

# **Sixth Annual Conference on Carbon Capture & Sequestration**

---

*Technical Session: Coal to Liquid with Sequestration*

## **Technical, Cost, and Financial Impacts for Carbon Separation and Compression on Large-Scale Coal to Liquids Plants**

Michael E. Reed (NETL) and Scott Olson (Nexant)

May 7-10, 2007 • Sheraton Station Square • Pittsburgh, Pennsylvania

---

# Outline

- 50,000 bbl/day CTL Facility without Carbon Compression
  - Technical Description
  - Capital Cost Estimate
  - Financial Performance
- Adding Compression of CO<sub>2</sub>
- Q&A

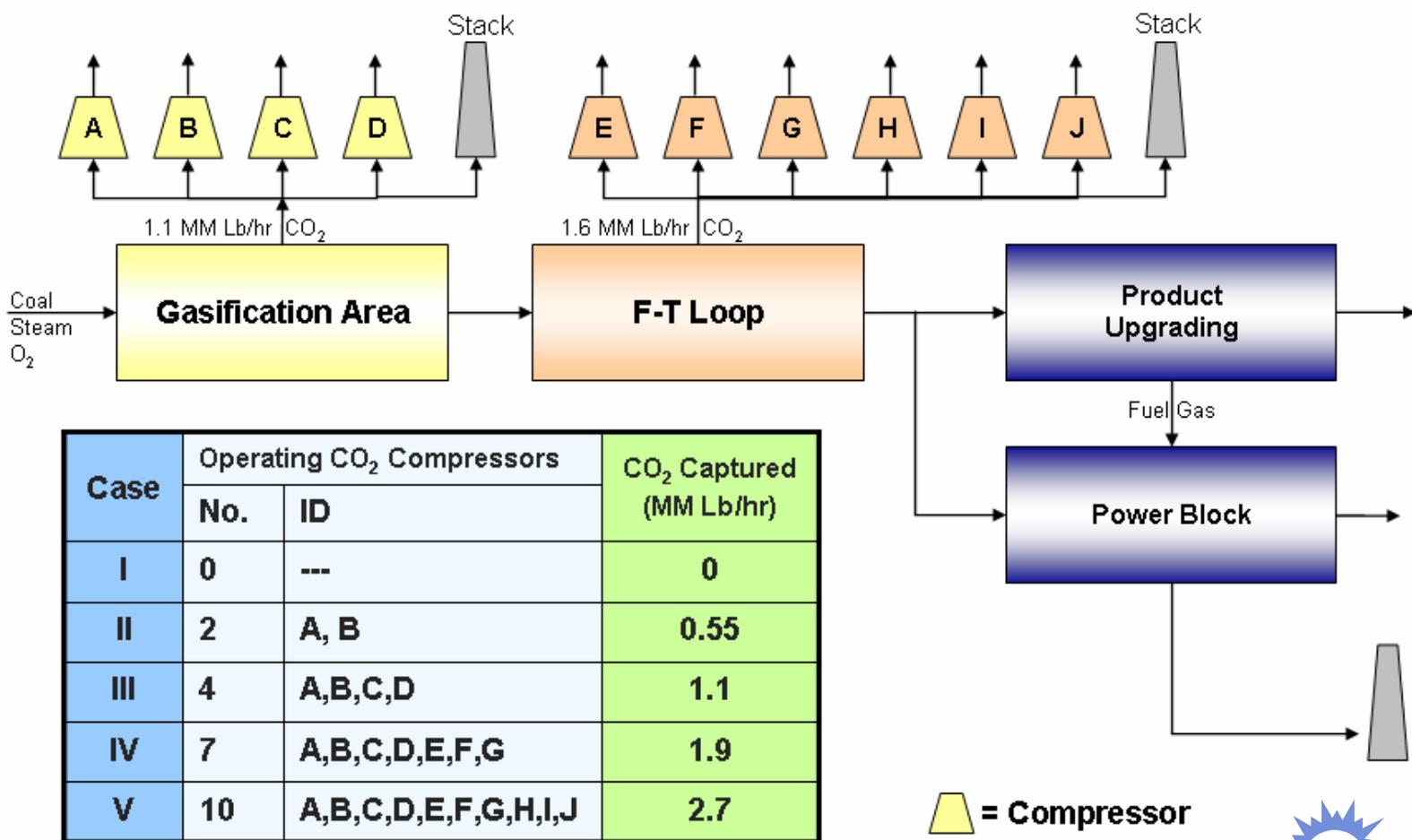


# Base Plant Description

- Illinois #6 coal
- ConocoPhillips E-Gas™ gasification
- 2-stage Selexol™ acid gas clean-up
- Recycle to Maximize Liquids Production
- 3-phase F-T reactor with Iron catalyst
- Minimal upgrading to product “syncrude” product
- Combined cycle power production to produce parasitic power with minimum excess



