The Brattle Group

Barriers to Transmission Investments and Implications for Competition in Wholesale Power Markets

Presented by:

Johannes Pfeifenberger

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Role of Transmission in Competitive Power Markets

Transmission is key to enabling competition in wholesale power markets

- Increases the relevant "geographic markets," reducing market concentration
  - Allows for more competition between sellers and buyers
  - Enables trading to take advantage of load, fuel, and cost diversity
  - Increases market liquidity
- Larger geographic markets offer significant economic benefits
  - Increased competition in power generation reduces inefficient mark-up of prices above marginal costs
  - Reduces incentives to depress prices with subsidized generation
  - Increased diversity reduces risks
  - Increased liquidity reduces transactions costs, increases price transparency, allowing for improved risk management

Despite these benefits, competitive impact of transmission expansion is rarely considered in planning processes

Examples of "Competitive" Transmission…

Some merchant transmission lines with market-based cost recovery:

- Where market fundamentals create long-lasting price differences
  - In regions with pancaked transmission service (e.g., WECC)
  - To areas with generation cost advantage (e.g., high-capacity factor wind generation in Wyoming and Montana)
  - To load pockets without new generation (e.g., NYC and LIPA)
- Where siting/permitting barriers are more modest (e.g., open public lands in West or ocean floor off MidAtlantic and Long Island)
- Where long-term transmission contracts are still available (e.g., from wind developers in WECC; from public power such as LIPA)
- Where owners are able to control access and capture a sufficient share of overall benefits (e.g., through HVDC technology)

Mostly anchor-tenant/open-season model similar to pipelines

- Examples: Neptune, MATL, Chinook/Zephyr

… but Mostly "Regulated" Transmission

Transmission largely <u>infrastructure investments</u> based on <u>state or regional planning</u> with cost recovery at <u>regulated rates</u>

- Public goods aspect of transmission:
  - Benefits broad in scope, wide-spread geographically, diverse in impacts on market participants, and occurring over many decades
  - Owner generally unable to capture sufficient portion of benefits
  - Will tend to lead to under-investment and over-use
- Some competition for developing regulated transmission
  - Out-of-footprint investments by established transmission owners (ERCOT and SPP examples)
  - Independent transmission developers (Path 15, Trans Bay, other efforts)
  - Efforts to eliminate "Right of First Refusal" of incumbent transmission owners (e.g., FERC NOPR, CAISO, Primary Power, and Central Transmission orders)

Barriers to Efficient Transmission Investments

Numerous barriers reduce transmission investment below optimal levels:

- Siting and permitting barriers
- Planning barriers
  - Planning focused on reliability project, some “economic” or “congestion relief” projects
  - Only starting to learn how to plan for “public policy” (renewables) projects
- Cost recovery barriers
  - Issue most acute for multi-state, inter-regional, and multi-purpose projects
- Opposition based on economic and competitive impacts
  - By load serving entities and state regulators if increased export capability might increase wholesale power prices
  - By generators (including transmission owners with affiliated generation) if increased import capability would decrease wholesale power prices
  - By established transmission owners to third-party transmission development within their footprint (ROFR)

FERC “incentives” help overcome but do not actually reduce key barriers

Planning & Cost Recovery: What Works?

Existing transmission planning and cost recovery processes have varying degrees of effectiveness

- ***Works well*:** traditional single-utility, single-state projects built to satisfy reliability needs
- ***Mostly works*:** reliability-driven regional projects and *conventional* generator interconnection requests at the RTO level
  - Some unintended consequences of existing RTO cost allocation framework
  - MISO's assignment of wind integration costs illustrates difficulties
- ***Still mostly unresolved*:** all other types of regional and inter-regional projects, including "economic" projects, *renewable integration* projects, EHV overlay projects, and any multi-purpose projects
  - ERCOT and CAISO (two single-state ISOs) first resolved planning and cost recovery for multi-utility, multi-purpose, and renewable integration projects
  - SPP and Midwest ISO now have planning and cost recovery for regional projects (approved by FERC in June and December), though still untested
  - Other RTOs and regions have only started to address this issue
  - FERC NOPR: delegation of planning and cost recovery to each "region"

Cost Allocation: A Barrier for Regional Projects

Planning, permitting, and cost allocation process is "easier" (and more sequential) for single-state projects:

