Analysis of Benefits and Costs for a U.S. Interstate EHV Transmission System

Recent calls for expanding and strengthening the U.S. transmission grid, stemming in part from a desire to integrate large scale renewables, have spurred debate regarding the costs and benefits of such a system. Extrapolated from an independent study by CRA International, the following analysis is intended to assist policymakers by providing national scope and context to the debate.

This conservative analysis demonstrates that as long as costs are allocated broadly across all customers (regardless of the method), the build-out of an interstate EHV transmission system that enables the integration of wind and other new energy resources will provide economic benefits that outweigh the costs. In defining the benefits, the analysis primarily includes generation production costs, congestion, and loss savings.

- Using a simplified alternative approach of allocating a flat charge per customer meter would result in a progressively increasing net savings to around $5/month for the average residential customer. This is achieved for around $1/month of fixed transmission costs over 20 years.[1] Commercial and industrial customers would see similar or greater benefits depending on energy usage and the assumed allocation among residential, commercial, and industrial sectors.

- Using traditional ratemaking with costs allocated based on energy use results in a progressively increasing net savings to as much as $4/month for the average residential customer. This is achieved with transmission costs added on a progressive basis over a 20 year period, with lower costs in earlier years and higher costs in later years. Commercial and industrial customers would see similar or greater benefits depending on usage.

In all cases, the benefits outweigh the cost and result in a net savings on the customer bill. Benefit/cost ratios also improve as more transmission is built over time. After year 20, the fixed charge or the rate base (and associated costs to the customer) will be continually depreciated, even as the associated benefits continue. In addition, this analysis does not include benefits such as reliability, generation reserve sharing, generation diversity, deferred upgrades, economic development/jobs, etc. which further the case for transmission expansion.

The intent of this document is not to promote or advocate a particular cost allocation methodology, but to provide information and context for consideration by policy makers and interested stakeholders.

[1] The average residential customer in the U.S. uses approximately 1,000 kWh (1.0 MWh) per month.

Methodology:

The study by CRA International demonstrated the benefits of constructing 1,200 miles of 765 kilo-volt (kV) transmission in the Southwest Power Pool (SPP) to enable the development of 14 GW (approximately 20% of the SPP load) of wind energy. Including a CO_2 price of $18/ton, the study revealed an $11.90/MWh gross benefit in power supply costs including production cost savings, loss savings, and reduced congestion. The study demonstrated that building transmission results in a net benefit to customers in the SPP region, including those states where no transmission was anticipated to be built.

This study is available at:
http://www.spp.org/publications/Analysis_of_Benefits_Two_Loop_SPPFinal.pdf

To be conservative in applying benefits to the entire U.S., this analysis assumes 50% of these benefits ($5.95/MWh) are achievable for a similar 20% wind penetration level across the country.[2] This attempts to recognize that there are regional differences in fuel mix, production costs, losses, and congestion.

Using the most recent Energy Information Administration load data[3] and assuming a 1.0% annual load growth, a projection was made for a 20-year build-out of EHV transmission overlay for the contiguous 48 states beginning in 2011. For the cost of this EHV overlay, this analysis assumes a range of $60-$100 billion. The timing of cash flow spend could vary, so for simplification it was assumed that this would require a level $3-5 billion of investment each year for 20 years. This analysis also assumes that the benefits will increase linearly with the transmission build to a final total of $5.95/MWh in year 20.

Summary Using Simplified Cost Allocation:

As an alternative to traditional ratemaking, which would allocate the cost of a new EHV interstate transmission system on a load ratio share, this method assumes the costs are allocated on a per meter basis with a flat surcharge starting in Year 1. These costs would not go into a usage rate, but rather would be recovered through some form of FERC recovery mechanism by transmission developers and shown as a separate line-item on the customer bill.

- There are 141,338,278 electric meters in the lower 48 U.S. states (EIA).
  - 123,277,321 residential
  - 17,269,171 commercial
  - 791,736 industrial

- Low ($60B) and High ($100B) cost scenarios shown.

