Economic Study Process Improvements Phase 2

Overview of the development of Phase 2 of System Efficiency Needs Scenario (SENS) process

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Project Title: Economic Study Process Improvements Phase 2

Proposed Effective Date: Q3 2025

- The Economic Study Process Improvements effort was bifurcated into two phases:
  - The ISO submitted its Phase 1 Tariff revisions to the Federal Energy Regulatory Commission (FERC) on January 27, 2023, and FERC accepted the revisions on March 30, 2023
- Phase 2 focuses on making changes to identifying system efficiency issues and needs by establishing a clear trigger for when to issue a Request for Proposal (RFP), defining benefit metrics for evaluating RFP responses, and streamlining the RFP process into a single-stage
  - As part of this change, the ISO proposes renaming "Market Efficiency" to "System Efficiency," which is reflected in this deck
- This is the third presentation for the Phase 2 effort and focuses on addressing follow-up questions and requests from the November TC as well as introducing the proposed Tariff redlines
  - See the October 2024 and November 2024 TC presentations for additional background information

FOLLOW-UP FROM NOVEMBER TC

Lessons Learned from Economic Planning for the Clean Energy Transition (EPCET) Modeling

Changes to ISO's Approach to Economic Studies, Informed by EPCET

- **Question:** What lessons could be learned from the EPCET to inform the Economic Studies Phase 2 process?
- **ISO Response:**
  - Significant amounts of work were performed during EPCET on the System Efficiency Needs Scenario (referred to as Market Efficiency Needs Scenario in EPCET)
  - A summary of the ISO's lessons learned under EPCET is provided on the next slide

Changes to ISO's Approach to Economic Studies, Informed by EPCET, cont.

- *Historical vs. future interchange*
  - The ISO previously utilized an averaged historical profile to represent interchange with surrounding areas
  - Because New England is not the only region in a period of transition, import/export patterns will likely change significantly in the future
  - The ISO has moved to an interregional model that explicitly models the projected future demand and resources of surrounding regions
    - The resulting import and export patterns vary from historical profiles, but give a better forward-looking view of the system

- *Pricing of imports*
  - The ISO has historically represented imports as a zero or negative cost resource
  - Though imports into New England have zero New England production cost, the end cost to consumers is not zero
    - Treating the energy as zero cost in a benefit-to-cost ratio may distort the actual benefit to the region
  - While some historical interregional data is available on price differentials, forecasting this data into the future requires an interregional model
  - The ISO has created an interregional model and will price additional energy flowing into New England at the external locational marginal price (LMP)
  - This approach follows the modeling techniques of other ISOs and RTOs

FOLLOW-UP FROM NOVEMBER TC

Use of Load Serving Entity Energy Expense (LSEEE) vs. Production Cost

Use of LSEEE vs. Production Cost

- **Question:** Why is the ISO proposing to use production cost as the screening metric rather than other metrics, such as LSEEE, as used in past economic studies?
- **ISO Response:**
  - The ISO proposes to utilize production cost as the screening metric for an RFP and as one of three benefit metrics to evaluate an RFP
  - While the LSEEE metric did produce larger benefit numbers in past economic studies, past study results also illustrate why the ISO does not recommend using LSEEE in the SENS analysis
    - The LSEEE metric's larger benefit value was driven using negative threshold prices set by the ISO
    - In a directional study, threshold prices accomplished the task; however, they have the potential to produce dubious results in a precise quantitative analysis used to build transmission
    - *There is no accurate way to set threshold prices in a precise quantitative analysis*

Production Cost vs. LSEEE for Transmission Evaluation

- In a 10-year out New England system, fossil generation will likely continue to frequently be the unit on margin
  - Production cost reflects the benefit to the system of more zero-cost energy
  - LSEEE may show an increased cost to the system when constrained energy is allowed to serve the rest of the system
- Threshold price assumptions drive LSEEE, but do not affect production costs
  - Forecasts of bidding behavior of these future resources is incredibly difficult and would vastly drive benefit calculations if LSEEE were used to evaluate transmission

Production Cost vs. LSEEE for Transmission Evaluation, cont.

- The LSEEE metric can be significantly distorted with zero or negative cost resources behind a congested element
- Even if a transmission upgrade reduces production cost, the upgrade could increase overall LSEEE
- Unlocking an export-constrained area will slightly lower LMPs in the rest of the system, but will increase LMPs in the formerly constrained area
- The increase in the constrained area could be greater than the decrease across the rest of the system
  - An example that illustrates this is provided in *Appendix 2*

FOLLOW-UP FROM NOVEMBER TC

System Efficiency Processes in Other Regions

Comparison of System Efficiency Planning Processes in Other ISOs and RTOs

- **Request:** Perform a detailed review of PJM's System Efficiency Process, which uses different metrics to calculate benefits based on the size of the project
- **ISO Response:**
  - At the November TC, the ISO presented a comparison of System Efficiency Planning Processes and metrics for NYISO, MISO, PJM, and CAISO
    - The ISO found that all other areas utilize production cost savings, load cost savings, or a combination of both
  - The following slides go into further detail on PJM's processes

PJM Market Efficiency Process: Benefits Calculation

Project Class	Class Definition	Energy Market Benefits	Capacity Market Benefits
Regional Projects	345 kV double-circuit, or above	50% Change in Total Energy Production Cost + 50% Change in Load Energy Payment	50% Change in System Capacity Cost + 50% Change in Load Capacity Payment
Lower Voltage Projects	345 kV single-circuit, or below	100% Change in Load Energy Payment	100% Change in Load Capacity Payment

- PJM's market efficiency process differentiates between projects based on voltage
  - In both project classes, only zones that show an LMP decrease are considered in load energy payment calculations

PJM Market Efficiency Process: Recommended Projects

RTEP Window	Regional	Lower Voltage
2014-15	1	12
2016-17	0	1
2018-19	0	2
2020-21	0	4
2022-23	No congestion drivers identified	

- Over the past 5 Regional Transmission Expansion Plan (RTEP) windows, 20 market efficiency projects have been advanced:
  - 1 Regional (765 kV)
  - 19 Lower Voltage (69-345 kV single-circuit)

