Transport vs. Transmission:
Comparative Hybrid LCA

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CEIC Seminar

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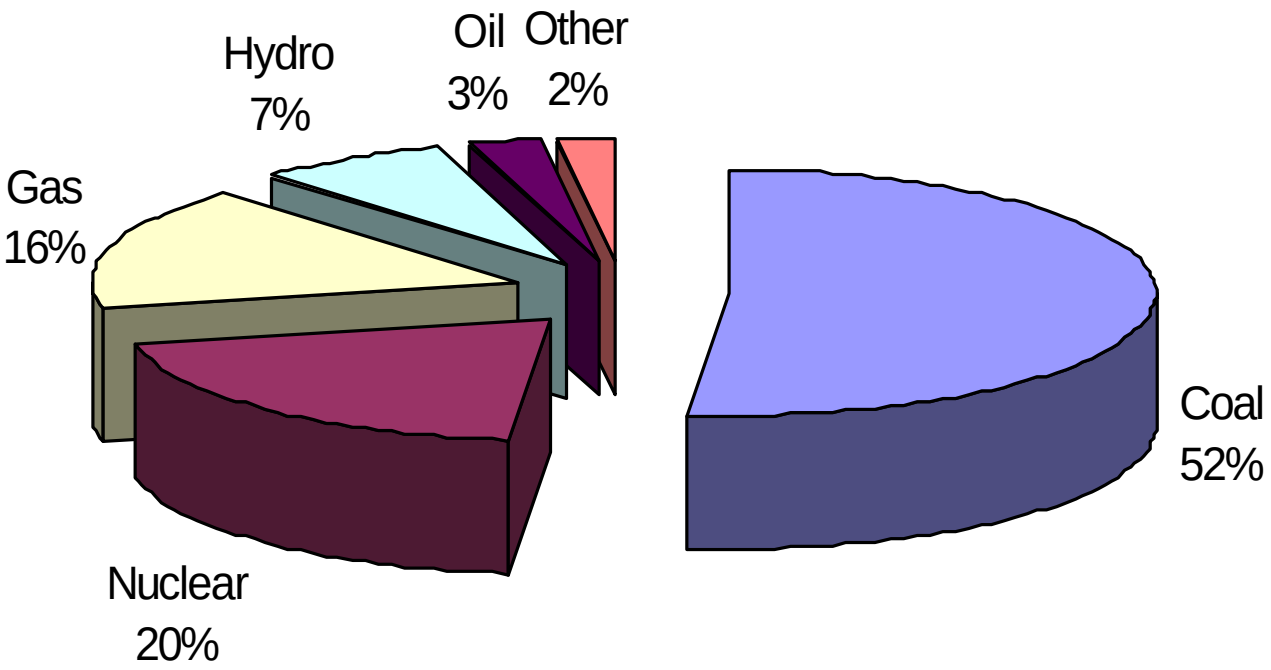
Overview

***Policy Problem**: Should energy be transported from the source to the demand as fuel or electricity?*

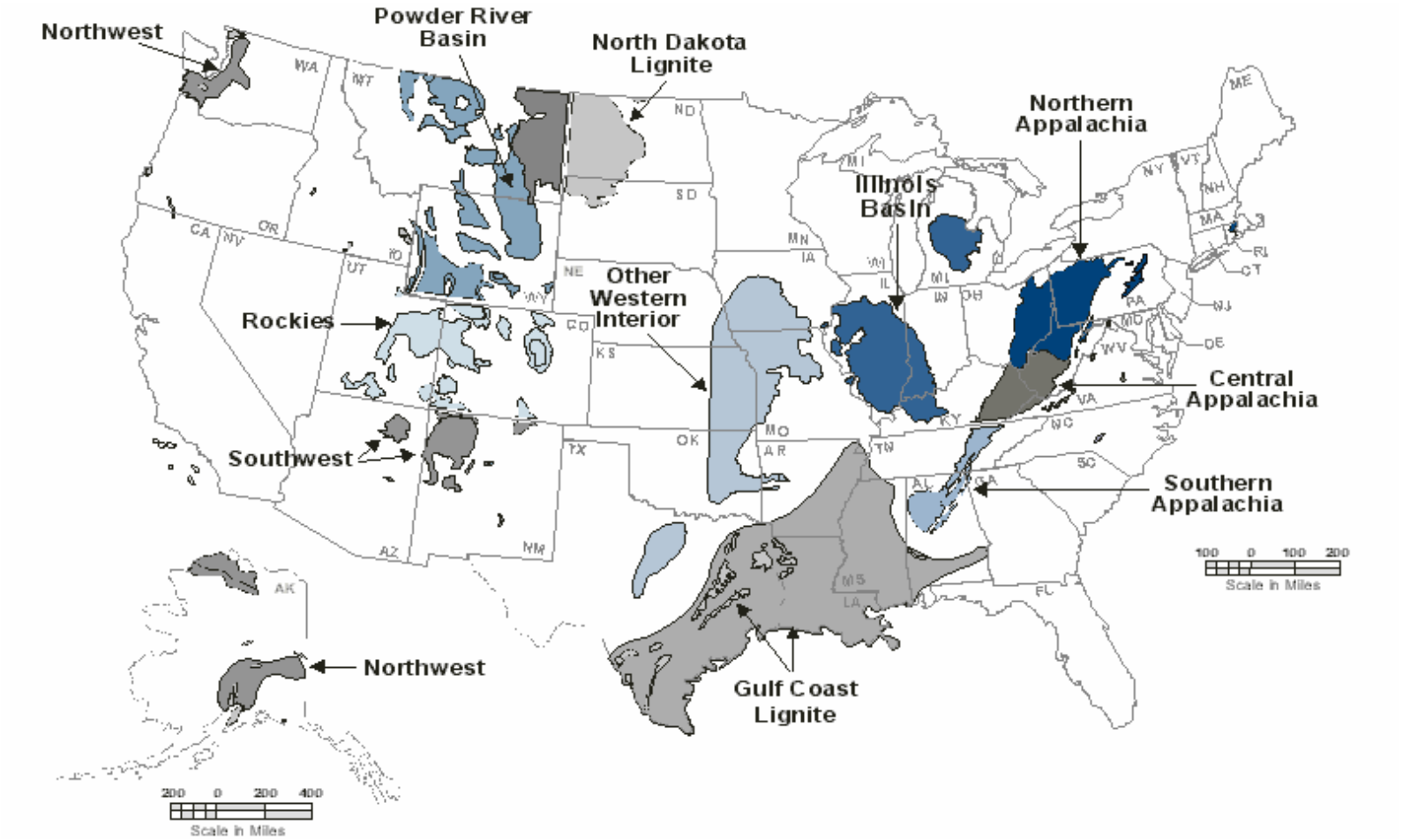
- Importance of Research
- Method
- Economic Results
- Environmental Results
- Implications of Research

