

# I PRO 302

## *Techno-Business Impacts of Sulfur Capture Technology in Coal-Based Power Plants*

# Background

- Coal will continue to be an important energy source
- Possible new regulations may require reducing the CO<sub>2</sub> output of power plants.
- A new process, called coal gasification, can be used to capture carbon emissions.



# Background

- Sargent and Lundy is analyzing the costs of gasification process as compared to the conventional process.
- Sulfur has to be removed from coal during the power generation process.
- Pulverized Coal → Gypsum
- Gasification → Elemental Sulfur

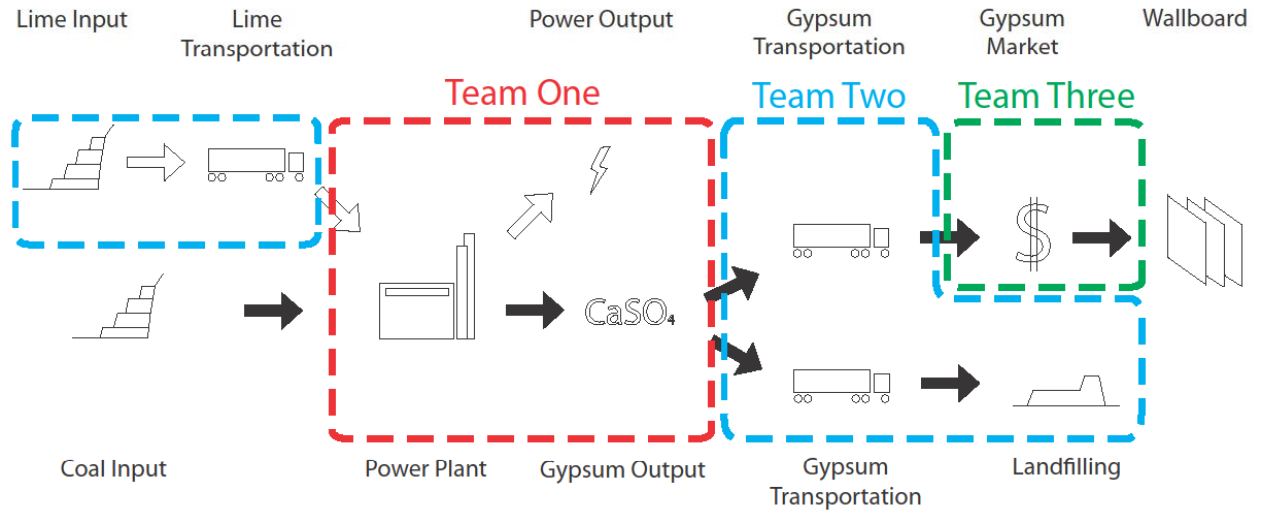
## Purpose

- *To compare the economic and environmental costs associated with sulfur removal from two pulverized coal and gasification power plants of equal capacity. This includes the costs of inputs, transportation and disposal as well as the revenue from the market*