PJM Market Efficiency Process: Key Takeaways

- The ISO does not see PJM's dual process as a good fit for the New England region
- PJM's process partly or fully uses load cost savings rather than production cost savings
  - Other Tariff language for economic studies and longer-term transmission studies already specifies production cost, rather than load cost savings
  - The ISO does not recommend using load cost savings due to potential distortions caused by zero- and negative-cost energy
  - This difference is further expanded upon in upcoming slides
- PJM's process bifurcates cost allocation by voltage class, in a way that has no analogue in other ISO-NE processes
  - PJM bifurcates cost allocation for many other types of upgrades by voltage class as well
  - New England has a strongly-networked 115 kV system, leading to the historic practice of allocating costs for PTF upgrades ~115 kV and above addressing economic and reliability needs regionally

FOLLOW-UP FROM NOVEMBER TC

Other Outstanding Items

Congestion Points Below $4.3 Million/Year Threshold

- **Question:** Has the ISO considered an alternative process to advance solutions to alleviate congestion below the $4.3 million/year threshold?

- **ISO Response:**
  - For congestion below $4.3 million/year on a given point of the system, the ISO will report results to stakeholders, take feedback, and then will conclude the SENS process for that point on the transmission system
  - The ISO considered alternative processes for congestion below $4.3 million/year but does not propose to design such a process at this time
    - Instead, the ISO will monitor the points of congestion that fall below the dollar SENS threshold over this Economic Study cycle and future cycles
    - As ISO processes continue to evolve and expand in response to the changing grid, there may be opportunities to pursue addressing congestion points below the dollar threshold in a future process
  - Not pursuing an alternative process in Phase 2 will allow the ISO to complete the 2024 Economic Study per the Tariff-defined timeframe

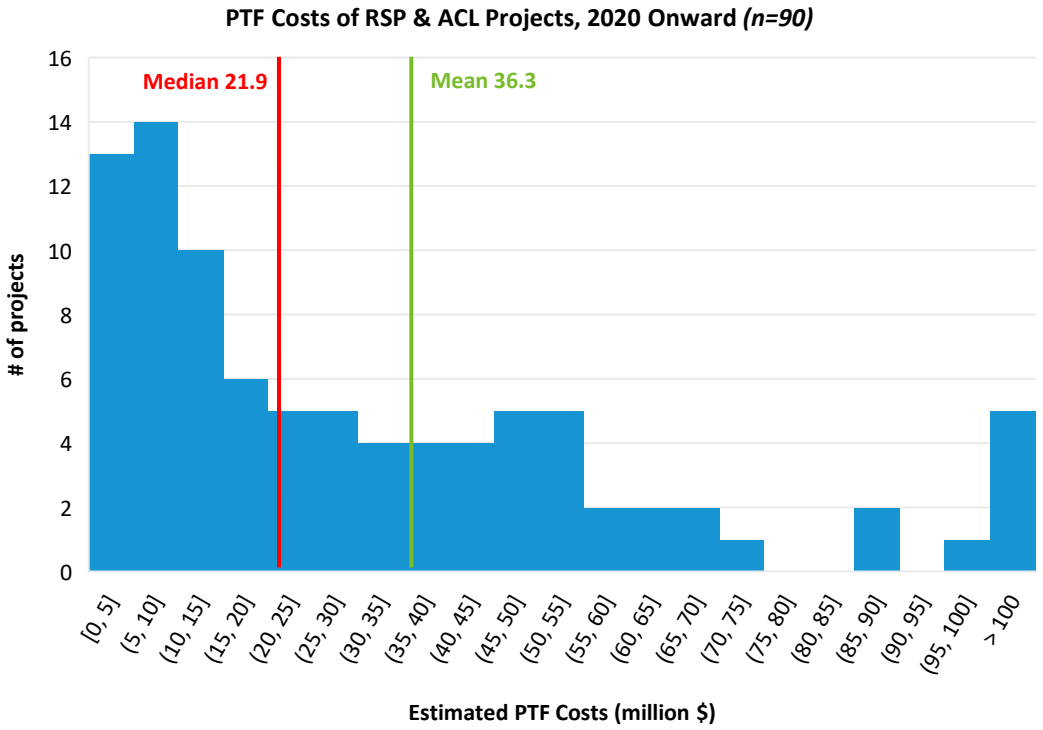
Consideration of Capacity Savings

- **Request:** Consider capacity savings in SENS analysis
- **ISO Response:** The ISO does not propose to pursue consideration of capacity savings in Phase 2
  - The ISO's capacity market design is currently being changed
  - To consider capacity savings in the 2024 Economic Study, a capacity evaluation at the ten-year mark would need to quickly be designed ahead of the completion of those projects
- Currently, there is no reliable method to estimate capacity savings in the SENS time horizon

Use of Other Metrics in the Screening Process

- **Request:** Consider using more than a single metric in the screening step
- **ISO Response:** The calculation of additional metrics in the screening process would require the creation of representative solutions to derive them
  - The creation of representative solutions is time consuming and could divert ISO resources away from other processes, including LTTP

- Instead, the ISO has set the congestion threshold below the recent average cost to allow more congestion points to clear the threshold ($30 million capital costs)
- The congestion threshold exists to enable the ISO to manage time spent on the SENS process and increase the chances of RFPs that result in construction



Will SENS Parallel LTTP in Considering All Transmission Equipment Over 40 Years Due for Replacement?

- **Question:** Will SENS adopt LTTP's consideration of transmission elements that are over 40 years old as due for replacement in its calculation of avoided transmission savings?
- **ISO Response:** The ISO proposes to mimic LTTP in this regard as part of the avoided transmission benefit metric
  - If a proposal includes rebuilding or eliminating a transmission element that is on the Asset Condition List, or an element that is more than 40 years old, the avoided cost of that upgrade will be counted as an avoided transmission investment
    - To avoid an asset condition project, the proposal would have to directly replace that asset
      - *E.g.*, rebuilding a transmission line
    - For elements more than 40 years old that are not on the Asset Condition List, generic per-mile cost assumptions will be used to calculate this benefit

REDLINES

Tariff

Overview of Tariff Redlines

- The following slides provide an overview of impacted documents and the changes within each document
- The package of proposed redlines included with today's meeting materials should be referenced for complete details

Overview of Tariff Redlines, cont.