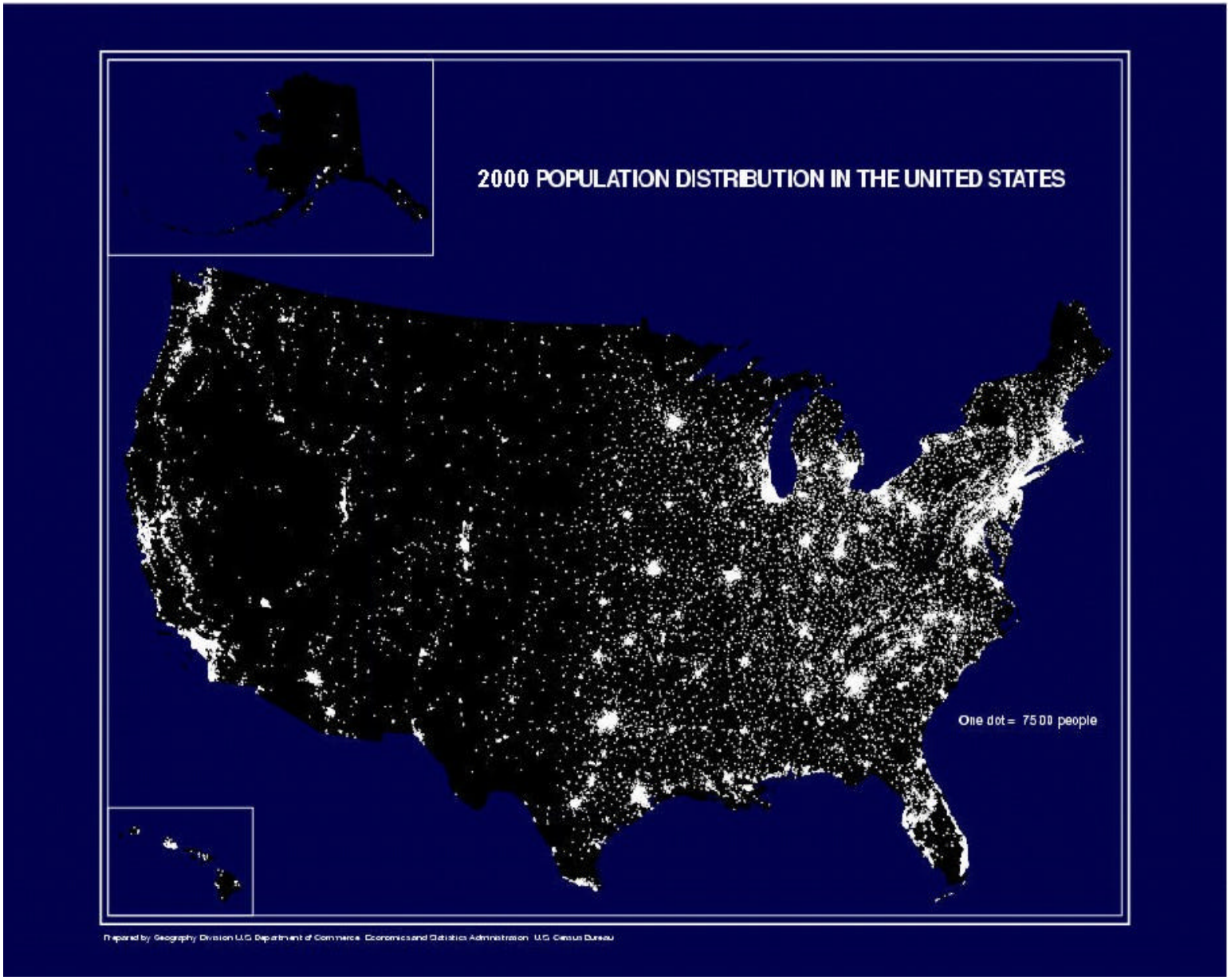
US Electricity Breakdown
(% based on generation)



