IPRO 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_2 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.

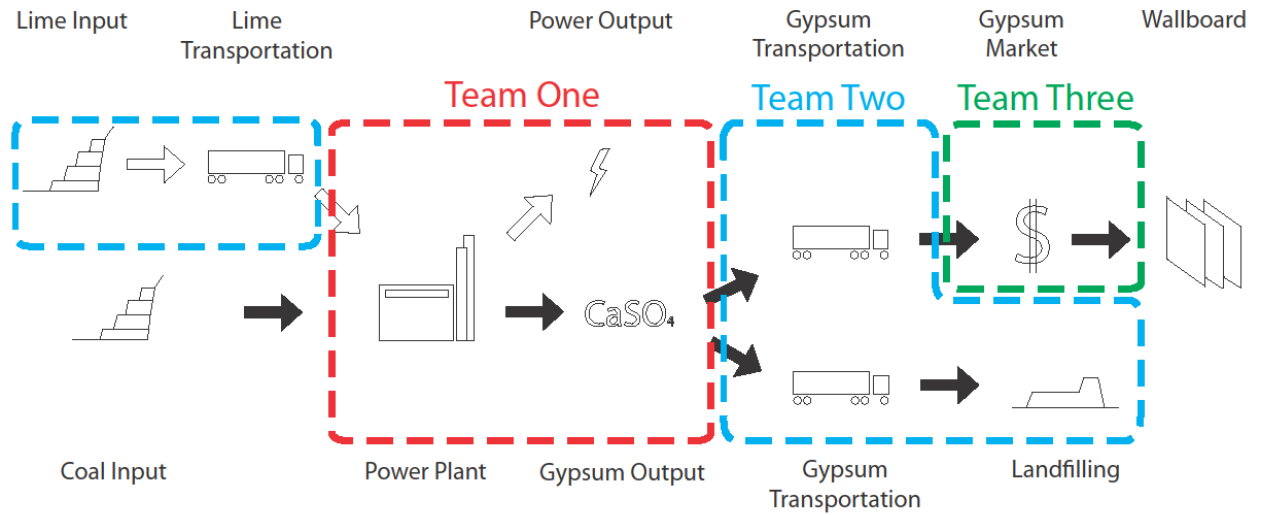- Pulverized Coal ➔ Gypsum

- 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*
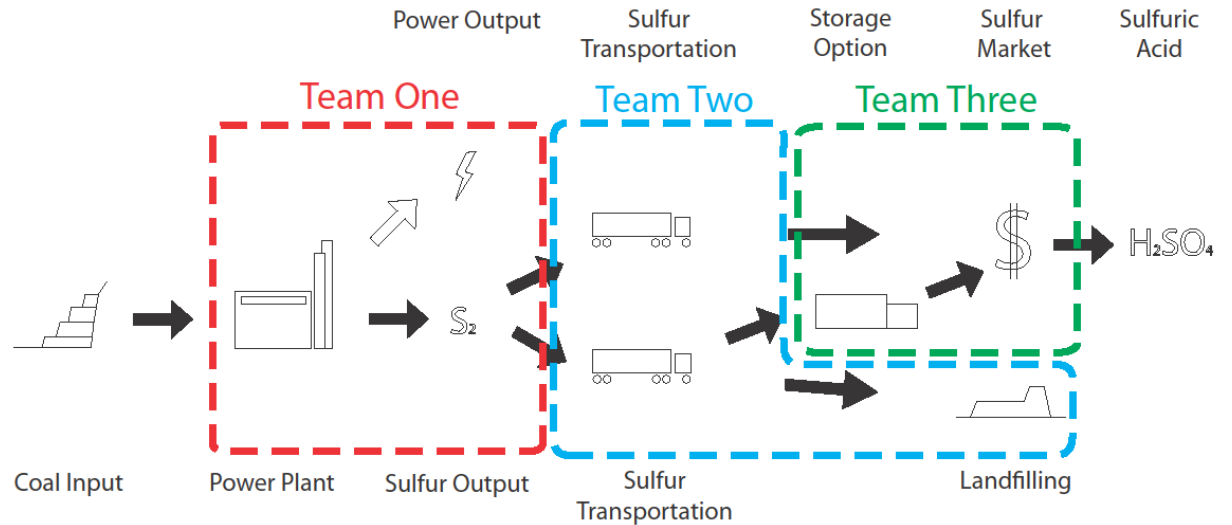
Constraints