- Planning determines need (e.g., overall benefits in excess of total project costs)
- State permitting/regulatory process confirms need and approves project
- Approved projects receive cost recovery from customers within state
- Still, some challenges for in-state projects with regional benefits (e.g., Brookings line in MN)

Interaction between cost allocation and permitting creates barrier for many multi-TO, multi-state projects:

- Permitting processes primarily focused on costs and benefits to individual states and utilities: share of benefit in excess of allocated share of costs
- "Beneficiary pays" framework creates incentives to dismiss difficult-to-quantify benefits to achieve lower cost allocation
- Result: projects beneficial to region often do not appear to be beneficial to individual states or utilities based on their shares of costs and benefits

Cost Allocation: Fight Over "Measurable" Benefits

CAISO, SPP, MISO and ERCOT:

- Postage stamp allocation for policy-driven regional projects based on showing (or belief) that **benefits broadly accrue to region** as a whole

FERC NOPR:

- Allocation should be based on "cost causation" or "beneficiary" principles
- Should be "**at least roughly commensurate with estimated benefits**"; those that receive no benefit must not be allocated costs involuntarily
- Postage stamp may be appropriate if all customers tend to benefit from class or group of facilities or if distribution of benefits is likely to vary over long life of facilities
- FERC will use backstop cost-allocation authority if no agreement is reached amongst regional stakeholders

Proposed new legislation (Corker et al.)

- "…no rate…shall be considered just and reasonable unless…based on an allocation of costs…reasonably proportionate to **measurable economic or reliability benefits [to] 1 or more persons** that pay the rate…"

Cost Allocation for Projects vs. Regional Plans

- Cost allocation frequently unworkable or not even meaningful on a project-by-project basis
  - Sum of benefits of individual projects are often significantly less than the overall benefits of a comprehensive regional plan ➔ resulting in rejection of desirable projects
- Cost allocation less contentious for regional plans than individual projects
  - Estimated benefits will be more uniform across region for regional plan than for individual projects ➔ allocation that is “roughly commensurate with estimated benefits” will be more uniform
  - Portfolio of projects in regional plans allows consideration different types of benefits to different types of stakeholders ➔ makes it easier to achieve multi-state agreements
- More uniform distribution of benefits allows for less contentious, less complex cost allocation methodologies

Planning: Reliability vs. Economics & Public Policy

- Well-established process for reliability-driven transmission planning:
  - Engineering analyses based on well-defined cases to first identify and then address reliability violations
  - Clear criteria (reliability standards) and well-honed (formulaic) evaluation processes
  - Established analytical tools (load flow analyses, stability analyses)
  - "Economics" limited to estimation and comparison of project costs (though economic value increasingly explored for large projects)
- Several eastern RTOs developed similar process for "economic" and "public policy projects"
  - Formulaic production cost analyses and benefit-cost thresholds
  - Unintended consequence: rejection of most "economic" projects
- Frameworks similar to reliability planning process are not effective for "economic" and "public policy" projects

Urgent need for flexible planning framework that recognizes broad range of transmission-related benefits

Transmission Benefits: To Whom and When?

The benefits of regional transmission projects are:

▪ **Broad in scope**	• Increased reliability and operational flexibility • Reduced congestion, dispatch costs, and losses • Lower capacity needs and generation costs • Increased competition and market liquidity • Renewables integration and environmental benefits • Insurance and risk mitigation benefits • Fuel diversification and fuel market benefits • Economic development from G&T investments
▪ **Wide-spread geographically**	• Multiple transmissions service areas • **Multiple states** or regions
▪ **Diverse in their effects on market participants**	• **Customers**, **generators**, **transmission owners** in regulated and/or deregulated markets • Individual market participants may capture one set of benefits but not others
▪ **Occur and change over long periods of time**	• Several decades • Changing with system conditions and future generation and transmission additions • Individual market participants may capture different types of benefits at different times