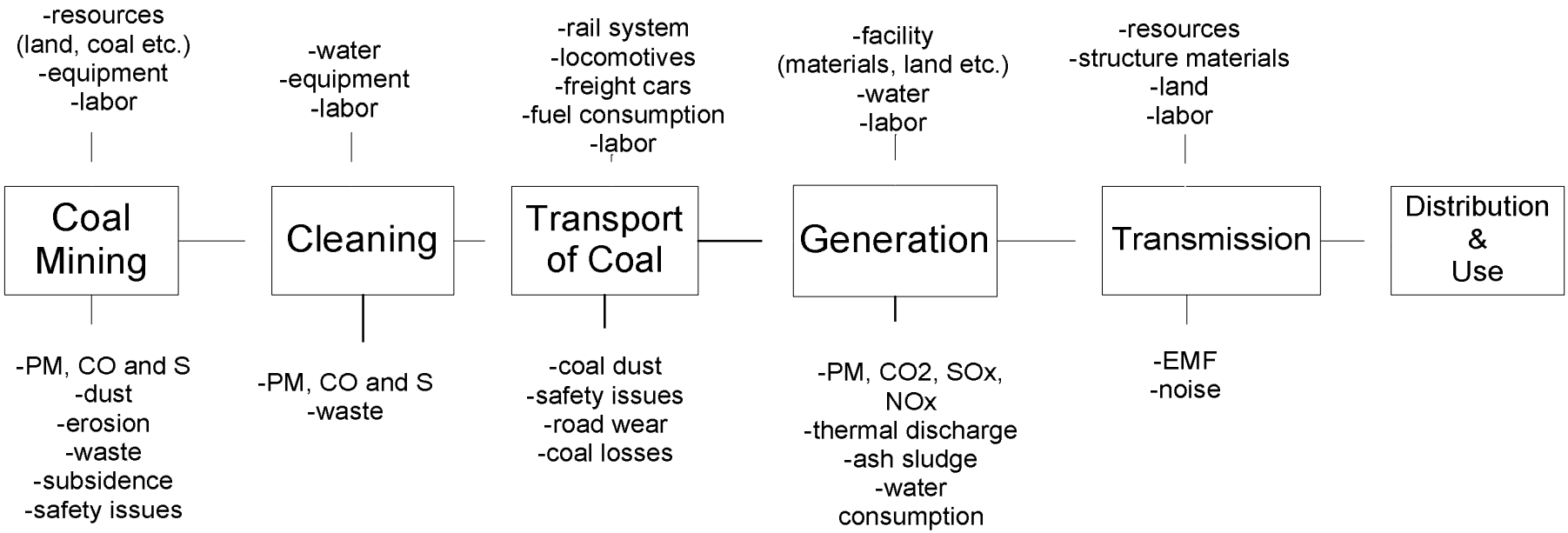
US DOE 2001

US Coal Supply




2000 POPULATION DISTRIBUTION IN THE UNITED STATES
One dot = 7500 people
Prepared by Geography Division U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau

Life Cycle of Coal-Fired Electricity



Input Requirements for Model

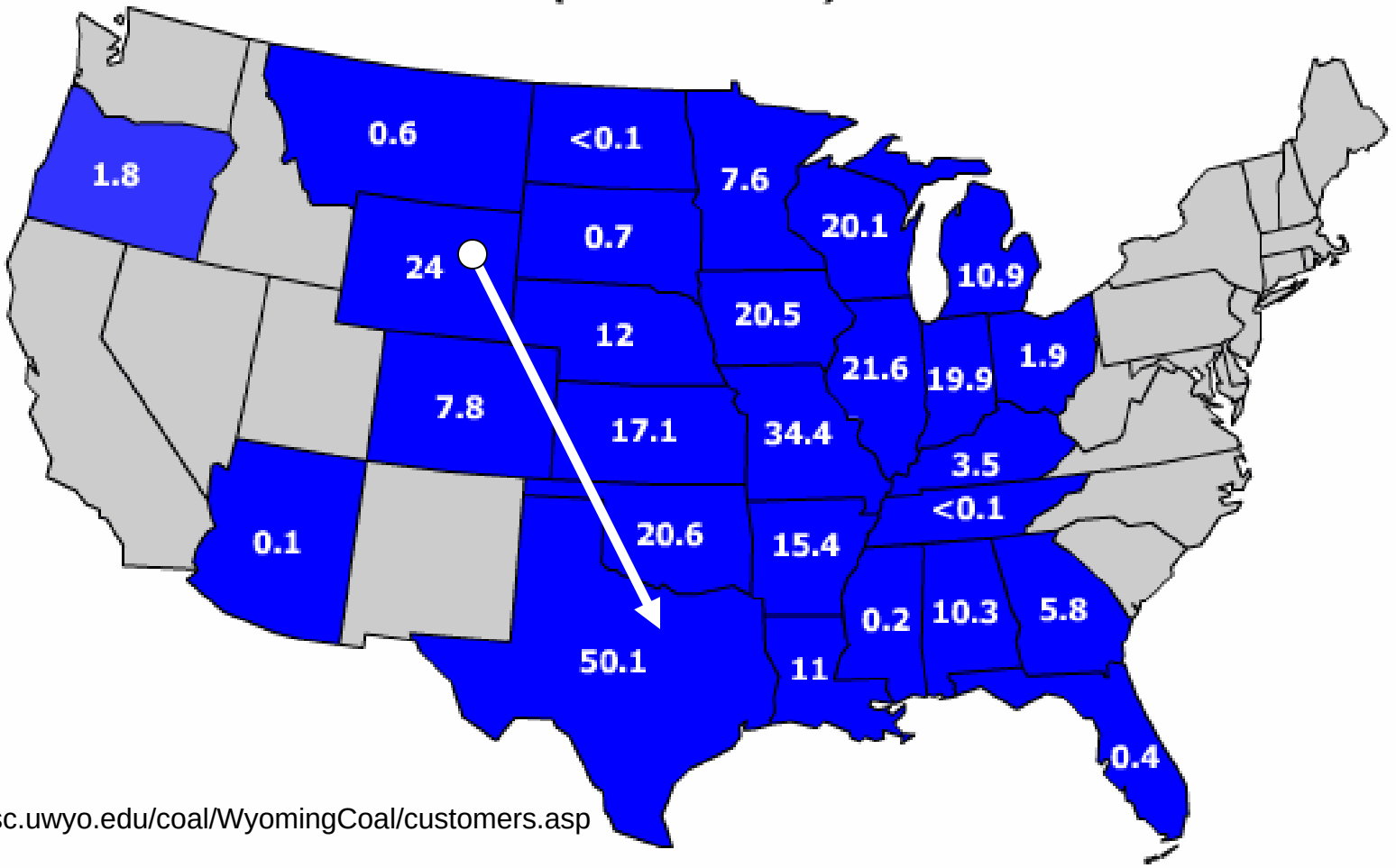
- Coal type (heating value, sulfur content, cost)
- Existing Rail?
- Existing Transmission?
- Distance
- Terrain
- Grade Crossings

Structure of Analysis

1. Build base cases
2. Verify assumptions
3. Identify and estimate all costs for each case
4. Categorize costs in eiolca sectors
5. Estimate environmental emissions (eiolca)
6. Supplement emissions estimates with specific data for sensitive parameters

