ESIG
ENERGY SYSTEMS INTEGRATION GROUP

ESIG REPORT

Multi-Value Transmission Planning for a Clean Energy Future

FACT SHEET

Achieving the country's rapid decarbonization and renewable energy goals requires not only significant investment in wind, solar, and other renewable generation technologies, but also investment in and expansion of the underlying transmission network. A robust transmission system can move low-cost renewable energy across long distances and improve reliability. The system benefits from the increased diversity in load and renewable generation, as the grid spans regions having different weather patterns and experiencing periods of scarcity or abundance at different times. When one region faces a power shortage, a well-designed transmission grid provides support from neighboring areas.

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A Need for Multi-Value Planning to Evaluate Transmission Investments

Currently, transmission planning processes are built around achieving a reliable system at the local level, not necessarily improving economic efficiency or bulk system reliability. Moreover, while the current planning framework may be efficient under average circumstances, it fails to protect consumers from tail-end risks—low-probability but high-impact events—and potential exposure to extreme costs.

Production costs, the de facto metric for measuring economic transmission benefits and justifying investment, are only one piece of the puzzle. A wide range of benefits should be considered when evaluating transmission, including reduced operating costs, environmental benefits, access to low-cost renewable energy, generation capital cost benefits, risk mitigation benefits, and improvements in reliability and resilience. In addition, transmission planning horizons should reflect the lifetime of the asset, going out far enough to see the benefits that arise with system changes. Moving away from a snapshot framework to assess multiple future scenarios is vital for effective planning. Not only does transmission provide near-term efficiency, it also serves as an insurance policy that protects customers against extreme weather or macroeconomic volatility.

Case Study of a Methodology to Quantify a Range of Benefits

The Energy Systems Integration Group's Transmission Task Force undertook a case study to demonstrate useful methodologies for employing a multi-value framework to plan transmission effectively. It quantifies two types of transmission upgrades: large-scale transmission upgrades connecting the West Texas renewable energy zones to East Texas and the Houston load center, and a transmission line between the Electric Reliability Council of Texas (ERCOT) and the southeastern United States (Georgia, Mississippi, and Alabama). This case study seeks to revitalize multi-value transmission planning, provide a playbook for transmission planners to implement on their own system, and inform comments and proposals

This fact sheet is adapted from ESIG's report Multi-Value Transmission Planning for a Clean Energy Future.

to the Federal Energy Regulatory Commission's Notice of Proposed Rulemaking (FERC NOPR)[1] and ongoing stakeholder efforts at independent system operators and regional transmission organizations on transmission planning reform.

Types of Transmission Benefits

Considerable work in recent years has helped to categorize and implement a wide range of transmission benefits. This study built on these and focused on six core benefits deemed most important for transmission planning reform. See Table 1.

Study Results

Our results showed that a multi-value transmission planning framework yielded significant benefits beyond production cost savings. While production cost savings are enough for some of the evaluated transmission projects to break even, the multi-value framework showed that when a full range of benefits was evaluated, all three of the transmission projects studied had significantly higher benefit-cost ratios. Recognizing these benefits could ultimately change transmission investment decisions (Figures 1 and 2).