# Block Diagram of Cases



## Base Plant Capital Cost

<b>Plant Section</b>	<b>Cost (\$ million)</b>
Coal and Slurry Preparation	295
Gasifier and Gas Clean-up	1,989
F-T Process	653
Power Block	174
Balance of Plant	422
<b>Total Plant Cost (TPC)</b>	<b>3,534</b>

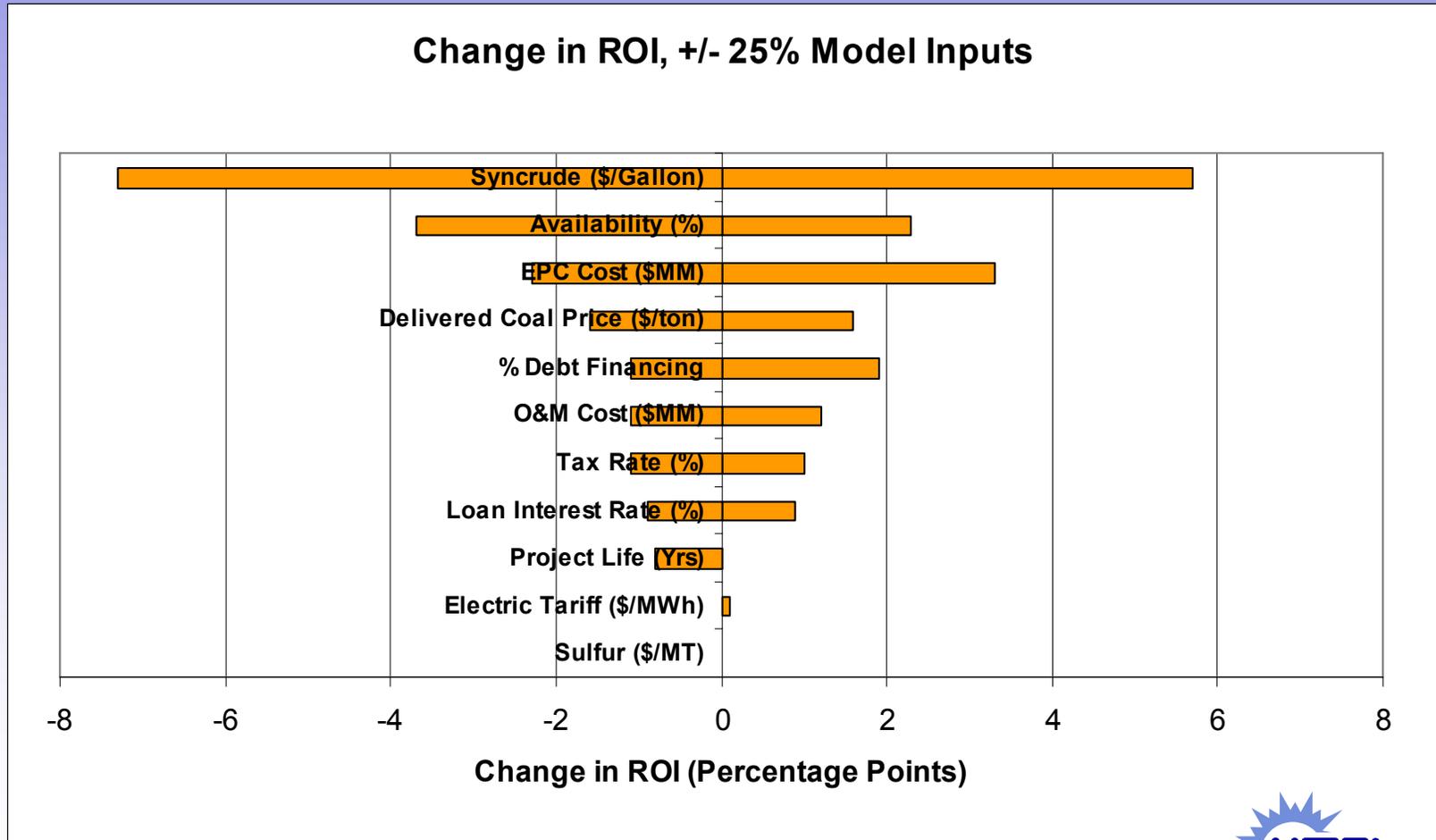


