EAST COAST ENERGY GROUP

Transmission: How Much Should Be Built? What are the Benefits and Costs?

Presentation

by

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April 16, 2004

powered by perspective

Outline

- ICF Background
- Study Overview (Background; Objective)
- Approach
- Results
- Questions

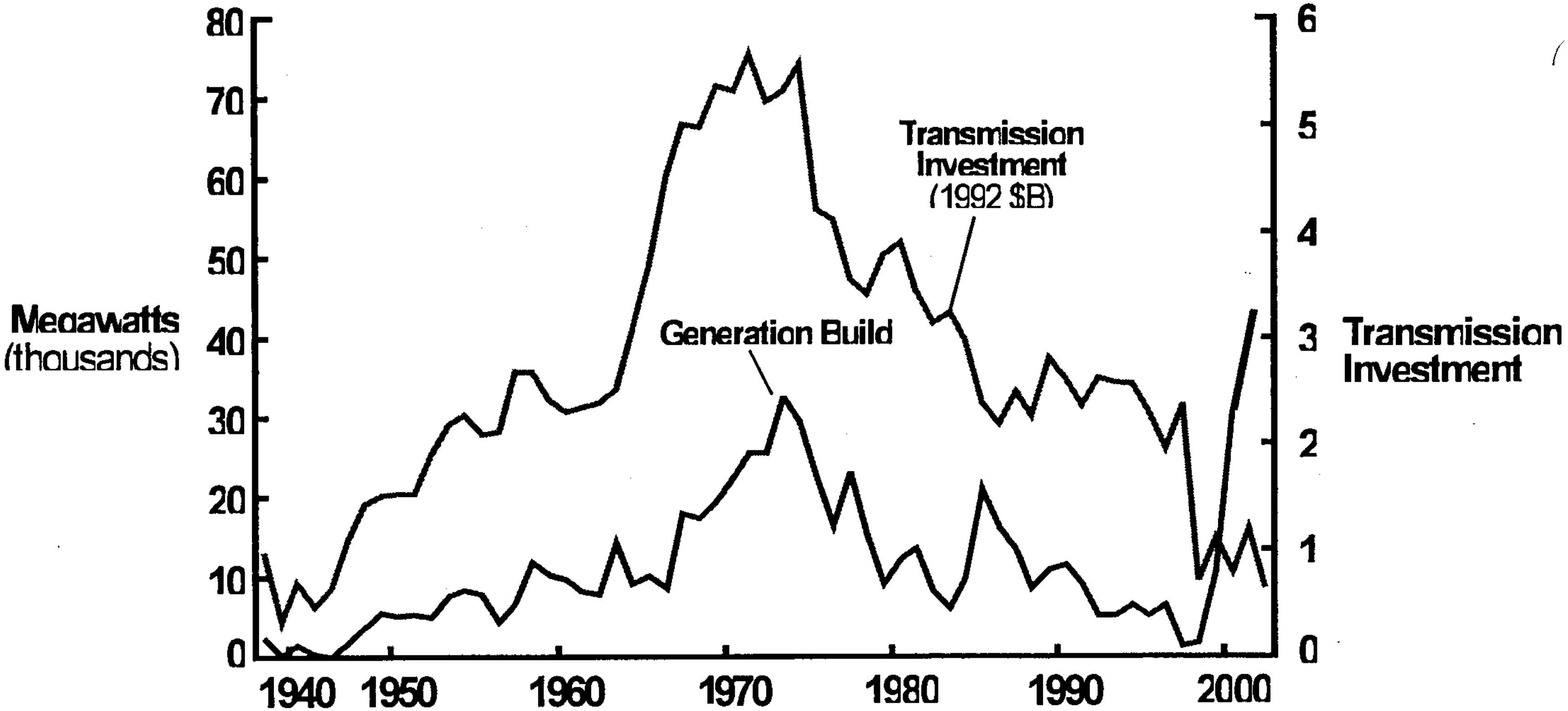
ICF Background

Introduction to ICF Consulting

- 34 years of experience
- Energy and Environmental Consulting
- 1,000+ employees
- $150 million revenue
- Privately owned
- Headquartered in Fairfax, VA
  - Offices on 4 Continents
- Independent analysts and advisors