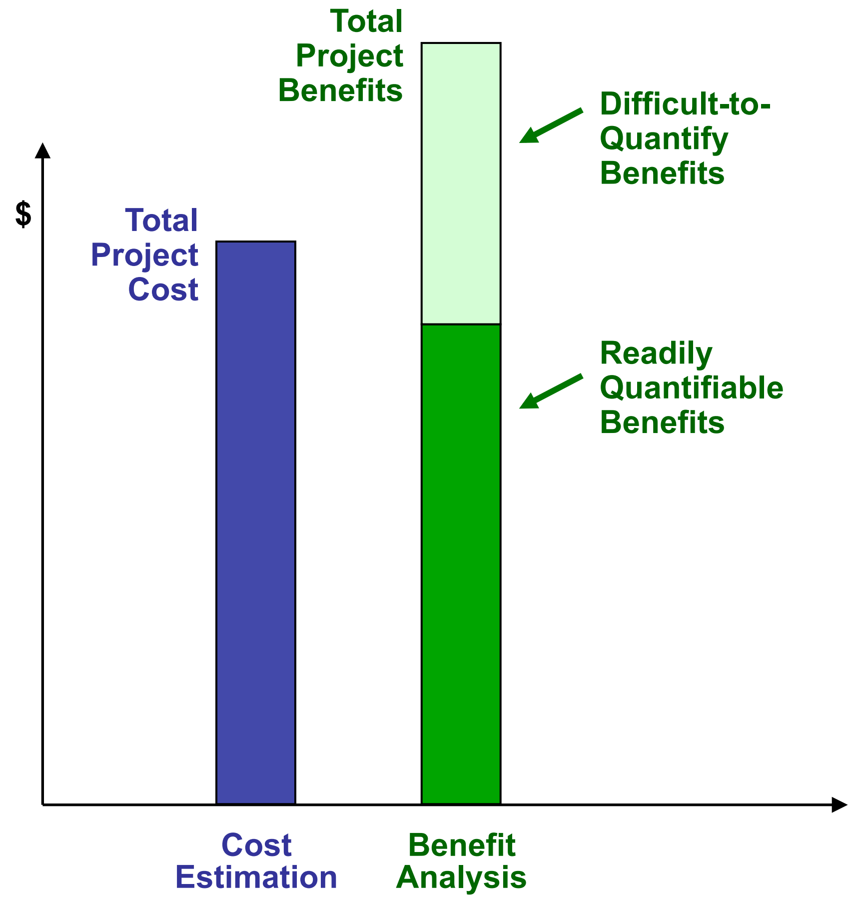
Implications of "Difficult to Quantify" Benefits

Planning processes need to recognize that many transmission benefits are difficult to quantify

- ♦ There are no "unquantifiable" or "intangible" benefits!
- ♦ Difficult-to-quantify benefits need to be explored and considered at least qualitatively
- ♦ Standard economic analysis tools (e.g., production cost models) capture only a portion of transmission-related benefits

Failure to consider difficult-to-quantify benefits can lead to rejection of desirable projects:

- ♦ Total benefits > Costs
- ♦ Quantified benefits < Costs



Total Benefits vs. Benefits that Can be Allocated

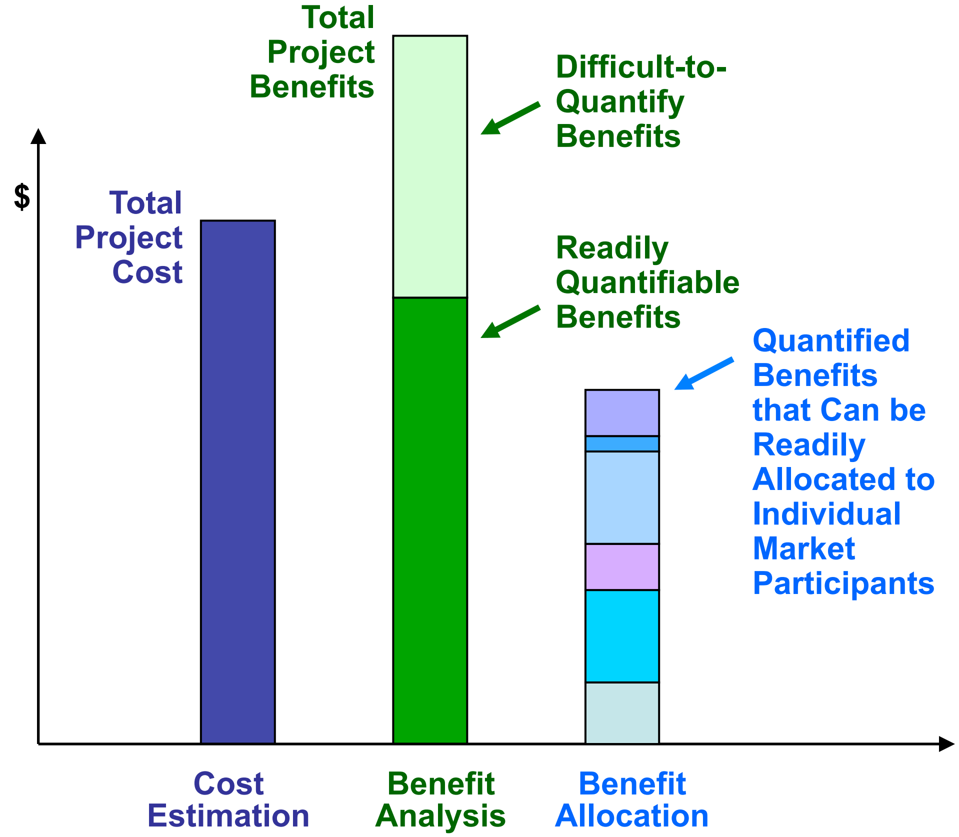
Benefits of transmission projects should be analyzed prior to and separate from analyses to determine how costs should be allocated

