Workshop on

Gasification Technologies

June 8-9, 2004

Wabash River Coal Gasification Repowering Project Overview

Phil Amick, Technology Director - Gasification

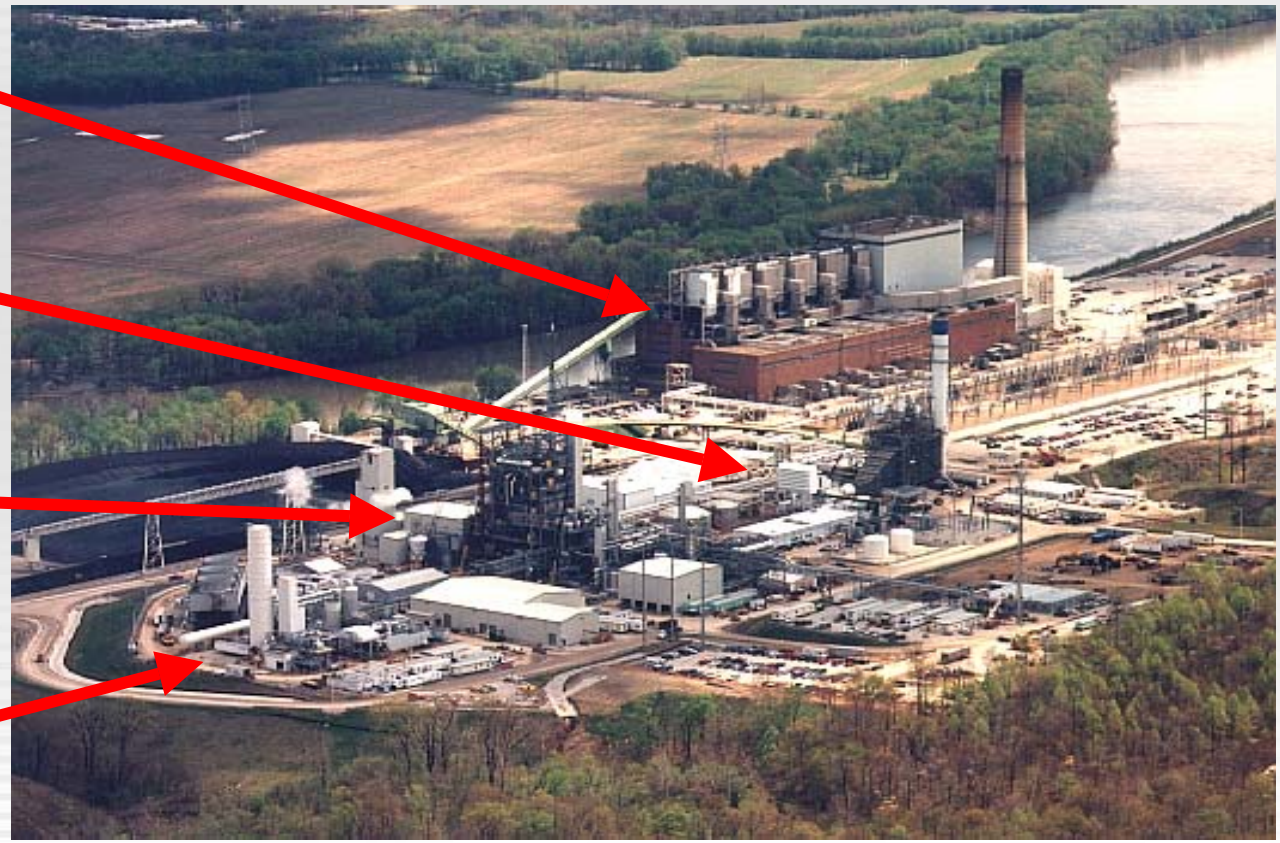
Wabash Facility Location

Steam Turbine

Combustion Turbine

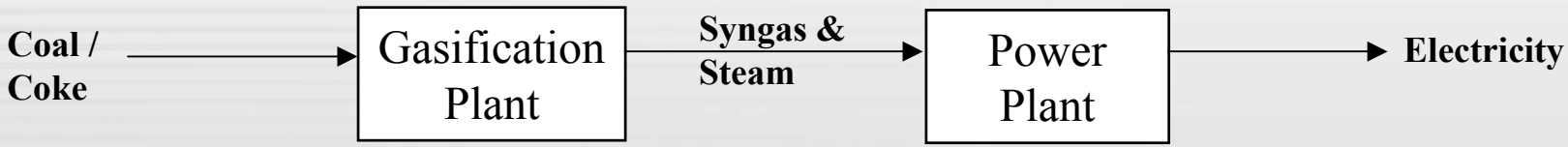
Gasification Plant

Oxygen Plant



ConocoPhillips

Wabash River Coal Gasification Repowering Project



1991 Ownership

DESTEC ENERGY

Public Service Indiana

2004 Ownership

GLOBAL ENERGY

CINERGY®

GASIFICATION TECHNOLOGY PROCESS HERITAGE

2003 ConocoPhillips

Global Energy acquired Dynegy's Gasification Assets in January 2000

GLOBAL ENERGY

DYNEGY

NGC changed its name to Dynegy in June 98

NGC

NGC Corporation Purchased Destec from Dow in June 1997

DESTEC ENERGY

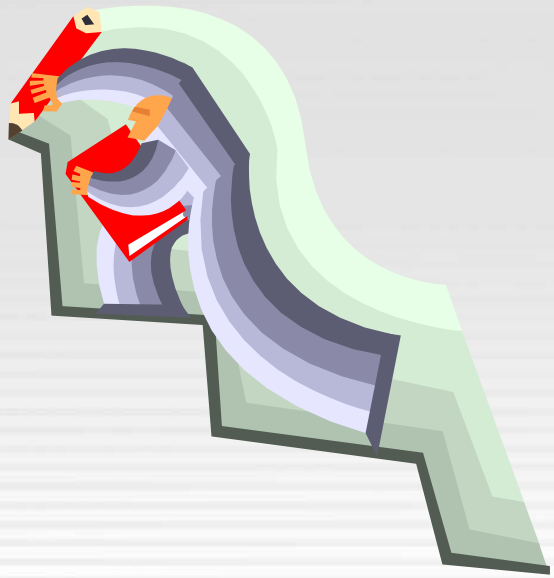
Spun off from Dow in 1989, built Wabash River

DOW

Developed Technology, Proto Plants & LGTI 1973 - 1989

ConocoPhillips

History Making Technology



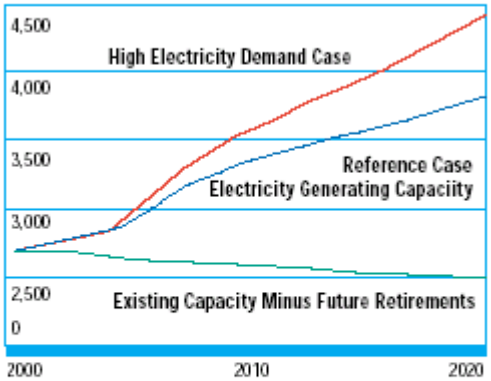
ConocoPhillips

Wabash River Energy Recognition

- Power Plant of the Year 1996 (Power Magazine)
- Power Plant Hall of Fame 2000 (Power Magazine)
- 1996 Certificate of Recognition for Energy Efficiency & Renewable Energy from the US DOE
- 1997 Certificate of Environmental Achievement from the National Awards Council for Environmental Sustainability
- 1998 Governor's Award for Excellence in Recycling
- Recognition in 2001 National Energy Policy
- Cover of DOE's Study on Environmental Aspects of Gasification
- Cleanest Coal/Coke Fired Power Plant in the World

