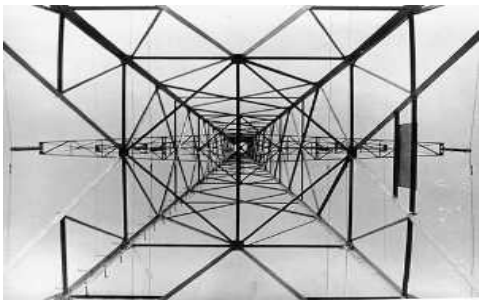
EXECUTIVE SUMMARY

The Costs and Benefits of Investing in the US Transmission Grid



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I. Introduction and Executive Summary

ICF Consulting (ICF) is pleased to provide this white paper analyzing the need for electric transmission investment in the United States. Under contract to Kohlberg Kravis Roberts & Co. (KKR), ICF has prepared this analysis to contribute to the public debate about the appropriate level of such transmission investment.

It is a challenging time with regard to electric transmission. For the past few years, many analysts and policy makers have called for increased investment in the grid. With increasing demand for power and little new transmission investment, it has been clear for several years that the transmission network was becoming overloaded. For example:

- The North American Electric Reliability Council (NERC) reports that power deals not fulfilled due to transmission constraints (also known as Transmission Loading Relief, or TLRs) increased *five-fold* to nearly 1,500 instances in 2002 compared to 300 in 1998.
- According to the Edison Electric Institute (EEI), transmission investment fell $115 million per year for 25 years, from about $5 billion in 1975 to $2 billion in 2000 (in 1997 dollars). In the same period, investment in generation increased by hundreds of thousands of megawatts, placing increasing burdens on a slow-growing network.
- The cost of transmission congestion in the most developed market in the US, the PJM serving the mid-Atlantic region, grew *eight-fold* in the past three years, reaching $401 million in 2002. The overall cost of congestion is in the billions, amounting today to several percent of the national bill for electric power. In addition to increasing costs, congestion acts somewhat like cholesterol in the body, causing flows to be constrained, increasing stress on the system, and contributing to the likelihood of a breakdown.
- In its "National Transmission Grid" study in 2002, the US Department of Energy identified the major power corridors that were congested, with some at their maximum capacity more than 80% of the time. This is equivalent to having rush hour on these critical arteries of the power system nearly all year long.

In this light, few would dispute the need for additional throughput capacity in the transmission network. However, a number of impediments have prevented such enhancements and cast a pall over transmission investment. These factors include: uncertainty over regional transmission organizations (RTOs); long lead times for transmission projects; uncertain returns compared to other rate-based investments; lack of clear incentives for transmission development; lack of a clear regulatory path for merchant transmission projects; and challenges regarding transmission rights-of-way and siting. From 2003-2012, NERC projects an increase of just 6.7 percent in the line-miles of high-voltage transmission.

In the wake of last August's Blackout in the Midwest and Northeast, many hoped that the Congress would pass an Energy Bill that would require mandatory reliability standards and provide a number of incentives for transmission investment. While it came close in the last session of Congress, to date this Bill has not passed, and its outlook in this Congress is at best uncertain. Further, at the state and project level, there are real questions about who should pay for needed upgrades (utility customers or "participants"). Thus, the outlook for new transmission investment at present appears downbeat, in spite of the clear need for such investment.

In this situation, it is important to ask the right questions. In specific: KKR has asked ICF to assess how much *should* be invested in transmission, and what is this deficit of investment in the grid costing customers? Further, what would be the benefits of making the right investments in the grid?

This ICF white paper analytically and directly answers these critical questions. Stated more completely, the key issue is—in light of the increases expected in demand for power on a region-by-region basis; the tradeoffs between building new generation versus new transmission; the opportunities for imports and exports of power between regions; the rate of return that utilities and investors must make; the need to enforce Federal and State environmental laws; the regional outlook for fuel prices; and the need for a reliable network—what is the optimal amount of transmission that compared to the costs be sited and built over the long term, and what is that investment worth to customers?

The purpose of this paper is not to focus on the causes of shortfalls in transmission investment, or to advocate specific remedies, but rather to evaluate the magnitude and impact of this shortfall, and the results of alleviating this shortfall. To do so, ICF has analyzed two types of benefits from adding the right amount of transmission:

1) The benefit in lower electricity bills for consumers that would result from optimizing the level of economic transmission investments (in addition to transmission built to maintain reliability); and
2) The benefit to the economy (in higher output of goods and services) due to the reduction in transmission outages, also called the Value of Lost Load (VoLL). To our knowledge, no previous public study has incorporated this factor into a detailed quantitative analysis of the need for new transmission.

This paper analyzes both components to determine a comprehensive cost of the current deficit in transmission investment, and the benefits of relieving it. Our key findings are summarized in Exhibits 1.1 and 1.2 below in year 2003$. Values are presented on both a total basis covering 2004-2030, and a net present value basis utilizing a 7 percent discount rate.

Exhibit 1.1
Summary of Transmission Benefit-Cost Study Results

	2004-2030 Total (Billion 2003$)	NPV[1] 2004-2030 (Billion 2003$)	Benefit/Cost Ratio[2]
Optimal Transmission Investment Cost	$12.0	$8.2	-
Net Savings in Production Costs Compared to ICF's Base Case[3]	$9.7	$4.4	1.5
Net Savings with Benefits from Reserve Sharing[4]	$26.5	$9.7	2.2
Net Savings with Reserve Sharing and Value of Load Lost (VoLL)	$175.6	$59.7	8.3

[1] Discounted at 7% real
[2] Calculated on NPV basis. See sample calculation in points below.
[3] Base Case assumed no new transmission investments above the level of investments required to maintain existing transfer capabilities. Net savings equal to gross production cost savings less transmission investment
[4] Assumes that with increased throughput capacity of the grid, various regions would avoid the cost of holding significantly high amounts of capacity in reserves.