- 600 MW Power plant

- Located in Texas

- Texas Lignite Coal to be used

- Capacity factor is 85%

Pulverized Coal

Lime Input — Lime Transportation — Power Output — Gypsum Transportation — Gypsum Market — Wallboard

Team One — Team Two — Team Three

Coal Input — Power Plant — Gypsum Output — Gypsum Transportation — Landfilling

$CaSO_4$

Gasification

Power Output — Sulfur Transportation — Storage Option — Sulfur Market — Sulfuric Acid

Team One — Team Two — Team Three

Coal Input — Power Plant — Sulfur Output — Sulfur Transportation — Landfilling

S_2

H_2SO_4

Team Organization

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

Challenges

Information

- Limiting the scope of our analysis

- Determining our actual purpose

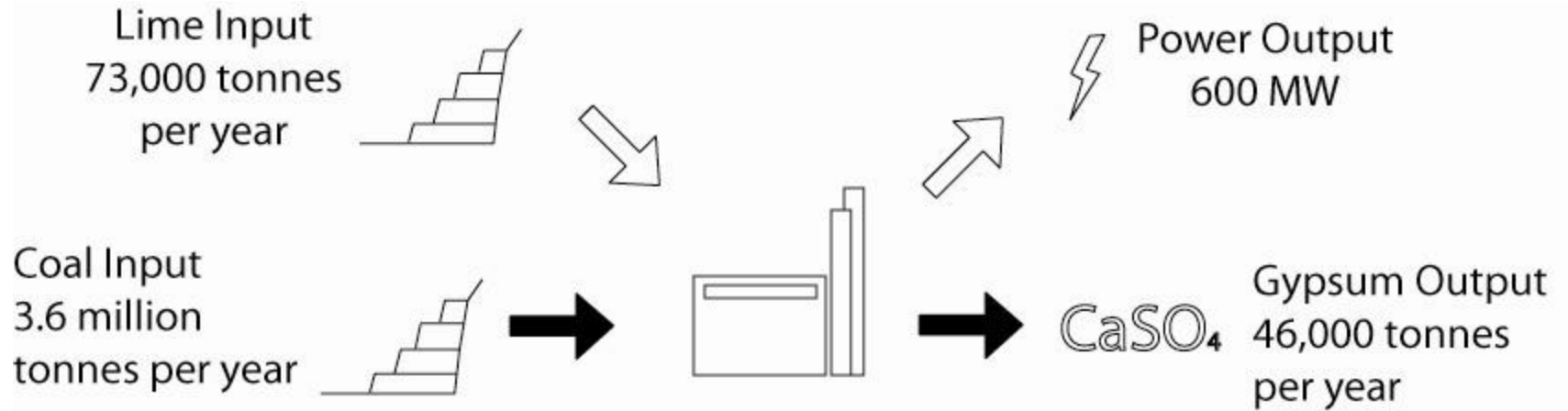- Team organization and structure

Ethical

- Making sure we used the correct information

- Verifying information by using multiple sources

- Citing sources

Pulverized Coal Process

Mass Balances

Lime Input
73,000 tonnes
per year

Coal Input
3.6 million
tonnes per year

Power Output
600 MW

$CaSO_4$ Gypsum Output
46,000 tonnes
per year
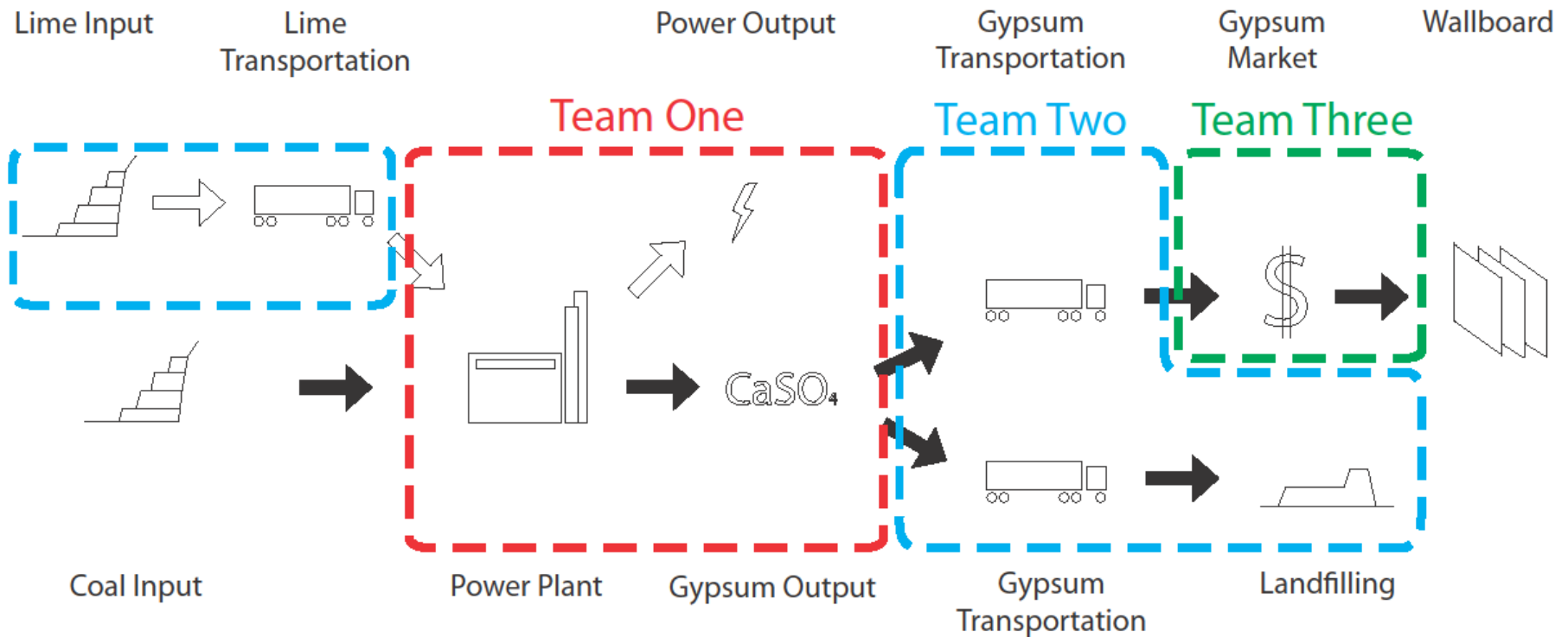
Locations & Transportation

Gypsum

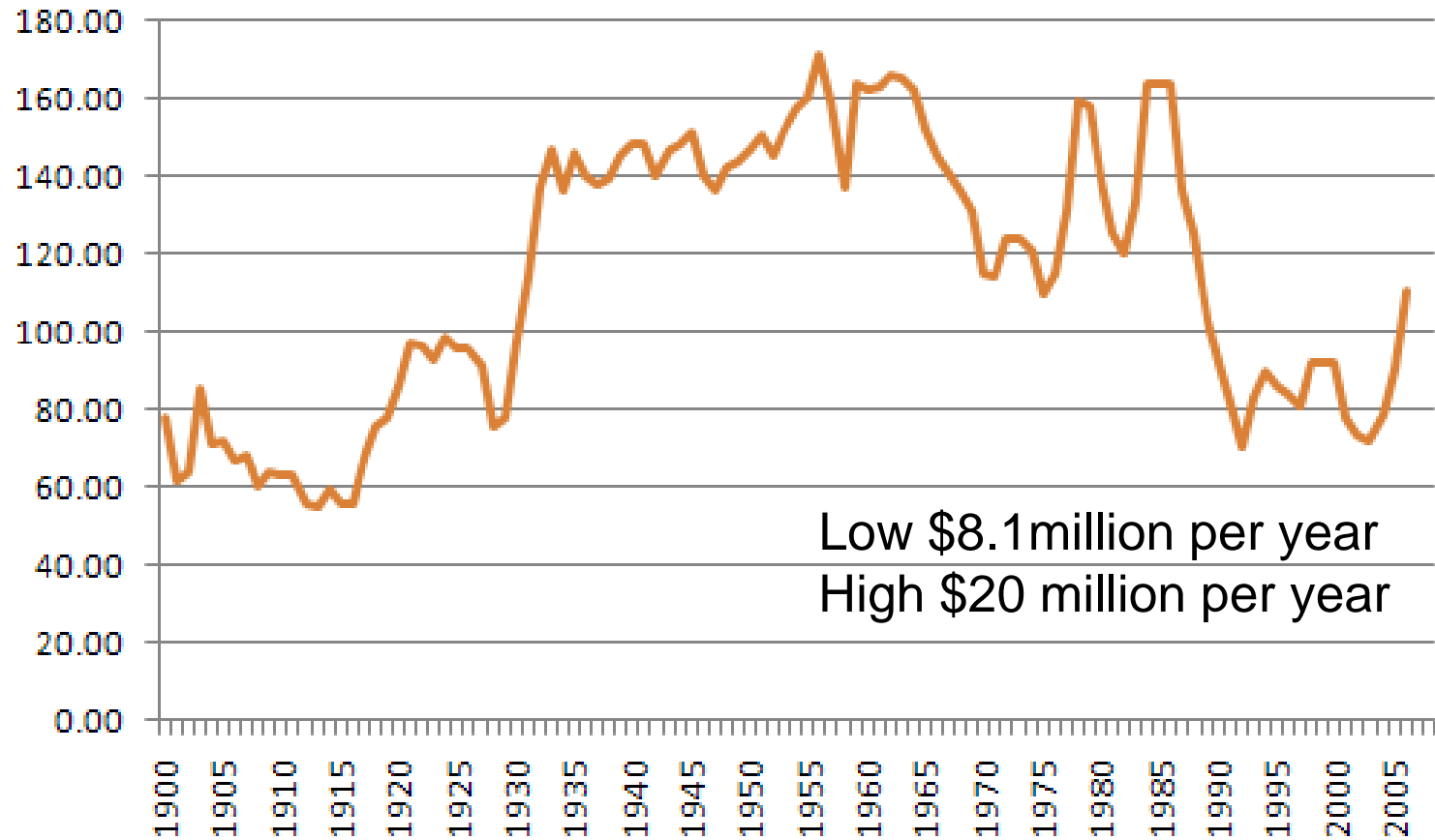- Drywall manufacturers ~ 200 mi north
- $2.7million per year