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TABLE 1

The Six Transmission Benefits Categories Evaluated

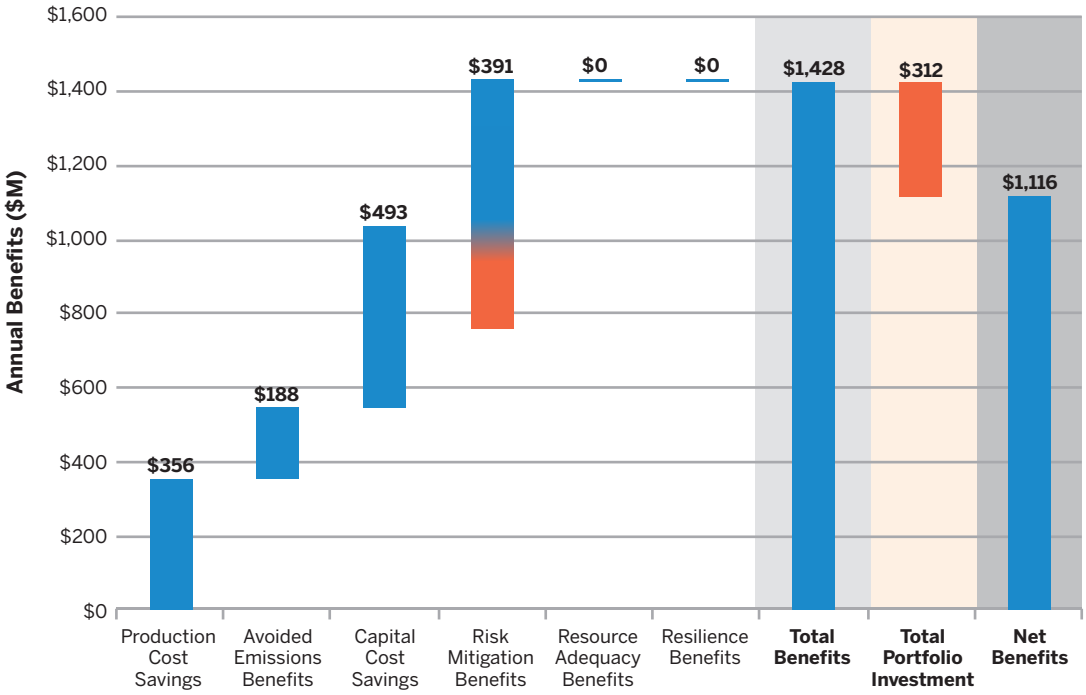
Benefit	Description
Production cost benefits	Quantification of fuel cost savings, reduced curtailment, variable operations and maintenance costs, reduced cycling of thermal power plants.
Emissions reduction benefits	The reduction in emissions of environmental pollutants, including CO_2, NOx, SOx.
Generation capital cost benefits	Reduced capital costs of new generating capacity and lower costs of achieving a renewable energy target from being able to access lower-cost renewable regions that are associated with better resource quality, lower land cost, and easier development.
Risk mitigation benefits	Production cost savings across a range of uncertain future conditions associated with varying gas prices, load growth, renewable build-out and thermal plant retirements.
Resource adequacy benefits	The reduction in loss-of-load expectation attributed to the transmission line, compared to the net cost of a new combustion turbine(s) necessary to achieve the same level of reliability.
Resilience benefits	The reduction in unserved energy attributed to the transmission line during the loss-of-load events remaining after resource adequacy improvements, valued at the ERCOT loss-of-load assumption of $20,000/MWh.

Source: Energy Systems Integration Group.

1 Federal Energy Regulatory Commission Notice of Proposed Rulemaking, April 2022, https://www.ferc.gov/news-events/news/ferc-issues-transmission-nopr-addressing-planning-cost-allocation.

FIGURE 1

Multi-Value Benefit Stacking for the Transmission Line Relieving the West Texas Export Constraint, 2030



The six bars on the left represent benefits that are added together to arrive at the total benefits of $1.4 billion. After investments are subtracted (red bar), the net annual benefits of the transmission line are calculated to be $1.1 billion (blue bar on the far right).

Source: Energy Systems Integration Group.

These results also highlight a key finding for transmission planning: different transmission projects can have large differences in the *types* of value they bring. Transmission that helps to access new, low-cost generating resources, and deliver that energy to load centers, yields large production cost savings and environmental benefits, helps meet public policy goals, and brings risk mitigation benefits. Other transmission projects that help a region access more *diversified* resources are better suited to provide resource adequacy and resilience benefits. The latter have relatively greater generation capital cost benefits and provide an insurance policy against macroeconomic volatility, extreme weather, and other unexpected events.

The multi-value framework also examines the potential avoided cost for ratepayers during extreme events or macroeconomic uncertainty, showing that transmission is a valuable insurance policy for the system and one that will pay dividends throughout the energy transition.

