Indiana's Stake in the CO_2 Control Debate

CCTR Director, Marty W. Irwin
765/494-7414 mwirwin@purdue.edu
317/232-8970 mirwin@OED.IN.GOV

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Indiana Government Center
Indianapolis, Indiana

The Energy Center at Discovery Park
Purdue University
CCTR, Potter Center, 500 Central Drive
West Lafayette, IN 47907-2022

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

Evolution of the Coal Power Plant

Yet the electricity per ton of coal input stays level

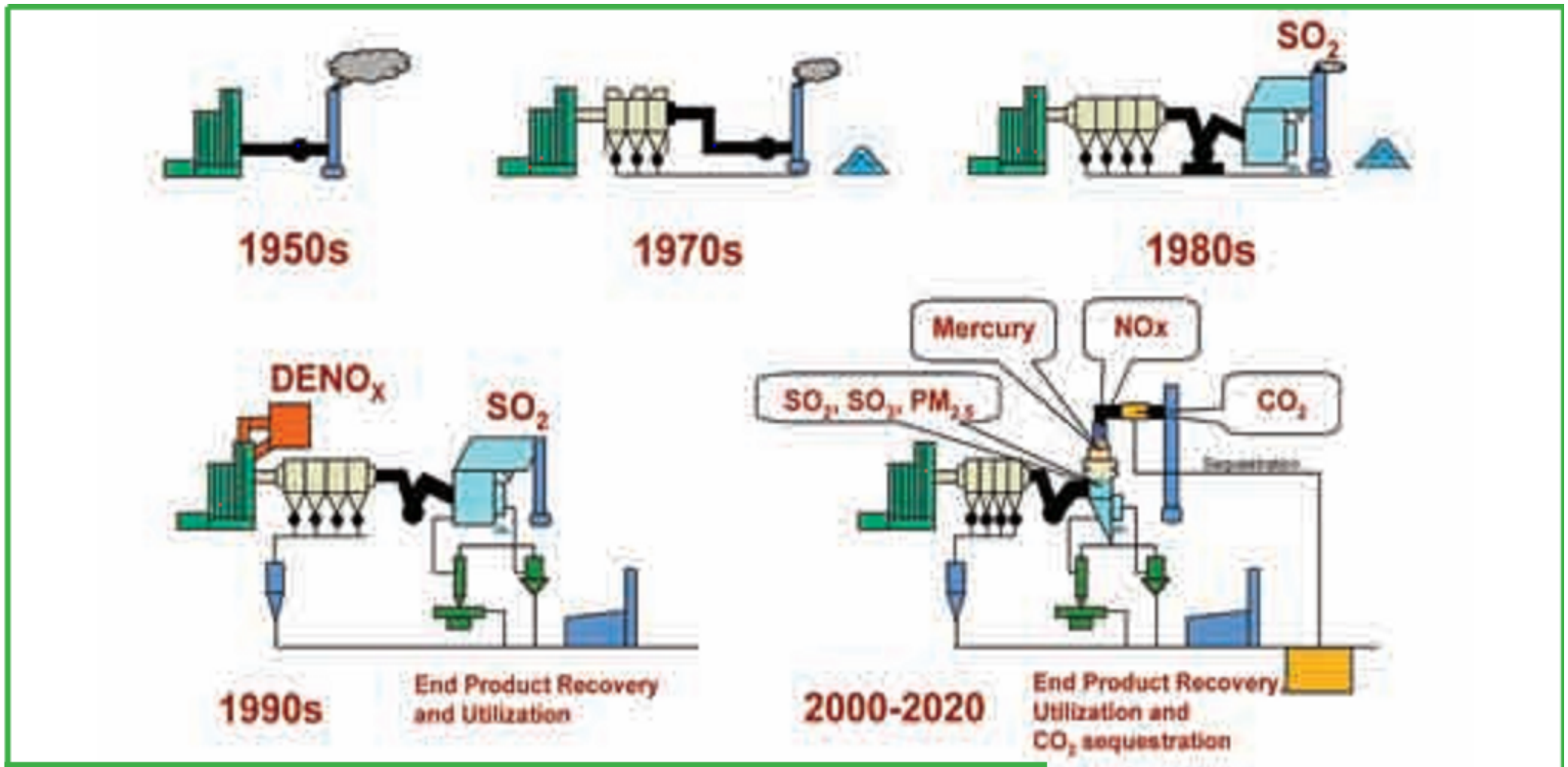


Figure ES-1

Evolution of Coal Fired Power Plant Emissions Capture[2]