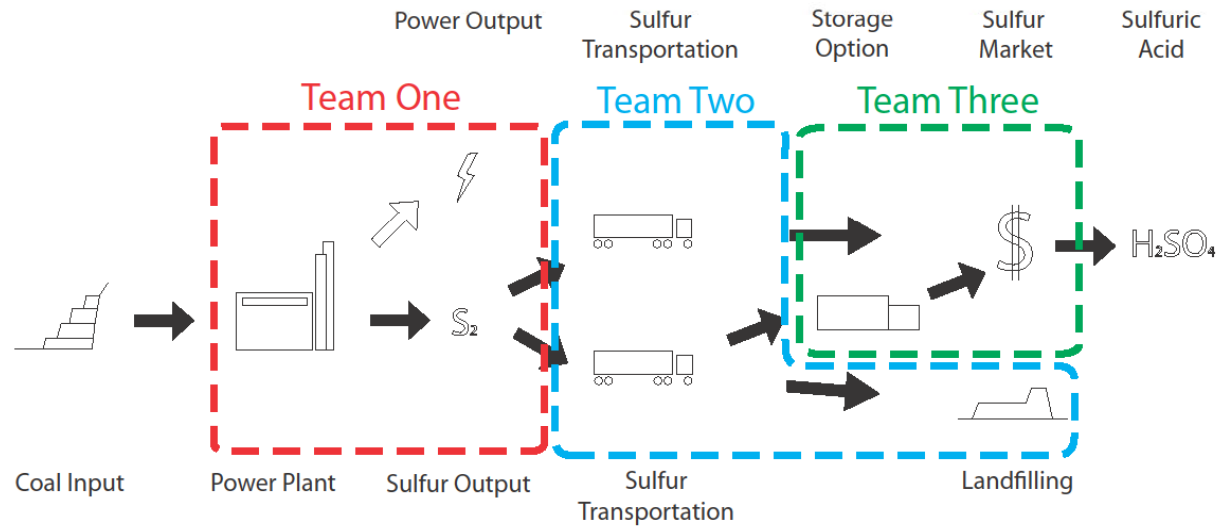
## Constraints

- 600 MW Power plant
- Located in Texas
- Texas Lignite Coal to be used
- Capacity factor is 85%

# Pulverized Coal



# Gasification



# Team Organization

Ryan Murphy *			
	Analysis		
	<i>Mass Input</i>	<i>Transportation</i>	<i>Market</i>
<b>Deliverables</b>			
<i>Poster</i>	Bryce *	Abraham	Mike M.
<i>Brochure</i>		Justin	Gregory
<i>Report</i>	Ryan K.	Terrika *	
	Mike H.		
<i>Presentation</i>	Hector	Oluwaseun	Brian *

