Transmission Cost Allocation

Harvard Electricity Policy Group
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New Conventional Wisdom

• Put a Price on Carbon.

• Promote Energy Efficiency and Renewable Supply.

• Provide Bigger and Smarter Grids.
Old Controversial Wisdom

• Expand Regional Transmission Organizations (RTOs).
  – Open Access
  – Bid-Based, Security-Constrained, Economic Dispatch

• Adopt Smarter Pricing for Smarter Grids.
  – Dynamic Pricing
  – Reliability Pricing Impacts

• Develop Hybrid Transmission Expansion and Cost Allocation Framework.
  – Regional Scope
  – Beneficiaries Pay
Transmission Expansion

• **What to Build?** Smart grid, its complements and its substitutes. Reliability expansion, economic investments, and green strategies.

• **Where to Build?** Large scale remote connections or incremental expansions of the network. State and federal siting authority.

• **Who Pays?** Socialize the costs or emphasize the principle that beneficiaries pay.

• **Who Decides?** Congress, regulators, system operators, load serving entities, and merchant investors. Central planning or a hybrid system.
Transmission Uncertainty
What to Build, Where to Build, Who Pays, and Who Decides?

• “We know where the wind blows. We know where the loads are going to go. We know absolutely beyond the shadow of a doubt what the RPS standards are. Yet we want to design these [lines] one at a time and build a spaghetti network that’s both inefficient and ineffective, where we could just make the calculation.” Joseph Welch, ITC, in PUF, March 2009, p. 24.

• “In May 2007, the Arizona Corporation Commission unanimously rejected SoCal Ed’s proposed [line] between Arizona’s Palo Verde hub and Southern California. … ACC commissioners, in part, were concerned that California would reap the benefits of Arizona’s generating capacity, while Arizona ratepayers would be stuck with higher costs.” “Southern California Edison officials said Friday that the utility will … cease efforts to develop … the project has become uneconomic. … Changes in the economic picture include an increase in expected renewable resources, reduced differences between Arizona and California fuel supplies, and a drop in California electricity demand, due to the economic downturn, [Pedro] Pizarro said.” Megawatt Daily, May 18, 2009, p. 7.
## Transmission Beneficiaries

What to Build, Where to Build, Who Pays, and Who Decides?

### Identifying Beneficiaries

Change in Zonal Load Payments & FTR Credits associated with 502 Junction-Loudoun Line