- Tariff Section I.2.2, *Definitions*
  - Introduction of new terms to support additions to Section 17 of Attachment K:
    - System Efficiency Needs Assessment
    - System Efficiency Needs Scenario
    - System Efficiency Transmission Upgrade
    - System Efficiency Transmission Upgrade Proposal
    - System Efficiency Transmission Upgrade Solution
  - Removal of terms as part of the name change from Market Efficiency to System Efficiency:
    - Market Efficiency Needs Scenario
    - Market Efficiency Transmission Upgrade

Overview of Tariff Redlines, cont.

- Tariff Section I.2.2, *Definitions*, cont.
  - Changes to definitions:
    - Economic Study or Economic Studies
  - Conforming changes have been made to the definition of:
    - Backstop Transmission Solution
    - Phase One Proposal
    - Phase Two Solution
    - Selected Qualified Transmission Project Sponsor
    - Reliability Benefit Upgrade
    - Reliability Transmission Upgrade
  - General clean up:
    - *E.g.*, Replacement of the word “Market” with “System”

Overview of Tariff Redlines, cont.

- OATT III.12.6.4, OATT II.46, Schedule 12, Schedule 14, and Attachment K, N, & P:
  - Conforming changes to reference Section 17 and change “Market” to “System”
- Creation of Schedule 14B, which closely mirrors Schedule 14A (Longer-Term):
  - Details recovery of transmission upgrade costs associated with System Efficiency Transmission Upgrades
- Attachment K Appendix 3:
  - Added Viridon New England LLC to the list of Qualified Transmission Project Sponsors
- Minor grammatical changes throughout

Overview of Tariff Redlines – Attachment K

- Updates to the Table of Contents to reflect creation of Schedule 14B
- Addition of references to Section 17 (in place of previous references to Sections 4, 4A, or 16) and change “Market” to “System” throughout
- Attachment K Section 4:
  - Removal of Market Efficiency from this section
  - System Efficiency Needs Assessment (including the RFP process) is now in Section 17
- Attachment K Section 17:
  - Addition of several new sections on how System Efficiency Needs Assessment are conducted
    - New Sections 17.9-17.14 (Note: prior Sections 17.7-17.10 are now 17.5-17.8)
    - These are similar in construction to Section 4.3 (Needs Assessment) and 16 (LTTP)
  - Minor updates and clarification of phase one language
  - Re-arrangement of Section 17 so that the System Efficiency Needs Assessment subsections are grouped at the end of the Section

Proposed Tariff Changes

Tariff Section	Tariff Change	Reason for Change
Attachment K, Section 17.2(b)	(b) SystemMarket Efficiency Needs Scenario The purpose and scope of the SystemMarket Efficiency Needs Scenario is to identify systemmarket efficiency needsissues ofin the PTF portion of the New England Transmission System. The System Efficiency Needs Scenario shall be evaluated in accordance with Section 17.9 of this Attachment. at the end of the ten-year planning horizon pursuant to Section 17.5 of this Attachment. Pursuant to Section 4.1 of this Attachment, the ISO shall conduct a market efficiency Needs Assessment to evaluate and determine whether market efficiency issues identified in a Market Efficiency Needs Scenario are market efficiency needs. The model used for the SystemMarket Efficiency Needs Scenario shall be the updated base case from the Benchmark Scenario and forecasted out to the ten-year planning horizon year at the time of the initiation of the System Efficiency Needs Assessment using assumptions and criteria in Section 17.4.1(f) of this Attachment and Section B.1 of Attachment N. The study year shall be year N+10 and the simulation length shall be one year for the SystemMarket Efficiency Needs Scenario.	Clarify language, group details of System Efficiency Needs Assessment in other sections

Proposed Tariff Changes, cont.

Tariff Section	Tariff Change	Reason for Change
Attachment K, Section 17.9	**17.~~9~~5 System~~Market~~ Efficiency Needs Assessment** The ISO shall use the System~~Market~~ Efficiency Needs Scenario ~~and~~, criteria in Section 17 of this Attachment and Section B.1 of Attachment N to identify instances where system~~market~~ efficiency ~~issues~~ production cost savings at a given part of the system are equal to or greater than $4.3 million/year on the PTF portion of the New England Transmission System and, as applicable, identify system~~market~~ efficiency needs on the PTF portion of the New England Transmission System. ~~will need to~~shall All of the system~~market~~ efficiency issues and associated benefits of relieving those issues will be documented in a S~~system~~market e~~E~~fficiency Needs Assessment conducted pursuant to Section 17~~.4.1~~ of this Attachment. Any system~~market~~ efficiency ~~issues~~ production cost savings greater than $4.3 million/year that meet the criteria in Section 17 of this Attachment and Section B.1 of Attachment N will be identified as system~~market~~ efficiency needs, and a request for proposal or multiple requests for proposals will be issued to initiate the competitive solution process for System~~Market~~ Efficiency Transmission Upgrades to address the identified system~~market~~ efficiency need or needs pursuant to Section 17~~.3~~ of this Attachment.	Update references to relevant sections, add cost threshold

Overview of Tariff Redlines – Attachment N

- Attachment N Section II.B:
  - Modified language to point to Section 17.12(g) of Attachment K for financial benefit factors to identify System Efficiency Transmission Upgrades
- Attachment N Section II.B.1:
  - Clarifications and updates to language regarding economic model creation
    - Update to introduction paragraph to describe applicable economic factors that may be considered in evaluation of financial benefits
    - Removal of “present worth factors for each project specific to the owner of the project,” “present worth period not to exceed ten years,” and “cost of project”
    - Addition of description of model and reference to Section 17.7 of Attachment K

Proposed Tariff Changes, cont.