# Challenges

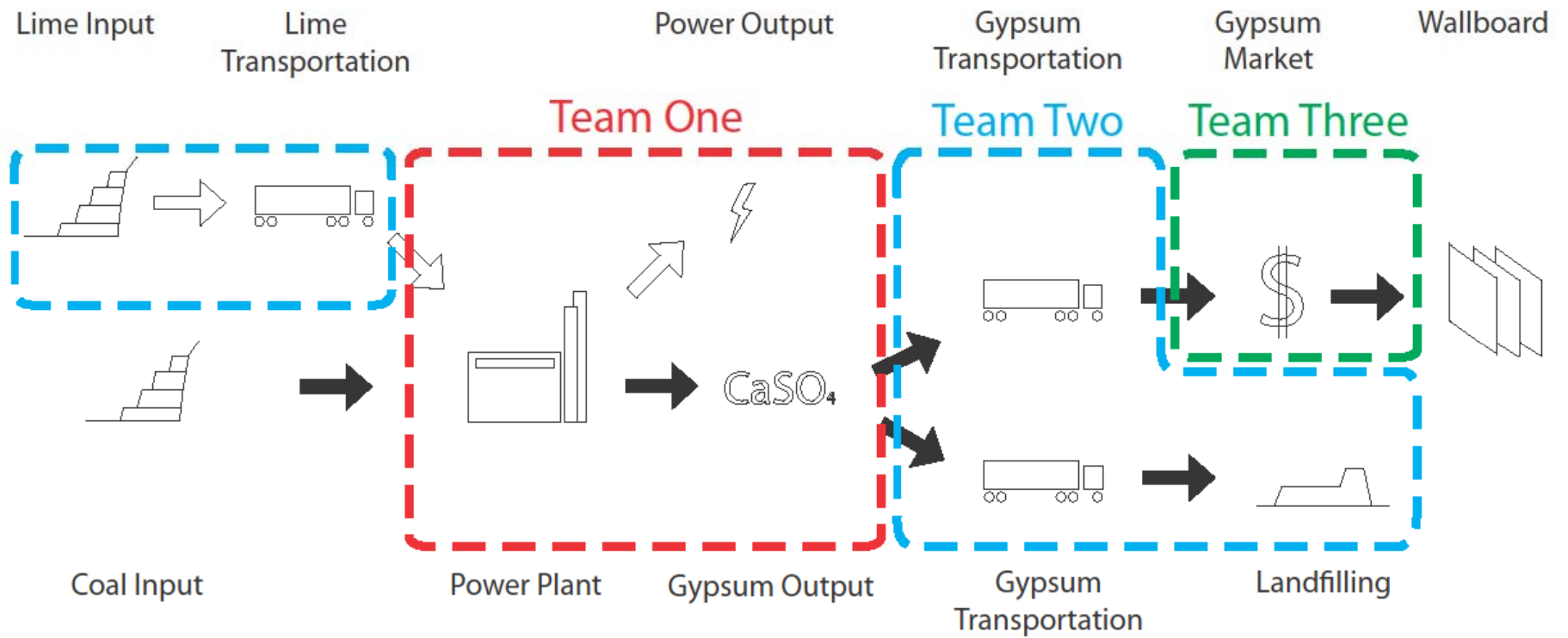
## Information

- Limiting the scope of our analysis
- Determining our actual purpose
- Team organization and structure

## Ethical

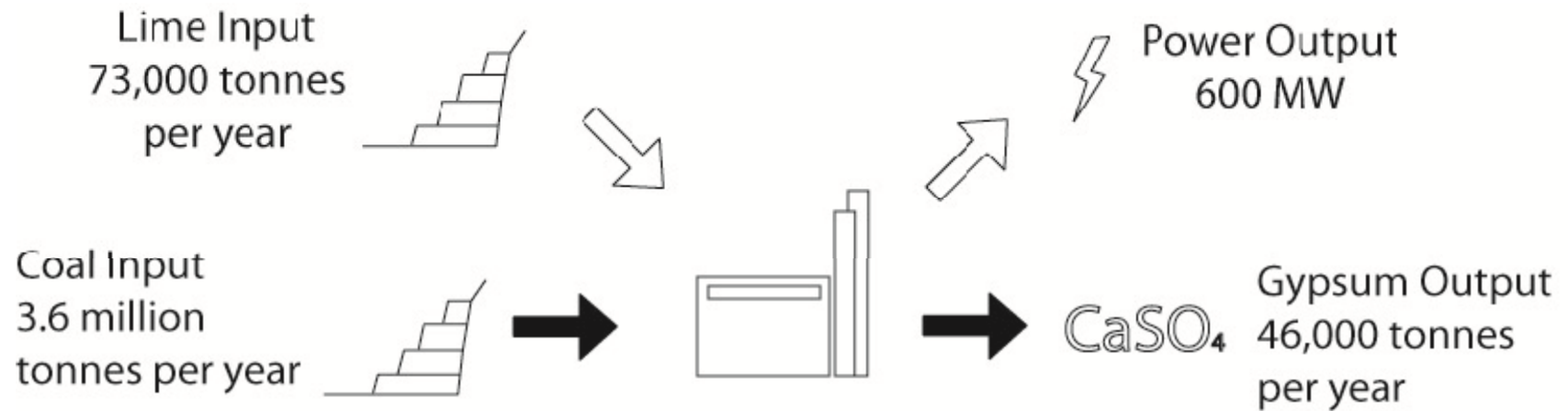
- Making sure we used the correct information
- Verifying information by using multiple sources
- Citing sources