Recommend 2-step approach:

1. Determine whether projects are beneficial to the region
2. Evaluate how the cost of beneficial projects should be allocated

Because:

- ♦ Benefits that can be allocated readily or accurately tend to be only a subset of readily-quantifiable benefits
- ♦ Relying on allocated benefits to assess overall project economics would result in rejection of some desirable projects



Understated Benefits “Built Into” Many Models

Narrow focus on “production cost” simulation models understates transmission-related benefits

- Production cost models quantify short-term dispatch cost savings but cannot capture a wide range of transmission-related benefits:

  “The real societal benefit from adding transmission capacity comes in the form of enhanced reliability, reduced market power, decreases in system capital and variable operating costs and changes in total demand. The benefits associated with reliability, capital costs, market power and demand are not included in this [type of] analysis.”

  (SSGWI Transmission Report for WECC, Oct 2003; emphasis added)

- Narrow or unrealistic modeling assumptions and simplistic benefit metrics fail to capture full impact of transmission buildout
- Process fails to capture important (but hard to quantify) benefits of regional transmission projects, including competitive impacts

Important Transmission Benefits are Often Ignored

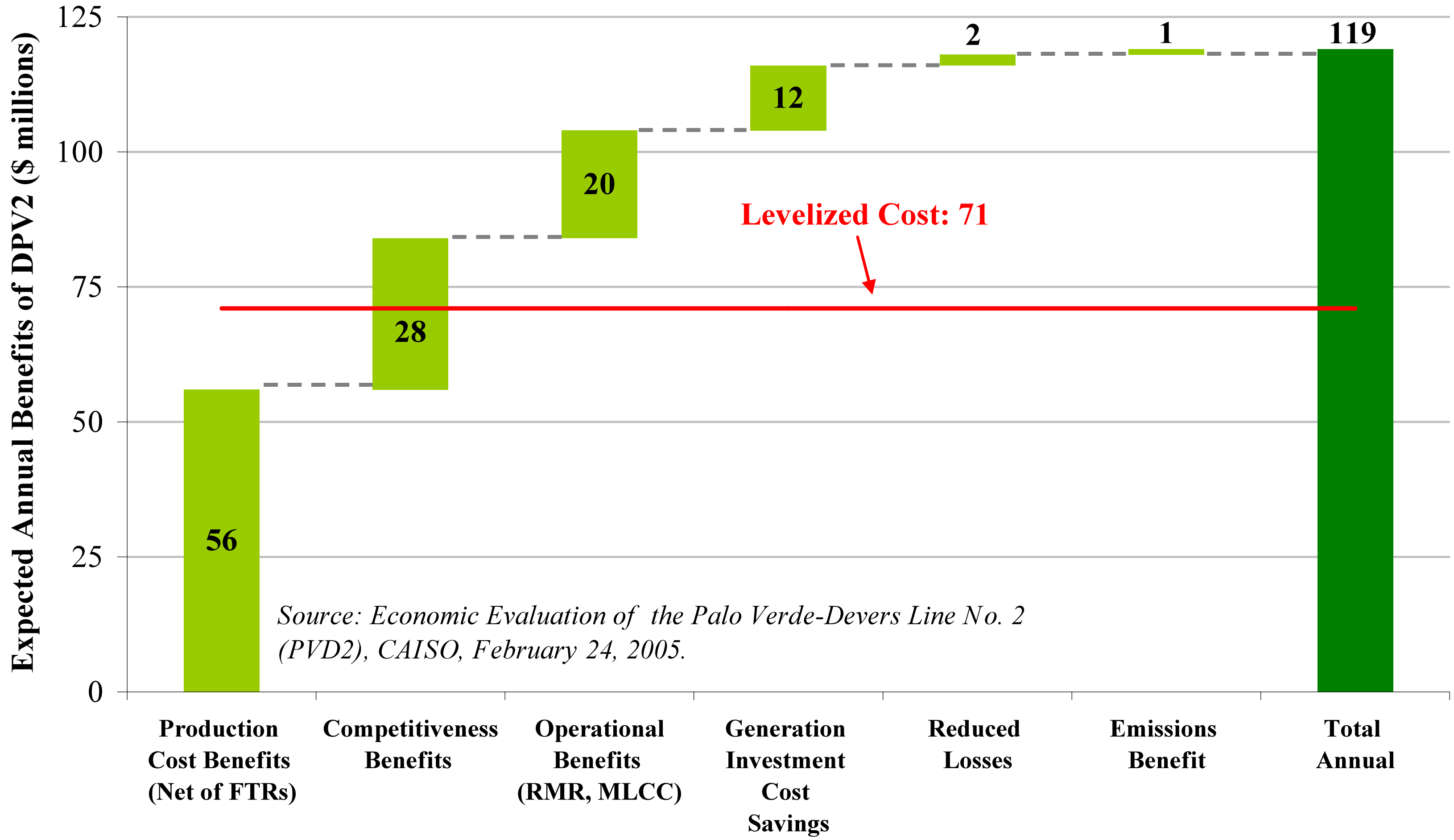
"Production cost" studies quantify dispatch cost and LMP impacts, without considering:

♦ Enhanced market competitiveness ♦ Enhanced market liquidity	Additional market benefits
♦ Economic value of reliability benefits ♦ Added operational and A/S benefits ♦ Insurance and risk mitigation benefits	Reliability/operational benefits
♦ Capacity benefits ♦ Long-term resource cost advantage ♦ Synergies with other transmission projects	Investment and resource cost benefits
♦ Impacts on fuel markets ♦ Environmental and renewable access benefits ♦ Economic benefits from construction and taxes	External benefits

See Appendix. These omitted benefits (which can double the benefits quantified in production cost studies) make formulaic beneficiary-pays cost allocation approaches unworkable

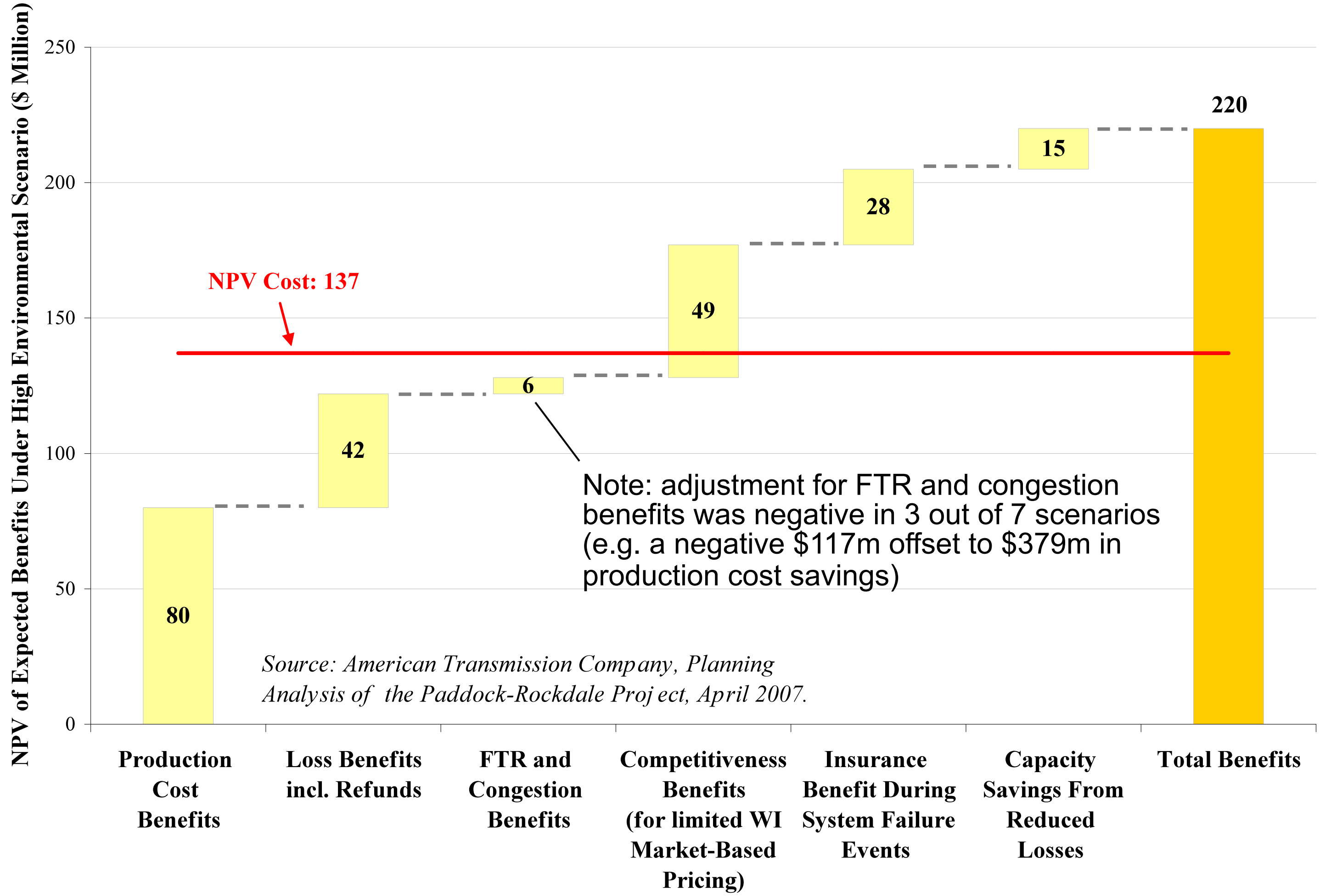
Often Ignored "Other" Benefits Can Be Large