Key Recommendations for Grid Planners

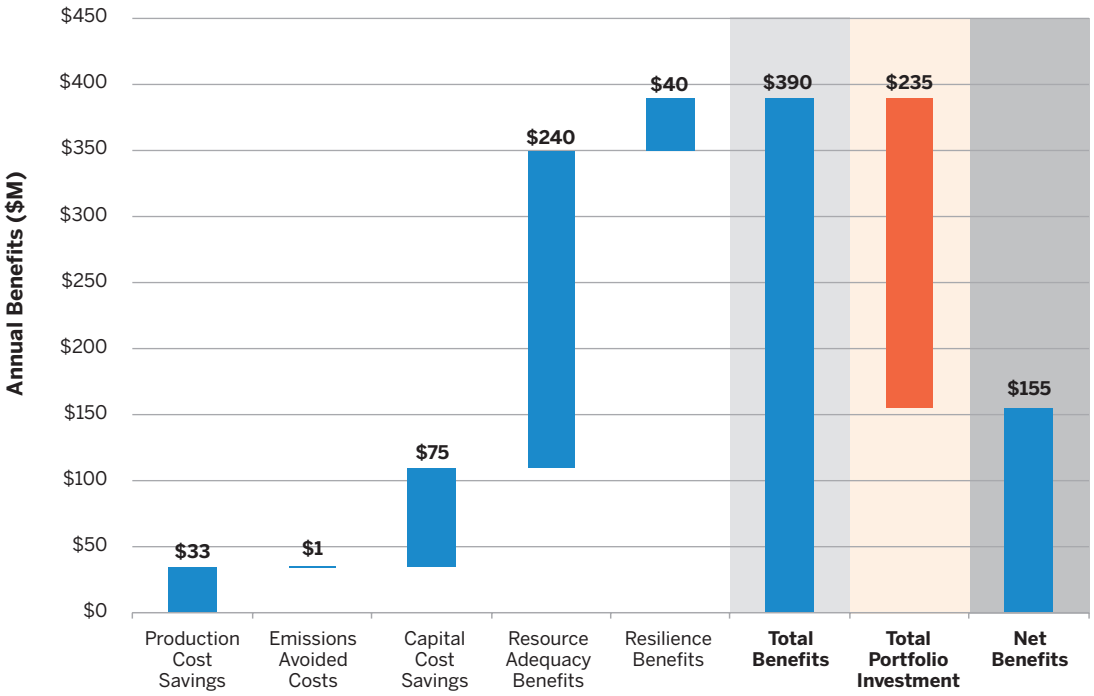
The planning processes in use today can be improved with the following recommendations for transmission planners, policymakers, and regulators.

1. **Go beyond production costs and implement a multi-value benefit framework.**

   Accurately assessing the wide range of benefits from transmission is important as the system transitions to zero-marginal-cost renewable resources. These benefits should be identified, prioritized, and clearly defined early in the transmission planning process.

FIGURE 2

Multi-Value Benefit Stacking for the Transmission Line Connecting ERCOT and Southern Company, 2030



Results from stacking the multi-value benefits for the ERCOT-Southern Company transmission line show total benefits of $390 million, compared to $33 million when considering production cost savings only. This increases the benefit-cost ratio from 0.14 to 1.66.

Source: Energy Systems Integration Group.

2. Plan for the long term and start today.

Transmission infrastructure can be a 40- to 50-year asset. The planning horizon should reflect that and go out far enough to see the benefits that arise with specific system changes.

3. Get comfortable with uncertainty and adopt established methods to deal with it.

Like all of us, grid planners do not have a crystal ball to see the future. The classic approach to solving this long-standing problem in power systems planning is to use heuristic-based scenario and parametric analysis. However, significant improvements in data science and statistics have been applied in other sectors, such as the tech and finance industries, and are now migrating to the energy field. Modern power planning tools offer significantly improved capabilities to better quantify risks and benefits.

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4. Quantify resource adequacy and resilience benefits.

Transmission spanning regions that have different weather patterns can mitigate the impacts—both financial and social—of extreme events. This provides an insurance policy for ratepayers. Through transmission expansion, individual regions can achieve reliability with lower capacity investments than if they were unable to share energy with neighbors and had to build a full suite of resources themselves. When extreme weather strikes, *not* having built new interregional transmission can have devastating consequences for ratepayers.

5. Break down silos and plan interregional projects.

Interregional coordination is a bedrock of the energy transition. Reliability and resilience benefits accrue most strongly from transmission that connects electrically diverse systems, but market and planning constructs need to account for value from sharing between neighboring systems.

Enabling a proactive, scenario-based, multi-benefit framework for long-term regional transmission planning will ensure that the power system is reliable, efficient, and increasingly clean for today and into the future.

Adapted from *Multi-Value Transmission Planning for a Clean Energy Future,* a report by the Energy Systems Integration Group's Transmission Benefits Valuation Task Force. This fact sheet and the full report are available at https://www.esig.energy/multi-value-transmission-planning-report.

To learn more about the recommendations described here, please send an email to info@esig.energy.

The Energy Systems Integration Group is a nonprofit organization that marshals the expertise of the electricity industry's technical community to support grid transformation and energy systems integration and operation. Additional information is available at https://www.esig.energy and info@esig.energy.