential-Commercial *Truck*

Ohio: 195 Total
188 Electricity Generation
Rail 73 River 96 Truck 19
7 Industrial Plants *Truck*

Pennsylvania: 546 Total
475 Electricity Generation
Rail 223 River 251
68 Industrial Plants *Truck*

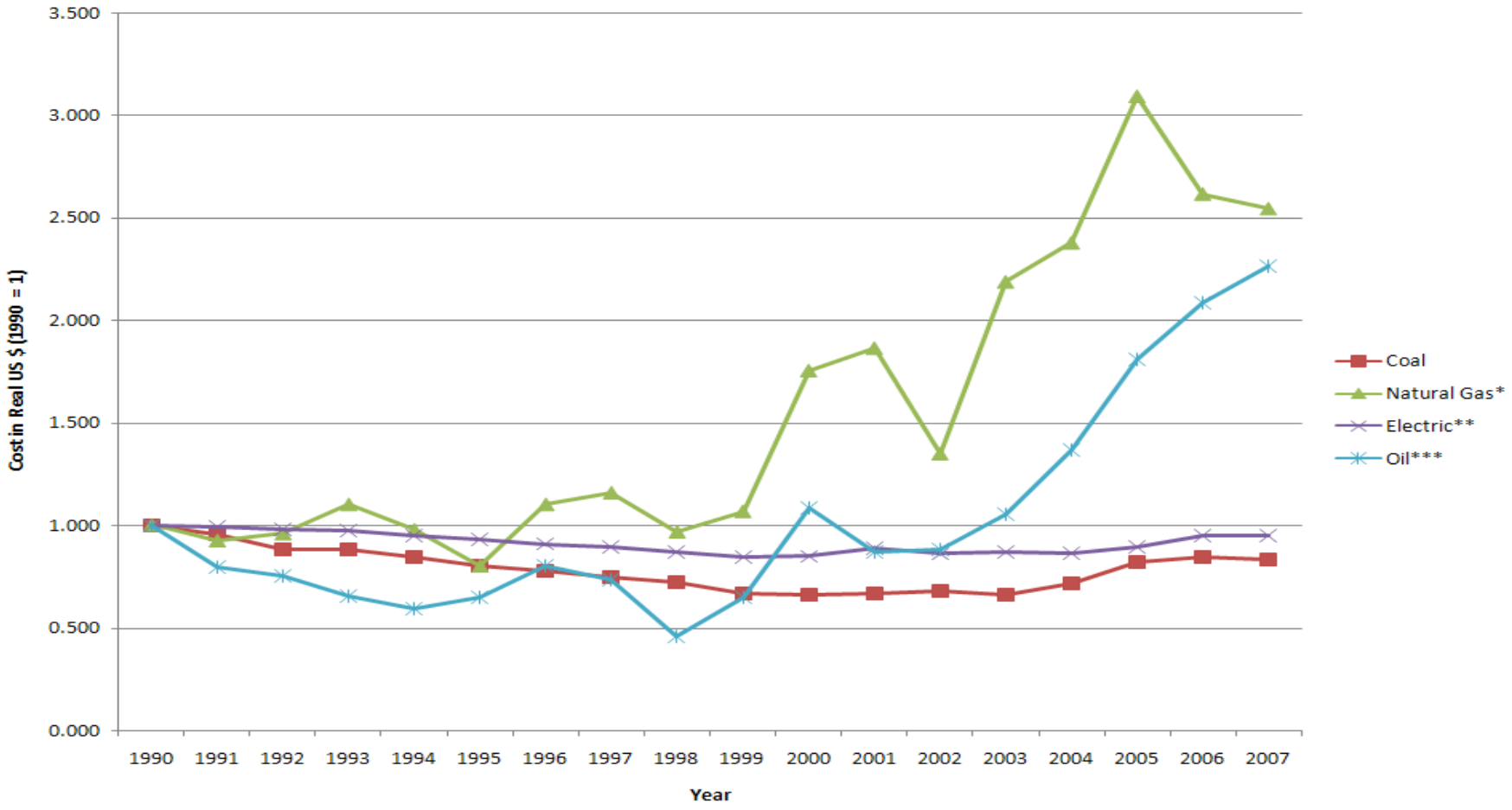
Virginia: 670 Total
670 Coke Plants *Rail*

West Virginia: 7,942 Total
2,111 Electricity Generation
Rail 1,114 River 968 Truck 28
4,634 Coke Plants
Rail 4,163 River 420, Truck 51
1,197 Industrial Plants
Rail 949 River 246 Truck 2