These results are summarized below:

a. Appropriate economic investment in transmission would provide gross savings of approximately $21.7 billion between 2004 and 2030, and net savings of $9.7 billion after taking $12.0 billion of costs into account. This represents avoided production cost savings only, i.e., there are no benefits from reserve sharing (reduced reserve margins) compared to ICF's Base Case. With such benefits, net savings to consumers would be $26.5 billion. On a net present value basis, the investment cost during the study period would be $8.2 billion year 2003$, with net savings of $4.4 billion from avoided system production costs alone, and $9.7 billion when reserve margin effects are included.

b. At this "optimum" level of transmission investment, consumers could save an additional $149.1 billion to the economy between 2004 and 2030 ($50 billion on a net present value basis) due to a reduction in transmission outages, also called "Value of Lost Load" (VoLL).

   While these figures are much larger than the savings in reduced power costs, the amounts are modest in the context of an economy with a current annual GNP of over $11 trillion. In addition, EPRI has estimated that the current annual cost of transmission and distribution outages to 2 million businesses in the commercial sector is about $46 billion, plus another $6.7 billion annually due to power quality issues. In that light, ICF's projected VoLL amounts seem quite reasonable over a 27-year period (2004-2030).

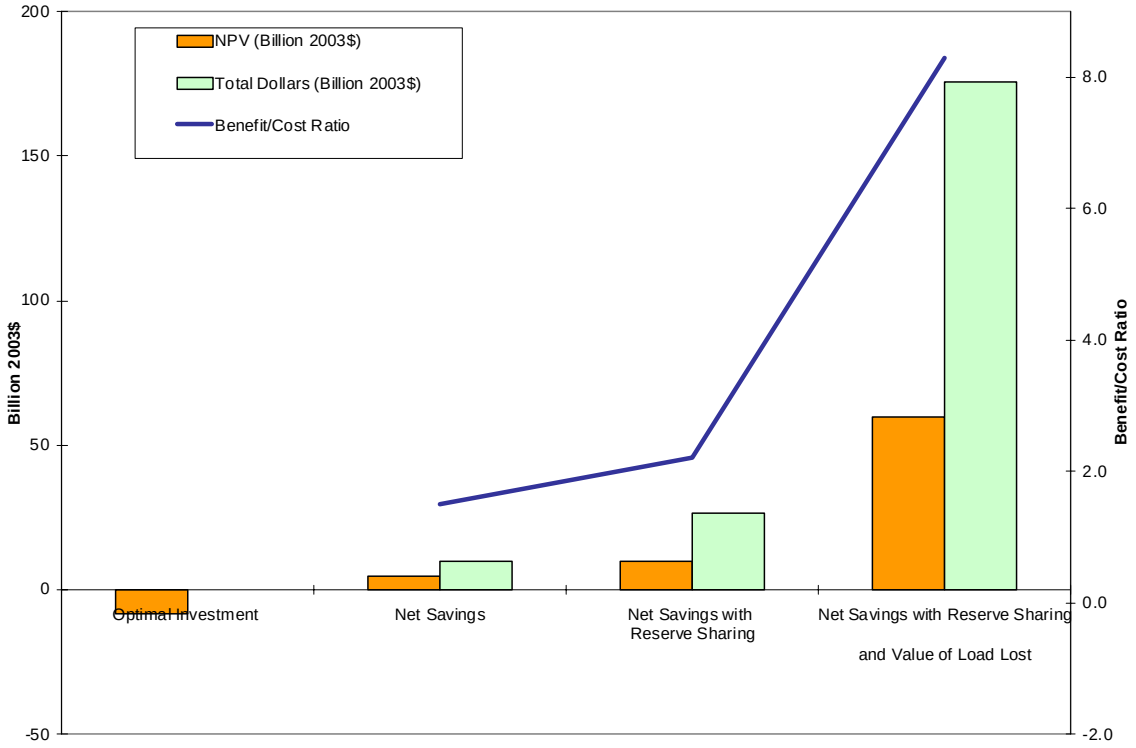
c. In total, ICF forecasts that net savings totaling as much as $175.6 billion could be realized between 2004 and 2030 from an investment of $12.0 billion in transmission over the same period. In Net Present Value, terms this translates to a net present value savings of $59.7 billion from an investment of $8.2 billion.

d. Translating these values to a Benefit/Cost (BC) Ratio yields a positive expected ratio of 1.5. That is, the Base Case yields a net savings of $4.4 billion, and a total gross savings of $12.6 billion. $12.6 billion divided by $8.2 billion total cost yields a 1.5 BC. When the benefits of reserve sharing are included, we expect a BC ratio of 2.2, and if the VoLL is added, the ratio increases to 8.3.

e. Cumulatively, the net savings from economic transmission investment could be approximately $33 in net present value per current customer[1]. Including reserve sharing, the total net present value of benefits could be $73 per current customer (an additional $40), while the total savings including the value of lost load could be approximately $449 per current customer (an additional $376).

[1] Assumes 133 million US electric customers (2002); the number of customers will grow over time.

Exhibit 1.2
ICF Analysis of Net Present Value of System Savings from Economic Transmission Investment (2004 – 2030)



These results indicate that public policy should favor appropriate transmission line development, and that regulations and statutes that discourage such development should be revised. The next two sections describe each component of ICF's analysis in detail.