Study Overview

Significant Shortfall In Transmission Investment

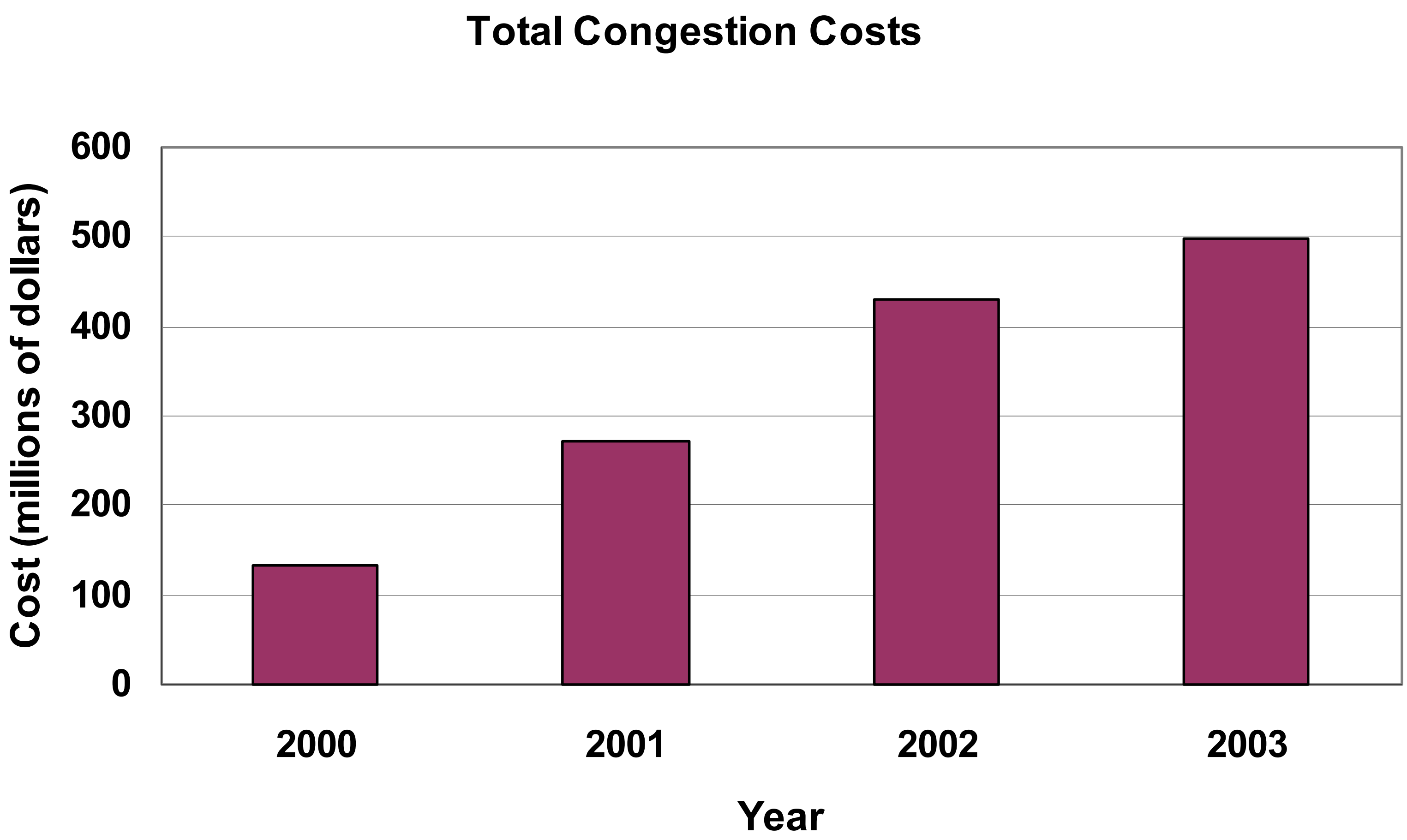


Source: Cambridge CERA Workshop

One Metric of Shortage Transmission Capacity (TTCs)

Year	Region A to Other Surrounding Regions (Non-Simultaneous TTCs/GW)
1998	1.7
1999	5.9
2000	3.7
2001	5.4
2003	0.3

Increasing Annual Cost of Congestion - PJM



Source: PJM ISO

Atomization/Islanding of Grid Has Cost Consequences as Well as Accelerating Market Recovery

Market Size	Approximate Required Reserve Margin (%)
80 GW	13.5
55 GW	14.5
30 GW	15.5
15 GW	17.5
10 GW	19.0

Study Objective

- Given the significant shortfall in transmission investment;
  - How much should be invested in transmission
  - What are the potential benefits/costs in making the right transmission investments

Cases Examined

- Base Case – Market As-Is
- Change Cases
  - Optimal Case
  - 25%; 50%; 75%; 125% of Optimal Level of Investment Cases
- Effect of Reserve Sharing Case