Tariff Section	Tariff Change	Reason for Change
Attachment N, Section II.B	**B. Identification of System~~Market~~ Efficiency Transmission Upgrades** System~~Market~~ Efficiency Transmission Upgrades are upgrades designed primarily to provide financial benefits that exceed their cost ~~a net reduction in total production cost to supply the system load~~. Proposed System~~Market~~ Efficiency Transmission Upgrades shall be identified by the ISO where the financial benefit of the upgrade, as determined by the ISO using the factors and calculation described in Section 17.12(g) of Attachment K exceeds the cost, as determined by the ISO using the calculation described in Section 17.12(g) of Attachment K. ~~net present value of the net reduction in total cost to supply the system load, as determined by the ISO, exceeds the net present value of the carrying cost of the identified transmission upgrade.~~ An upgrade identified as a Reliability Transmission Upgrade may qualify for interim treatment as a System~~Market~~ Efficiency Transmission Upgrade if system~~market~~ efficiency is used to influence the schedule for the implementation of the upgrade. Such opportunities shall be identified by the ISO when the ~~net~~ present value of the financial benefits of the upgrade, as determined by the ISO using the factors and calculations described in Section 17.12(g) of Attachment K~~reduction to total production cost to supply the system load, as determined by the ISO~~, exceeds the ~~net~~ present value of the Reliability Transmission Upgrade after it is advanced less the ~~net~~ present value of the upgrade for when it is projected to be needed for reliability.	Update references to relevant sections, revise calculation of benefits versus cost

Proposed Tariff Changes, cont.

Tariff Section	Tariff Change	Reason for Change
Attachment N, Section II.B.1	**1. Base Economic Evaluation Model** In supporting the evaluation of financial benefits, the ISO may take into account applicable economic factors in its base economic evaluation model, such as: ~~In making a determination of the net present value of bulk power system resource costs, the ISO shall take into account applicable economic factors that shall include the following projected factors~~: • energy costs; • Capacity Costs; • cost of supplying total operating reserve; • system losses; • available supply and transmission (i.e., known resource changes, which includes anticipated transmission enhancements (considering Elective Transmission Upgrades and Merchant Transmission Facilities), demand side resources and new, retired or unavailable generators); • load growth; • fuel costs; • fuel availability; • generator availability; • release of bottled generating resources; ~~• present worth factors for each project specific to the owner of the project;~~ ~~• present worth period not to exceed ten years; and~~ ~~• cost of the project.~~	Update and clarify description of base economic evaluation model

Proposed Tariff Changes, cont.

Tariff Section	Tariff Change	Reason for Change
Attachment N, Section II.B.1-2	The modeled system will consist of the projected New England Transmission System, the forecasted New England energy demand, and the expected resource mix within New England given inclusion factors in Section 17.7 of Attachment K. In an Economic Study cycle, for external areas' demand, external resource mixes, and interregional transmission topology, when possible, a consistent external data source will be used to model economic and contracted interchange between neighboring regions. ~~Analysis may include utilization of historical information such as may be included in market reports as well as special studies and should report cumulative net present value annually over the study period.~~ **2. Other Data Provided to Stakeholders** Although not used to evaluate the net economic benefit of the system upgrade, analysis may be provided to illustrate the net cost to load, system emissions, fuel consumption, or any other model outputs which may be illustrative and informative to stakeholders. ~~with and without the transmission upgrade considering additional factors such as locational installed capacity, congestion costs, and impacts on bilateral prices for electricity.~~	Update and clarify description of base economic evaluation model and date provided to stakeholders

REDLINES

TOA

TOA Tariff Redlines

- Schedule 1.01, *Schedule of Definitions*
  - Removal of market efficiency from Backstop Transmission Solution definition
- Schedules 2.01(a) and 2.01(b)
  - Updated links
- Schedule 3.09(a), *Planning and Expansion – Participating Transmission Owner Rights and Obligations*
  - Deletion of economic efficiency from discussion of Backstop Transmission Solution

CONCLUSION AND NEXT STEPS

Conclusion

- The proposed Phase 2 Economic Study Process Improvements incorporates revisions to identifying system efficiency issues and needs by establishing a trigger for when to issue an RFP, defining benefit metrics for evaluating RFP responses, and streamlining the RFP process
  - The proposed process will use three benefit metrics, a single-stage RFP, and identify smaller needs for assignment to a different streamlined process
- In conjunction with Phase 1 changes, the resulting process is a periodic evaluation of the system for SETUs with a separate process and defined metrics independent of reliability upgrades

Next Steps

- Any incremental redlines will be reviewed at the February TC
- Stakeholders are encouraged to submit additional questions or comments on today's material to the Acting TC Secretary (jsingh@iso-ne.com) by Friday, February 7
  - Please contact the Acting TC Secretary by no later than Friday, February 14 to request time on the February TC agenda to present any related amendments
- Discussion on conforming changes are ongoing at the RC
- Proposed updates to the ISO New England Economic Studies Technical Guide occurred at the January PAC
  - The updated guide will be issued by early February

Stakeholder Schedule

Proposed Effective Date – Q3 2025

Stakeholder Committee and Date	Scheduled Project Milestone
Transmission Committee **October 24, 2024**	Present conceptual design, including input assumptions and decisional criteria
Transmission Committee **November 21, 2024**	Present any additional or revised criteria and design
Reliability Committee **January 22, 2025**	Introduce Tariff redlines (conforming changes)
Transmission Committee **January 29, 2025**	Introduce Tariff redlines
Reliability Committee **February 13, 2025**	Present incremental redlines (conforming changes); Vote
PTO AC **February 20, 2025**	Vote
Transmission Committee **February 27, 2025**	Present incremental redlines; Vote
Participants Committee, **April 3, 2025**	Vote

Questions

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APPENDIX 1

Background and Summary of Enhancements Presented at October and November 2024 TC Meetings

Introduced at October TC Meeting

Background

- Under the provisions added to the Tariff in Phase 1 of the Economic Study Process Improvements, the ISO shall conduct defined scenario-based studies designed to:
  - Identify market efficiency issues, and as applicable, market efficiency needs on the PTF portion of the New England Transmission System
  - Provide the New England region more insight into system trends using consistent analysis
  - Facilitate comparison across Economic Study Cycles, all of which can inform future transmission investment decisions

Background, cont.

