An Introduction to Metrics for Market Participant Benefits from Transmission Upgrades

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Outline

A. Benefit metrics for full market participants
B. Benefit metrics for those who are not full market participants.
C. Allocations: Market Participants vs. Load Zones.
D. What about detriments?
E. Reflecting benefits from expanded competition

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Full Market Participants Vertically Integrated Utilities

- Full Market Participants bid in both generation and load and are exempt from having to pay congestion costs from their generation to their load.
- Basic Metric for Full Market Participants

Production Costs =

- $+$ **Generation Costs**
- $+$ **Purchase Power Expense**
- $-$ **Power Sales Revenues**

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Production Cost Benefits

- Metric = change in production costs coming from the expansion of the transmission system

Δ = (After – Before)

Production Cost Benefits =

- $-\ \Delta$ Generation Costs
- $-\ \Delta$ Purchase Power Expense
- $+\ \Delta$ Power Sales Revenues

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What About Δ Congestion Costs?

- Generation Costs: This calculation assumes that delivery of power from the LSE's generation sources to its load sinks will be forgiven congestion costs – **moreover Δ in market participant congestion costs are omitted.**
- Expenses from purchases: are made at the load sinks' LMPs.
  - To the extent that LMPs change, this reflects a change in congestion from imports (i.e., purchases do not include MWhs from own generation).
- Revenues from sales: are made at the generator sources' LMPs.
  - To the extent that LMPs change, this reflects a change in congestion for exports (i.e., sales do not include MWhs to serve load associated with the generator).

Example Calculation in Appendix A

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Important Points!

- While LMPs (spot market prices) have a function in determining benefits, that function is limited to off-system purchases and sales of power.
- Vertically integrated utilities do not sell all generation into spot markets and purchase from the spot markets to supply load. Thus, spot market prices have a limited roll in determining benefits related to transmission expansion for vertically integrated utilities.
- This is not the case for other types of market participants.

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What About Those Who Are Not Full Market Participants?

- Stand-Alone Generators
  - Generation not under contract
- Stand-Alone Loads
  - Not applicable (i.e., Load without contracts to serve)
- Competively Supplied Loads
  - Wholesale Competition (TDUs)
  - Retail Competition (Retail Choice States)

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Stand Alone Generator Benefits

From the perspective of a stand alone Generator, benefits (detriments) are measured by

$$(LMP_G^{After} * MWh_G^{After}) - (LMP_G^{Before} * MWh_G^{Before})$$

1. With decrease in export congestion, the MWh_G after will likely be higher than before.
   a. Same generation used to serve native load.
   b. Increased generation will be for sales – netting this revenues from sales gives essentially the same answer as above.
2. With a decrease in import congestion, the MWh_G after will likely be lower than before.
   a. Reduced generation to serve native load.
   b. Increased purchases will replace generation to serve load.

Example Calculations in Appendix B

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Stand-Alone Load Benefits

From the perspective of a stand alone Load, benefits (detriments) are measured by

$$-(LMP_L^{After} * MWh_L^{After}) + (LMP_L^{Before} * MWh_L^{Before})$$

1. MWh_L are assumed not to change.

   $$\text{S-A Load Benefits} = -\Delta LMP_L * MWh_L$$

2. With decrease in export congestion, the LMP_L after will likely be higher than before.
3. With a decrease in import congestion, the LMP_l after will likely be lower than before.

Example calculations of S-A Load Benefits in Appendix B

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Competitively Supplied Loads

- In the short-run, where there are no turnovers in contracts:
  - If the contract includes a fuel adjustment clause with purchases and sales, then the results are the same as for the vertically integrated utilities.
  - If the contract does not include an adjustment for purchases and sales, then there are zero short-term benefits.
- In the long-run, where all contracts can be turned over:
  - Some argue that the benefits will be similar if not equal to stand-alone load benefits.
  - Others argue that this over estimates benefits to load because it does not take into account the benefit that load has from not having to pay congestion cost from the generation serving that load.
    - In this case, an approximation metric has been proposed that substitutes the change in generator LMPs in the load zone for the change in load LMPs.- defined as Net S-A Load Benefit.
    - This substitution assumes that zonal load will be scheduled from zonal generation.

Example Calculations of Net S-A Load Benefits in Appendix B

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Testimony of Missouri Association of Municipal Utilities

Before the Missouri Senate Interim Committee on 21st Century Choice in Technology (August 4,2006)

"Municipal utilities want long-term power supply contracts to avoid the greater risk and volatility of spot markets. But efforts to negotiate long term contracts are now typically greeted with offers that reflect the high market clearing prices the supplier might be giving up if the sale were made in spot market."