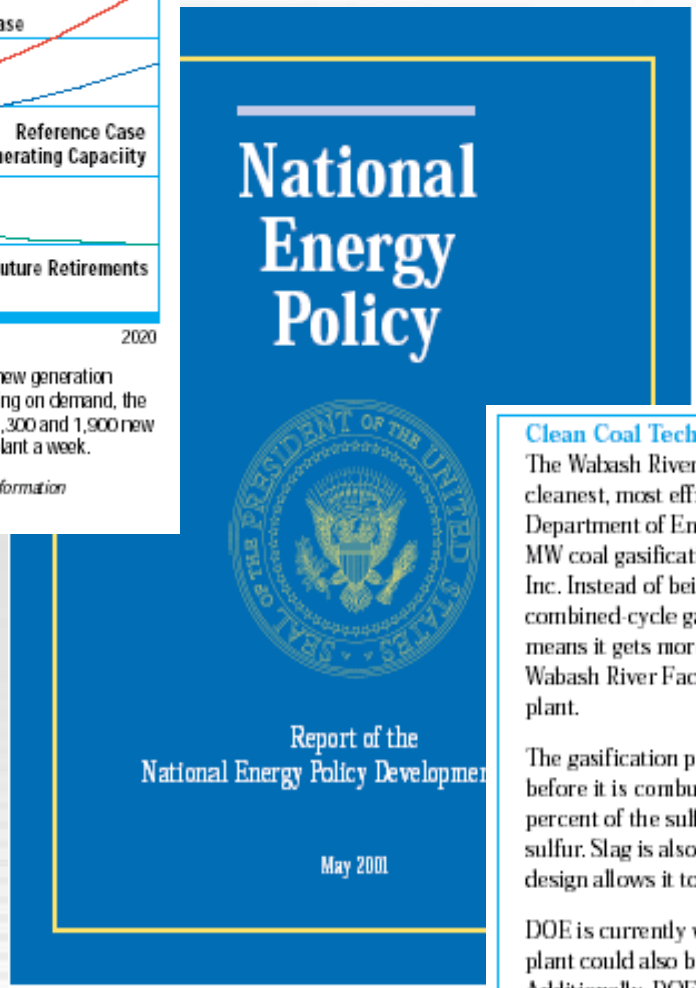
ConocoPhillips

Figure 1-2
The U.S. Needs More Power Plants



The nation is going to require significant new generation capacity in the next two decades. Depending on demand, the United States will need to build between 1,300 and 1,900 new power plants—or about one new power plant a week.

Source: U.S. Department of Energy, Energy Information Administration.



Clean Coal Technologies Up Close

The Wabash River Coal Gasification Project in Terre Haute, Indiana, is one of the cleanest, most efficient coal-burning facilities in the country. Partly funded by the Department of Energy (DOE) as part of its Clean Coal Technology Program, the 262-MW coal gasification facility is owned and operated by PSI Energy and Global Energy, Inc. Instead of being directly burned, the coal is gasified and then combusted in a combined-cycle gas turbine. This allows the coal to burn more efficiently—which means it gets more energy than a traditional plant out of the same amount of coal. The Wabash River Facility is over 20 percent more efficient than a typical coal-fired power plant.

The gasification process also allows many of the impurities in the coal to be removed before it is combusted to generate electricity. At the Wabash River project, over 99 percent of the sulfur is removed from the coal and marketed to industrial users of sulfur. Slag is also removed and is marketed to the construction industry. The plant's design allows it to burn other fuels, such as petroleum coke.

DOE is currently working with Global Energy and other industry partners to see if the plant could also be used to co-produce chemical feedstocks and transportation fuels. Additionally, DOE and its partners are studying lessons learned from the project to design a less expensive, more efficient coal gasification facility that would be ready for commercial deployment by 2005.