Wyoming Coal Deliveries to Electric Generating Plants in 1999

(millions of tons)



http://nasc.uwyo.edu/coal/WyomingCoal/customers.asp

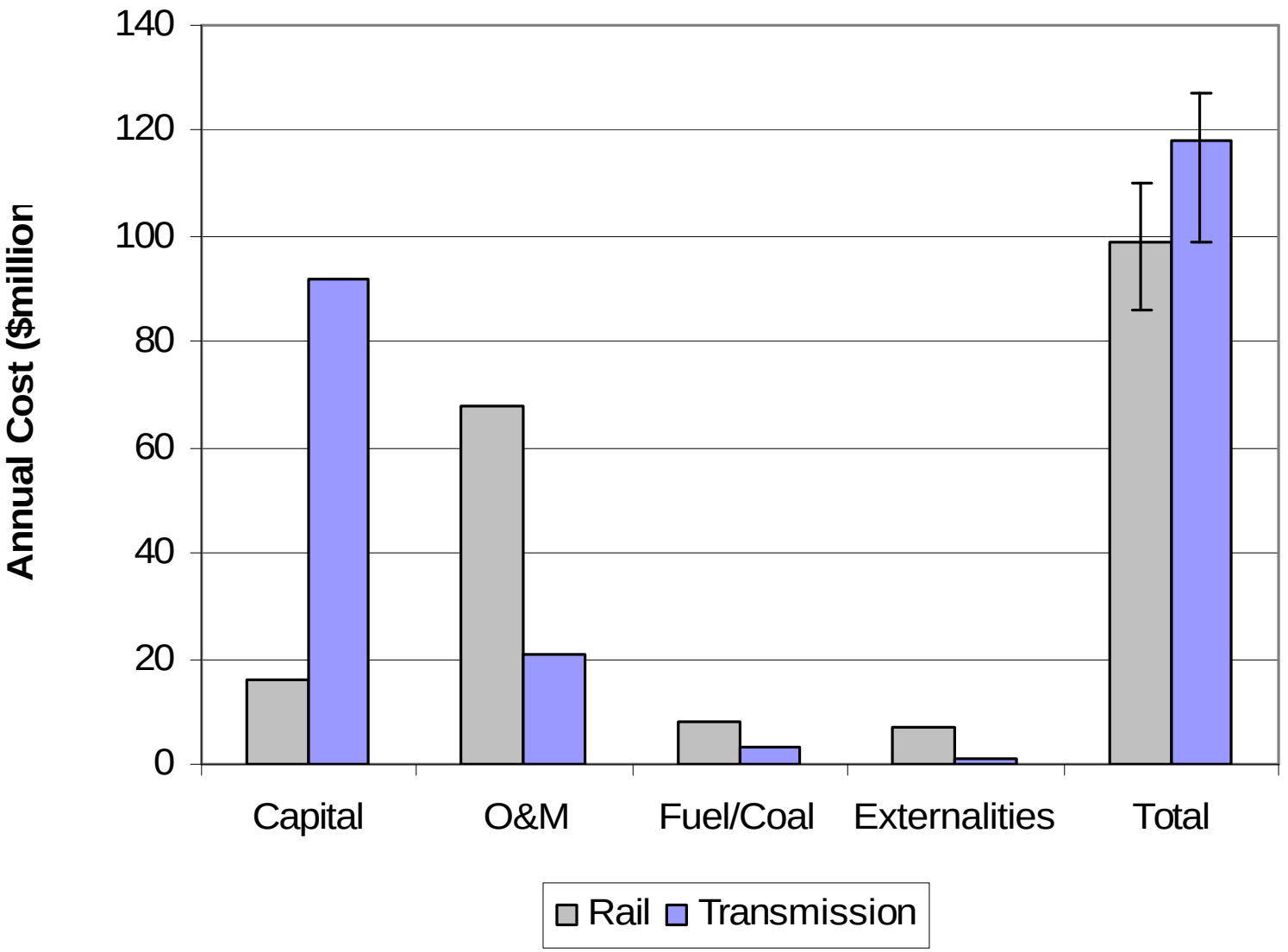
- 350 million tons of coal from WY / year
- 30% of US coal production in **Powder River Basin**
- 30,000 unit trains per year