Gypsum Disposal

- On-site
- $2.5million per year
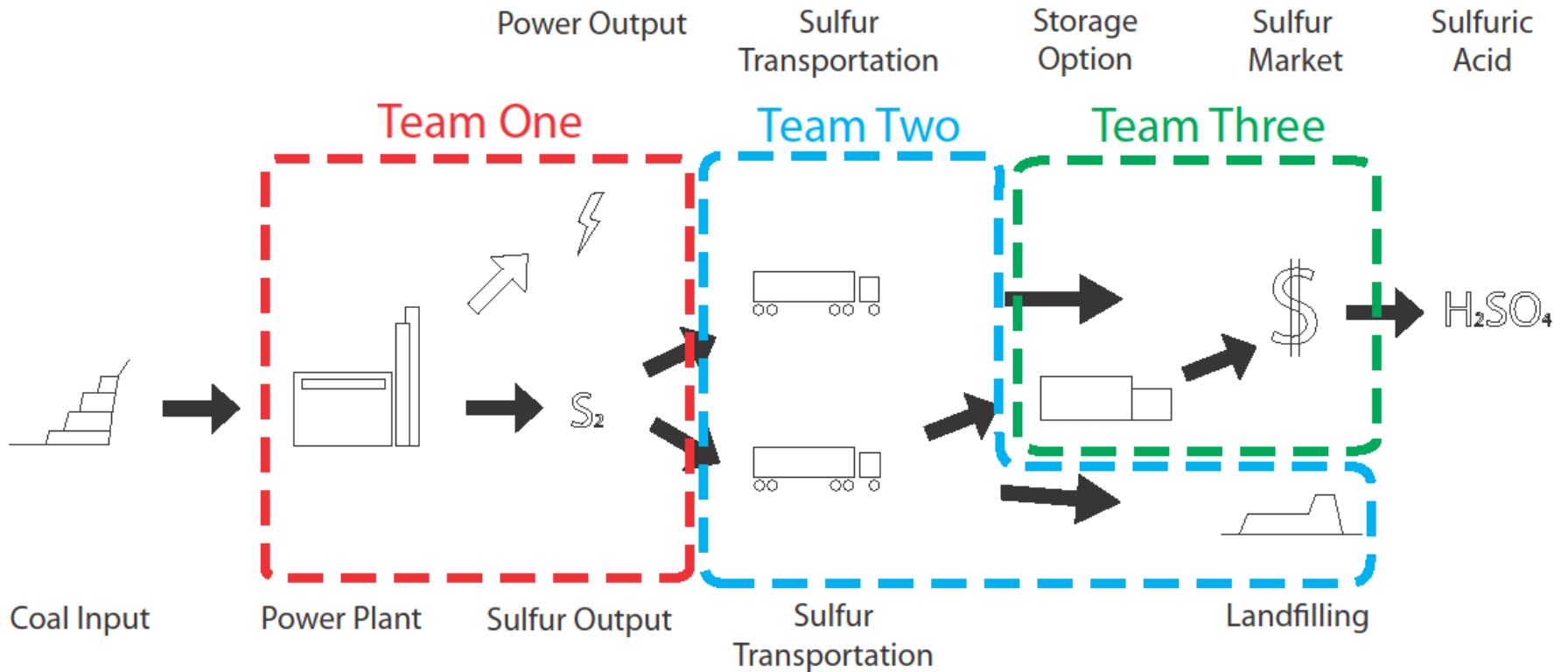
Limestone