Approach

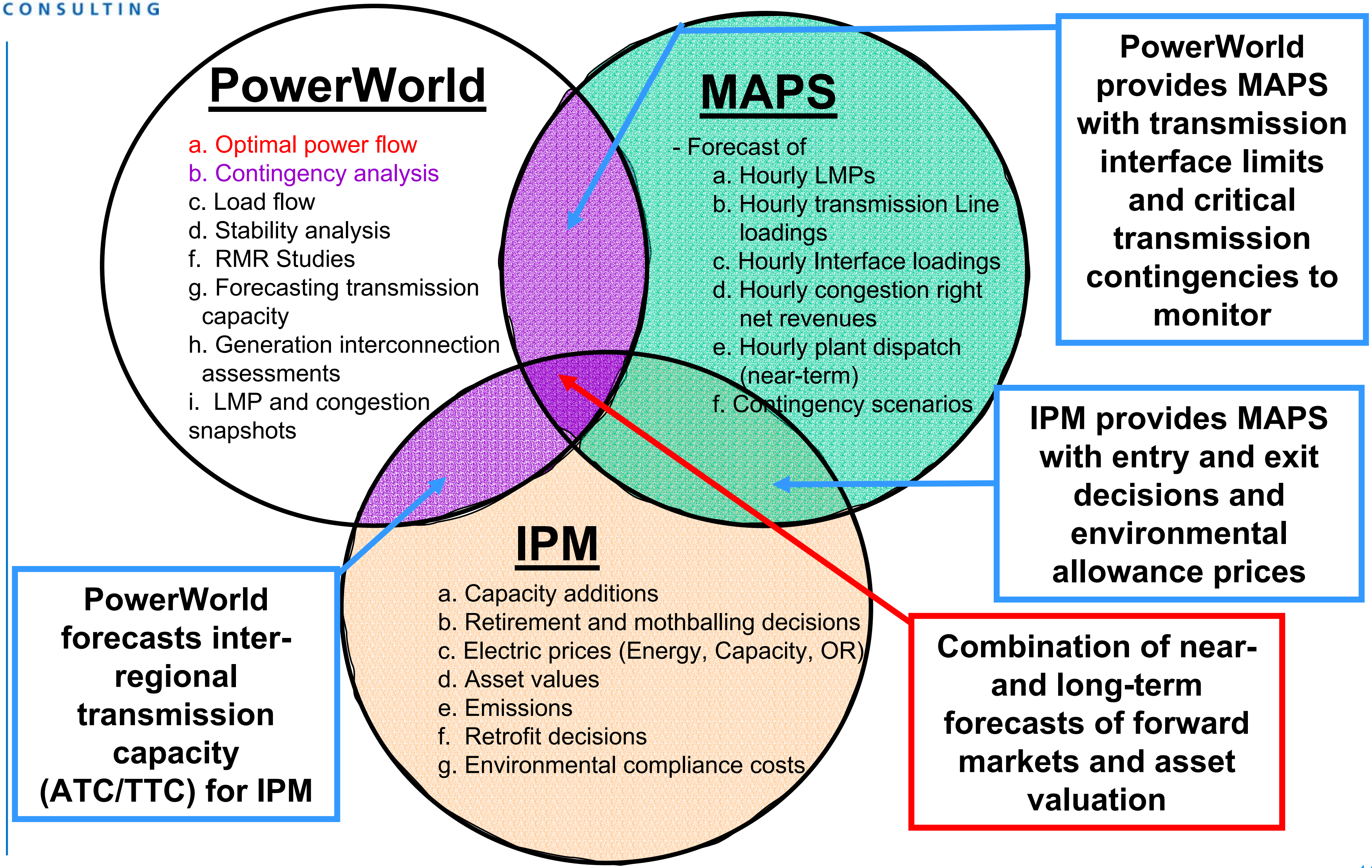
Estimating Additional Transmission Capacity is a Non-Trivial Exercise

- Complexity of Power Flows
- Large Network Externality
- Balancing Reliability and Economic Transmission Capacity Needs