- The provisions in Section 17 of Attachment K provide stakeholders with a cohesive, repeatable study process based on defined reference scenarios and additional stakeholder-requested sensitivities
  - The provisions meet the requirements and planning principles of Order Nos. 890 and 1000. Attachment K revisions, including Phase 2, must meet or exceed Order Nos. 890 and 1000
- Under the current Tariff rules, the ISO develops a SENS every two to three years as part of the Economic Study Process
  - The ISO first develops a SENS reference case
  - Only the SENS reference case can be used to identify solutions
- The Phase 2 proposal does not change this process

Introduced at November TC Meeting

Summary of Phase 1 Enhancements

- Created a standard reference scenario framework to conduct economic studies
- Laid out a process that shall be conducted at least once every three years and at most once every two years, providing stakeholders with consistent and comparable information
- Allows stakeholders the option to request sensitivities or a stakeholder-requested scenario

Introduced at November TC Meeting

Proposed Enhancements Under Phase 2

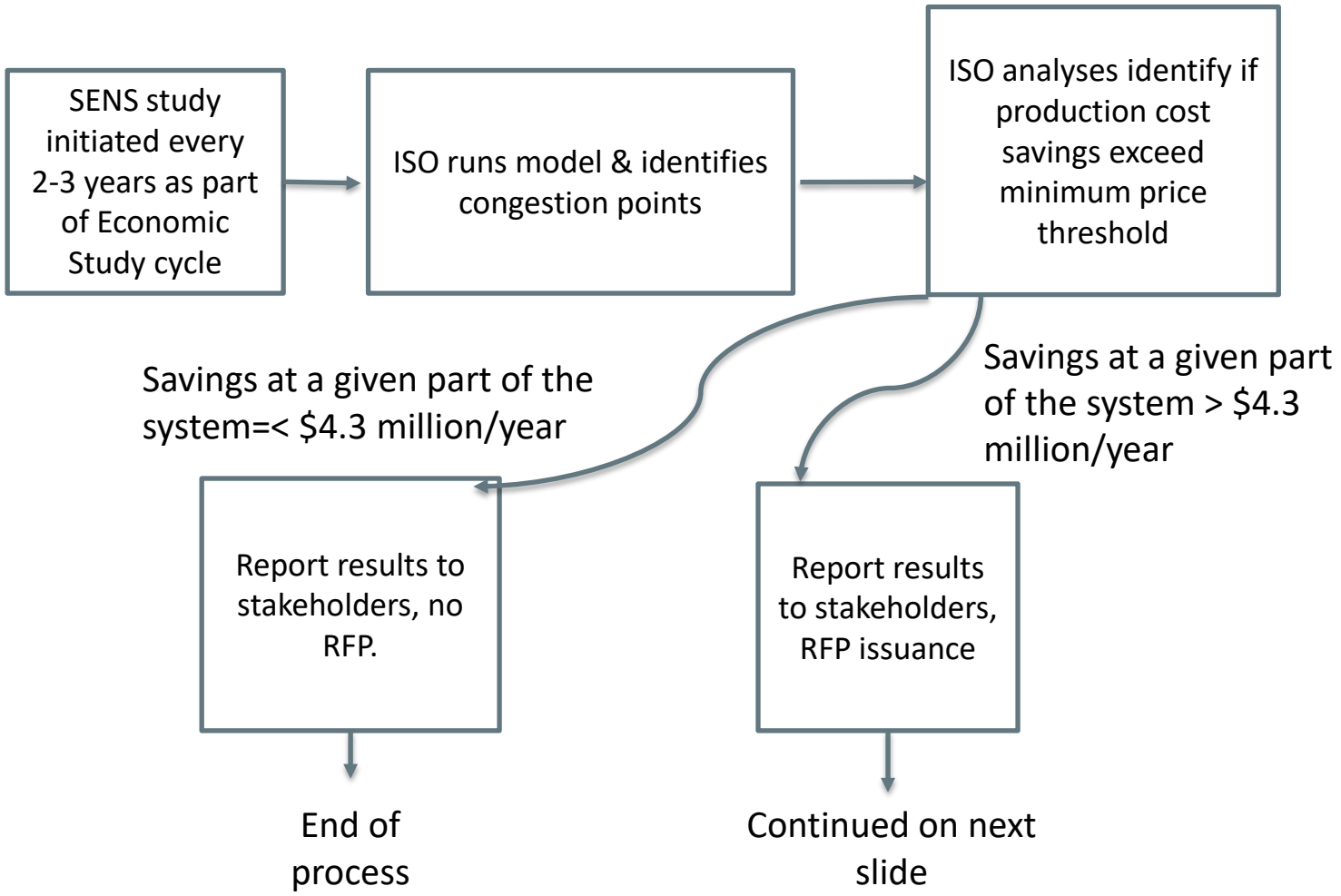
- Establish a clear trigger for a Request for Proposals (RFP) for potential solutions when identified congestion exceeds a set dollar threshold
- Using three clearly defined benefit metrics to evaluate responses to an RFP: **production cost savings, avoided transmission costs, and reduced transmission losses**
- Shift SENS from the current two-stage RFP process used to address Reliability, System Efficiency, and Public Policy needs to a single-stage process like the Longer-Term Transmission Planning (LTTP) Process

