Congestion Cost Savings Test Evaluation Guideline

Version 1.0

Document Revisions

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1. Economic Project Evaluation Overview

To perform an economic project evaluation, a chronological 8760-hour economic evaluation simulation is run both with (i.e., the project case) and without (i.e., the base case) the proposed economic project. The outputs from the simulation are then used to calculate the economic benefits of the project. The simulation produces a variety of outputs and different outputs are used to evaluate a project under the production cost savings test or the congestion cost savings test. For the production cost savings test, production cost is obtained for each simulation and is then used for the economic benefit calculation. For the congestion cost savings test, the system-wide consumer energy cost is obtained for each simulation and is then used for the economic benefit calculation. Figure 1 illustrates the high-level process of the economic benefit calculation for economic project evaluation. The detailed calculation of the system-wide consumer energy cost is outlined in section 2.

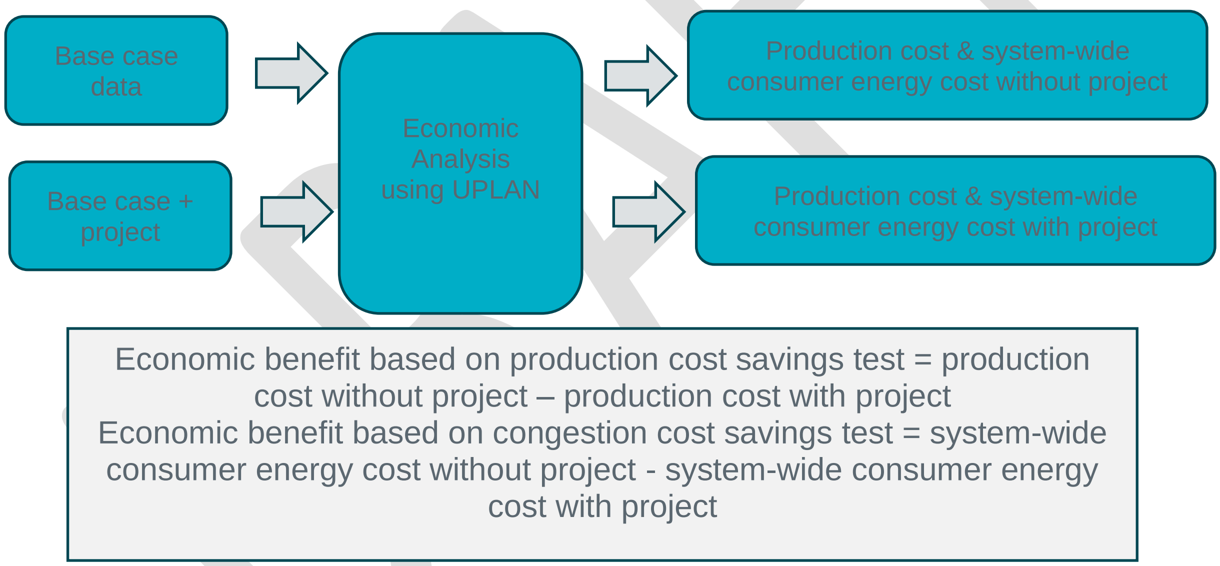

Figure. 1. Project benefit calculation

The economic project evaluation uses study cases identified in the ERCOT Planning Guide based on the projected in-service date of the project. ERCOT produces two economic cases annually (year 2 and year 5) in its Regional Transmission Plan (RTP) process to be used for economic project evaluation. If a project is evaluated in both years based on the in-service date, the benefits are then levelized to the first year as a single annual value.

The levelized annual benefits are calculated as follows when both years are studied:

$$Levelized\ Economic\ Benefit_1 = \left[\sum_i \frac{Economic\ Benefit_i}{(1+r)^{i-1}}\right] \frac{E_1}{\sum_i E_i}$$

where

$Levelized\ Economic\ Benefit_1$ is the annual project benefit levelized to the first year

$Economic\ Benefit_i$ is annual project benefit in year i (nominal $M)

E_i is the annual energy for year i (GWh)

r is the assumed inflation rate

i is the year number, for example, if 2026 and 2029 are included in the study, 2026 will be year #1 and 2029 will year #3

A transmission project satisfies the economic criteria when either of the following conditions are met:

1. For production cost savings test:
$\frac{Levelized\ Economic\ Benefit_1}{Project\ Capital\ Cost} \geq first\ year\ annual\ revenue\ requirement\ of\ the\ project$
2. For congestion cost savings test
$$\frac{Levelized\ Economic\ Benefit_1}{Project\ Capital\ Cost} \geq Average\ of\ first\ three\ years\ annual\ revenue\ requirement\ of\ the\ project$$

The revenue requirement is calculated using a scheduled-based methodology based on the review of Transmission Service Provider (TSP) filings related to wholesale transmission rates.[1] These financial assumptions are reviewed annually and posted on the ERCOT MIS Secure site.[2]

2. System-Wide Consumer Energy Cost Calculation for the Congestion Cost Savings Test

In 2023, ERCOT commissioned a study by Energy and Environmental Economics, Inc (E3) to develop the congestion cost savings test as required by the Public Utility Commission of Texas in 16 Texas Administrative Code § 25.101(b)(3)(A)(i)(I). E3 reviewed economic benefits tests used in jurisdictions throughout North America, as well as in Australia and Ireland, to provide a wide range of options for application in the ERCOT market. Based on this evaluation, E3 recommended using the system-wide

[1] *See* Financial Assumptions for ERCOT Economic Planning Criteria at slide 5 (Sept. 12, 2018) (describing TSP revenue requirement filings), available on the ERCOT website at: https://www.ercot.com/files/docs/2018/09/12/FinancialAssumptions_EconomicCriteria.pdf.