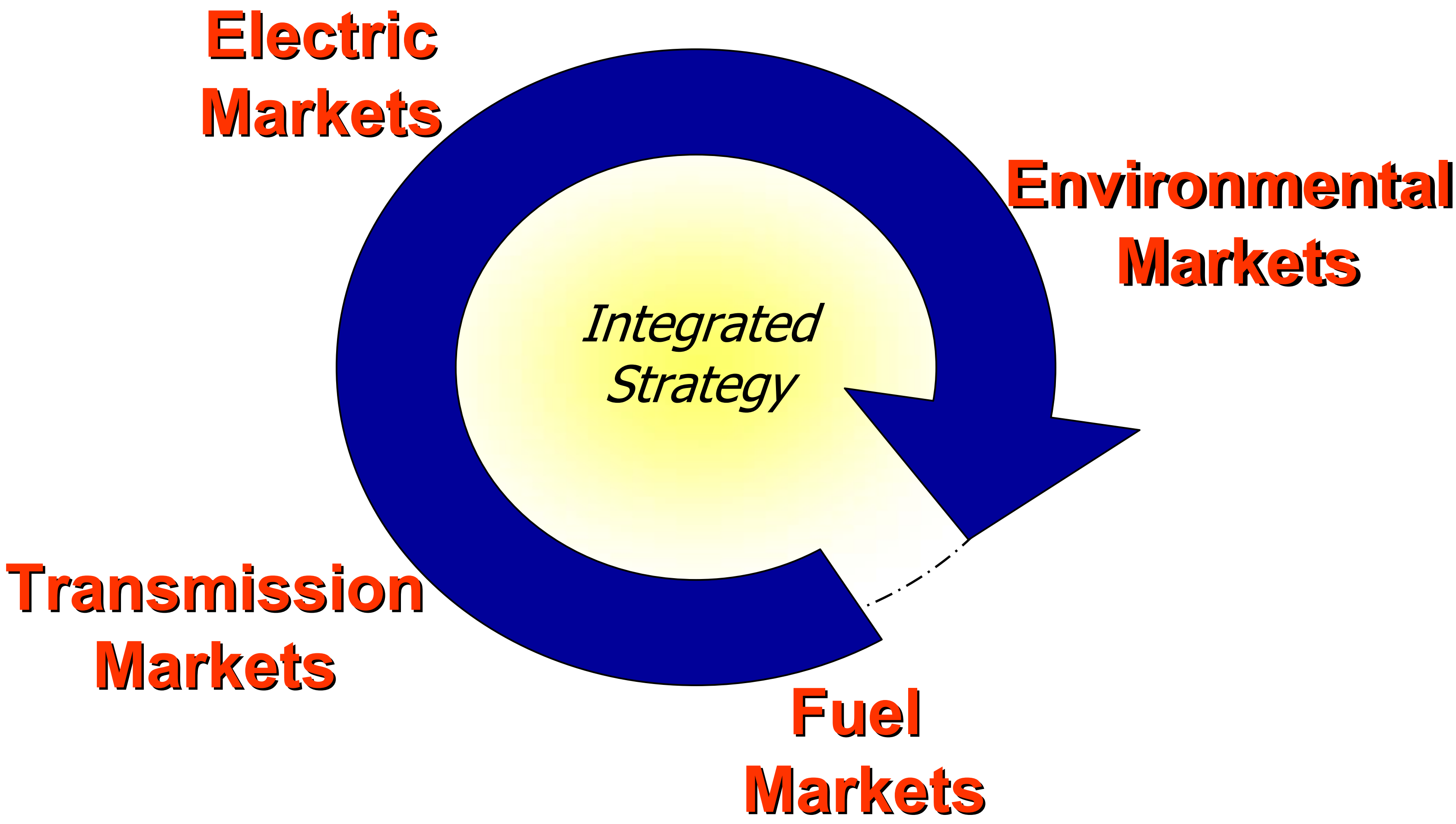
Balancing Market Risks

- Entry and Exit Decision Dynamic
  - Entry from competing generation options
  - Environmental Retrofits
  - Mothballing and Retirements
  - DSM and Response from Loads
- Fuel Price Volatility
- Environmental Regulations and Its Impact on Allowance Prices/Unit Compliance Options

Multi-Model Analytic Platform



Estimating Transmission Investments Requires A Fully Integrated Market Study



Treatment of Existing Transmission Capacity

- Assumed existing Transmission Owners will continue to make incremental investments to maintain current transfer capabilities
- Margins reserved for reliability
- Firm transmission capacity was used for economy energy and capacity flows
- Incremental non-firm transmission capacity was used for only additional economy energy flows
- Used non-simultaneous and simultaneous open and closed-loop interface limits

Key Transmission Build Assumptions

Contribution of New Transmission Capacity to Actual Transfer Capability

- The right percent contribution depends on several factors including:
  - Network topology
  - Location of generation injections and loads
  - Generation and demand patterns
- 60% was used. For every 1MW of physical transmission capacity, 0.6 MW counts towards firm transmission capacity. Higher or lower percentages may be tested in sensitivity analysis cases.
- Assumed all nodal transmission voltages were maintained within $\pm$ 5% of nominal - adequate reactive power compensation for all transmission facilities.