Introduced at November TC Meeting

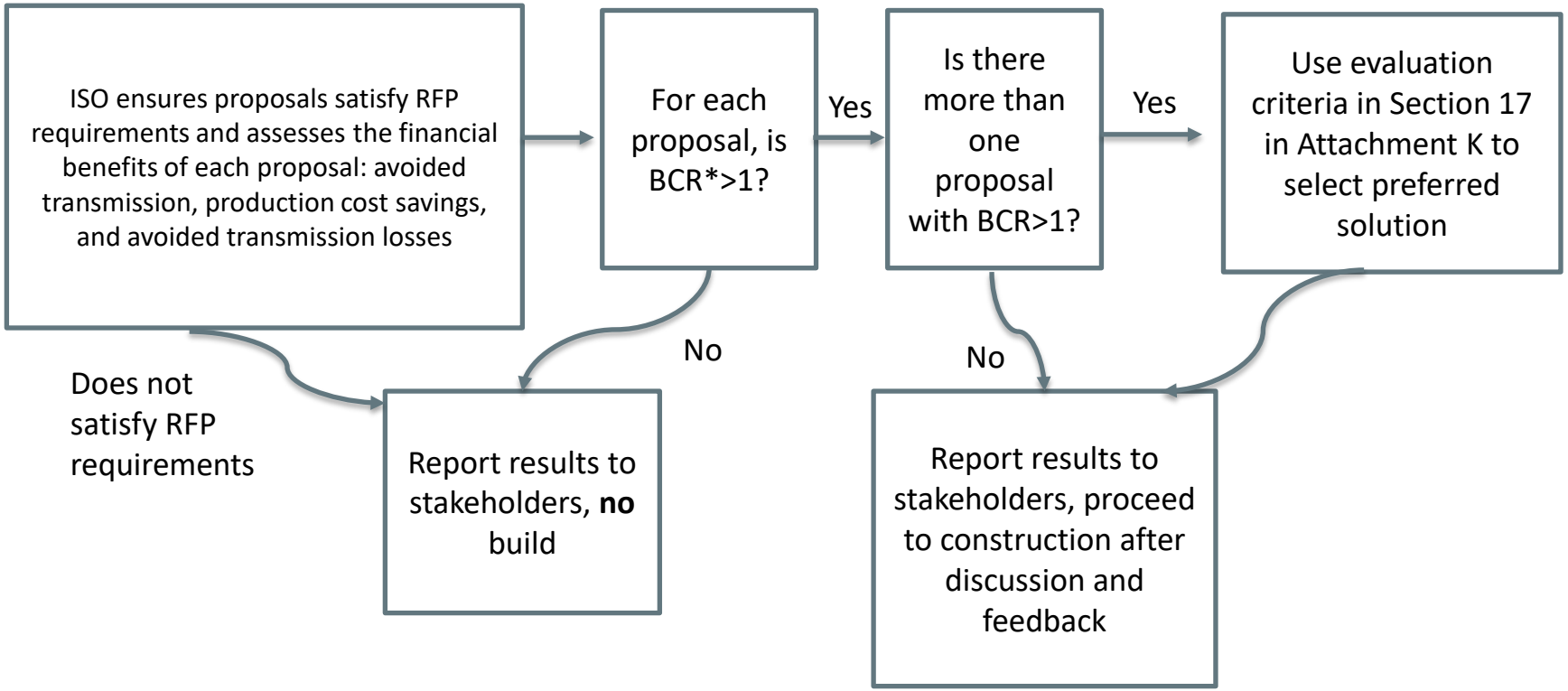
Proposed Enhancements under Phase 2, cont.

- Dollar threshold for RFP:
  - Congestion at a given part of the system greater than or equal to $4.3 million/year would trigger an RFP for that congestion point
  - To determine this threshold, the ISO reviewed the current RSP project list and asset condition projects for post-COVID project costs to determine a threshold of $30 million
    - Applying a 14.4% carrying charge factor to that $30 million investment leads to a $4.3 million/year threshold
    - Carrying charge factors over the past three years has averaged 14.4%
      - (14.42% in 2024, 14.44% in 2023, 14.46% in 2022)

Proposed Solution Flow Chart



Proposed Solution Flow Chart, cont.



*Benefit to Cost Ratio

APPENDIX 2

Production Cost vs LSEEE for Transmission Evaluation

Example of Production Cost vs LSEEE

- The following slides demonstrate scenarios where production cost analysis is more advantageous than LSE Energy Expense (LSEEE) for evaluating transmission benefits
  - On a 2-bus system with a constrained line
  - The effects of relieving the constraint on the line by increasing the flow from 2 MW to 5 MW
  - The volatility of LSEEE when used to evaluate transmission benefits by changing the curtailment price of wind from -$10/MWh to -$20/MWh

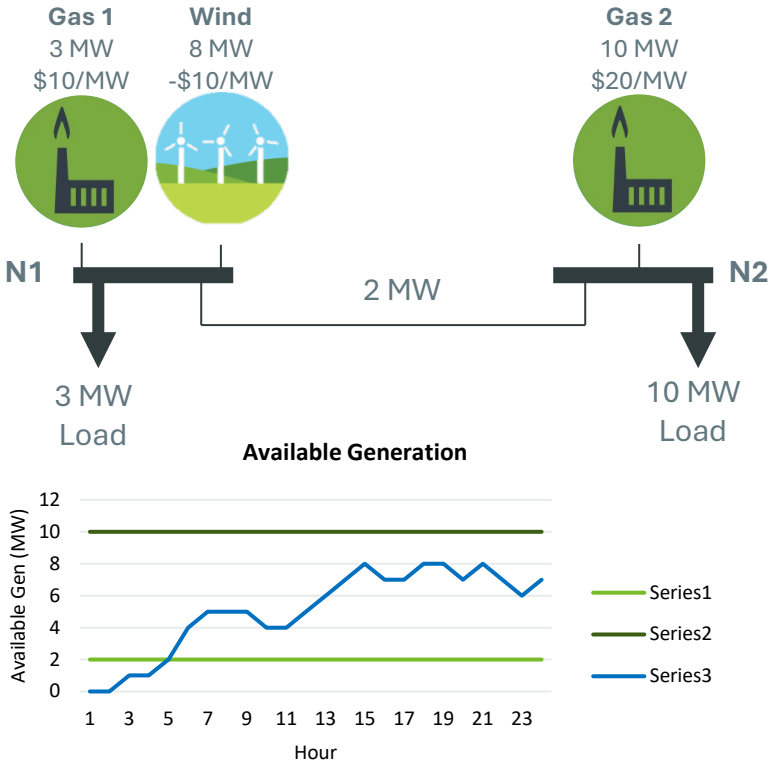
2-Bus System Assumptions

- Firm 3 MW load at Node 1 and firm 10 MW load at Node 2
- Production Cost =

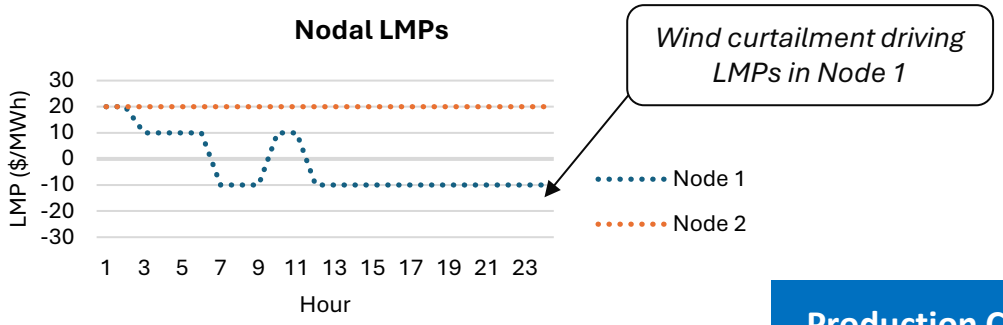
$$\sum_{Hour}\sum_{Gen} Cost_{Gen} \times Generation_{Gen}$$

