A Nebraska Proposal for Conducting a Reasonableness Assessment and Mitigating Transmission Cost Allocation Inequities

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Lincoln Electric System

Nebraska Public Power District

Omaha Public Power District

Reasonableness Assessment Approach Overview (1)

- Quantify financial benefit metrics to include:
  - reliability, economic, and public policy objectives
  - quantifiable "conservative" and "moderate" tier metrics
- Compute zonal *expected* net present values that account for uncertainty in the base case assumptions and data, and the dynamics of transmission planning over long time horizons by
  - scenario analysis with probability weights
  - discount factors applied to net benefit values at future time points

Reasonableness Assessment Approach Overview (2)

- Conduct net benefit test.
  - Set benefit-cost ratio thresholds below 1.0 to avoid triggering unnecessary mitigation
- Mitigate identified inequities through cost reconciliation using:
  - Zonal transfers similar to those used for Balanced Portfolio
  - Zonal discount factors applied to cost allocations

Reasonableness Assessment Criteria

- *Simplicity*
  - Net benefits should:
    - be assessed using a single present value for each zone
    - account for modeling, data and planning uncertainties
- *Efficiency*
  - Transmission investments should be consistent with:
    - lowest-cost investment portfolio that satisfies reliability, economic, and public policy goals
    - ITP10 and ITP20 planning process and optimal portfolios identified therein
- *Fairness*
  - The reasonableness assessment should:
    - Identify and reconcile significant benefit-cost imbalances
    - Avoid complications of reconciliations that can flip-flop every three years

Defining Net Benefits

- Net benefit value defined as:

  Net Benefit

  = Use Value – Expected Outage Costs – Environmental Costs
  – Generation Operating Costs – Generation Capital Costs
  – Transmission Capital Costs
  – Transmission Operating Costs

- Transmission investment should be made when the change in Net Benefit is positive:

  ΔUse Value – ΔExpected Outage Costs – ΔEnvironmental Costs
  – ΔGeneration Operating Costs – ΔGeneration Capital Costs

  > ΔTransmission Capital Costs + ΔTransmission Operating Costs

Benefit Metrics

- Reliability Benefits (Expected Outage Costs)

  = Loss of Load Expectation (LOLE) x Value of Lost Load

- Environmental Benefits

  = Emissions reductions valued at emissions cost or REC price

- Generation Operating Cost Benefits
  - Based upon Adjusted Production Cost (APC)
- Generation Capital Cost Benefits
  - Based upon changes in planned generation
- Transmission Capital Cost Benefits

  = Value of delayed or avoided transmission projects

Quantifiable Financial Benefit Metrics

Benefit Category	Conservative Tier	Moderate Tier
Generation Operating Costs	Dispatch Savings	
	Loss Reductions	
	Interconnection Improvements	
Generation Capital Costs	Reduction in Required Operating Reserves	Positive impact on Capacity Required for Losses
	Interconnection Improvements	
Environmental Costs	Applicable Environmental Impacts	Meeting State and Utility Goals and Standards
Expected Outage Costs		Improvements in Reliability
Transmission Capital Costs	Avoided Transmission Projects	

Net Benefit Valuation

- The basis for a "reasonableness assessment" is the Present Discounted Value (PV) of the Benefits B_{zjt} minus Costs C_{zjt} for each project j (or portfolio of projects, j = 1) at each time point t considered in the future:

$$NB_z = \sum_t \left[\sum_j \left(B_{zjt} - C_{zjt} \right) \Big/ (1+r)^t \right]$$

where r is a discount rate.

Accounting for Uncertainty

- Scenario analysis can address uncertainties about the accuracy of zonal Net Benefit values due to modeling assumptions and data.
- Compute expected zonal Net Benefits as a probability-weighted sum of Net Benefit values NB_{zs} across scenarios

$$E[NB_z] = \sum_s P_s \times NB_{zs} = \sum_s \left\{ P_s \times \sum_t \left[\sum_j \left(B_{zjts} - C_{zjts} \right) / (1+r)^t \right] \right\}$$

where P_s is probability of scenario s.

Benefit-Cost Ratio Test

A test of "reasonableness" can be based on an average benefit-cost ratio for zone z computed as the average (across scenarios) of the PV of Benefits (E[B_{zjt}]) divided by the average PV of Costs (E[C_{zjt}]):

$$E[BC_z] = \frac{E[B_z]}{E[C_z]} = \frac{\sum_s \left\{ P_s \times \sum_t \left[\sum_j B_{zjts} \Big/ (1+r)^t \right] \right\}}{\sum_s \left\{ P_s \times \sum_t \left[\sum_j C_{zjts} \Big/ (1+r)^t \right] \right\}}$$

Benefit-Cost Ratio Test with Timepoint Discounting

The average benefit-cost ratio may include timepoint discounting, using discount weights (D_t) to account for uncertainty arising from the dynamics of transmission planning:

