Efficient Grid Expansion and Participant Funding

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Plan of Presentation

1. What is Participant Funding (PF)? How does it work?

2. Network Upgrade Price Signals - - What would an Optimal Scheme look like?


4. Concluding observations on PF.

5. Addendum: What will PF do for the Slippery Slope?
Overview

- Participant Funding (PF) is billed as a way to send efficient locational signals to generators and pay for grid upgrades efficiently.

  “... Requiring interconnection customers to pay the costs of transmission upgrades is bringing efficiency to the siting of generation and is concomitantly encouraging increased use of relatively underutilized portions of PJM transmission system, where generators can obtain transmission capability at lower cost than in areas where available capacity is limited.”

  *(Additional Comments of PJM Interconnection, L.L.C, Federal Energy Regulatory Commission, Docket No. RM01-12-000, January 10, 2003, p. 21.)*

- Not clear that the resulting locational signals are efficient in the broadest sense.

- Implementation of PF involves much planner discretion.

- Rolled-in upgrade costs by zone (such as in UK) may be roughly as efficient less and prone to arbitrary or subjective cost allocations.
Participant Funding – PJM Style

• “Baseline” process forces TOs to do any upgrades needed to meet reliability criteria and not funded by PF. These upgrades are rolled in.

• “Beneficiaries” are new generators asking for interconnection.

• Tranche of new generators created by queue.

• Network upgrades determined via System Impact Studies.
  – Add one plant from queue and dec all other gen.
  – Look for 5% impact on constraint.
  – Repeat for other queue generators.
  – Devise package of upgrades to relieve constraints.
  – Allocate costs of upgrades based on ‘the sum product of generation shift factor and unit size.’

• G’s paying allocated upgrade costs get revenues from new FTRs created.
Some Immediate Discretion Issues

- Upgrades done prior to a new generator queue “for reliability purposes” may have a large impact on specific generator upgrade costs.

- Dec-ing all generators to measure impact of the new generator is unrealistic.

- The package of options implemented to accommodate all generators in the queue embodies scale and scope economy judgements.

- Allocation of these costs to generators in the queue involves judgement and omits allocating costs to any other users, as explained *infra.*
Optimal Grid Expansion Under Full Regulation and Perfect Information

• Regulator chooses set of plants \( \{ G^* \} \) and network upgrades \( \{ T^* \} \) such that NPV total supply costs are minimized subject to network balance and security constraints, at each node and each period.

• When minimized, the total additional NPV cost of network upgrades over the existing network is \( C^* \). Call the levelized per-unit cost of these upgrades \( c^* \).
Conceptual Optimal Location Payments

• Now assume all generators are deregulated and are paid LMPs and forecasts are good.

• Objective is to charge grid upgrade fees by location that induce the same least-cost set of generators to be sited.

• Charge all loads a surcharge of $c^*$ per MWh paid to grid owner.

• Publish the nodes and time periods on each network where an optimally sited generator would be.

• For location away from node charge a penalty equal to the difference in the NPV cost of upgrading the network between location chosen and least-cost location.

• The aggregate penalty fee is equal to the difference between $C^*$ and actual network upgrade costs. This aggregate is lumpy, not continuous.
Economic Fairness and Cost Allocation

• New generators that have ≈5% impact on constrained facilities potentially pay 100% of cost of upgrading facilities.

• The existing users impact ≈95% of the constrained facility.

• Absent new generation, constrained facilities likely to be upgraded sooner or later anyway by the ≈95%.

• Allocating upgrade costs to all megawatts, not just new MW, send the most efficient LRMC price signals. NPV least-cost upgrade costs should be allocated to all users even if their demand is unchanged.

• Where integrated regulated utilities continue, still efficient to allocate NPV integrated upgrades to regulated load or charge LRMC to all and rebate revenue surpluses, if any.
What’s the Alternative?

• Variations on zonal rolled-in embedded rates -- ideally reflecting least-cost alternative upgrade paths.

• Shallow/deep ratio allocates some upgrade costs to all zones.

• All generators in zone pay.

• Examples: NEPOOL, National Grid (U.S.), U.K.

• Some differences versus PF are:
  – Less attribution of specific facility upgrades to specific plants
  – Smoother price signals spread around to many more grid users
  – Still plenty of judgement and planner discretion
  – Closer to the optimal scheme?
<table>
<thead>
<tr>
<th>Comparison</th>
<th>“Zonal Shallow Fees”</th>
<th>Participant Funding</th>
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<tbody>
<tr>
<td>Determination of upgrades needed</td>
<td>• Clean-sheet determination of alternative upgrade plans.</td>
<td>• Impacts of new queue on constrained facilities and cost of relieving constraints</td>
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<tr>
<td>Locational Signals</td>
<td>• Less lumpy and facility-specific and more broadly applied</td>
<td>• All upgrade costs loaded on generator(s) triggering upgrade</td>
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<tr>
<td>Incentive to Challenge Allocation or Other Aspects</td>
<td>• Fight over the larger structure or zone boundaries.</td>
<td>• Many aspects might be subject to discretion/challenge</td>
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<td>Long-Term Capital Impacts</td>
<td>• Transmission companies build and finance most upgrades</td>
<td>• Merchant generators finance most of grid expansion; regulated T rate base decays</td>
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Concluding Observations

• Under participating funding, most new grid capacity is effectively financed by merchant G’s. Their capital is inherently more costly.
• The locational signals sent by PF are not optimal-location signals, thought they are certainly locational. They allocate nearly all costs to G, not locational penalty costs.
• The distinction between “reliability-driven” and “participant-driven” upgrades is arbitrary – depends on which upgrades go first.
• Cost allocation of simultaneous upgrades among multiple generators also requires judgment. Any incentives by the system planner to bias allocations may result in messy litigation requiring FERC judgement.
• Scale economies may be sacrificed in favor of more smaller, more incremental, and more costly additions to keep generators from challenging paying for “overbuilding now.”
• Since the difference in efficiency benefits is uncertain, choose based on:
  • Ability to keep grid well-invested
  • Perceived fairness/political acceptability
  • Lowest transactions costs
• Bright lines are essential, but some scope for regional variation:
  • Where no independent RTO, rules should be simple and transparent
  • Do regional T owners want to invest or disinvest?
  • Topology of regional grid
Addendum:

Does Participant Funding bear on the “slippery slope” between Market-Funded and Regulated Grid Upgrades?
Slippery Slopes - - Hogan and Fox-Penner

• Hogan: A regulated backstop for T upgrades will remove incentives for economics-driven upgrades. Need a bright line between upgrade types to prevent this.

• There is a parallel slippery slope within PF as long as there are reliability-driven, rolled-in upgrades distinct from PF upgrades.

• Fox-Penner: Uncertain and higher per-unit grid upgrade costs placed on generators by participant funding will shrink regulated T investment as a whole. Battles over cost allocation will cause industry and regulators to “look to the market” for all grid upgrades.

• We agree on the need for bright line tests!
More Than One Way To Slip Down A Slope?

Hogan's Run

Let the market do it. I'm outta here!

Fox-Penner's Folly

Just charge the Ratepayers. Gotta Run!

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