Price of Coal
- Mine mouth $5 / ton
- Texas $23 / ton

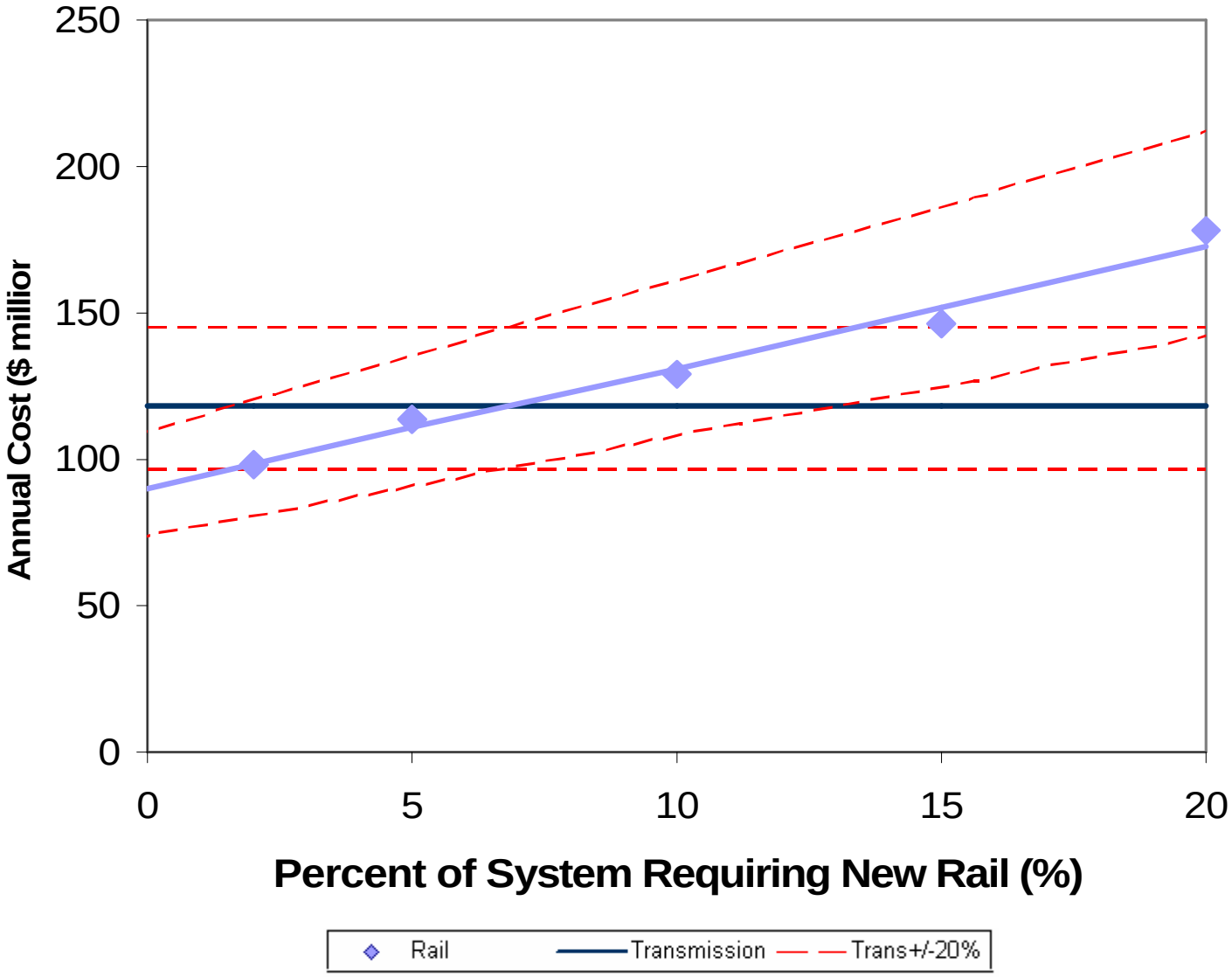
Base Case Assumptions

- Power Plants identical (SUPC – 40% efficiency, 75% capacity factor)
- 1000 MW (transmission -more for 14% losses)
- Approximately 1000 miles from PRB to TX
- No siting difficulties
- Capital
  - Rail – minimal new track capacity, new trains
  - Transmission – new HVDC lines, substations
  - Amortized over life of investment (cost of capital 8%)