# Pulverized Coal Process





# Mass Balances



# Locations & Transportation

## Gypsum

- Drywall manufacturers ~ 200 mi north
- \$2.7million per year

## Gypsum Disposal

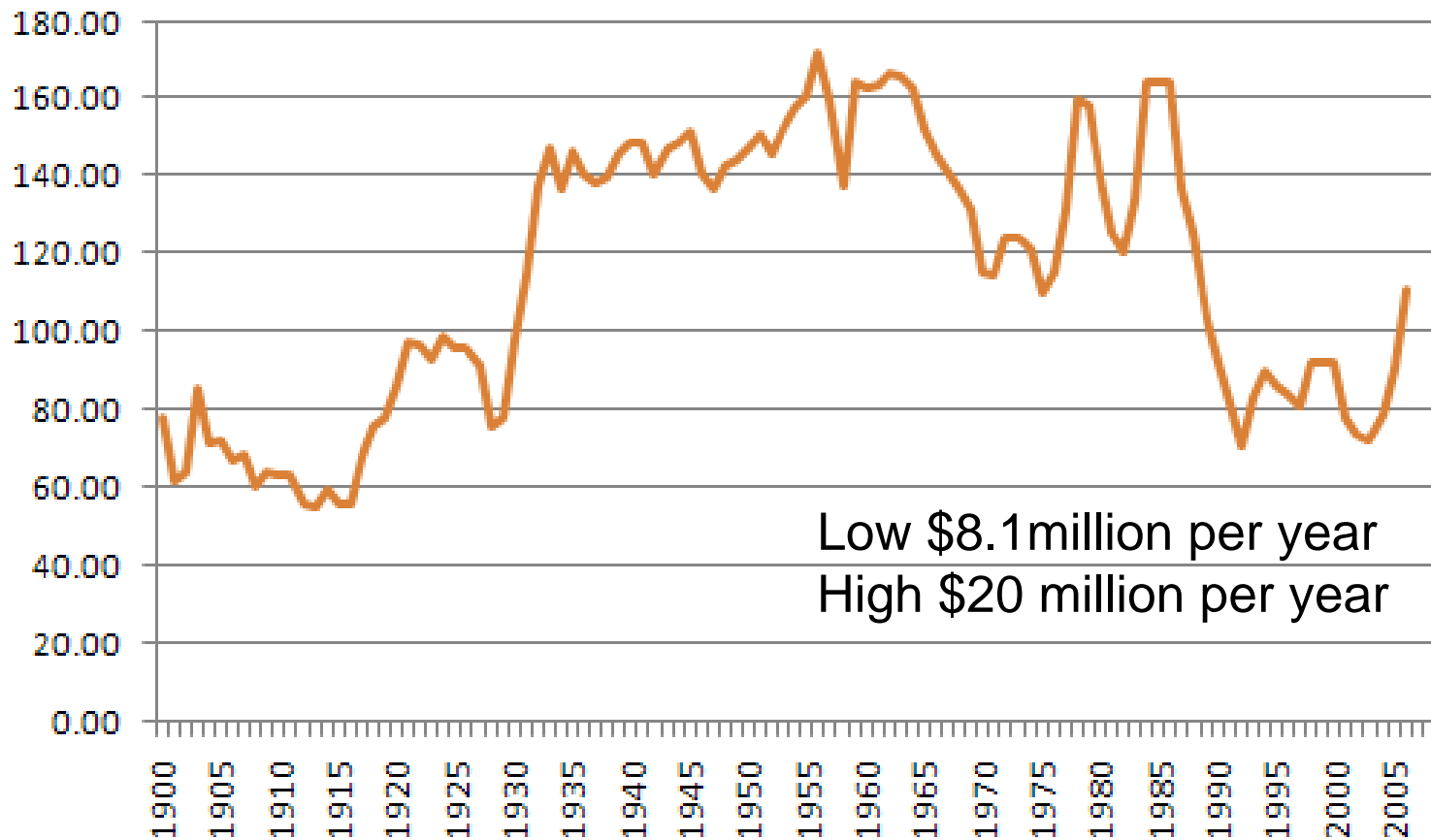
- On-site
- \$2.5million per year