Price of Energy

Demand Increases even as Price Increases

From 1995 to 2006 :

• Coal price per MBtu increased	**21.1%**
Demand increased	14.0%
• NG price per MBtu 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%

Estimates of Cost of Impact of CO_2 Controls

Type	size	Plant	CO2	Water	Cost of	Plant Cost
Coal		Efficiency	lb/MBtu	gal/min	**Electricity**	$/kW
IGCC	**630MW**	**39.53%**	198.7	3850.6	77.9 mils	$1,841
IGCC	**630MW**	**32.07%**	20.6	4425.7	106.3 mils	$2,49
with CCS 90% reduction						
Difference		**-18.9%**	**-89.6%**	**+14.9%**	**+36.4%**	**+35.5%**
PC	**550MW**	**37.95%**	203.0	5826.5	63.65 mils	$1,562
PC	**550MW**	**26.05%**	20.3	13128.5	116.80 mils	$2,882
with ccs 90% reduction						
Difference		**-31.4%**	**-90%**	**+125.3%**	**+83.5%**	**+84.5%**

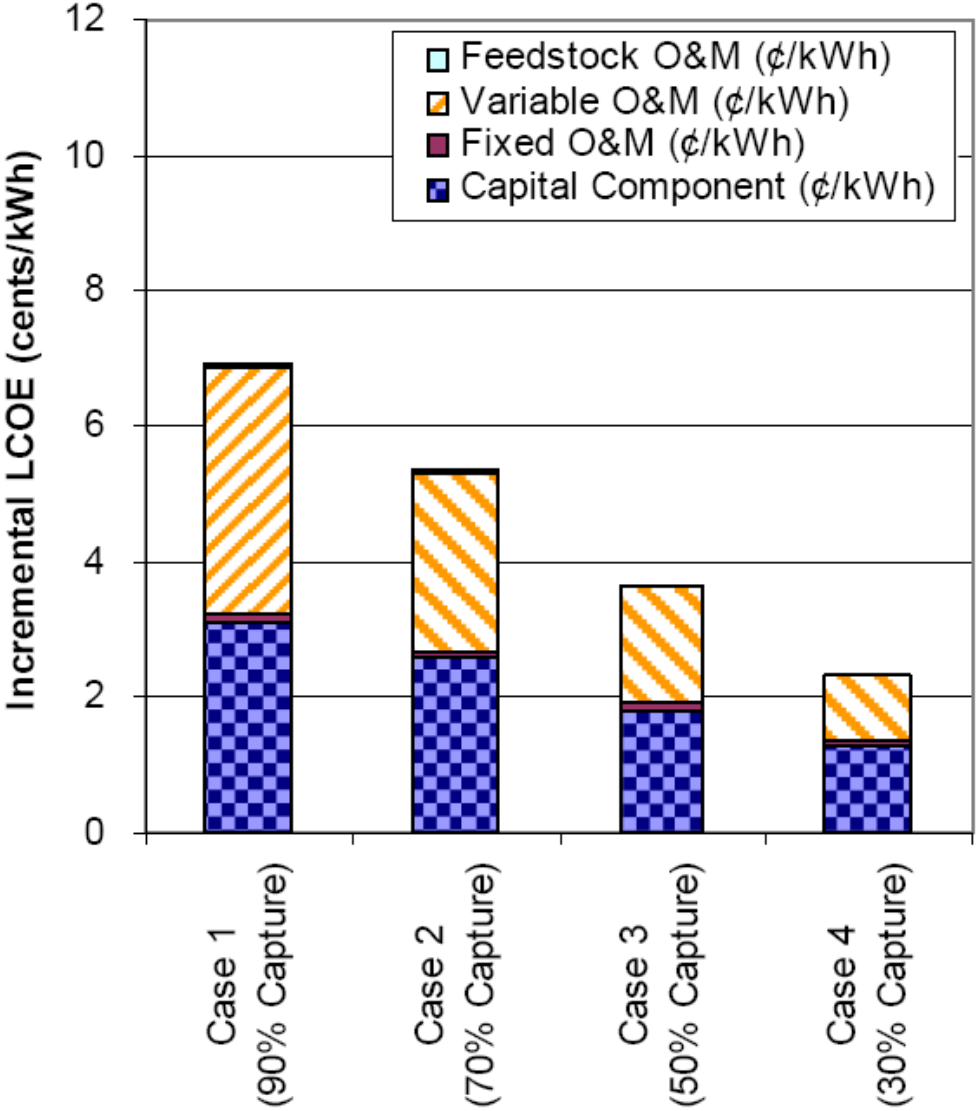
DOE/NETL-2007/1282, May 2007

How much water does your cell phone consume?

2.8 gallons a day if you charge it at home, 0 if you charge it with your car.

Retrofit Cost by Level of Capture

DOE/NETL-401/11/110907



Power Production Losses Associated with CO_2 Capture

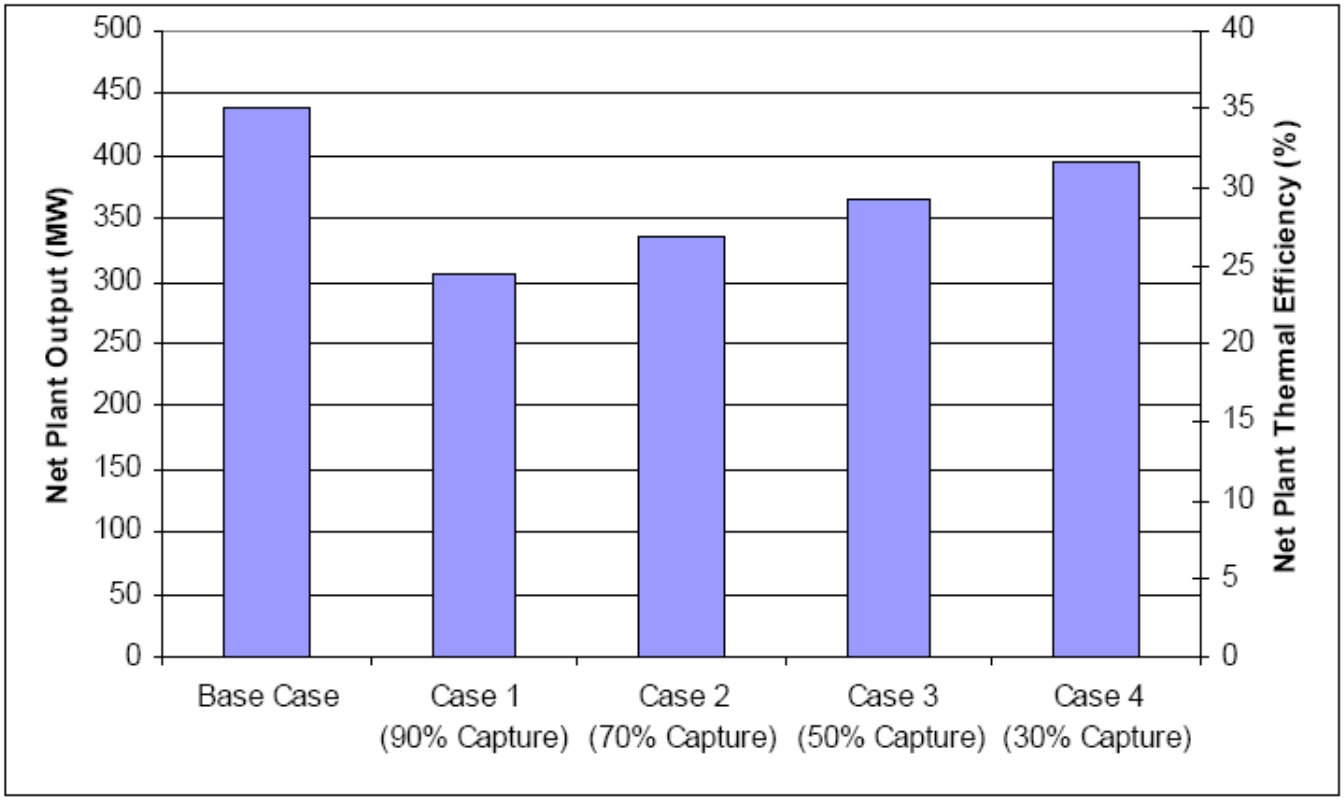
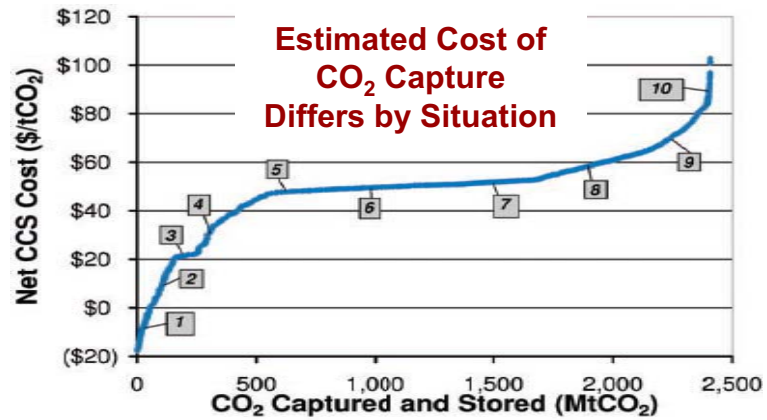