Example: Total benefits of SCE's DPV2 project in CAISO were more than double its production cost benefits



Often Ignored "Other" Benefits Can Be Large

Example: Production cost savings were insufficient in some scenarios of ATC's Paddock-Rockdale study



Takeaways: Options and Recommendations

- Strong support from (or direct involvement by) state policy makers needed to achieve efficient regional or sub-regional solutions
  - RTOs, transmission owners, and market unlikely to move beyond least-common denominator approaches without multi-state support
  - State commissions often lack “authority” to consider broader policy objectives and negotiate regional solutions without support from state policy makers
  - Need to demonstrate and increase awareness of broad range of transmission-related benefits
- Aggregate and simplify!
  - Formulaic “beneficiary pays” concepts (an economist’s dream) unworkable due to broad range and wide-spread nature of transmission-related benefits
  - Aggregation of projects into regional or sub-regional plans to produce region-wide benefits and facilitate multi-state cost allocation
  - Regional or sub-regional postage stamp tariffs offer hope for workable “second-best” solutions (e.g., CA, TX, SPP, MISO)
- Regional plans and federal cost-allocation backstop to facilitate timely multi-state agreements

Appendix

Estimating Difficult-to-Quantify Benefits

Additional Reading

About *The Brattle Group*

1. Market Competitiveness Benefits

- **New transmission enhances competition (especially in load pockets) by broadening set of suppliers**
  - Impacts structural measures of market concentration (HHI, PSI)
  - Various approaches are available to translate improvements in these structural measures into potential changes in market prices
  - Size of impact differs in restructured and non-restructured markets
- **Can substantially reduce market prices during tight market conditions**
  - Competitiveness benefits can range from very small to multiples of the production cost savings, depending on
    1. Fraction of load served by cost-of-service generation
    2. Generation mix and load obligations of market-based suppliers
  - CAISO estimated competitiveness benefits can average up to 50% to 100% of project cost (for DPV2 and Path 26 Upgrade), with wide range (5% to 500%) depending on future market conditions
  - We estimated competitiveness benefits ranging from 10% to 40% for ATC's Paddock-Rockdale project, as approved by Wisconsin PSC