<table>
<thead>
<tr>
<th>Zone</th>
<th>2007 Base Simulation w/o 502 Junction-Loudoun Line</th>
<th>2007 Base Simulation w/ 502 Junction-Loudoun Line</th>
<th>Delta Load Payment ($)</th>
<th>Delta FTR Credit ($)</th>
<th>Delta Load Payment minus Delta FTR Credit ($)</th>
<th>$/MWh</th>
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<tr>
<td>ACEC</td>
<td>618,616,364</td>
<td>603,210,345</td>
<td>-15,408,019 ($1.29)</td>
<td>-1,545,577 ($1.16)</td>
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<td>AEP</td>
<td>5,371,261,728</td>
<td>5,595,668,290</td>
<td>224,404,564 ($1.61)</td>
<td>62,015,390 ($1.17)</td>
<td>162,399,174 ($1.00)</td>
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<td>APS</td>
<td>2,339,348,764</td>
<td>2,382,018,354</td>
<td>-42,689,590 ($0.83)</td>
<td>-410,427,673 ($8.77)</td>
<td>453,097,263 ($0.87)</td>
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<td>BG&amp;E</td>
<td>1,978,166,180</td>
<td>1,760,499,769</td>
<td>-217,666,411 ($6.17)</td>
<td>-36,804,827 ($5.13)</td>
<td>-180,861,584 ($5.13)</td>
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<td>COED</td>
<td>4,164,080,516</td>
<td>4,310,488,946</td>
<td>146,408,430 ($1.38)</td>
<td>-5,349,609 ($1.43)</td>
<td>151,758,039 ($1.43)</td>
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<td>DOM</td>
<td>5,183,001,308</td>
<td>4,627,398,244</td>
<td>-555,603,064 ($5.84)</td>
<td>-358,968,286 ($2.07)</td>
<td>-196,614,778 ($1.77)</td>
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<td>DP&amp;L</td>
<td>724,906,697</td>
<td>752,371,800</td>
<td>27,463,104 ($1.46)</td>
<td>-5,745,651 ($1.77)</td>
<td>33,208,754 ($1.77)</td>
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<td>DPLC</td>
<td>1,027,352,040</td>
<td>997,157,095</td>
<td>-30,194,955 ($1.53)</td>
<td>-5,172,447 ($1.26)</td>
<td>-25,022,508 ($1.26)</td>
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<tr>
<td>DQE</td>
<td>558,563,943</td>
<td>617,669,745</td>
<td>59,105,802 ($4.03)</td>
<td>16,292,179 ($2.92)</td>
<td>42,813,622 ($2.92)</td>
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<td>JC</td>
<td>1,306,051,858</td>
<td>1,282,434,900</td>
<td>-23,616,958 ($0.94)</td>
<td>-10,442,764 ($0.53)</td>
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<td>ME</td>
<td>793,076,158</td>
<td>770,322,760</td>
<td>-22,733,396 ($1.44)</td>
<td>14,174,194 ($0.53)</td>
<td>-6,608,776 ($0.42)</td>
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<td>PECO</td>
<td>2,139,352,180</td>
<td>2,086,785,257</td>
<td>-52,566,923 ($1.27)</td>
<td>-4,894,038 ($1.15)</td>
<td>-47,472,885 ($1.15)</td>
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<td>PEPCO</td>
<td>1,933,019,895</td>
<td>1,676,834,934</td>
<td>-266,184,961 ($7.68)</td>
<td>-17,042,605 ($7.17)</td>
<td>-239,142,356 ($7.17)</td>
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<td>PN</td>
<td>771,591,700</td>
<td>810,742,112</td>
<td>39,150,412 ($2.16)</td>
<td>-9,748,947 ($2.70)</td>
<td>48,899,359 ($2.70)</td>
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<td>PPL</td>
<td>2,091,095,307</td>
<td>2,052,912,311</td>
<td>-38,182,996 ($0.90)</td>
<td>-28,820,188 ($0.22)</td>
<td>-9,362,808 ($0.22)</td>
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<td>PSEG</td>
<td>2,501,099,258</td>
<td>2,454,367,526</td>
<td>-46,731,729 ($0.96)</td>
<td>-5,518,397 ($0.95)</td>
<td>-41,213,332 ($0.95)</td>
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<td>RECO</td>
<td>79,706,373</td>
<td>79,395,461</td>
<td>-1,310,912 ($0.86)</td>
<td>-71,899 ($0.81)</td>
<td>-1,382,811 ($0.81)</td>
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<td>Neptune</td>
<td>283,516,438</td>
<td>278,529,398</td>
<td>-4,987,040 ($0.83)</td>
<td>-106,482 ($0.81)</td>
<td>-4,880,558 ($0.81)</td>
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<tr>
<td><strong>Total</strong></td>
<td>33,863,810,704</td>
<td>33,137,805,238</td>
<td>-726,005,466 ($1.00)</td>
<td>-838,516,441 ($0.16)</td>
<td>112,512,976 ($0.16)</td>
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Hybrid Transmission Framework

What to Build, Where to Build, Who Pays, and Who Decides?

• Some of the requirements of a hybrid system seem clear. Property rights must be defined for the transmission investor. Cost allocation must follow the beneficiary pays principle. Decisions should defer to market choices when there is no compelling evidence of a market failure. There must be a mechanism to separate cases where regulated investments mandates would be appropriate from those where market choices should prevail.

• “The proposed cost allocation mechanism is based on a ‘beneficiaries pay’ approach, consistent with the Commission's longstanding cost causation principles. … Beneficiaries will be those entities that economically benefit from the project, and the cost allocation among them will be based upon their relative economic benefit. … The proposed cost allocation mechanism will apply only if a super-majority of a project's beneficiaries agree that an economic project should proceed. The super-majority required to proceed equals 80 percent of the weighted vote of the beneficiaries associated with the project that are present at the time of the vote.” New York Independent System Operator, Inc Docket No. OA08-13-000, “Order No. 890 Transmission Planning Compliance Filing,” Cover Letter Submitted to Federal Energy Regulatory Commission, December 7, 2007, pp. 14-15.
Expansion Cost Allocation
What to Build, Where to Build, Who Pays, and Who Decides?