Figure ES-3: Plant Performance Impact of Retrofitting a Pulverized Coal-Fired Plant at Various Levels of Carbon Capture

DOE/NETL-401/11/110907

Best to Worse Scenarios



Range from -$10/ton to $90/ton

1) High purity ammonia plant / nearby (<10 miles) EOR opportunity
2) High purity natural gas processing facility / moderately distant (~50 miles) EOR opportunity
3) **Large, coal-fired power plant / nearby (<10 miles) ECBM opportunity $20/ton**
4) High purity hydrogen production facility / nearby (<25 miles) depleted gas field
5) **Large, coal-fired power plant / nearby (<25 miles) deep saline formation $45/ton**

Source: Global Energy Technology Strategy Program, Battelle & PNNL, May 2007

Best to Worse Scenarios (continued)

6) Coal-fired power plant / moderately distant (<50 miles) depleted gas field

7) Iron & steel plant / nearby (<10 miles) deep saline formation

8) Smaller coal-fired power plant / nearby (<25 miles) deep saline basalt formation

9) Cement plant / distant (>50 miles) deep saline formation

10) Gas-fired power plant / distant (>50 miles) deep saline formation

Source: Global Energy Technology Strategy Program, Battelle & PNNL, May 2007

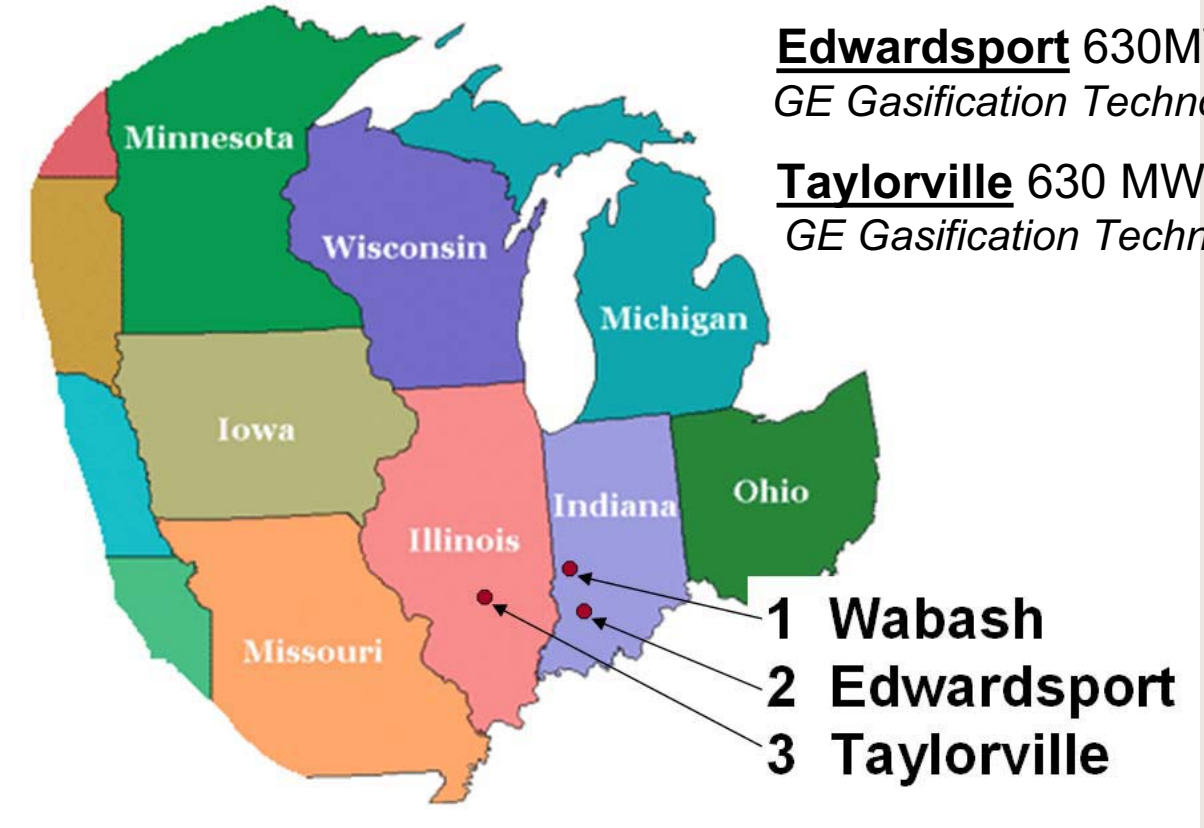
Midwest CO_2 Capture Potential

Midwest IGCC Power Plants

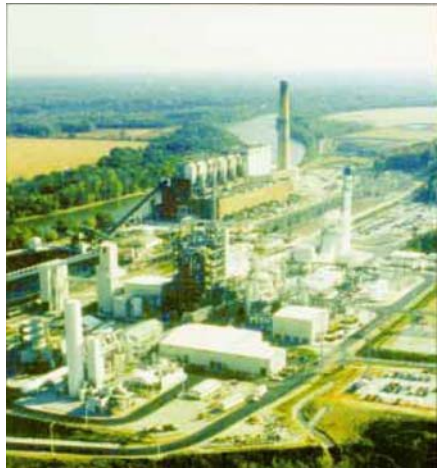
Wabash 262MW
ConocoPhillips E-Gas

Edwardsport 630MW
GE Gasification Technology

Taylorville 630 MW
GE Gasification Technology

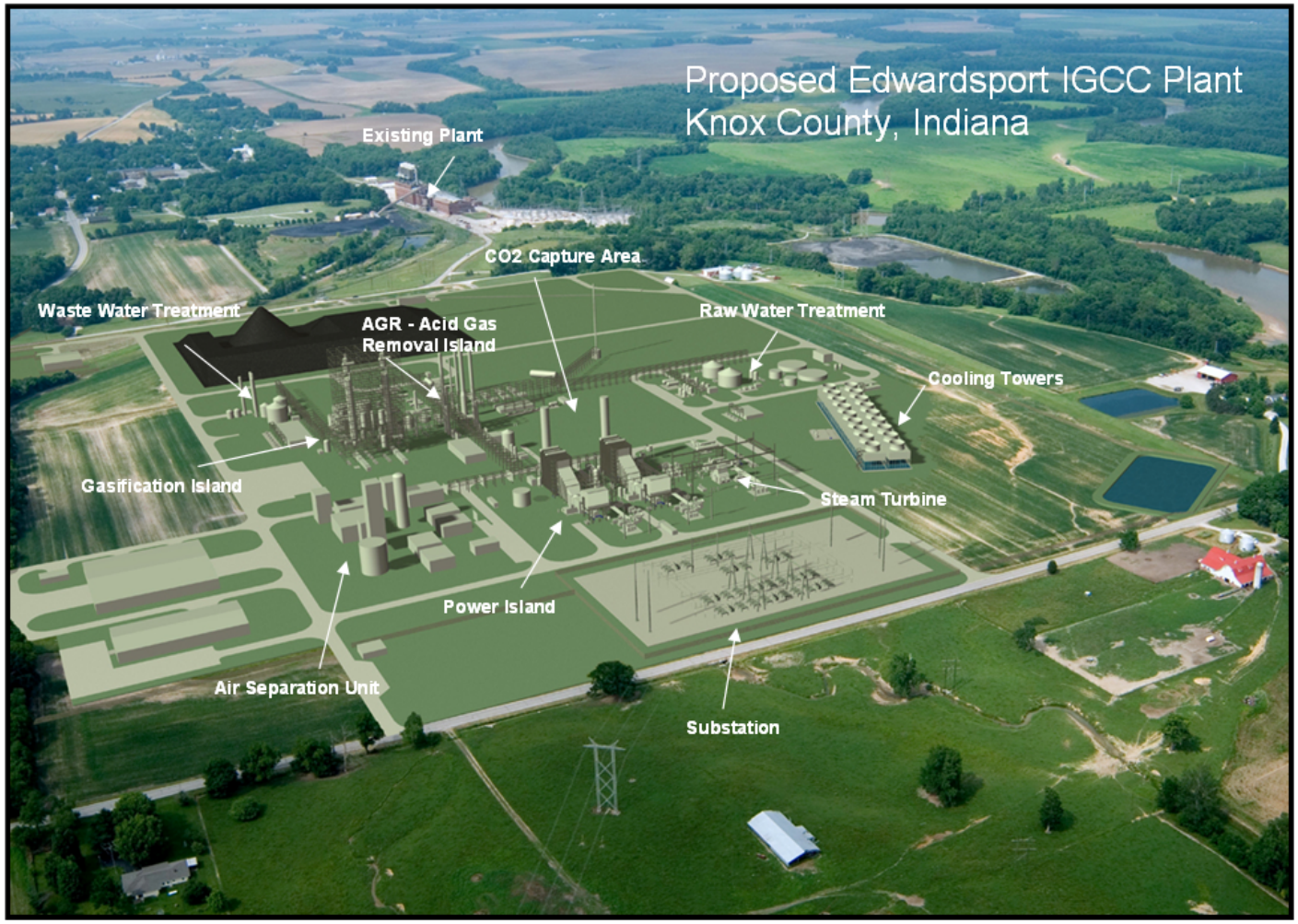


What Can Indiana Do NOW?
Wabash



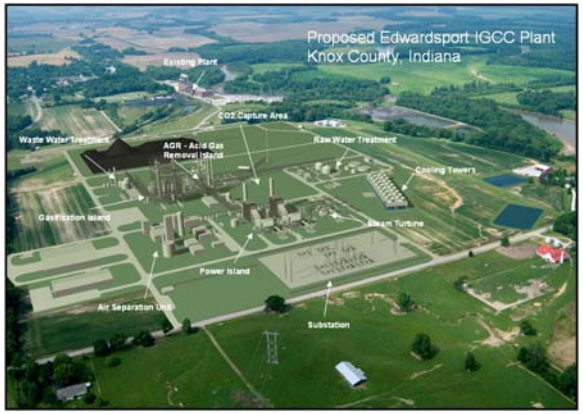
- **Started in 1994,** it was the most visited DOE research site outside of national labs for > 10 yrs.
- The **longest continuously operating coal and pet coke** gasifier in the US.
- Now it is a full gasification production site supplying syngas to Duke's Wabash River power station using pet coke as a fuel source.
- CCTR and Purdue University want to put 1 or 2 graduate engineering students at the Wabash site for the purpose of determining the training and education needs of future gasifier workers.
- **This facility is ready today to work on CO_2 capture, it is already built & functioning, & designed for research activity.**
- **The best short term site for CCS testing**.

Edwardsport