2. Market Liquidity Benefits

- **Limited power market liquidity is costly to participants in both restructured and non-restructured markets**
- **Added transmission can increase liquidity of trading hubs or allow access to more liquid trading hubs**
  - Lower bid-ask spreads
  - Increased pricing transparency, reduced risk of overpaying
  - Improved risk management
  - Improved long-term planning, contracting, and investment decisions
- **Quantification is challenging but benefit can be sizeable**
  - Bid-ask spreads for bilateral contracts at less liquid hubs are 50 cents to $1.50 per MWh higher than at more liquid hubs
  - At transaction volumes of 10 to 100 million MWh per quarter at each of 30+ trading hubs, even a 10 cent reduction of bid-ask spreads saves $4 to $40 million per year and trading hub

3. Reliability Benefits

- **Reliability has economic value**
  - Average value of lost load easily exceed $5,000 to $10,000 per MWh

  Reliability cost = (expected unserved energy) x (value of lost load)

  - About 24 outages per year with curtailments in 100-1,000 MW range, 5 in 1,000-10,000 MW range, and 0.25 in 10,000+ MW range
- **Even “economic” projects tend to improve reliability**
  - Increases options for recovering from supply disruptions and transmission outages
  - For example, DPV2 was estimated to reduce load drop requirements of certain extreme contingencies by 2300 MW (i.e., $10-$100 million benefit for each avoided event)
- **Production cost models understate unserved energy**
  - EUE/LOLP models often consider only generation reliability, not probability of transmission outages
  - Dispatch models do not cover full range of possible outcomes; generally also ignore transmission outages and voltage constraints

4. Added Operational Benefits

- **New transmission projects can reduce certain reliability-related operating costs**
  - Examples are out-of-merit dispatch costs, reliability-must-run costs, unit commitment costs (RMR, MLCC, RSG, etc.), which can be a multiple of total congestion charges
  - Added transmission can also reduce costs by increasing flexibility for maintenance outages, switching, and protection arrangements
  - Ancillary service benefits, particularly when balancing renewable resources over a larger regional footprint
- **Dispatch models do not generally capture these costs**
  - RMR costs not explicitly considered
  - Ancillary services modeled only incompletely
  - Transmission outages (planned or forced) not generally modeled
  - Uncertainty of intermittent resources not captured in production cost simulations
- **Benefits can be significant:**
  - CAISO estimated operational benefit of DPV2 would add 35% to energy cost savings
  - Reduced balancing costs for intermittent renewable generation can offset 10% of regional transmission overlay

5. Insurance and Risk Mitigation Benefits

- **Even if a range of "scenarios" is simulated in economic analysis, new transmission can offer additional "insurance" benefits**
  - Helps avoid high cost of <u>infrequent but extreme contingencies</u> (generation or transmission) not considered in scenarios
  - Incur premium to <u>diversify resource mix</u> to address risk aversion of customers and regulators
- **Insurance and risk mitigation value can be quantified:**
  - Calculate probability-weighed market price and production cost benefits through dispatch simulation of extreme events
  - Additional reliability value (EUE x VOLL)
  - Potential additional risk mitigation value if project diversifies resource mix and reduces the cost variances across scenarios
- **In ATC case, value of insurance against high energy costs during extreme events (even ignoring reliability value and risk premium) <u>added as much as 25%</u> to production cost savings, offsetting <u>20% of project costs</u>**

6. Capacity Benefits

- **New transmission can reduce installed capacity and reserve requirements**
  - ***Reduced losses during peak load*** reduces installed capacity requirement
    - In recent cases, loss-related capacity benefits on average added 5% to 10% to production cost savings
    - Combined energy and capacity value of loss reduction can offset up to 30-50% of project costs
  - ***Added transfer capabilities*** improves LOLE
    - Allows reduction in local reserve margin requirements or satisfy requirement by improving deliverability of resources
    - Reduced reserve margin or resource adequacy requirements often difficult to attribute to individual transmission projects, but benefits can be large in local resource adequacy zones
  - ***Diversification of renewable generation*** over a larger regional footprint can increase capacity value of intermittent resources
    - Can amount to 5% of nameplate renewables capacity

7. Long-term Resource Cost Advantage

- **Impact of transmission on total resource costs (capital and operating) often not captured in modeling efforts**
  - Simulations with and without the transmission project, but generally for fixed generation system
  - Dispatch models do not capture capital costs of resources nor the facilitation of unique low-cost generating options
- **Additional transmission can <u>lower total resource costs</u>**
  - Make feasible physical delivery from generation in remote locations that may offer a variety of cost advantages:
    - better capacity factors (e.g., renewables from wind-rich areas: 10% gain in wind capacity factor worth $600/kW of additional transmission)
    - lower fuel costs (e.g., mine mouth coal plants)
    - lower land, construction, and labor costs
    - access to valuable unique resources (e.g., pumped storage)
    - lower environmental costs (e.g., carbon sequestration options)
- **Transmission provides additional resource planning flexibility**
  - e.g., to address currently unexpected shift in fuel costs, changes in public policy objectives, or uncertainties in the location and amount of future generation additions and retirements