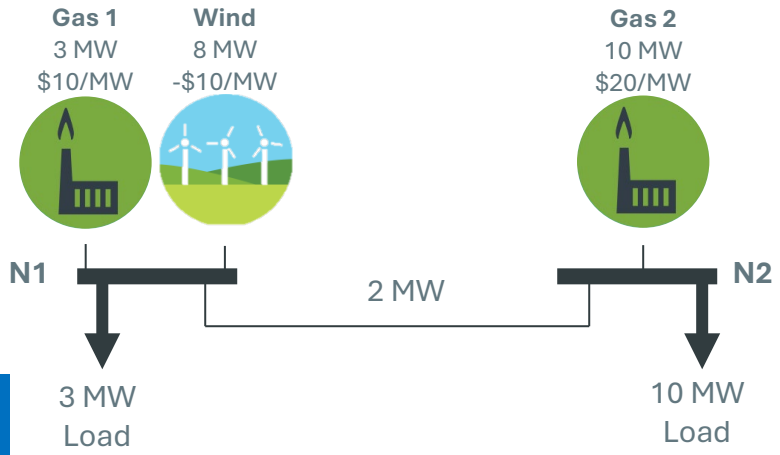
- LSE Energy Expense =

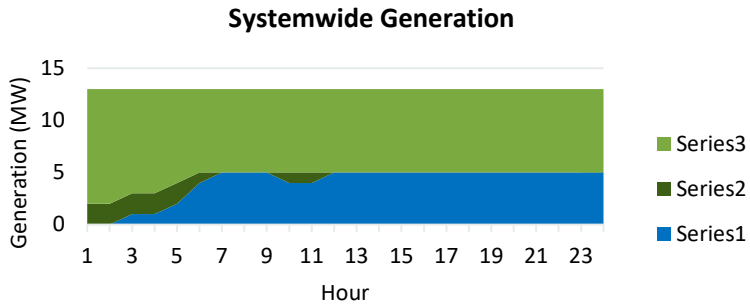
$$\sum_{Hour}\sum_{Node} LMP_{Node} \times Load_{Node}$$



Example: A Constrained Line Between the Buses

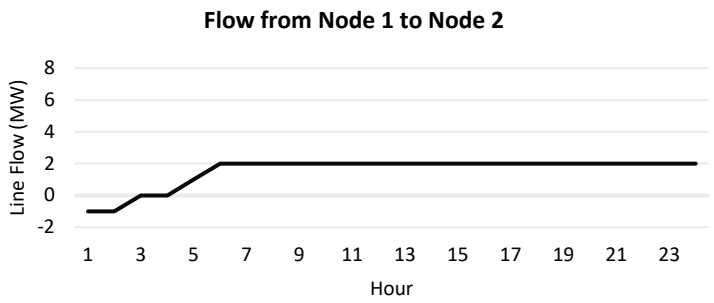






Production Cost
$4,190

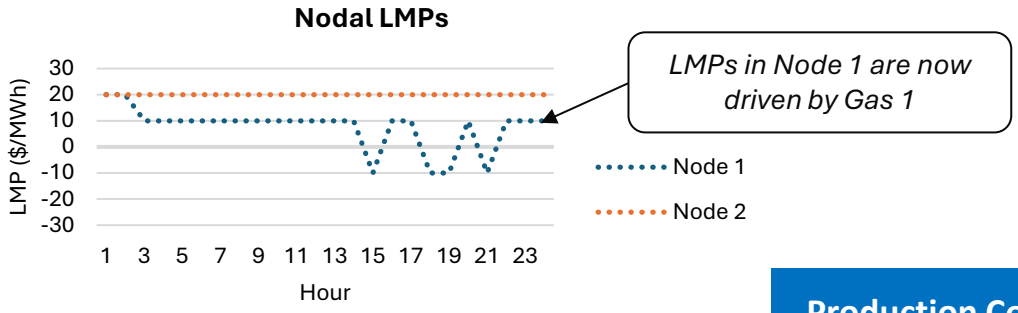
LSE Energy Expense
$4,620



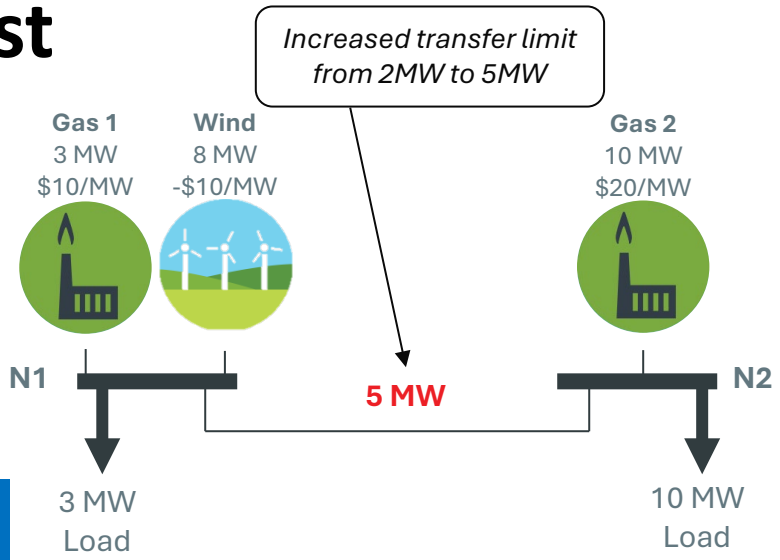
$$\text{Production Cost} = \sum_{Hour} \sum_{Gen} Cost_{Gen} \times Generation_{Gen}$$