• Beneficiary Pays
  – Gold Standard: Net Benefits > Total Cost
  – Cost Sharing: Commensurable with Benefits
  – Compatible with Larger Market Design

• Ex ante

• Net Benefits = Change in Expected Social Welfare
  – Counterfactual
  – Uncertainty

• Approximations
  – Reliability
  – Economic
  – Policy
Transmission Cost Allocation
What to Build, Where to Build, Who Pays, and Who Decides?

• Beneficiary Pays
  – “The cost of transmission facilities must be allocated to those within the transmission planning region that benefit from those facilities in a manner that is at least roughly commensurate with estimated benefits.” (NOPR, p. 91)

• Ex ante evaluation of benefits and beneficiaries
  – “Those that receive no benefit from transmission facilities, either at present or in a likely future scenario, must not be involuntarily allocated the costs of those facilities.” (NOPR, p. 91)
  – “For example, a postage stamp cost allocation method may be appropriate where all customers within a specified transmission planning region are found to benefit from the use or availability of a facility or class or group of facilities (e.g., all transmission facilities at 345 kV or higher), especially if the distribution of benefits associated with a class or group of facilities is likely to vary considerably over the long depreciation life of the facilities amid changing power flows, fuel prices, population patterns, and local economic developments.” (NOPR, p. 94, emphasis added)

• Implementation Challenge
  – Determine if benefits exceed costs
  – Estimate shares of benefits for cost allocation
A Stylized Investment Case

Transmission Between Regions

Illustrate benefits for this reduced model
Parsing the Expansion Benefits

Transmission Expansion Benefits

Base Case
- Import Benefits = A
- Export Benefits = E
- Congestion Rents = B + C + D

Expansion Case
- Import Benefits = A + B + F
- Export Benefits = D + E + H
- Congestion Rents = C + G

Net Benefits = F + G + H
**Cost Benefit Test**

Expansion Total Cost (TC) and Benefits

- **Gold Standard**: \( F + G + H > TC \)
- **Business Stealing**: \( B + F + G + D + H > TC > F + G + H \)
- **Core Coalition Case**: \( B + F + G + D + H > F + G + H > TC \)
- **Strict Merchant Case**: \( G > TC \)
Benefit Shares and Cost Allocation

Expansion Total Cost (TC) Allocation

Gold Standard
\[ F + G + H > TC \]

Business Stealing
\[ B + F + G + D + H > TC > F + G + H \]
Do not expand

Core Coalition Case
\[ B + F + G + D + H > F + G + H > TC \]
Import Region %
\[ = \frac{(B + F)}{(B + F + G + D + H)} \]
Export Region %
\[ = \frac{(D + H)}{(B + F + G + D + H)} \]
Transmission Rights %
\[ = \frac{G}{(B + F + G + D + H)} \]

Strict Merchant Case
Transmission Rights = 100%
Typical Cases: Natural Advantages

Expansion Total Cost (TC) Allocation

"Small Expansion"
G >TC> B,F,D,H
Strict merchant is easy

"Large Expansion"
B+D+F+H> G >TC
Core is large
Unpacking Reinforces Natural Advantages

Unpacking Transmission Benefits

Export Region
- Generator gains
- Load losses

Import Region
- Generator losses
- Load gains

Gains - Losses = Net Benefits
Gains ~ Net Benefits implies merchant case.
Gains >> Net Benefits implies core coalition.
Transmission Cost Allocation
What to Build, Where to Build, Who Pays, and Who Decides?

• Challenge
  – Determine if benefits exceed costs
    • Precision not required
    • Standard methods provide a good approximation
    • Regulators apply gold standard
  – Estimate shares of benefits for cost allocation
    • Expected shares ex ante
    • Shares of benefits easier to estimate than exact benefits