60,582 Power Generation
(**9,300** from Synfuel)
6,140 Coke Plants
5,932 Industrial Plants

Source: http://www.eia.doe.gov/cneaf/coal/page/coaldistrib/coal_distributions.html

Real Cost of Energy



The New Economy and Alternate Energy

- Wind turbines
- Transmission Lines
- Gasifier
- CO_2 Pipelines
- Light Rail
- Ethanol
- BioDiesel
- ***<u>How do you build these without Steel and Aluminum?</u>***
- ***You cannot build an economy without steel***
- ***You cannot make steel without coal***

Steel Production and Air Quality

One impact of Importing Steel:

Northwest Indiana

– Indiana Steel Industry operating at 83% capacity in 2008 yet no **Ozone Action days.**

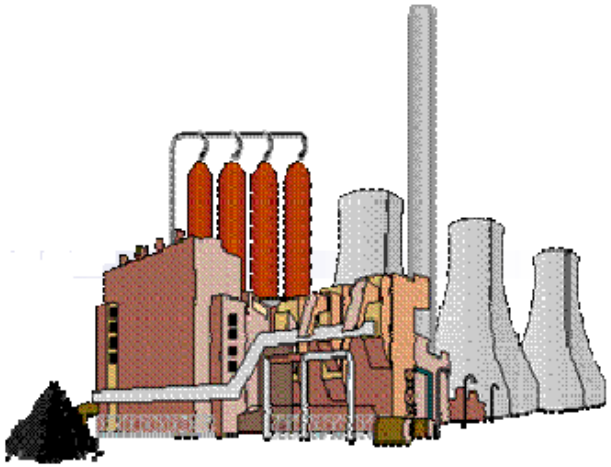
Import steel from India, China, Russia:

Can they make the same air quality claims?

(Has ArcelorMittall or US Steel ever been asked to halt operations so Chicago can run its marathon?)

CO_2 Emissions from Coal

Different rank coals produce different amounts of CO_2 lbs/Million Btu (MBtu)



CO_2 lbs/MBtu from Coal

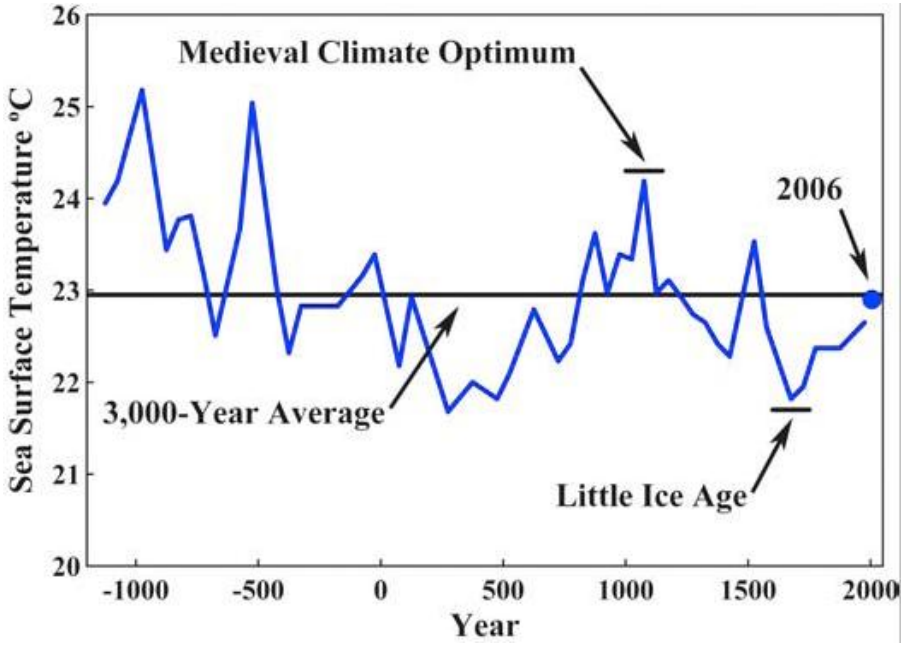
U.S. averages:

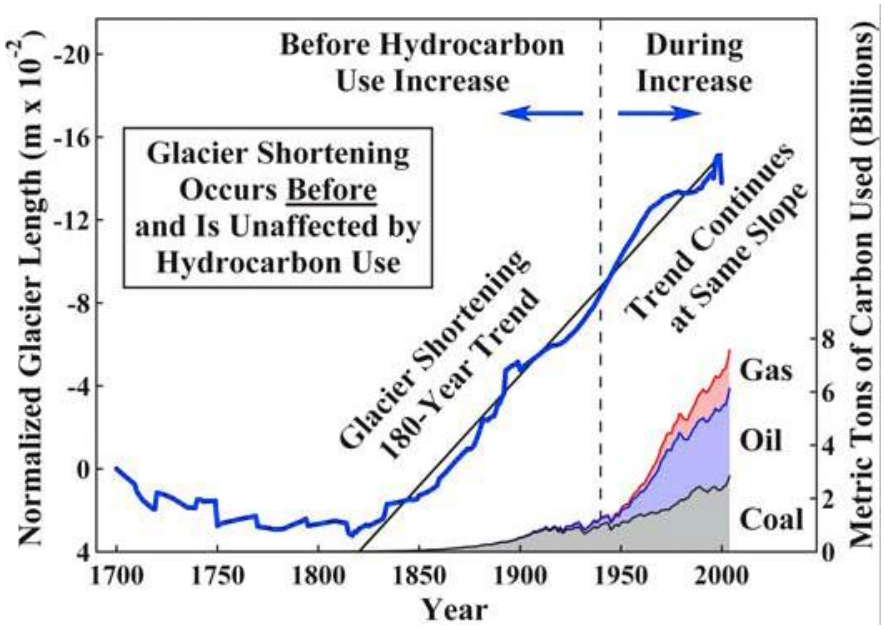
227.4 for **anthracite**
216.3 for **lignite**
211.9 for **sub-bituminous**

205.3 for **Indiana bituminous**

Souce: http://www.eia.doe.gov/cneaf/coal/quarterly/co2_article/co2.html

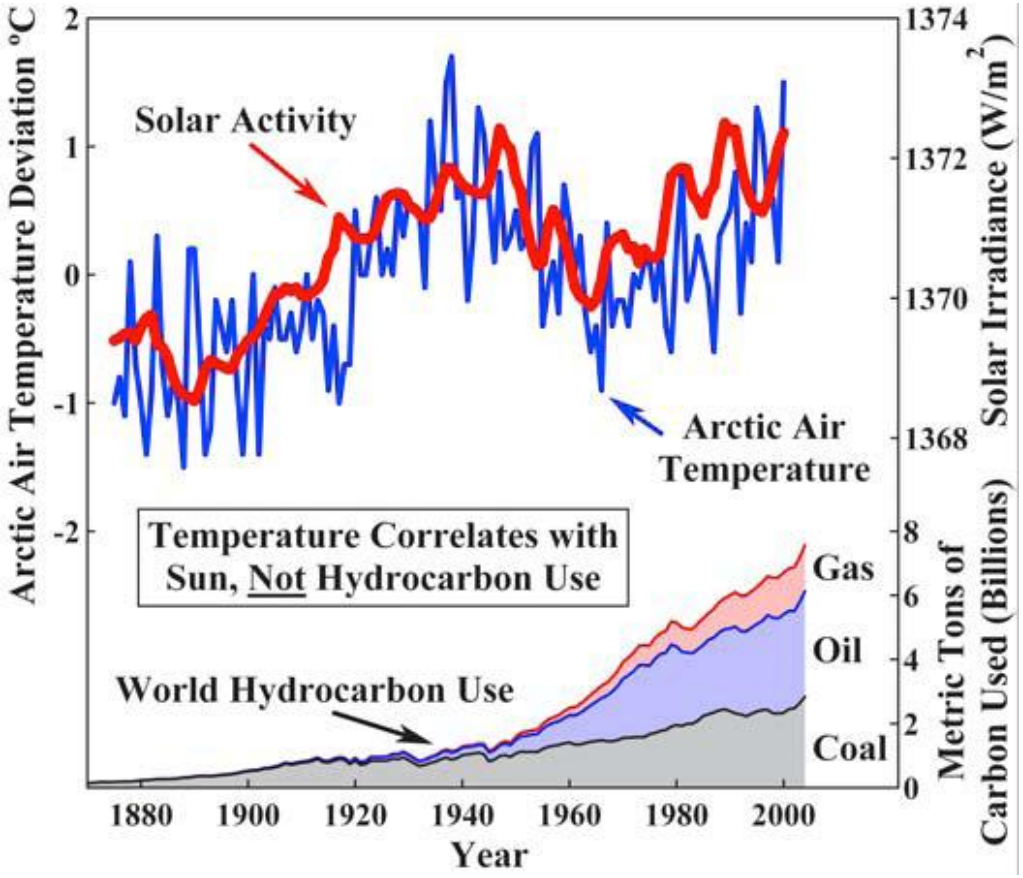
Global Warming or Cooling?
Depends on Where you Start your Analysis





Source: Arthur B. Bobinson et al,, Journal of American Physicians and Surgeons (2007) 12, 79-90.