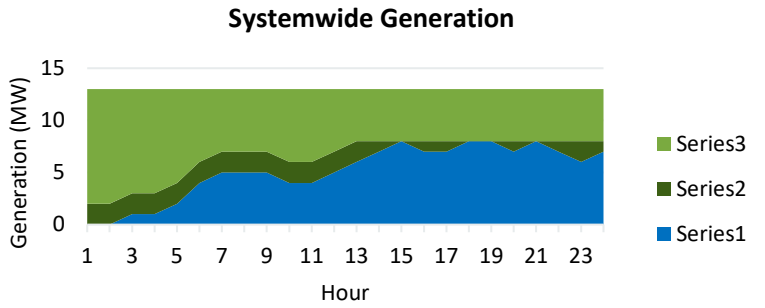
$$\text{LSE Energy Expense} = \sum_{Hour} \sum_{Node} LMP_{Node} \times Load_{Node}$$

Example: Effects of Relieving a Constraint Line on LSEE and Production Cost



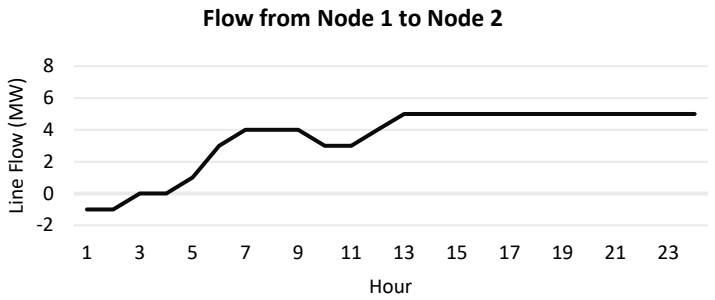
LMPs in Node 1 are now driven by Gas 1





Production Cost
$3,460 ↓17%

LSE Energy Expense
$5,340 ↑16%



$$\text{Production Cost} = \sum_{Hour}\sum_{Gen} Cost_{Gen} \times Generation_{Gen}$$

$$\text{LSE Energy Expense} = \sum_{Hour}\sum_{Node} LMP_{Node} \times Load_{Node}$$

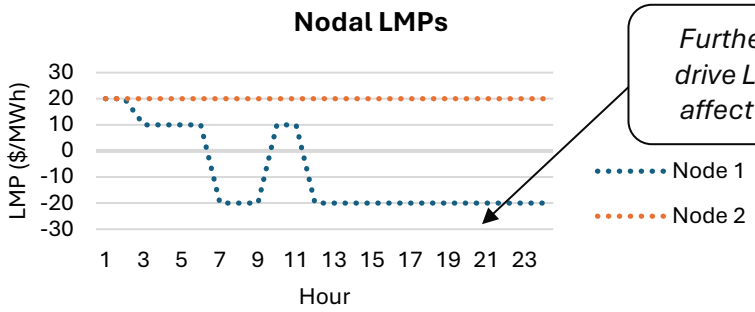
Effect of Increasing Transfer

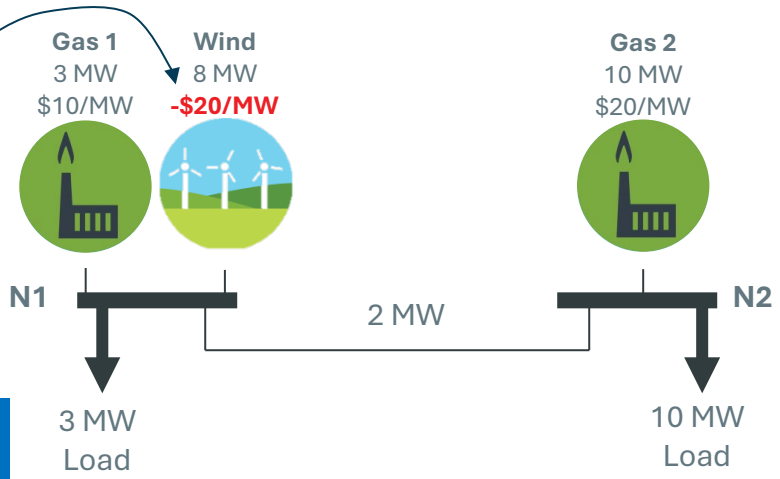
- While the interface is constrained, cheaper wind generation is marginal for most hours resulting in negative LMPs
- Relieving the constraint allows all wind energy to serve load, putting the gas units on the margin at a higher marginal price
- By relieving the constraint:
  - Production cost decreases due to the system being served by more wind generation
  - LSEEE increases since gas units are driving LMPs

Example: Effects of Changing Curtailment of Wind to -$20/MWh on LSEEE and Production Cost

Wind Curtailment Price Decreased from -$10/MWh to -$20/MWh

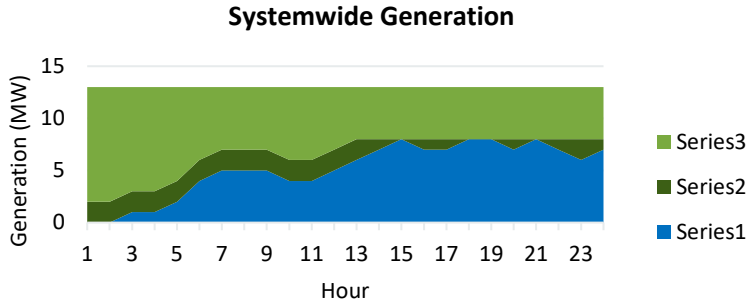
Further negative LMPs drive LSEEE, but do not affect production cost

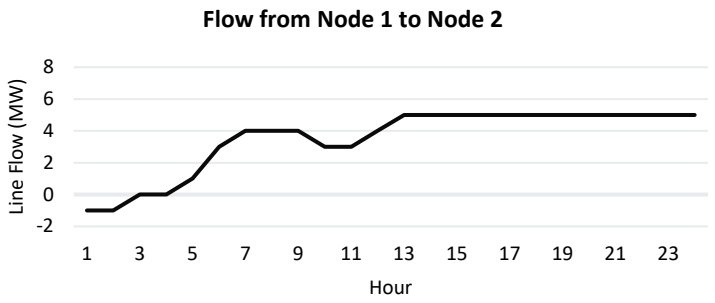




Production Cost
$4,190 |*0%*

LSE Energy Expense
$4140 ↓*10%*





$$\text{Production Cost} = \sum_{Hour} \sum_{Gen} Cost_{Gen} \times Generation_{Gen}$$

$$\text{LSE Energy Expense} = \sum_{Hour} \sum_{Node} LMP_{Node} \times Load_{Node}$$