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

Gypsum Unit Value ($/ton) in 1998 dollars
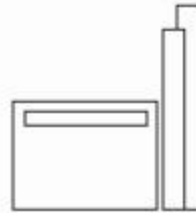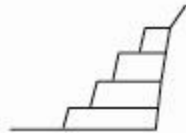

Low $8.1 million per year
High $20 million per year

Source: US Geological Survey

Gasification Process

Mass Balances

Coal Input
3.4 million
tonnes per year

Power Output
600 MW

Sulfur Output
S_2 22,000 tonnes
per year

Locations & Transportation

Sulfur

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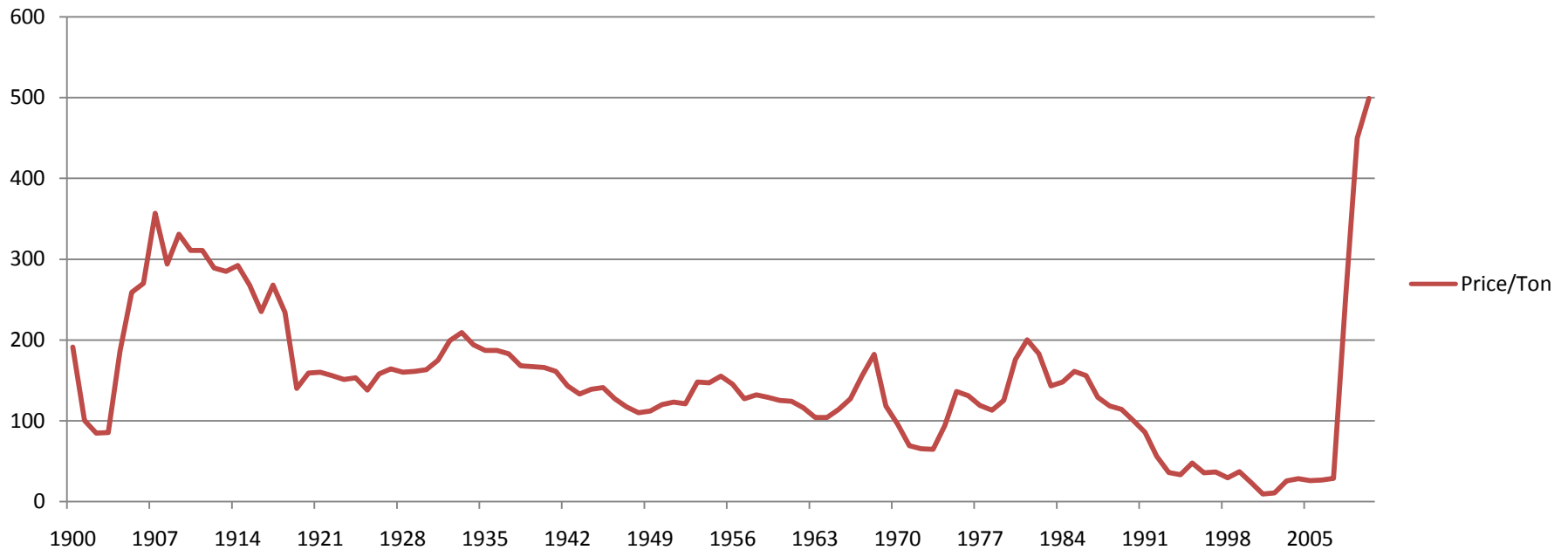- $237,000 per year

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.