ConocoPhillips

WABASH RIVER REPOWERING

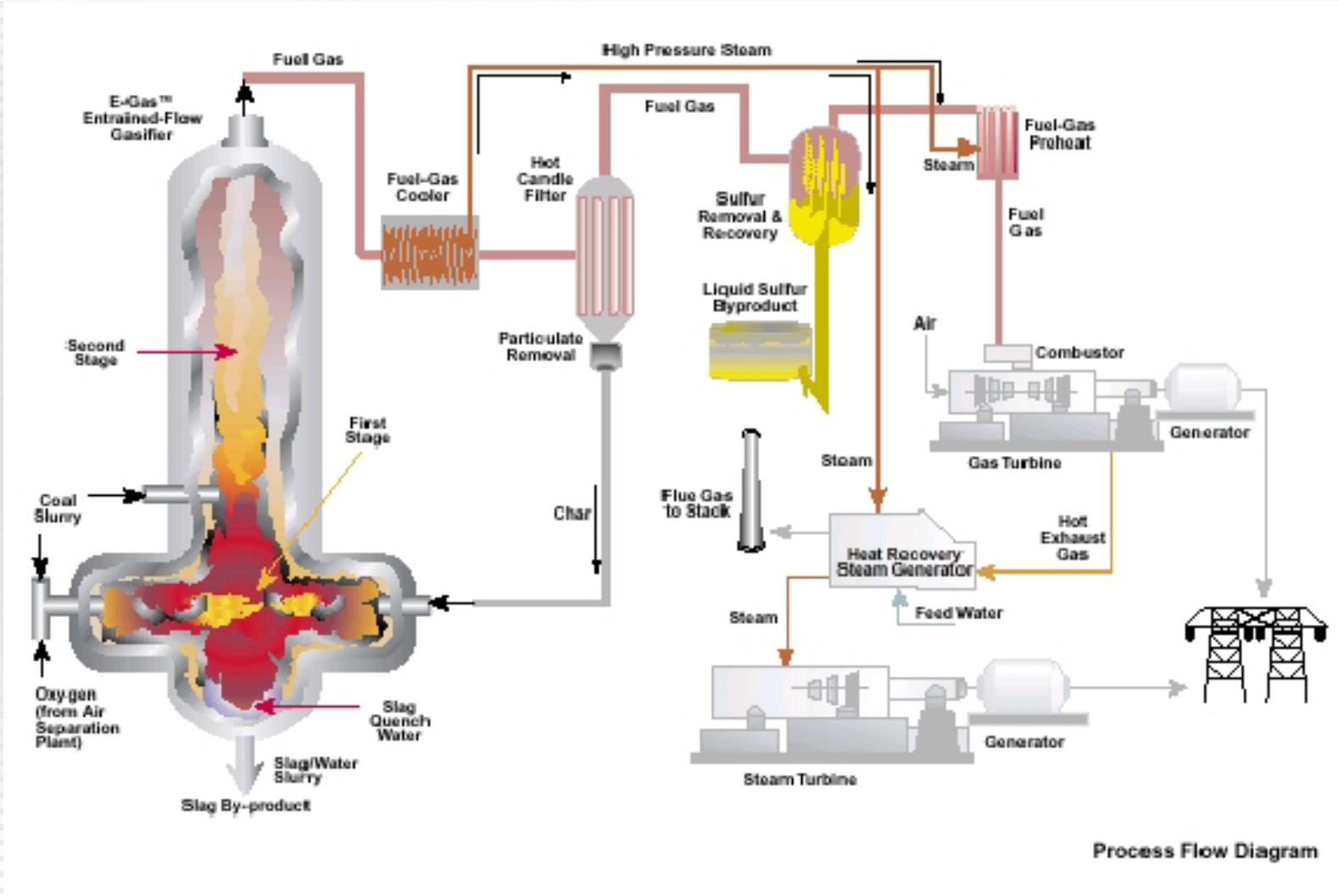
ConocoPhillips

Wabash River Project Overview

- Coal Gasification Combined Cycle Repowering
- 262 MWe Net Output by repowering 100 MW 1953 PC Unit
- Operational since 1995
- Bituminous Coal and Petcoke, up to 7 % S
- Heat Rate Improved by 20% (~ 8900 Btu/kWh HHV)

- Cleanest Coal/Coke Fired Power Plant in the World
- Highest demonstrated petcoke throughput of any gasifier