Sun, Temperature, CO_2 Correlations or Cause and Affect



Source: Arthur B. Bobinson et al,, Journal of American Physicians and Surgeons (2007) 12, 79-90.

Climate Sensitivity Reconsidered

- The IPCC's 2007 climate summary overstated CO_2 impact on temperature by 500-2000%
- CO_2 will add little more than 0.6 degrees F. to global mean temperature by 2100, if at any at all
- Not one of the above variables, whose product is climate sensitivity, can be measured directly
- The IPCC's value for the three keys is taken from 4 published articles not 2,500
- "Global Warming" stopped 10 years ago, and surface temperature have been falling for 7 years

Source: Christopher Monckton, Physics and Society, August 2008

Climate Sensitivity Reconsidered

- Not one of the computer models used by the IPCC predicted this cooling period
- The IPCC inserted a table into the scientists' draft overstating the effects of the ice-melt by 1000%
- It was proved 50 years ago that predicting climate more than 2 weeks ahead is impossible
- Mars, Jupiter, Neptune's largest moon, and Pluto warmed at the same time as Earth
- In the past 70 years the Sun was more active than at almost any time in the past 11,400 years

Source: Christopher Monckton, Physics and Society, August 2008

We must get the Science Right or we shall get the Policy Wrong

Problem

<u>We have a need for lots of Coal</u>

We produce heavy manufactured products used elsewhere,
We are responsible for producing the CO_2 that results from the production of goods demanded elsewhere.

<u>We have real issues with CO_2</u>

Regardless of whether there is any legitimate environmental basis for the concerns or not.
We are shipping out $1 Billion a year to buy coal from other states and bring it to Indiana.

We must get the Science Right or we shall get the Policy Wrong

What would resolve the issue?

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 (especially steel).
5) **Make CO_2 a desirable resource rather than a problem.**

<u>Ideas that are do-able now</u>

Newport Chemical Munitions Depot to Newport Advanced Energy Development Center

Best Infrastructure in the US

- 765 kV,
- Water,
- Natural Gas pipeline,
- Railroad

US needs a gasification test center

- Plasma,
- Biomass,
- Cellulose

Wind Power supplemental grid power system

- Ready user for all syngas produced: Cayuga
- Underground Coal Technology
- CO_2 Capture Technology

Need an infrastructure planning center to reduce time and cost of implementing new technologies.

Develop an in-depth scenario involving new rail infrastructure development

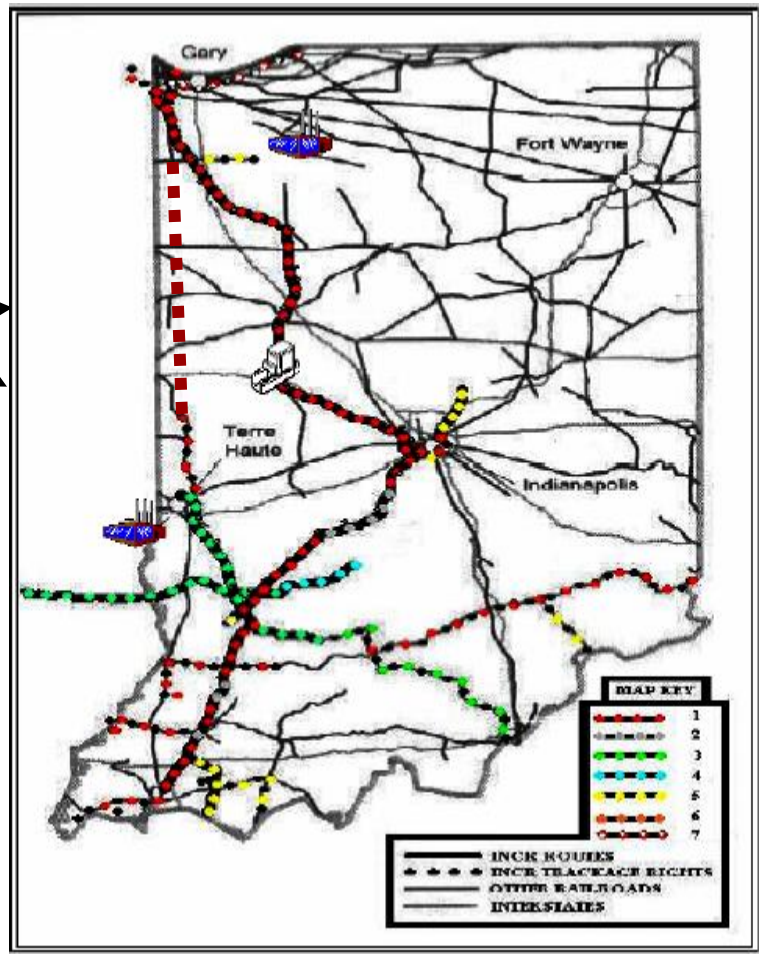
USING INFRASTRUCTURE TO REDUCE AIR EMISSIONS