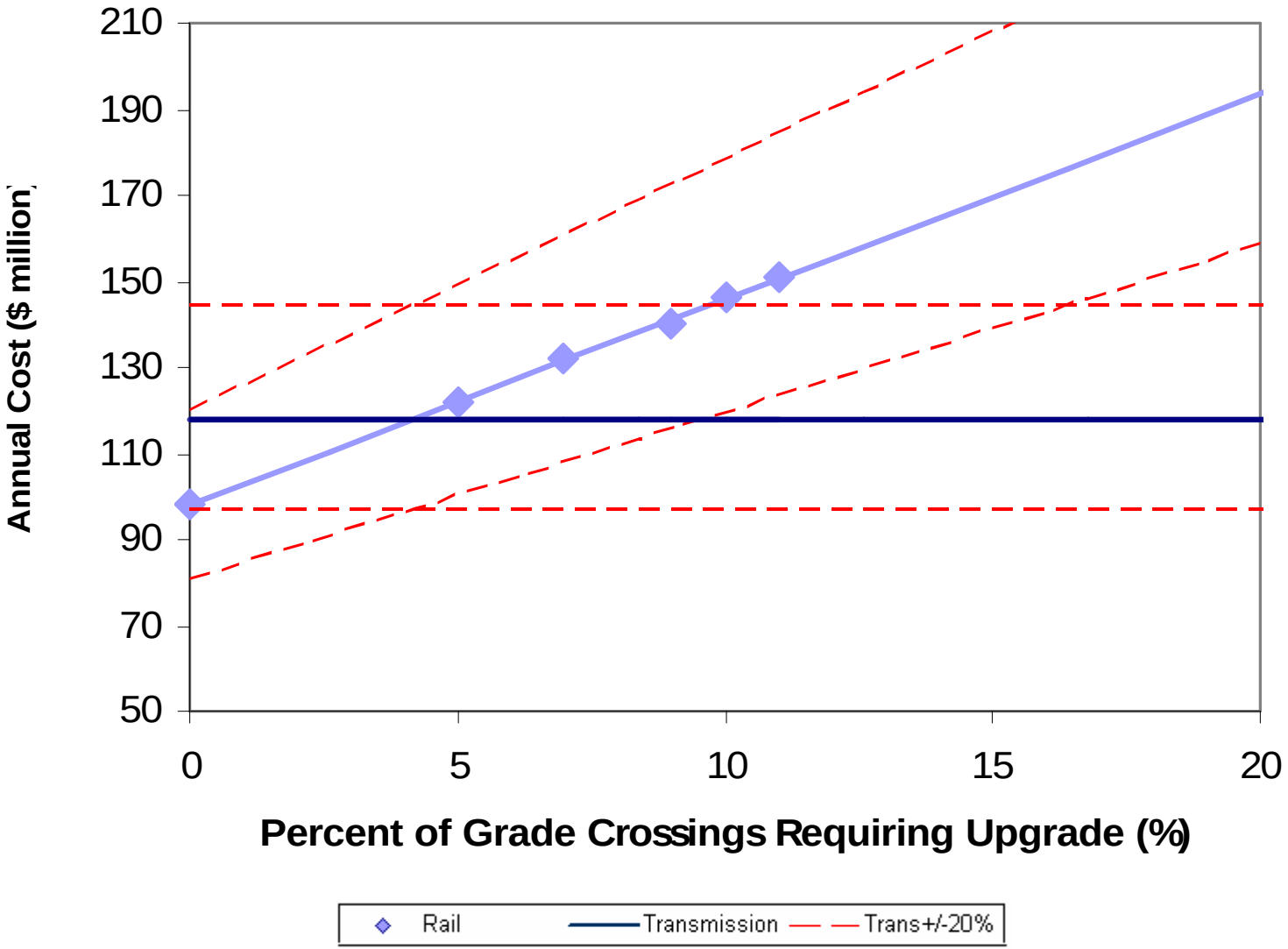
Base Case Economic Results



Scenario: New Rail Construction



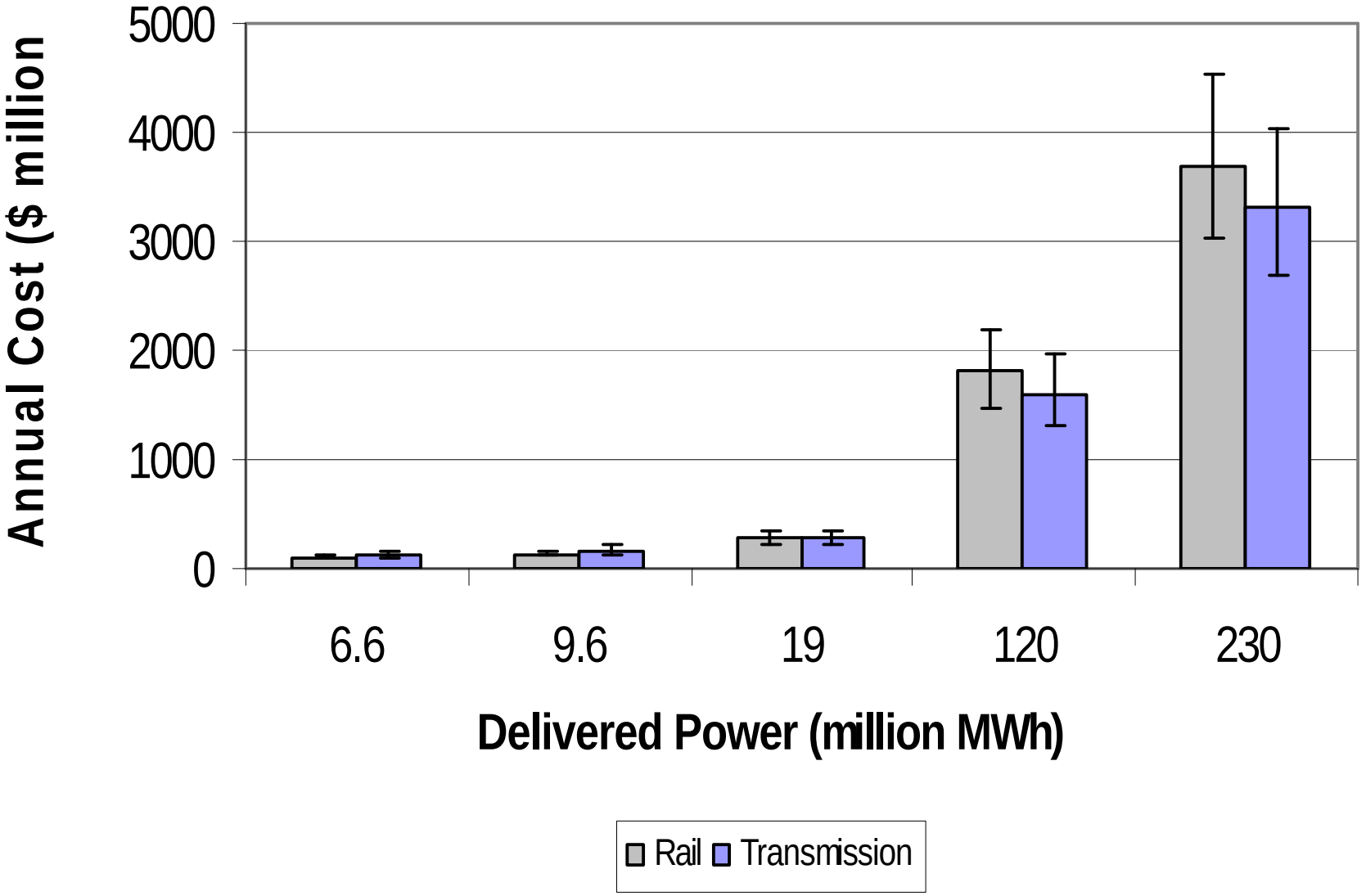
Scenario: Grade Crossings



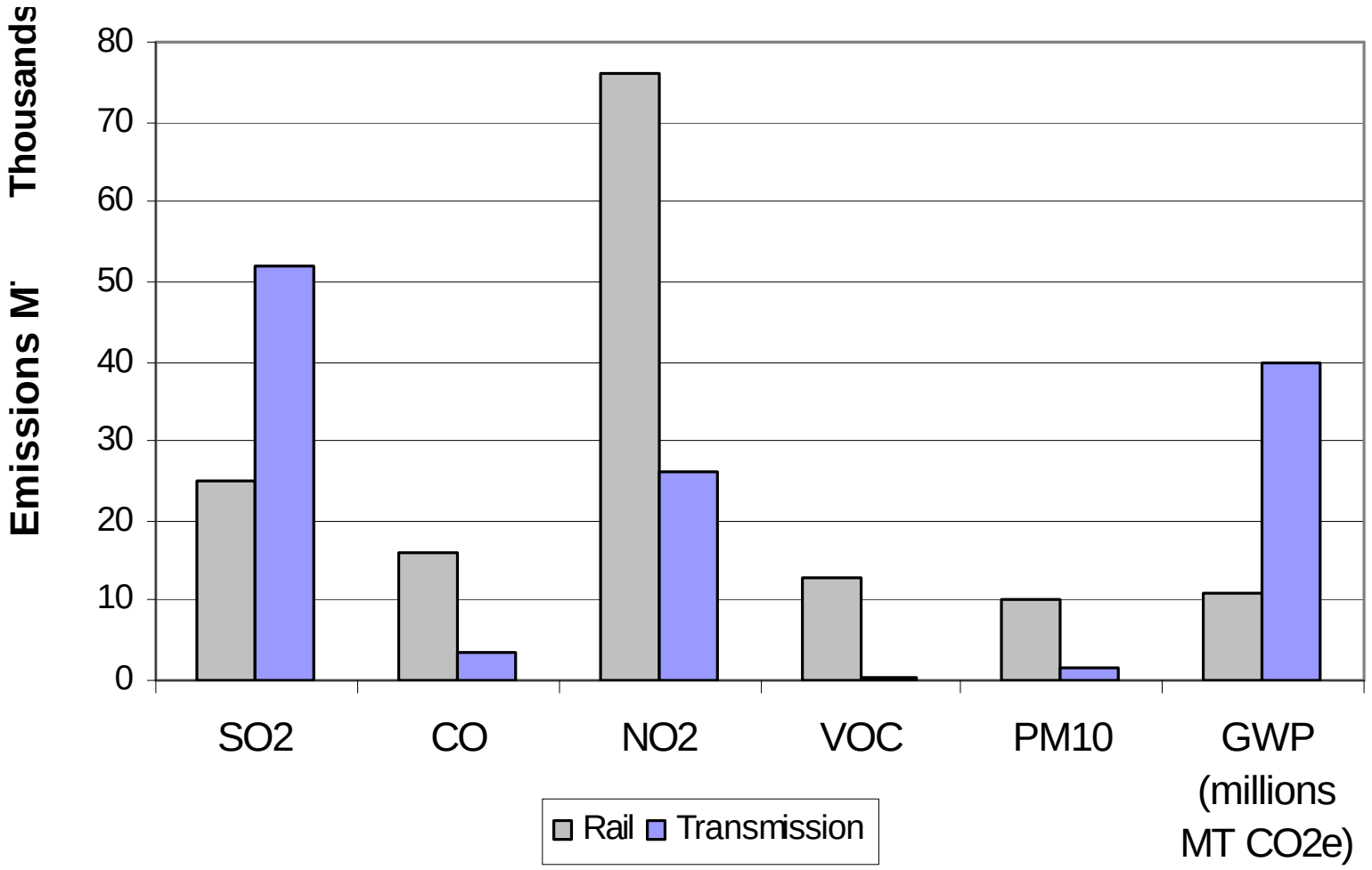
Scenario Analysis - Other