8. Synergies with Other Transmission Projects

- **Individual transmission projects can provide significant benefits through synergies with other transmission investments**
  - For example, construction of DPV2 to Palo Verde would have improved the economics and feasibility of other transmission projects (e.g., SunZia or High Plains Express)
    - Transmission to access renewables in Southwest may be uneconomic if California markets cannot be reached
  - Construction of the Tehachapi transmission project (to access 4,500 MW of wind resources) allows low-cost upgrade of Path 26 and provides additional options for future transmission expansions
  - Regional "multi-value" overlay in Midwest (e.g., RGOS, SMART) reduces costs of state-specific wind integration network upgrades
- **Economically justified transmission projects may avoid or delay the need for (or reduce the cost of) future reliability projects**

9. Impacts on Fuel Markets

- **Transmission can reduce fuel demand and prices**
  - Through dispatch of more efficient plants
  - Through integration of resources that don’t use the particular fuel
    - Western transmission projects (Tehachapi, Frontier, TransWest Express) each have the potential to reduce Southwestern natural gas demand by several percent through additional renewable or clean coal generation
    - SPP estimated natural gas price reduction of Priority Projects’ wind integration benefit worth approx. one third of project costs
- **As a substitute to transporting fuel, transmission projects can benefit fuel transportation markets**
  - “Coal by wire” can help reduce railroad rates (e.g., in the West)
  - Accessing generation on the unconstrained side of pipelines
- **Increased fuel diversity through larger regional footprint**
- **Fuel market benefits can be wide-spread**
  - Additional reductions in generation costs and power prices if fuel is on the margin (e.g., natural gas in the Southwest and East Coast)
  - All fuel users outside the electric power industry benefit as well

10. Environmental and Renewable Access Benefits

- **New transmission can reduce emissions by avoiding dispatch of high-cost, inefficient generation**
  - Can reduce SO2, NOx, particulates, mercury, and CO2 emissions by allowing dispatch of more efficient or renewable generation
    - DPV2 estimated to reduce WECC-wide NOx emissions from power plants by 390 tons and natural gas use by 6 million MMBtu or 360,000 tons CO2 per year (worth $1-10 million/yr)
    - Tehachapi transmission project to access 4,500 MW of renewable (wind) generation
  - Can also be environmentally neutral or even result in displacement of cleaner but more expensive generation (e.g., gas-fired)
- **Local-only or regional/national benefits?**
  - Reduction in local emissions may be valuable (e.g., reduced ozone and particles) irrespective of regional/national impact
  - May not reduce regional/national emissions due to cap and trade, but may reduce the cost of allowances and renewable energy credits
- **Additional economic benefits of facilitating renewables development** (see next slide)

11. Economic Benefits from Construction & Taxes

- **Comprehensive impact analyses may warrant quantification of direct and indirect economic stimulus benefits (jobs and taxes):**
  - Economic stimulus from construction activities and plant operations
  - Increased taxes for states and counties
  - Economic value of facilitating renewables development
- **These benefits can be important to state policy makers and entities along transmission path**
  - For example, we estimated that over a 5-10 year construction and 20 year operations period SPP's $1.1 billion Priority Projects and associated 3,200 MW wind investments will stimulate at least:
    - 38,000 FTE-years of employment and $1.5 billion in earnings by these employees, which is supported by (and paid from) over $4.4 billion in increased economic activity in states within SPP footprint
    - Economic stimulus benefits further increase by 40-80% with increasing in-region manufacturing of wind plant and transmission equipment
    - Transmission construction alone estimated to stimulate $40 million in additional local tax revenue (on top of any property taxes and right-of-way lease payments directly paid by the transmission owners)

Additional Reading

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About *The Brattle Group*

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies around the world.

We combine in-depth industry experience, rigorous analyses, and principled techniques to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

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Johannes Pfeifenberger (hannes.pfeifenberger@brattle.com)
44 Brattle Street, Cambridge, MA 02138
617-864-7900 (www.brattle.com)