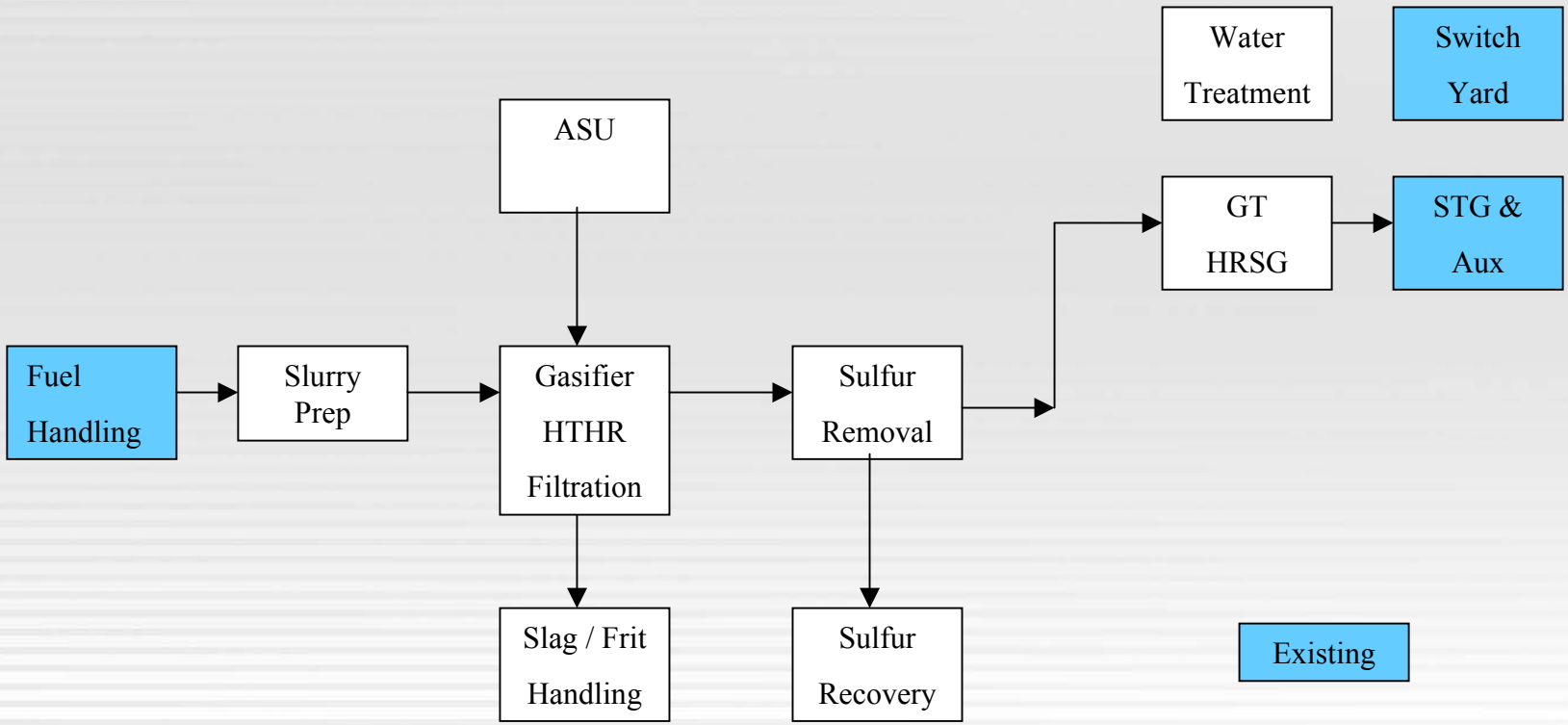
ConocoPhillips



Process Flow Diagram

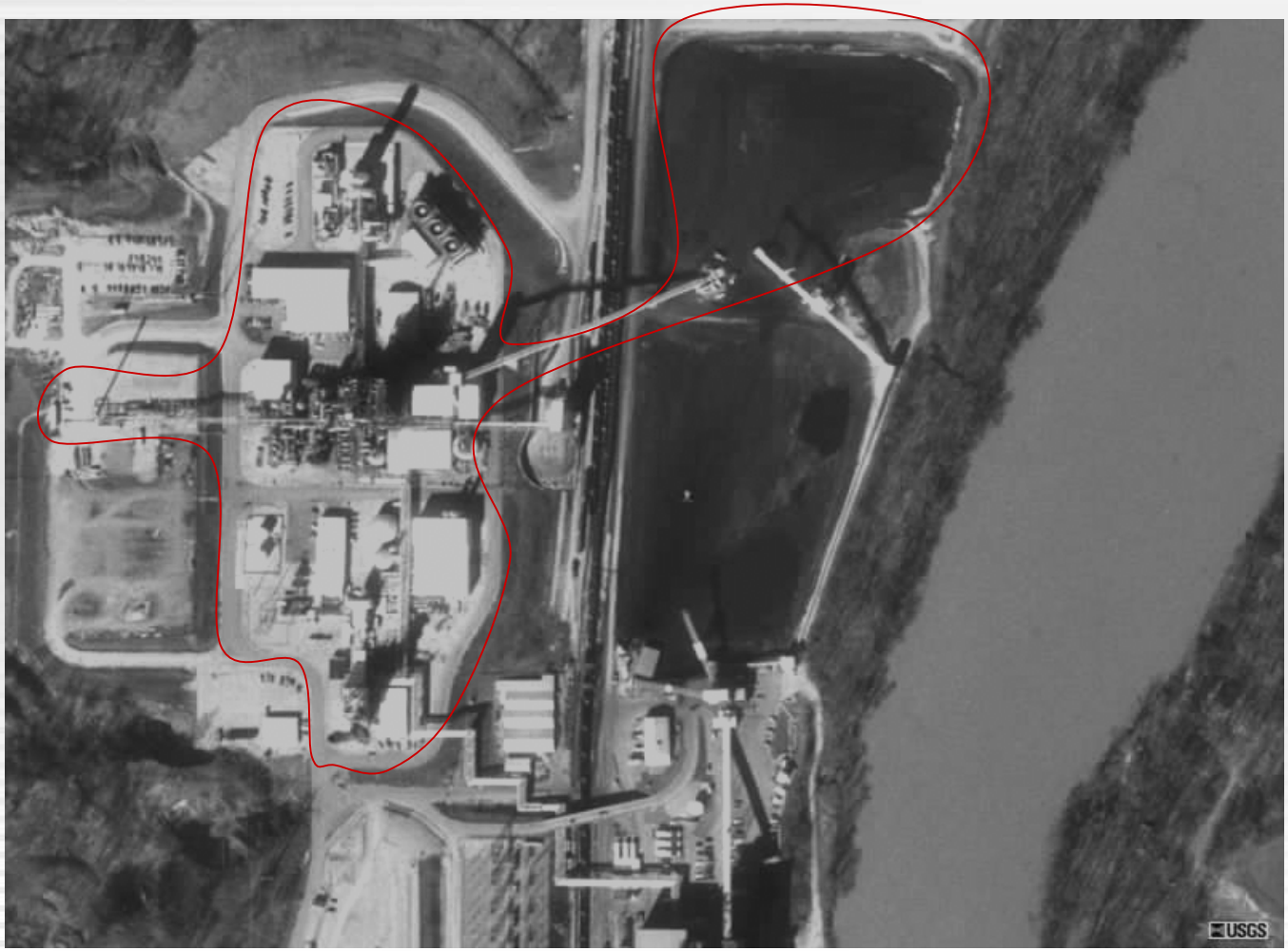
ConocoPhillips

WABASH REPOWERING



ConocoPhillips

WABASH RIVER IGCC PLOT ~ 20 ACRES



ConocoPhillips

ADVANTAGES OF REPOWERING

INFRASTRUCTURE

- Transmission
- Coal Delivery & Handling
- Steam Turbine & Auxiliaries
- Roads, Security