[2] https://mis.ercot.com/secure/data-products/grid/regional-planning?id=np3-112-m.

gross load cost (i.e., the system-wide consumer energy cost) as the metric to measure the congestion cost savings because this option best fit with the rules and structure of the ERCOT market. E3 also recommended the following methodology for the calculation of the system-wide consumer energy cost. The calculation is performed on an hourly basis and then summed for all the hours in the simulation. The system-wide consumer energy cost for each hour consists of three components: consumer energy cost, unserved energy cost, and cost associated with the reduction of the price-responsive load. The calculation of these components is included below.

a. Consumer Energy Cost

For each load modeled at transmission-level bus in each hour, the consumer energy cost for the energy consumption is calculated as the product of:

> (the energy consumed per each load in that hour, in MWh) * (the hourly Locational Marginal Price (LMP) for that load node, in $/MWh)

The hourly system-wide consumer energy cost is then calculated by adding the energy cost of all the loads in the system.

When the consumer energy cost is calculated on an hourly basis, the calculation will produce the same results regardless of whether the consumer energy cost is calculated on a zonal level or nodal level. The mathematical proof is provided below.

Assume that there are n load buses in a load zone. The corresponding load demand and LMP at each load bus is $MW_i\,(i = 1, \cdots n)$ and $LMP_i(i = 1 \cdots n)$, respectively.

Load zone price is the load-weighted LMP:

$$LMP_{zone} = \frac{MW_1}{MW_1 + MW_2 + \cdots + MW_n} LMP_1 + \frac{MW_2}{MW_1 + MW_2 + \cdots + MW_n} LMP_2 + \cdots$$

$$+ \frac{MW_n}{MW_1 + MW_2 + \cdots + MW_n} LMP_n$$

Load zone demand is the sum of load demand within that load zone:

$$MW_{zone} = MW_1 + MW_2 + \cdots + MW_n$$

Consumer energy cost is the multiplication of the load zone price and the load zone demand, which is the same as the sum of the nodal price times the nodal demand.

$$LoadCost_{zone} = LMP_{zone} \cdot MW_{zone} = MW_1 \cdot LMP_1 + \cdots + MW_n \cdot LMP_n$$

b. Unserved Energy Cost

Unserved energy represents load that is involuntarily curtailed due to a limitation of system generation or transmission to produce sufficient energy/deliver it to the location of the unserved load. In calculating consumer energy cost, it is important to identify whether the model results include a material amount of unserved energy. If there is a material amount of unserved energy, then it is important to adjust the consumer energy cost calculation to specifically reflect the value of this unserved load. Unserved energy represents a lack of energy provision to a customer on an involuntary, rather than economic, basis. The adjustment to consumer energy cost is calculated as a product of

(hourly unserved energy, in MWh) * (value of unserved energy, in $/MWh)

The value of unserved energy currently used is $5000/MWh.

c. Cost Associated with the Reduction of the Price Responsive Load

For certain loads, the consumer, if given the choice, would not pay the market price to consume the energy if the price is too high. This category of loads is designated as the price-responsive loads. If a market price is greater than the price-responsive load's willingness to consume that energy (i.e., the strike price), the load will not consume energy from the market in that hour. This indicates that the load's value for the energy is below the energy price actually cleared in the market. Thus, the strike price is used as a proxy to represent the load's value of that energy (if it had been served). The adjustment to consumer energy cost to reflect this is calculated as a product of:

(hourly curtailment of price-responsive loads, in MWh) * (strike price for that load in that hour, in $/MWh)

To determine the strike price, ERCOT reviews the historical responses from price-responsive loads, as well as other relevant information. The current strike prices used are as follows.

- 60% of price-responsive loads at $100/MWh
- 30% of price-responsive loads at $200/MWh
- 10% of price-responsive loads at $1,000/MWh

Appendix: Implementation Procedures for Congestion Cost Savings Test

This appendix describes the detailed steps to perform a congestion cost savings test, as shown in Table A.1:

Table A.1 Steps to perform congestion cost savings test

	Description
Step 1	Perform economic evaluation simulation using the base case without the proposed project and calculate the annual consumer energy cost without the proposed project.
Step 2	Add the proposed project to the base case and re-run the economic evaluation simulation, with all other model settings remaining unchanged. Calculate system-wide consumer energy cost with the project.
Step 3	Calculate the annual system-wide consumer energy cost reduction for a single year as system-wide consumer energy cost without project minus system-wide consumer energy cost with project.
Step 4	Repeat Steps 1 to 3 if both year 2 and year 5 are studied.
Step 5	Calculate the levelized system-wide consumer energy cost reduction using the annual system-wide consumer energy cost reduction results of multiple study years, if applicable.
Step 6	Calculate the benefit-to-cost ratio by dividing the levelized system-wide consumer energy cost from Step 5 by the capital cost of the transmission project.
Step 7	Evaluate the proposed project: 1. if the benefit-to-cost ratio obtained in Step 6 is greater than or equal to the average of the annual revenue requirement for the first three years of the proposed project, the project will be recommended.