New AC Overhead Transmission Line Costs and Thermal Capacities (2000$)

Line Voltage (kV)	Mean Capacity[1] (MVA)	Std. Dev. [1] (MVA)	68% Confidence Interval[1] (MVA)	95% Confidence Interval[1] (MVA)	ICF's Generic Assumptions (MVA)	Capital Cost[2] ($/kW-mile)
AC Transmission Lines						
115	150	197			100 – 175	2.24
138	203	230			175 – 315	2.00
230	530	191	340 - 721	149 - 912	316 – 768	1.64
345	1,073	258	815 – 1,332	557 – 1,590	769 – 1,435	1.17
500	2,291	754	1,537 - 3,045	784 – 3,799	1,436 – 3,103	0.74
765	3,803	644	3,160 – 4,447	2,516 – 5,091	3,104 – 5,000	0.50

[1] Source is empirical data of transmission line types and their capacities in U.S. Eastern Interconnect.
The thermal capacities referred to above reflect normal limits.
[2] Source is EEI "Transmission Planning for a Restructuring U.S. Electricity Industry" which cites Seppa (1999) "Improving Asset Utilization of Transmission Lines by Real Time Rating."
Line costs shown here include the costs of land, towers, poles, and conductors, substations and related equipment, and right of way. Costs do not include the system reinforcement cost of $336/kW that will be modeled.
EEI increased estimates of Seppa by 20 percent to account for the costs of substations and related equipment.
ICF then added costs to include right of way costs.

Financing Assumptions

Input Assumptions	Transmission	CC and Cogen	Coal	CT
Debt Life (years)	20	20	20	15
Book Life (years)	40	20	20	15
After Tax Nominal Equity Rate (%)	13			
Equity Rate (%)	40[1]	55	40	70
Pre-Tax Nominal Debt Rate (%)	9	8	8	9
Debt Ratio (%)	60	45	60	30
Income Tax Rate (%)	41.2			
Inflation (%)	2.25			
Other Taxes/Insurance – US Average (%)	1.7			
Output				
Levelized Real Fixed Charge Rate (%)	12.3	13.7	12.0	14.8

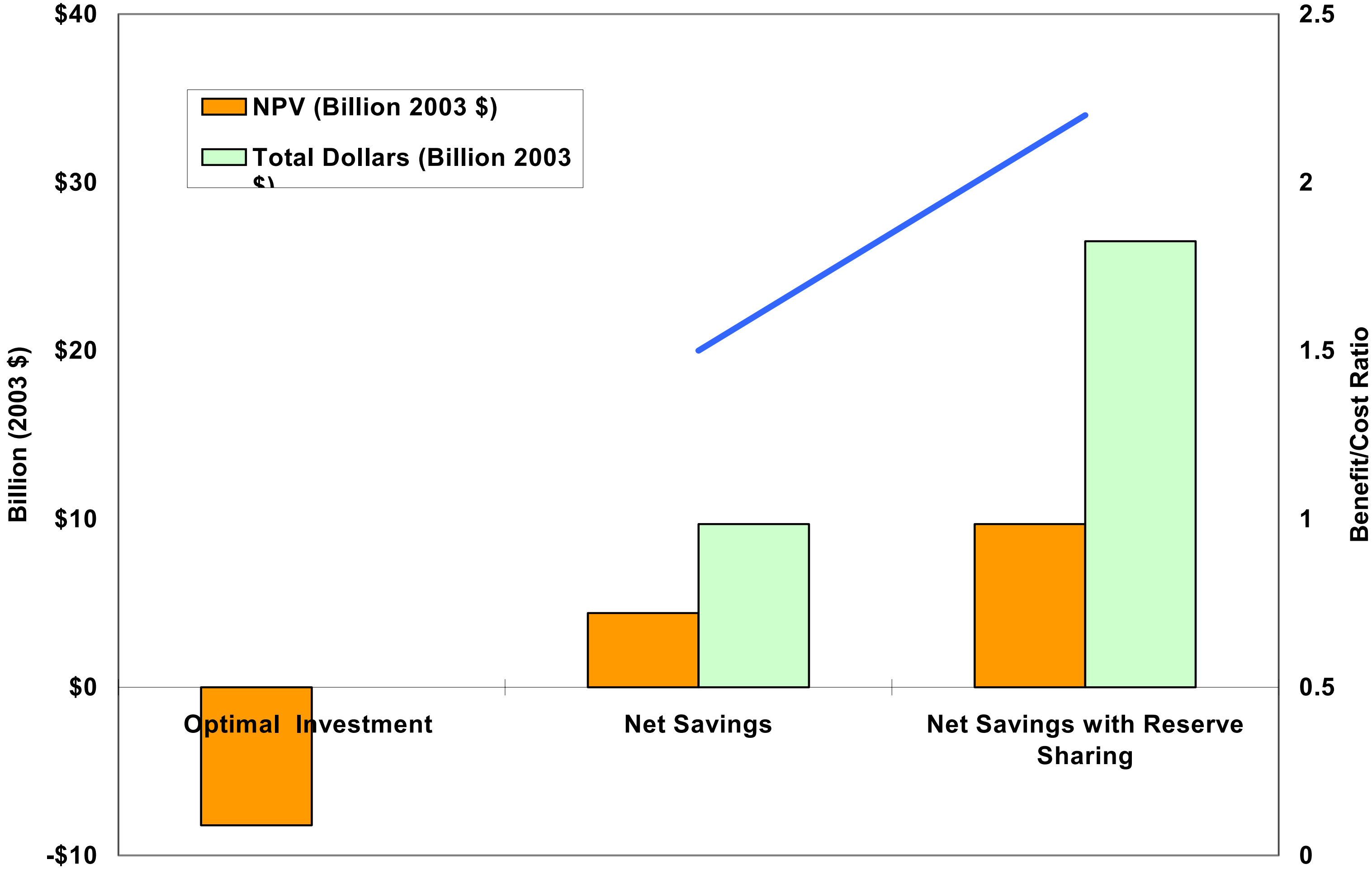
[1] Debt and Equity ratios for individual transmission and generation projects may vary.