PERMITTING

- River Water Cooling
- Reduced SOx, NOx, Particulates

SLIGHT CAPITAL COST REDUCTION ~ 8%

SAVED A YEAR OF DEVELOPMENT

ConocoPhillips

ADVANTAGES OF REPOWERING

BUT FOR THE COMMUNITY

MORE JOBS

REDUCED EMISSIONS

STABLE ELECTRICITY COSTS

MAINTAIN TAX BASE

ConocoPhillips

ENVIRONMENTALLY SUPERIOR

ConocoPhillips

Wabash Air Emissions

- No Significant Particulate Emissions

  Dissolved solids in cooling tower drift is the most significant particulate emission in gasification.

- SOx

  97% - 98+% Sulfur Removal

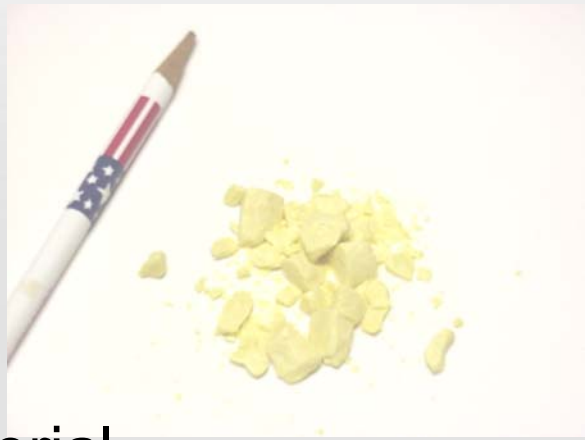
- NOx

  25 ppm in 1993 permit

ConocoPhillips

Solid Byproducts – not Wastes

- Sulfur - 99.99% pure
  100,000+ tons sold at Wabash



- Slag - Black, glassy sand like material
  Inert, passes TCLP & UTS
  Asphalt
  Construction backfill
  Landfill cover

ConocoPhillips

Wastewater Emissions

Gasification Island Wastewater

- Mostly recycled back into slurry water
- About 150 gpm per train cycle blowdown
- Zero Liquid Discharge from Gasification Island at Wabash

ConocoPhillips

WABASH EMISSIONS COMPARISON

Emissions, lb/MWh	SO2	NO x	CO	PM-10	VOC
Unit 1 before Repowering	38.2	9.3	0.64	0.85	0.03
IGCC (1999 annual average)	1.075	0. 75	0.555	0.09	0.09
Emissions Reduction TPY	**5505**	**1179**	**(83)**	**101**	**(25)**

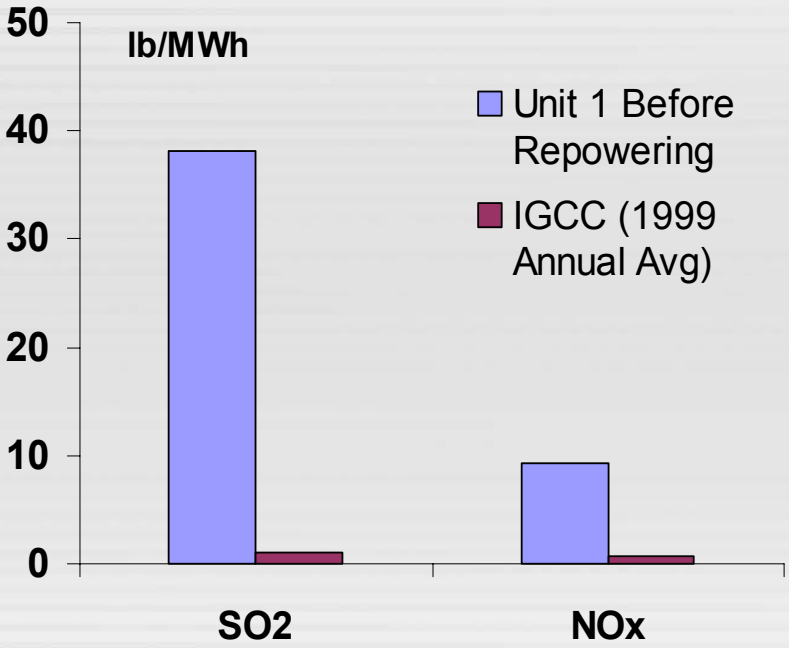
Comparing 100 MW PC unit running 35% availability and