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

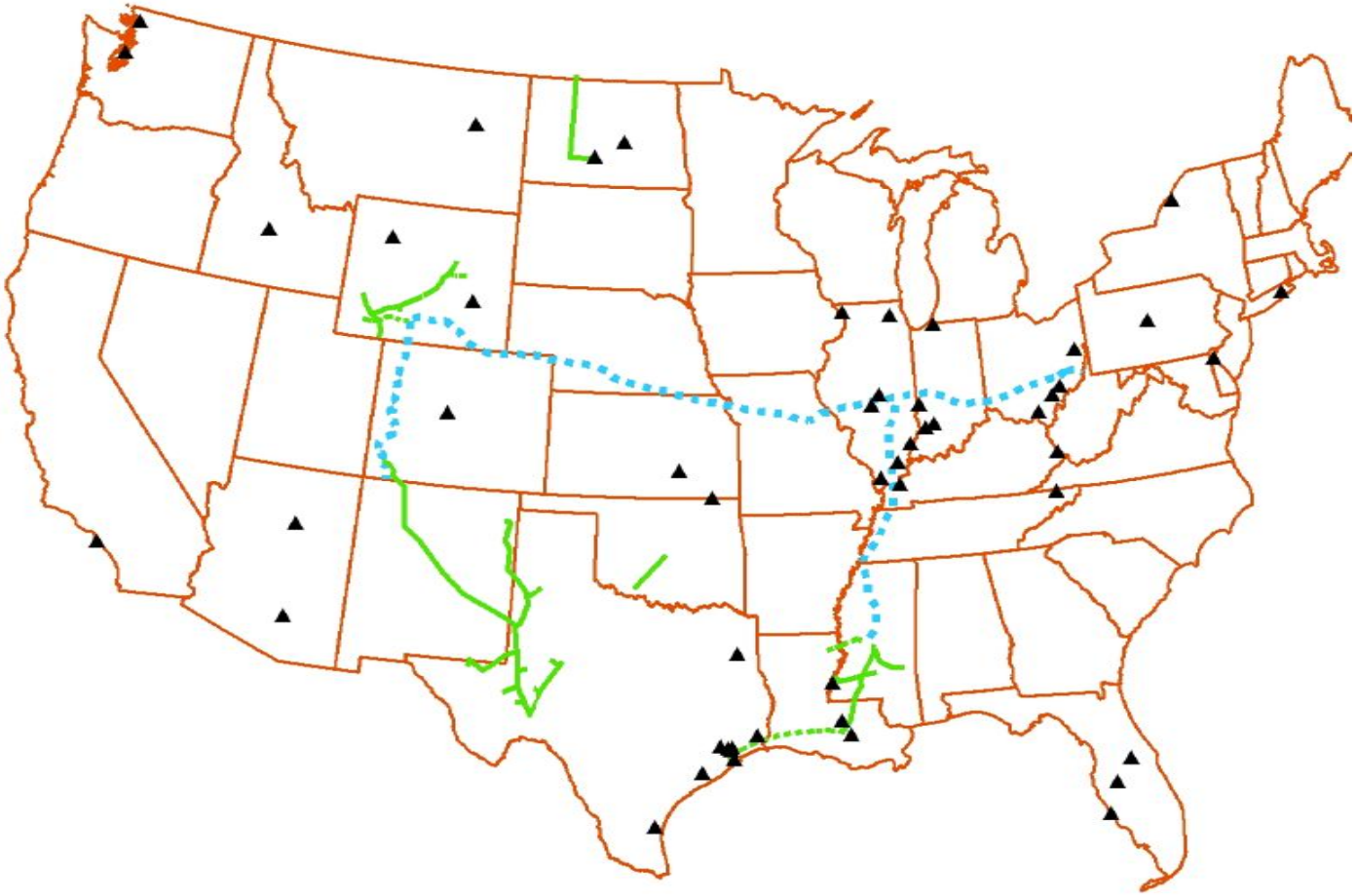
Allows for the access of Indiana coal to the northwest region.

Connects Indiana’s North and South Ports via rail.

Increase Indiana coal export market potential



Extensions & Existing CO_2 Pipelines in Relation to Gasification Projects



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.