# Base Plant Financial Performance

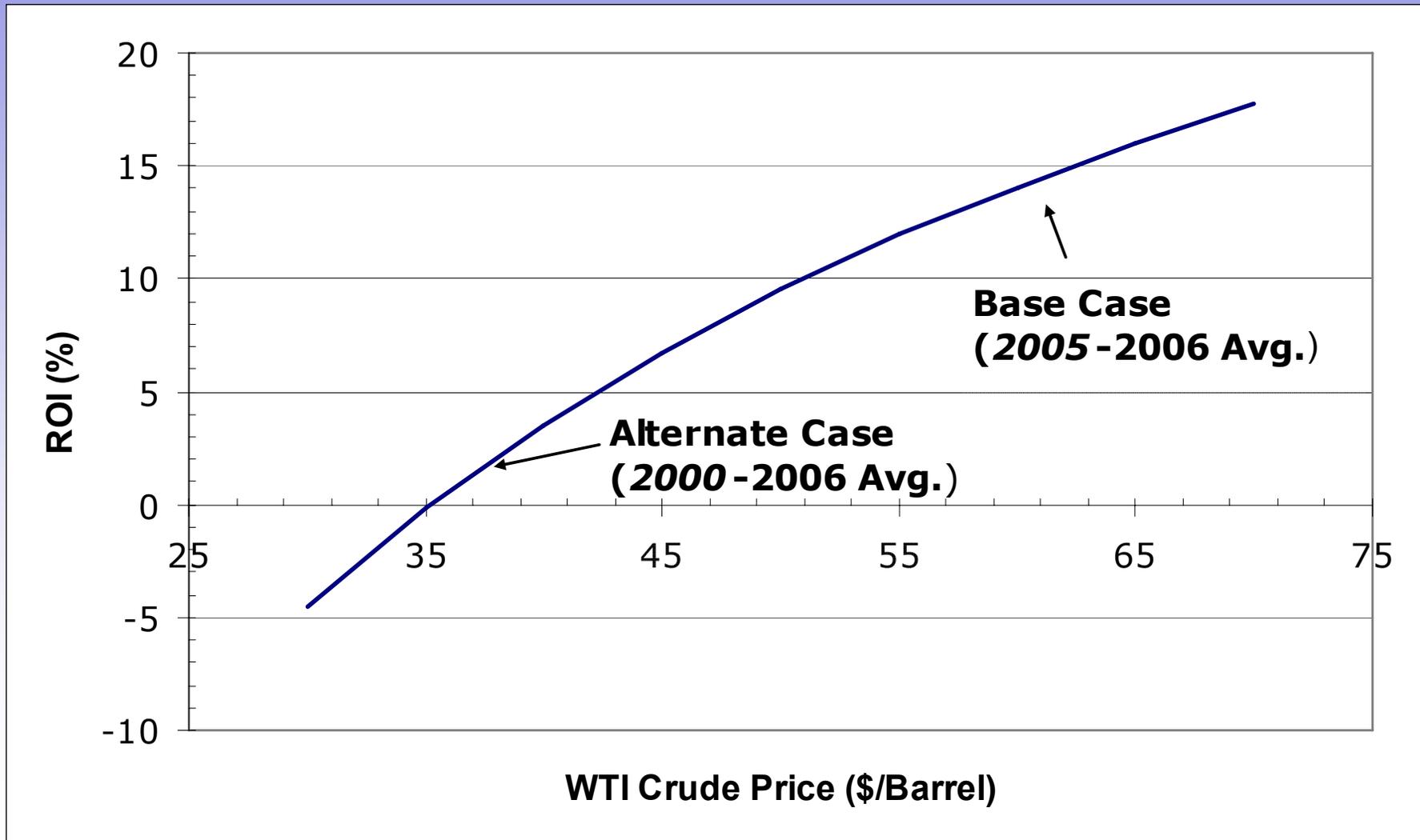
<i>Major Inputs</i>	
EPC Cost (\$MM)	2,722
Syncrude Production (BPD)	49,433
Coal Feed Rate (TPD)	24,533
<i>Major Results</i>	
ROI (%)	14.4
NPV (\$MM, 12%)	438
Payback Period (Yrs)	8
Crude Oil Price for 12% ROI (\$/Bbl)	55