Results

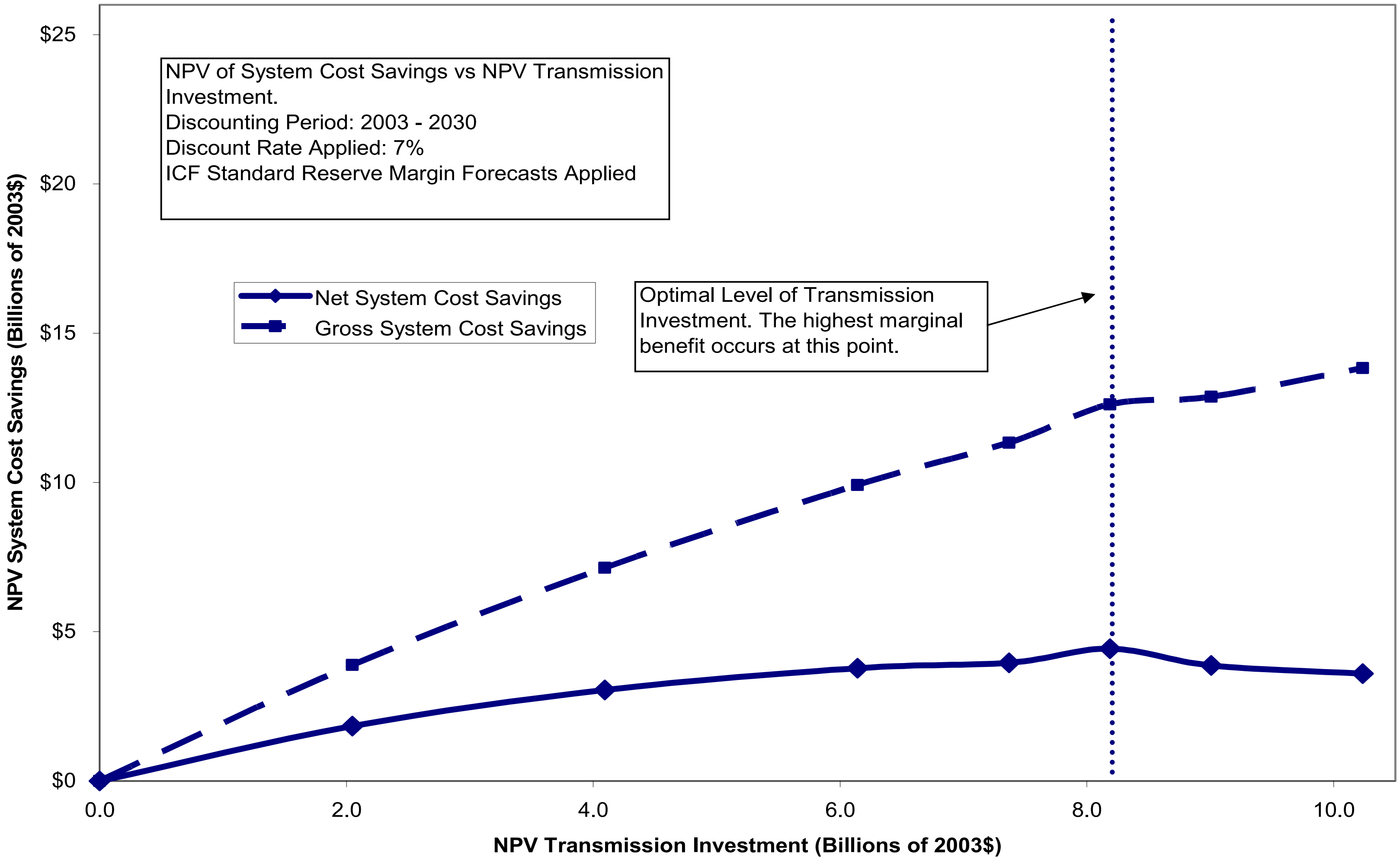
Optimal Investment in Transmission Capacity