- The only **IGCC that has both air permits & regulatory** authority to be built.

Edwardsport



- Edwardsport has **a market in place** for its electrical production adding to the Duke Indiana capacity, a capacity that is sorely in need of new generation.
- The IURC ordered Duke to perform a **study of how to reduce CO_2 emissions by 20%.**
- The study of how to add a CO_2 system onto an existing IGCC is very important. Other future IGCC facilities will use Edwardsport as a model not only of how to build an IGCC, but also how to accommodate CO_2 capture.

SAIC & Crane

Science Applications International Corporation

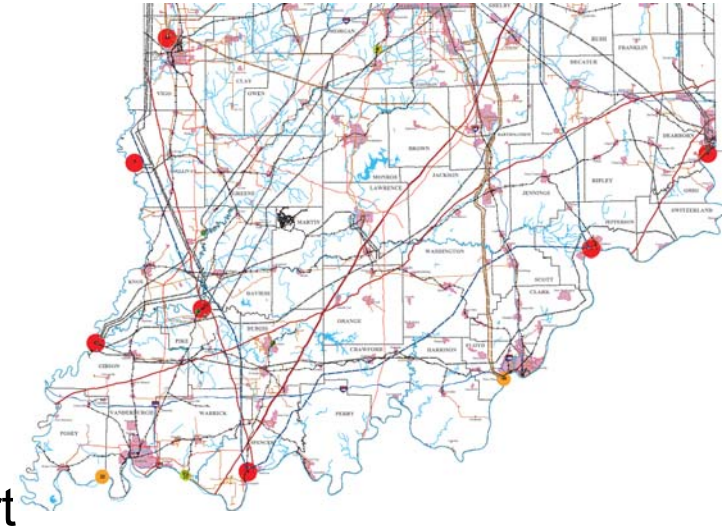
SAIC
From Science to Solutions

Type	Public (NYSE: SAI)
Founded	1969
Headquarters	La Jolla, California, USA
Key people	Ken Dahlberg (CEO) Dr. J. R. Beyster (Founder)
Industry	Defense contractor
Employees	44000
Website	www.saic.com

This CCTR sponsored project started as a proposal to put a **small scale IGCC inside Crane Military base** to make it energy self sufficient.

- **Early studies** indicates that this is **not practical**:
  - but a 25 MW system could supply Crane with its power needs,
  - maintain enough excess gas to supply a fertilizer plant or,
  - produce FT fuels for military use
  - if the facility is moved a few miles off base. (closer to a water source).
- The **key to the system** will be the capture of CO_2 for sale to industry. At this size facility CO_2 could be captured is technologically viable.
- This would prove to be **a very good test case** for how to scale up CO_2 technology.

Indiana Gasification & the CO_2 Pipeline



Indiana Gasification Inc.:

- This **large scale coal gasifier** will convert coal to usable natural gas for distribution through the existing gas pipeline system.
- The **location of this facility would also make it ideal** as a source of CO_2 for the proposed CO_2 pipeline that Indiana Illinois & Ohio have discussed.
- The gasification plant will be sized similar to that of an IGCC, but will have the flexibility of being able to move its gas production to where the market needs it.
- It also will be a perfect test case for large scale CO_2 technology development, In that the testing will not interfere with the gas production.