Testimony of Duncan Kinchelow, General Manager and CEO OF Missouri Public Utility Alliance

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The Argument for Using Net S-A Load Benefits for Competitively Supplied Loads

A. Generators will not enter into new contracts to sell for less than they expect to receive from selling into the wholesale spot markets without a contract.

B. Alternatively, generators will not enter into new contracts to sell for less than what new generation requires to earn a return of and on its cost.

C. In the long-run, if the wholesale spot market prices are below/above what new generation requires, new supplies will decrease/increase resulting in an increase/decrease in wholesale spot market prices.

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Allocating Benefits to Market Participants (Not to Pricing Zones)

- Loads served by vertically integrated utilities ➔ Production Cost Benefits
- Competitively Supplied Load ➔ S-A Net Load Benefits
- Stand Alone Generation ➔ S-A Generation Benefits

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Allocating Benefits to Pricing Zones (Not to Market Participants)

Proposals typically use a combination of market participant benefit metrics:

(X%)*(PC Benefits)

+ (Y%)*(Net Load Benefits)

+ (Z%)*(Generator Benefits

Examples in Appendix C.

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Allocate to Market Participants vs. Allocate to Pricing Zones

PRO:

1. Allocating costs to pricing zones is simpler and consistent with allocations for reliability upgrades.
2. Changes in intra-zonal congestion costs can easily be calculated and included in metrics – very difficult, if not impossible to do for individual market participants.

CON: Costs allocated to pricing zones are included in zonal rates:

1. Stand-Alone generators don't pay transmission rates – yet can benefit from transmission upgrades.
2. PC benefits to load served by vertically integrated utilities may not be proportionate to Net S-A Load benefits to competitively served load.

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What About Detriments?

Example 1: There are PC benefits to exporting and importing zones from reducing the congestion between the two.

- – Importing region's PC decreases with lower costs for purchased power.
- – Exporting region's PC decreases with higher profits from increased power sales.

• However, while S-A Net Load metrics will be positive for the importing region, it will be negative for the exporting region.

Example 2: It is possible for PC to actually increase for a utility if the benefits from increased sales go primarily to S-A generators and purchase power cost go up for the utility.

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Are Calculated Detriments Real?

- Transmission upgrades tend to increase competition and are generally supported by loads that are competitively supplied.
- When detriments show up in a load zone after an upgrade due to an increase in LMPs, it can be argued that the study did not include new generation that is likely to locate in that zone. New generation supply is likely to force back down LMPs resulting in:
  - Lower profit margins for sales and
  - Lower cost for purchases.

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How Should Benefit Studies Reflect Increased Competition Resulting From Transmission Upgrades?

- Add generation in zones where LMPs are increasing from the transmission upgrade.
- How much generation and what type?
  - Regional Resource Planning Model
    - Use generic cost types
    - Use locational cost differences for capacity costs, fuel costs and output efficiencies (e.g., wind)
    - Requires a regional resource adequacy standard
    - Evaluated demand response resources
    - Estimate optimal mix of supply/delivery/demand (generation/transmission/response) resources

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Appendix A

Calculations of Production Cost Benefits

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Δ Generation Costs

Δ Generation Costs =
Total Variable Generation Costs^{After} –
Total Variable Generation Costs^{Before}

Total Variable Generation Cost Components

- Fuel Expense
- Variable O&M Expense
- Emission Expense

Changes in Generation Costs

a. Generation costs and MWhs are likely to increase when transmission expansion decreases export congestion; i.e., increases will come from expanded power sales.
b. Generation costs and MWhs are likely to decrease when transmission expansion decreases import congestion; i.e., decreases will come from expanded power purchases.

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Δ Purchase Power Expense

Δ Purchase Power Expense =
$(LMP_L^{After} * MWh_P^{After}) - (LMP_L^{Before} * MWh_P^{Before})$

a. LMP_L = Prices at the load LMPs are associated with purchases and can change with transmission upgrades:
   a. If import congestion is reduced, load LMPs will most likely decrease.
   b. If export congestion is reduced, load LMPs will most likely increase.

b. MWh_P = MWhs of purchases (not all MWhs of load), so the before and after levels can be different.
   a. If import congestion is reduced, MWhs of purchases are most likely to increase with lower prices.
   b. If export congestion is reduced, MWhs of purchases are most likely to decrease with higher prices.