	2004-2030 Total (Billion 2003$)	NPV1 2004-2030 (Billion 2003$)	Benefit/Cost Ratio-
Optimal Transmission Investment Cost	$12.0	$8.2	-
Net Savings in Production Costs Compared to ICF's Base Case	$9.7	$4.4	1.5
Net Savings with Benefits from Reserve Sharing	$26.5	$9.7	2.2

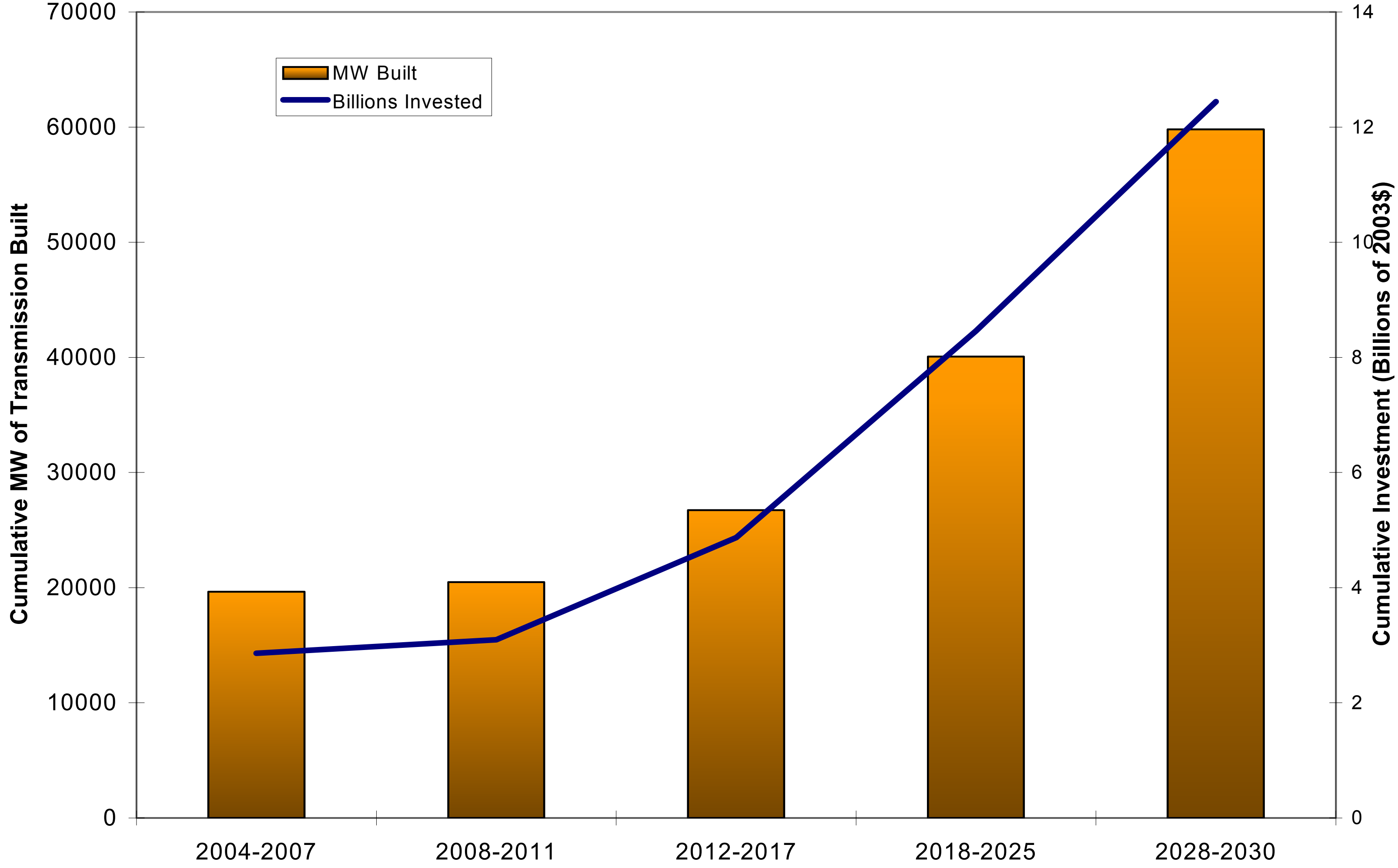
Estimated Economic Benefits at Different Levels of Transmission Investment