## Limestone

- ~ 100 mi away
- \$730,000 per year

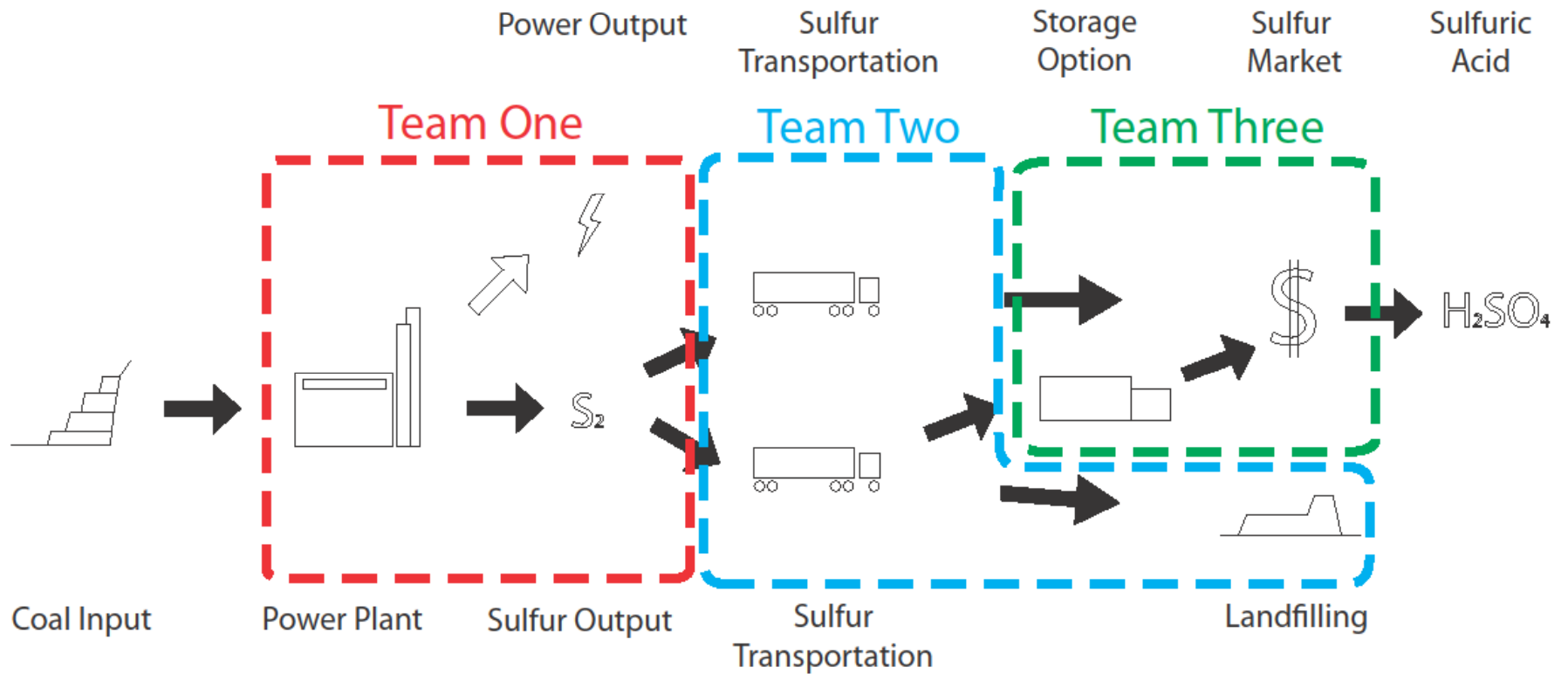


## Gypsum Unit Value (\$/ton) in 1998 dollars



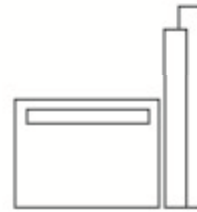
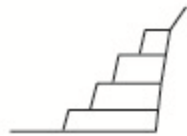
Source: US Geological Survey