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Δ Power Sales Revenues

Δ Power Sales Revenues =
$\sum\{(LMP_G^{After} * MWh_S^{After}) - (LMP_G^{Before} * MWh_S^{Before})\}$

a. LMP_G = LMPs at the generator are associated with sales and can change with transmission upgrades:
   a. If import congestion is reduced, generation LMPs will most likely decrease.
   b. If export congestion is reduced, generation LMPs will most likely increase.

b. MWh_S = MWhs of sales (not all MWhs of generation), so the before and after levels can be different.
   a. If import congestion is reduced, MWhs of sales are most likely to decrease with lower prices.
   b. If export congestion is reduced, MWhs of purchases are most likely to increase with higher prices.

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How To Measure

- There must be a matching of generation sources with loads
- Load = Native Load Served by Utility
- Generation =
  - Owned Generation
  - Long-Term Power Supply Contracts
- Calculate each component hourly by:
  - Purchases (MWh) = max {0, Load – Generation}
  - Sales (MWh) = max {0, Generation – Load}

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Appendix B

Sample Calculations

- Stand-Alone Generator Benefits
- Stand-Alone Load Benefits
- Stand-Alone Net Load Benefits
- Intra-zonal Congestion Costs

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Examples of S-A Generator Benefits

1. Generation is just serving load (1,000 MWhs) before, and incremental Generation costs are \$25. LMP before are \$24, and after ↑ to \$26. Generation increases by 100 MWhs.

   $(LMP_G^{After} * MWh_G^{After}) - (LMP_G^{Before} * MWh_G^{Before})$

   (\$26 * 1,100 MWh) – (\$24 * 1,000 MWh) =

   OR

   (\$2) * (1,000 MWh) + (\$26) * (100) = \$2,000 + \$2,600

   $\Delta LMP_G * MWh_G^{Before} + LMP_G^{After} * \Delta MWh_G$

   Notice that incremental generation costs have no direct role in this calculation of stand alone generator benefits.

2. Generation is just serving load (1,000 MWhs) before, and decremental Generation costs are \$25. LMP before are \$26 and after ↓ \$24. Generation decreases by 100 MWhs.

   (\$24 *900 MWh) – (\$26 * 1,000 MWh) = \$21,600 - \$26,000 = -\$4,400

   OR

   (-\$2) * (1,000 MWh) + (\$24) * (-100 MWh) = -\$2,000 - \$2,400 = -\$4,400

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Examples of S-A Load Benefits

- Load = 1,000 MWh. LMP before are \$24, and after ↑ to \$26.

$-\Delta LMP_L * MWh_L = -(-\$2) * 1{,}000 \text{ MWh} = +\$2{,}000$

- Load = \$1,000 MWh. LMP before are \$26 and after ↓ \$24

$-\Delta LMP_L * MWh_L = -(+\$2) * 1{,}000 \text{ MWh} = -\$2{,}000$

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Example of Calculation for Net S-A Load Benefits

- MWh at three generators with three different LMPs

Before

Generator	MWhs	LMPs	LMP Rev
1	500	$20.00	$10,000
2	200	$22.00	$4,400
3	100	$24.00	$2,400
Totals	800	$21.00	$16,800

After

Generator	MWhs	LMPs	LMP Rev
1	500	$18.00	$9,000
2	200	$20.00	$4,000
3	100	$22.00	$2,200
Totals	800	$19.00	$15,200

ΔLMP = $19 - $21 = -$3/MWh

Net Load Benefit =

-(-$3/MWh) * 800 MWh = $2,400

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Example of Calculation of Changes in Intra-zonal Congestion Costs

- Before average generation LMP = $21
  Before load LMP = $27
- After average generation LMP = $19
  After load LMP = $24
- Congestion before = ($27-$21) = $6
  Congestion after = ($24 - $19) = $5
- Change in congestion cost = $5 - $6 = -$1

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Appendix C

Calculations for
Allocating Benefits
To Load Zones

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Allocating Benefits to Pricing Zones (Not to Market Participants)

(X%)*(PC Benefits)

+ (Y%)*(Load Benefits)

+ (Z%)*(Generator Benefits)

Or

(x%)*(PC Benefits)

+ (1-x%)*(Load Benefits)

+ (Intra-zone Congestion Benefits)

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Calculation of %

x% = percent of load served by vertically integrated utilities in the zone.

1-x% = percent of load competitively served in the zone.

Z% = percent of stand alone generation in the pricing zone.

X% = x%*(1-Z%)

Y% = (1-x%)*(1-Z%)

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MISO’s Approximate Solution

x% = 0.7 or 70%

(1-x)% = 0.3 or 30%

Used as an approximation for the entire region instead of attempting to measure this for each pricing zone.

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