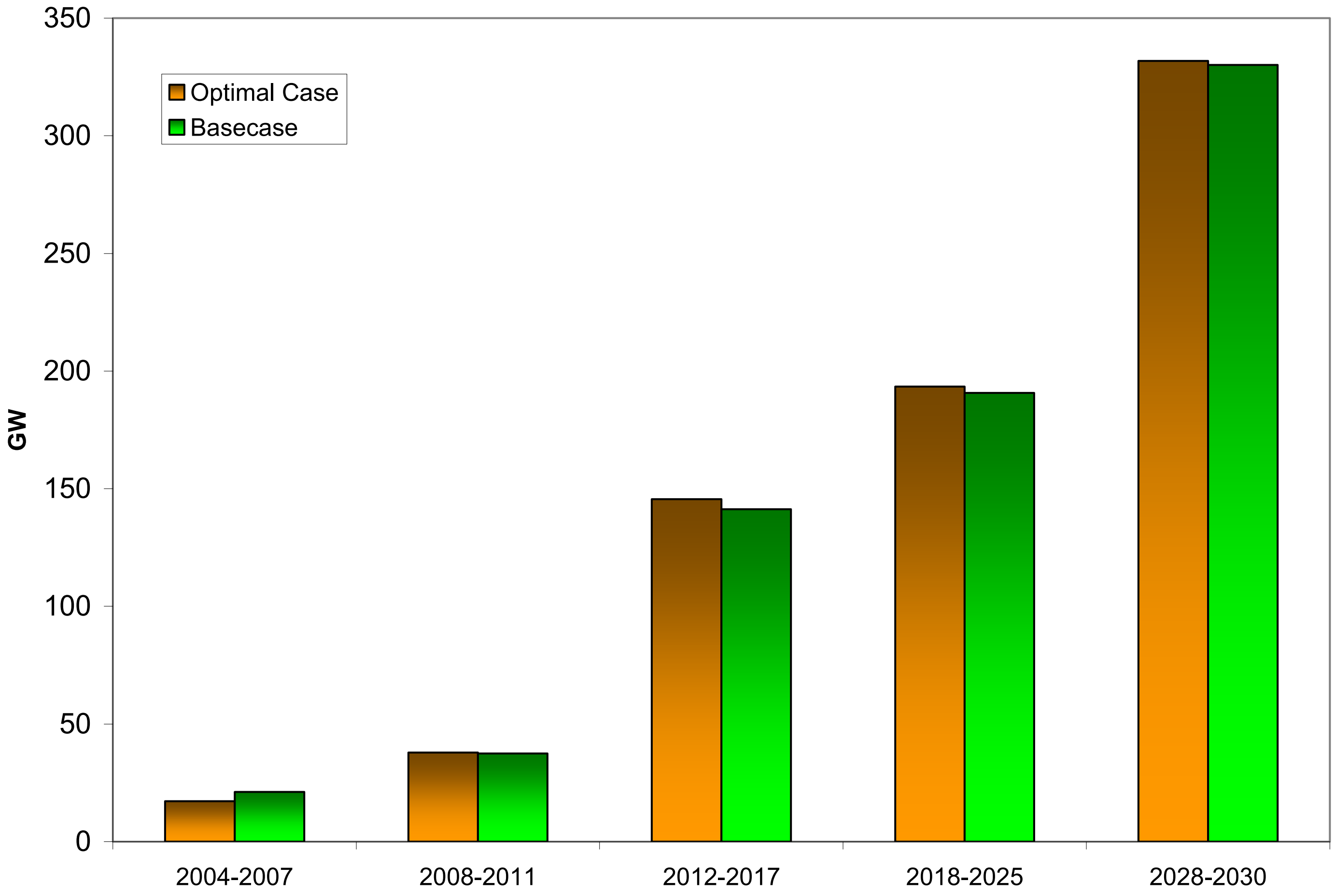
Production Costs Savings



Cumulative Economic Transmission Builds By Investment Year



Economic Generation Additions



Additional Benefits From Reserve Sharing