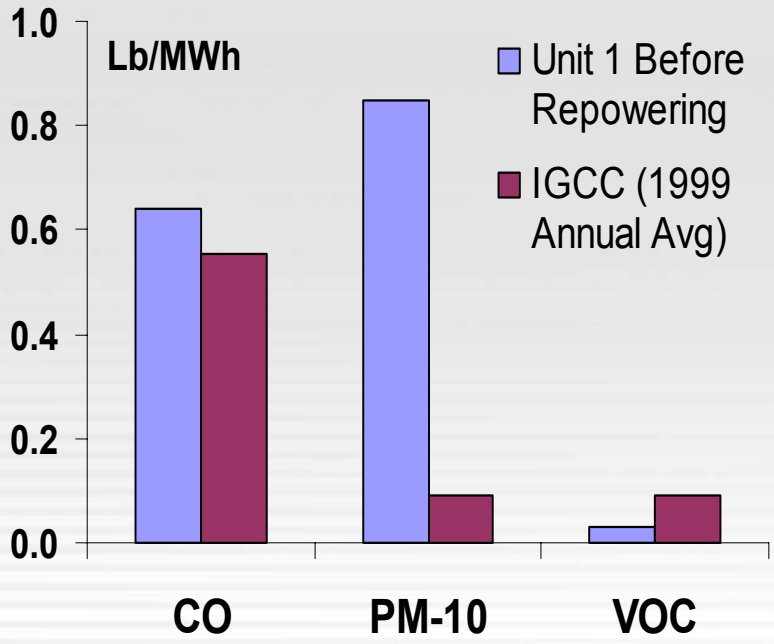
262 MW IGCC running 75% availability

(5.6 X more megawatt hours produced)

ConocoPhillips

REPOWERING EMISSIONS COMPARISON





ConocoPhillips

Cleanest Coal Fired Power Plant in the World

(How can he say that?)

ConocoPhillips

COAL FIRED POWER PLANT EMISSIONS

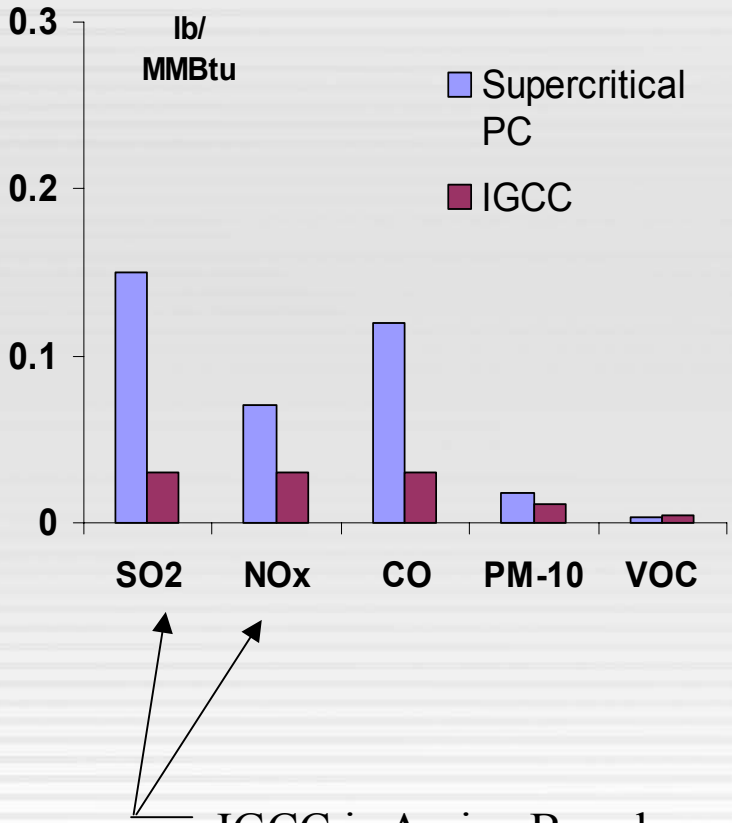
Lb/MMBtu	SCPC WePower[7]	PC Prairie State[5]	CFB Indeck[6]	IGCC WePower[1]	IGCC Wabash[2]
SO2	0.15	0.18	0.15	0.03	0.13[3]
NOx	0.07	0.08	0.08	0.03	0.103
VOC	0.004	0.004	0.004	0.004	0.002
CO	0.12	0.12	0.11	0.03	0.045
PM/PM10	0.018	0.015 w/o cwt	0.015	0.011	0.011 w/ cwt
Hg (lb/10^{12} Btu)	1.12	~ 2 estim	4.0	0.5	3.2[4]