Scenario	Base Case	Break Even Value
Fuel Price	$0.9/gallon	$6-7/gallon
Cost of Capital	8%	3-4%
Distance	1000 miles	600 - 700 miles
Carbon Tax	$0	as little as $5/ton

Size of Project

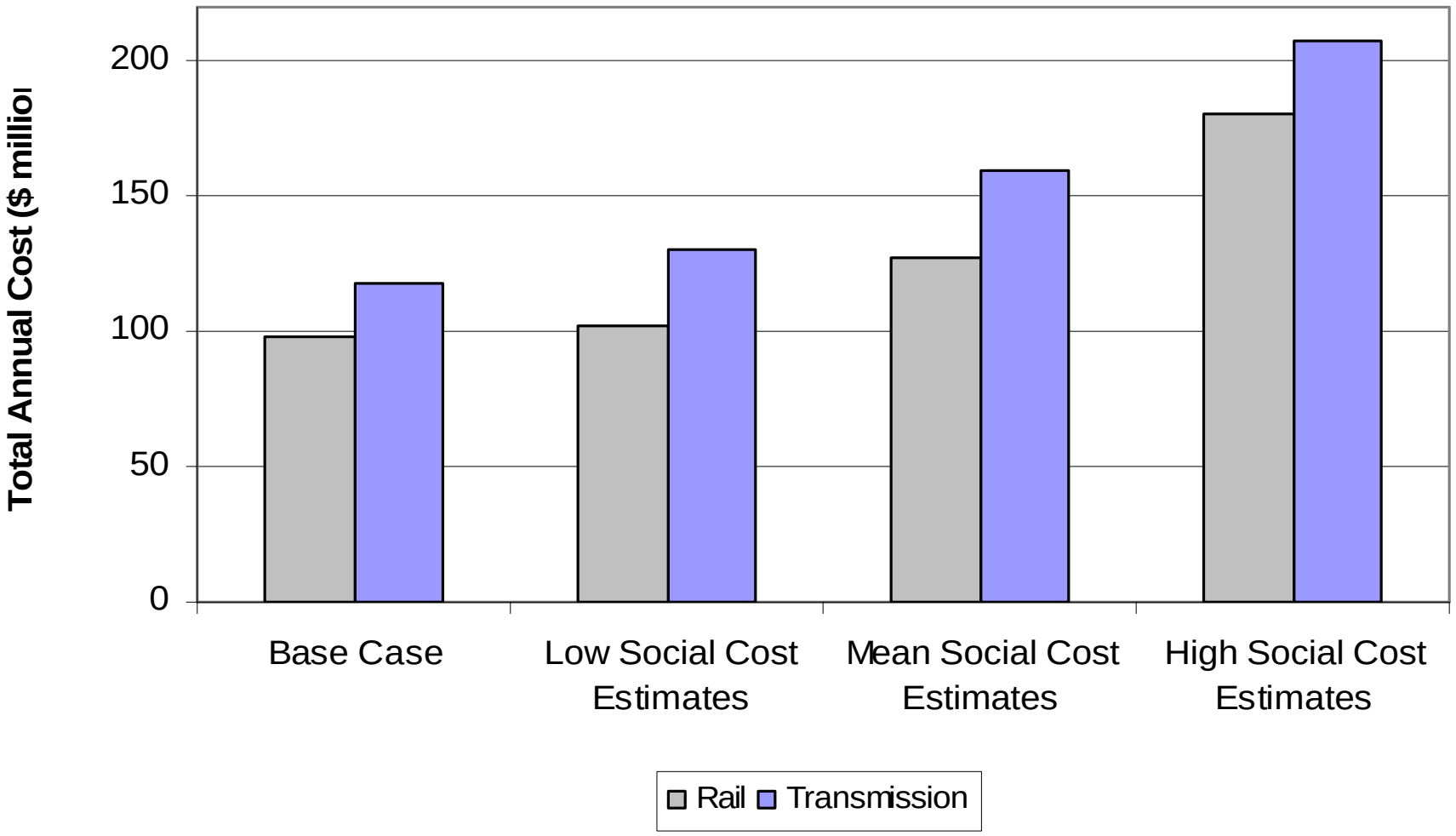


Environmental Emissions (30 years)