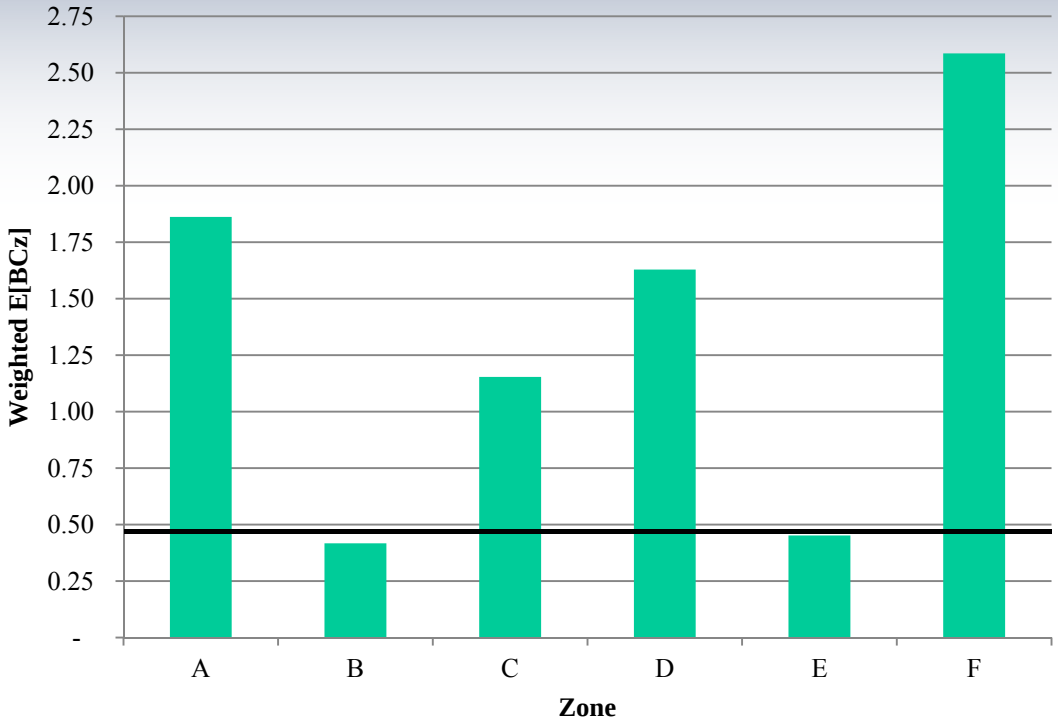
$$E\left[BC_z\right] = \frac{\sum_s \left\{ P_s \times \sum_t D_t \times \left[\sum_j B_{zjts} \Big/ (1+r)^t \right] \right\}}{\sum_s \left\{ P_s \times \sum_t D_t \times \left[\sum_j C_{zjts} \Big/ (1+r)^t \right] \right\}}$$

Example - Timepoint Discounting

		6-Year Look Ahead		6–Yr Wt		10-Year Look Ahead		10-Yr Wt		20-Year Look Ahead		20-Yr Wt	Wtd
Zone	E[B]	C	E[B/C]	0.75	E[B]	C	E[B/C]	0.5	E[B]	C	E[B/C]	0.25	E[B/C]
A	26	24	1.1		56	41	1.4		31	21	1.5		1.86
B	0	3	0.0		101	140	0.7		0	3	0.1		0.42
C	0	2	0.0		36	18	2.0		1	2	0.5		1.15
D	9	8	1.1		24	22	1.1		8	7	1.2		1.63
E	1	4	0.2		4	9	0.5		1	4	0.3		0.45
F	37	15	2.5		2	4	0.5		27	13	2.0		2.59

Alternative: Sum of weights equal to 1.0.

Example – Benefit-Cost Ratio Test



Benefit-Cost Ratio Test Threshold

Avg(E[BC_z]) = 1.35; Std Dev(E[BC_z]) = 0.85

β = Avg – Std Dev = 1.35 – 0.85 = 0.5

Mitigation Options

- Zonal (financial) transfers similar to approach used for inequities found in Balanced Portfolio
- Zonal cost allocation discounting
  - Use of a discount factor ($0 < d \leq 1$) for particular zonal imbalance applied to the postage stamp rate

Summary of Nebraska Transmission Owners' Recommendations (1)

- Quantify financial benefit metrics over time for:
  - Reliability
  - Economics
  - Public Policy
- Focus on financial benefit metrics along the lines of those in
  - "Conservative" and "Moderate" Tiers
  - Exclude "Broad" Tier metrics

Summary of Nebraska Transmission Owners' Recommendations (2)

- Net benefits test applied to each SPP pricing zone based on Net Present Value analysis
- Account for modeling and future project uncertainty:
  - Scenario analysis applies probability weights for scenarios (i.e., states of the world)
  - Time-based discount factors (weights) to account for uncertainty in net benefits for projects far forward in time

Summary of Nebraska Transmission Owners' Recommendations (3)

- Net benefit test thresholds chosen below 1.0 to avoid unnecessary mitigation and flip flopping due to variability in estimated net benefit outcomes
- Mitigation of identified imbalances through financial reconciliation such as:
  - Zonal transfers
  - Zonal cost allocation discounting

Questions?

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