1. WePower SCPC and IGCC information from April 2003 Draft Environmental Impact Statement, Elm Road Generating Station, Volume 1, Public Service Commission of Wisconsin & Department of Natural Resources, Table 7-11, p. 157 (Pittsburgh 8 coal)
2. Wabash River Repowering Project, 1997 and 1998 average reported to IDNR, including fuel oil (Illinois 6 coal)
3. Wabash River has demonstrated 0.03 lb/MMBtu SOx, but operates nearer the 0.20 lb/MMBtu permit for economic reasons
4. Electric Utility Steam Generating Unit Mercury Test Program, USEPA, October 1999 (no controls)
5. "Project Summary for a Construction Permit Application from the Prairie State Generating Company, LLC", Illinois Environmental Protection Agency. BOILER STACK ONLY
6. "Supplemental Information for Air Permit Application", March 25, 2003, Earthtech Inc.
7. "Analysis and Preliminary Determination for the construction and Operation Permits for the proposed Construction of an Electric Generation Facility for Elm Road Generating Station", October 2, 2003, Wisconsin Department of Natural Resources

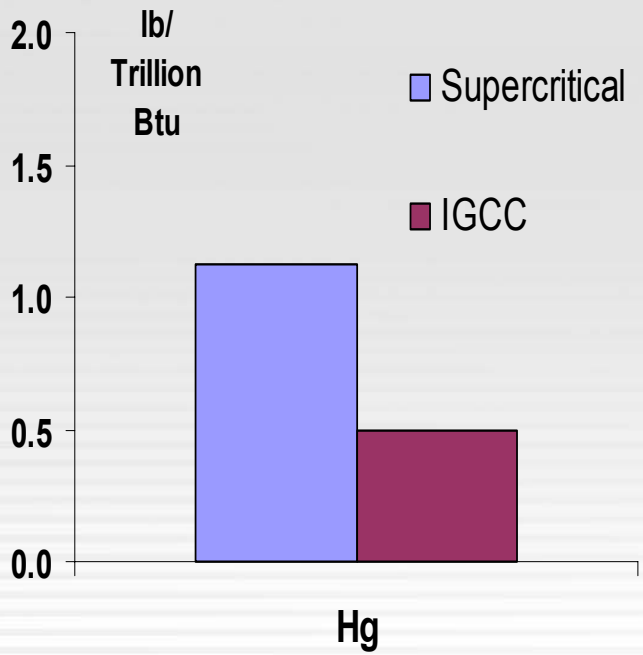
ConocoPhillips

GREENFIELD EMISSIONS COMPARISON

Based on Wisconsin DNR Air Permit



IGCC is Amine Based



ConocoPhillips

COAL FIRED POWER PLANT EMISSIONS

Tons per Year	SCPC WePower[1]	IGCC WePower[1]
SO2	4331	1117
NOx	1905	698
VOC	189	79
CO	3248	564
PM/PM10	487	199
Hg (lb/10^{12} Btu)	0.12	0.03
TOTAL, TPY (615 MW Basis)	10,160	3,173

1. WePower SCPC and IGCC information from April 2003 Draft Environmental Impact Statement, Elm Road Generating Station, Volume 1, Public Service Commission of Wisconsin & Department of Natural Resources, Table 7-11, p. 155 (Pittsburgh 8 coal)

ConocoPhillips

COAL FIRED POWER PLANT

SOLIDS GENERATION

Tons per year	SCPC WePower[1]	IGCC WePower[2]
Flyash	82,600	
Bottom Ash	19,300	
Synthetic Gypsum	124,400	
Slag		100,000
TOTAL, TPY (615 MW Basis)	226,300	119,400

1. WePower SCPC and IGCC information from April 2003 Draft Environmental Impact Statement, Elm Road Generating Station, Volume 1, Public Service Commission of Wisconsin & Department of Natural Resources, Table 7-11, p. 114 (615 MW plant)
2. WePower SCPC and IGCC information from April 2003 Draft Environmental Impact Statement, Elm Road Generating Station, Volume 1, Public Service Commission of Wisconsin & Department of Natural Resources, Table 7-11, p. 126 (515 MW plant)…sulfur not listed in this table

ConocoPhillips

SO WHY DID WISCONSIN PSC PICK SCPC?

	SCPC[1]	IGCC[2]	IGCC[3]
Capital Cost $/kW EPC	1385	1770	1312[3]
Heat Rate HHV	8816	9200	8500[3]

1. WePower SCPC and IGCC information from April 2003 Draft Environmental Impact Statement, Elm Road Generating Station, Volume 1, Public Service Commission of Wisconsin & Department of Natural Resources, p. xx and p. 122
2. ibid, p. xx and p. 107
3. "Comparative IGCC Cost and Performance for Domestic Coals", Dr. D. Breton and P. Amick, Gasification Technologies Conference 2002

ConocoPhillips

Wabash River

Still the Cleanest Coal Fired Power Plant in the World

ConocoPhillips