Environmental Externalities

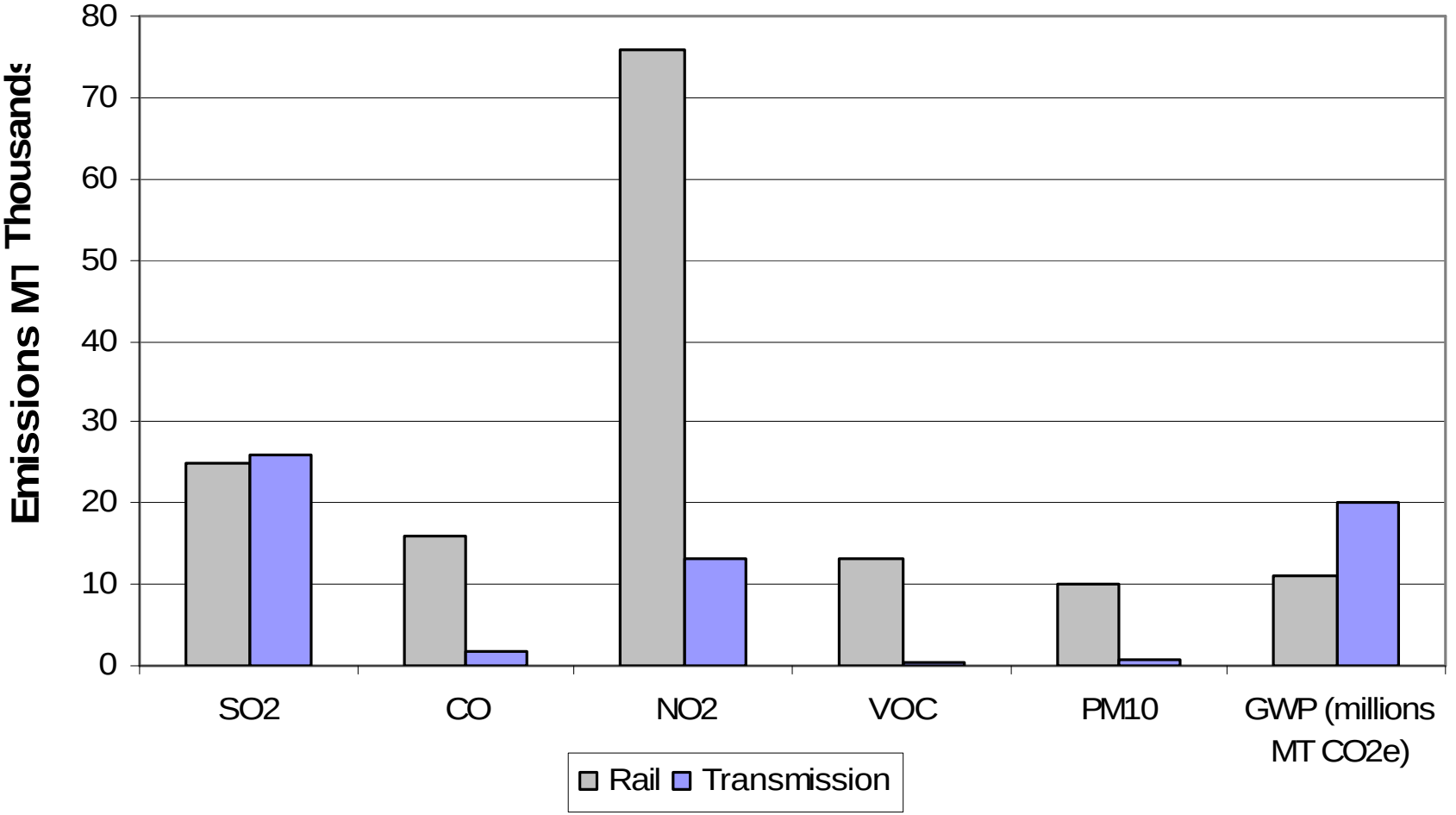
(Social cost calculated for each emission)



Annual Energy Comparison

		Fuel		Energy			CO_2	
		Coal - Base (million tons)	Diesel (million gallons)	Coal (BTU)	Diesel (BTU)	Total BTU	(million tons)	$ millions spent on fuel
Total Power Plant + Transport/ Transmit	Rail	3.3	9.2	5.60E+13	1.30E+12	5.80E+13	8.7	84
	Transmission	3.9	-	6.70E+13	-	6.70E+13	9.7	20
Just energy to transport /transmit	Rail	-	9.2	-	1.30E+12	1.30E+12	0.4	8.3
	Transmission	0.61	-	1.00E+13	-	1.00E+13	1.3	3.1

Environmental Emissions – 7% Losses



Other Considerations

- Coal to Methane or Hydrogen
- Coal Slurry Pipeline
- AC Transmission
- High Temperature Superconductors
- Barge

Conclusions

- From the current case there is no economic/environmental gain in switching to minemouth generation
  - Some scenarios change this result
- Cost and environmental emissions from existing system are significant
  - Other methods of transporting energy should be investigated
- Contribution is made from developing a method to compare alternative transport/transmission scenarios in terms of economic and environmental impact

Policy Implications

- New rail and transmission being considered
- Building new generation
  - Existing rail
  - Distance
  - Environmental Emissions
- Reliability
- Water
- Equity

Questions…