# Gasification Process




# Mass Balances

Coal Input  
3.4 million  
tonnes per year



 Power Output  
600 MW

 Sulfur Output  
22,000 tonnes  
per year

# Locations & Transportation

## Sulfur

- Chemical companies~ 100 mi south
- \$237,000 per year



## Landfill Costs

- \$1.2million per year

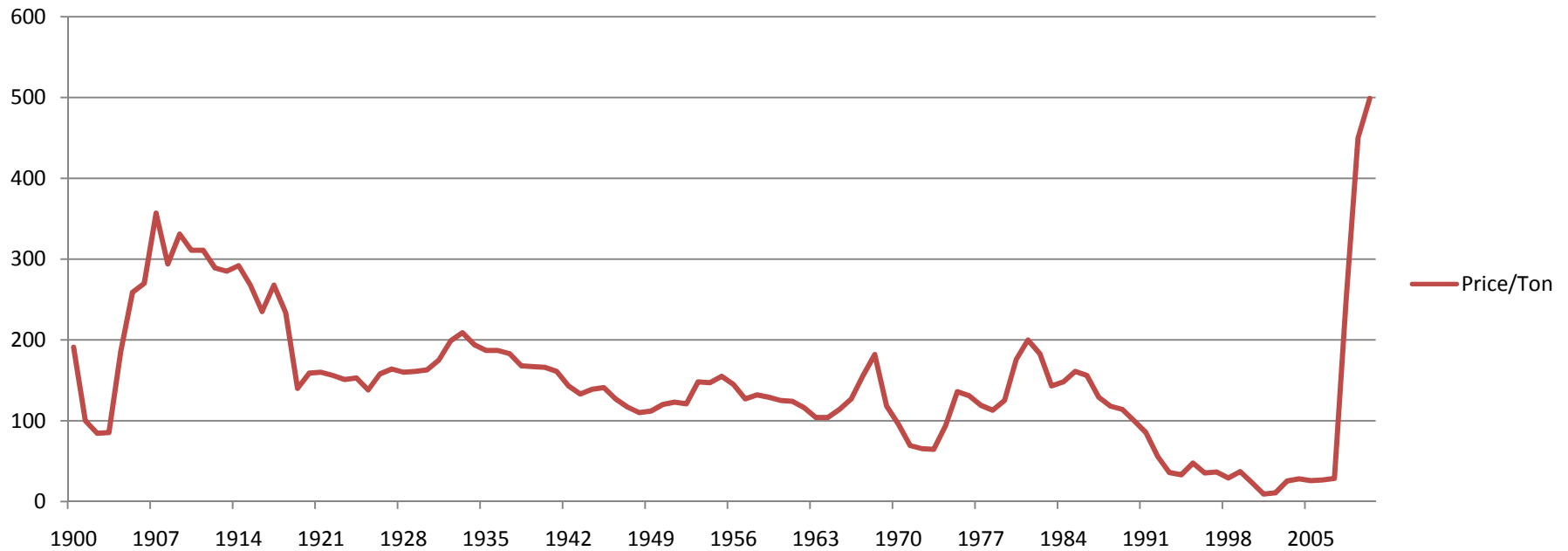
## Storage options

- Sulfur tank
- Sulfur pit
- Block pouring



# Elemental Sulfur Market

Market Price of Elemental Sulfur 1900-2010, Adjusted for Inflation



Low = \$0 per year  
High = \$10.9 million per year

# Financial Projections

## Pulverized Coal

- Sales Revenues
  - \$ 8 - 20 million annually
  - At current prices, \$14 million
- Costs of selling
  - \$3.4 million transportation costs
  - \$140,000 per year -lime
  - \$6 million O and M
- Net Revenue:
  - Potentially -\$1.5 – 10.5 million
  - Currently, \$4.5 million

## Gasification

- Sales Revenues:
  - \$0 - 10.9 million annually
  - Market seems to be rising
  - At current prices, 10.9 million
- Costs of selling:
  - \$240,000 – transportation costs
  - \$1.5 – 2 million O and M
- Net Revenue:
  - -\$2.3 – 9.2 million
  - Currently around \$8.9 million



# Implications

## High Sulfur Coal

- If we were to use bituminous coal in these power plants, how would the sulfur output change?
- Bituminous coal has around twice the heating value, but four times the sulfur content per gram.
- This could reduce coal required for power but would also double sulfur by-product.
- In Economic analysis the sulfur revenue becomes more important for determining power plants

## Nationwide Conversion

- If 100% of the coal power plants in the US were retrofitted for IGCC, what effects would this have on the sulfur market?
- Additional 12.3 million metric tons to the market
- This would double current supply on the US market
- Prices of gypsum could rise high enough to spur extensive gypsum mining

# Results

- Revenues from gypsum (at current prices) - \$4.5 million
- Revenues from sulfur (at current prices) - \$8.9 million
- It is almost always cheaper to sell the byproduct, or even give it away, than to landfill it.
- Sulfur has the potential to make more money back than gypsum, if price does not drop.
- However, this revenue is not enough to justify one power plant over the other.
- By-product markets can be a source of revenue but are too unstable to provide a reliable income.
- These results will be included in a more complete analysis by Sargent and Lundy for a final recommendation.