[2] The CRA analysis examined the benefits for 1,200 miles of the SPP EHV Overlay. To account for regional differences in applying the analysis nationwide, we estimated the benefits shown in the CRA analysis to be for the entire 2,400 miles proposed for the SPP EHV Overlay, thus discounting the benefits to 50%.

[3] http://www.eia.doe.gov/cneaf/electricity/esr/table5.html

- Note that this analysis subjectively shows monthly costs/meter that achieves a relative balance between the residential, commercial, and industrial sectors' respective contributions. This could be adjusted for a variety of reasons and is meant only to demonstrate the methodology.

- This methodology creates a slightly higher cost in early years in comparison with adding costs on a progressive basis, but these costs do not increase over the 20 years. All customers are provided with certain and predictable costs.

The benefits in year 2030 amount to $5.95/MWh (from the CRA study). The cost to the average residential customer would be a flat $0.70-1.15/month for 20 years, with the benefits increasing to $5.95/MWh over 20 years.

Cost Allocated Per Meter (Flat Surcharge)

$60 billion - $3 billion annual

	# Meters	Monthly Cost/Meter	Total Annual Charge
Residential	123,277,321	$0.70	$1,035,529,496
Commercial	17,269,171	$4.80	$994,704,250
Industrial	791,736	$105.00	$997,587,360
		TOTAL	$3,027,821,106

$100 billion - $5 billion annual

	# Meters	Monthly Cost/Meter	Total Annual Charge
Residential	123,277,321	$1.15	$1,701,227,030
Commercial	17,269,171	$8.00	$1,657,840,416
Industrial	791,736	$175.00	$1,662,645,600
		TOTAL	$5,021,713,046

Snapshot of Year 2020 (Residential - 1.0 MWh/month):

- Gross Benefits: $2.98/MWh
- Gross Transmission Cost (Low, High Case): $0.70/month, $1.15/month
- Net Benefit (Low, High Case): $2.28/month, $1.83/month
- Benefit/Cost Ratio (Low, High Case): 4.26, 2.59

Snapshot of Year 2030 (Residential - 1.0 MWh/month):

- Gross Benefits: $5.95/MWh
- Gross Transmission Cost (Low, High Case): $0.70/month, $1.15/month
- Net Benefit (Low, High Case): $5.25/month, $4.80/month
- Benefit/Cost Ratio (Low, High Case): 8.50, 5.17

Summary Using Traditional Ratemaking:

Using traditional ratemaking, costs are assumed to be allocated on a load-ratio share across the contiguous 48 states. This analysis used an annual carrying charge of 16%, which includes the required return on rate base, depreciation (depreciation and inflation were considered offsetting in this case), O&M expenses, and taxes. Since transmission costs are not immediately due and payable upfront, this number represents the amount that would be added to rates and paid by customers for the investments in a given year. This also assumes costs are recoverable without significant regulatory lag.

- Low ($60B) and High ($100B) cost scenarios shown.
- The costs to the customer start out lower than the alternative method, but increase progressively over time.

The benefits in year 2030 amount to $5.95/MWh (from the CRA study). When the overlay is completed in year 2030, the total cumulative cost would be between $1.95/MWh and 3.24/MWh, resulting in a net savings of $2.71-4.00/MWh (the benefits would increase to $5.95/MWh over 20 years).

Snapshot of Year 2020 (Applicable to All Customers):

- Gross Benefits: $2.98/MWh
- Gross Transmission Cost (Low, High Case): $1.07/MWh, $1.79/MWh
- Net Benefit (Low, High Case): $1.90/MWh, $1.18/MWh
- Benefit/Cost Ratio (Low, High Case): 2.79, 1.66

Snapshot of Year 2030 (Applicable to All Customers):

- Gross Benefits: $5.95/MWh
- Gross Transmission Cost (Low, High Case): $1.95/MWh, $3.24/MWh
- Net Benefit (Low, High Case): $4.00/MWh, $2.71/MWh
- Benefit/Cost Ratio (Low, High Case): 3.05, 1.84

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