# Base Plant Sensitivity Analysis



# Sensitivity to World Oil Price

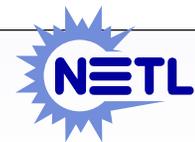
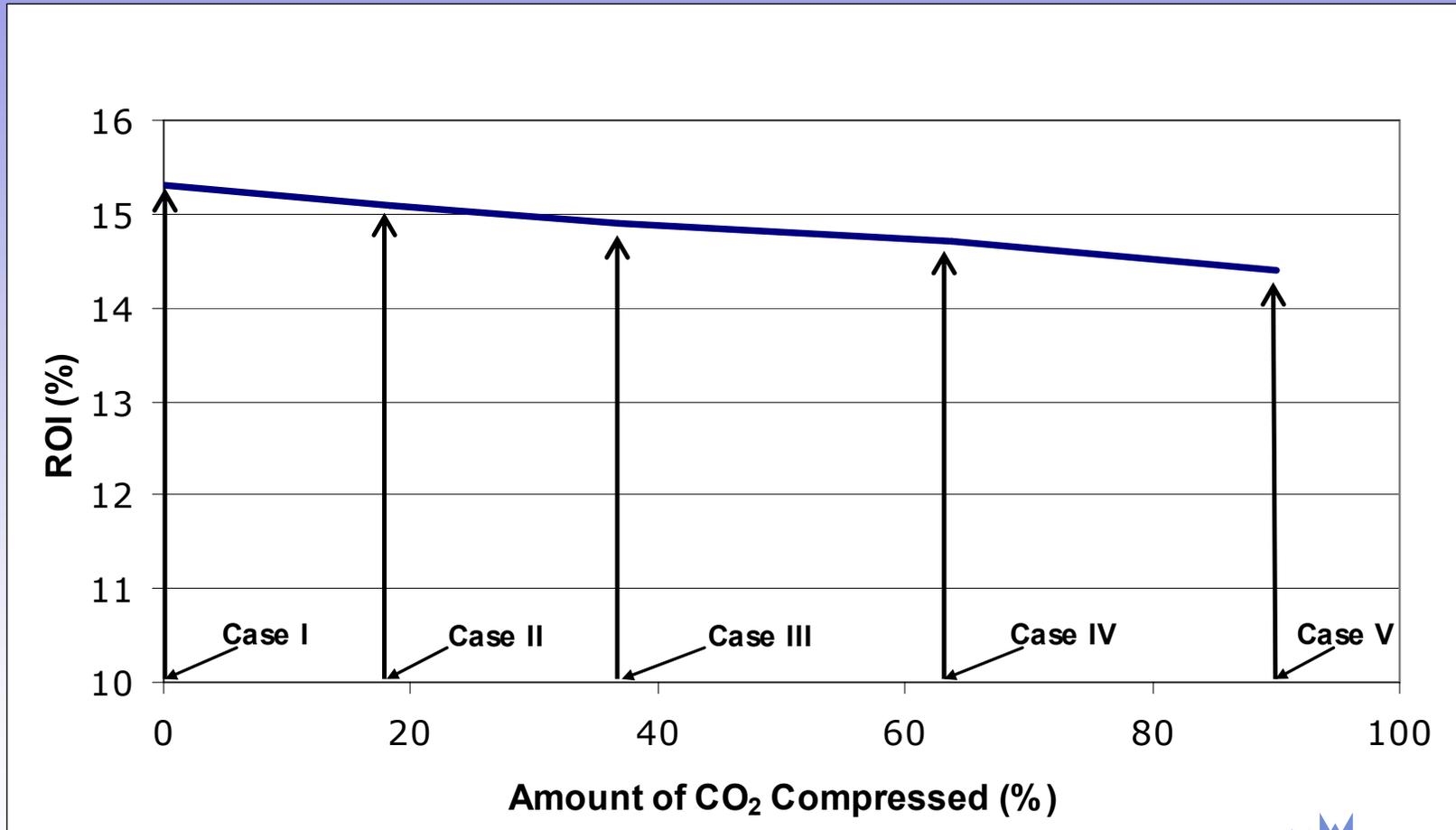


# CO<sub>2</sub> Compression – Capital Cost

Case	CO <sub>2</sub> Compressed		No. of Compressors	Increase in Capital Cost from Case I (\$ million)
	Lb/hr	STPD		
I	0	0	0	\$0
II	551,195	6,614	2	\$13.5
III	1,102,390	13,229	4	\$27.0
IV	1,901,458	22,817	7	\$47.2
V	2,700,525	32,406	10	\$67.4



# CO<sub>2</sub> Compression – Financial Performance



# Conclusions

- CTL is a “minimum hassle” build decision with respect to carbon regulation
- Capital equipment additions include drying and compression
- Incremental Capital Cost is roughly 2% of TPC
- Incremental change is ROI is less than 1%
- CTL economics are most sensitive to 1) world oil price, 2) availability of plant, and 3) capital cost of base plant



## Acknowledgements

- The authors would like to acknowledge the work of the following members of Research & Development Solutions, LLC who made significant contributions to this paper:
  - Lawrence Van Bibber
  - Erik Shuster
  - John Haslbeck
  - Michael Rutkowski
  - Sheldon Kramer

# Questions and Answers

