Capacity Auction Reforms: Seasonal/Accreditation (CAR-SA)

Seasonal LOLE Split and Related Parameters

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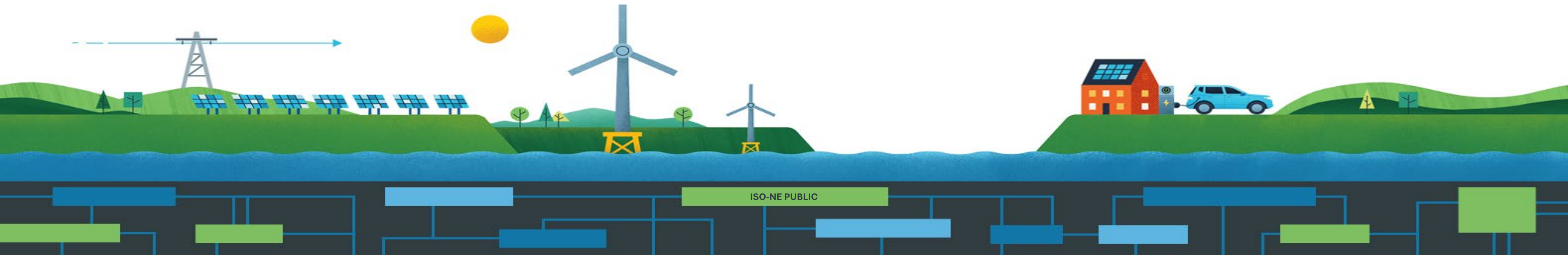


CAR-SA Project Overview

WMPP ID: 185

Proposed Effective Date: Q2-Q3 2027

- CAR-SA includes changes to introduce seasonality and accreditation reforms to the capacity auction
- Much of the process to establish the Net Installed Capacity Requirements (NICR) and related values will remain unchanged from current rules
- However, some changes will be necessary to ensure that this process continues to support the capacity market's reliability, sustainability, and cost-effectiveness objectives with the introduction of seasonality
- This presentation provides an overview of the ISO's current thinking regarding how this process would be updated under CAR-SA

CAR-SA

Key Topics Covered in Today's Discussion

- How does the ISO determine how much capacity to buy?
- Under current rules, this process is done on an annual basis, where the capacity procured corresponds with an annual delivery period
- However, under CAR-SA, the ISO is proposing to separately procure capacity for the summer and winter, and must determine how this process will be updated to account for the distinct seasons
- The assumptions used to determine key inputs and parameters related to this process, including Net ICR and resource accreditation values

Approach Discussed Today Represents ISO's Current Thinking

- The ISO is bringing this framework to stakeholders now to get initial feedback and questions
- Such feedback will help inform the ISO's proposal and highlight topics of stakeholder interest
- There are many outstanding details that have not been fully assessed at this time, but that we expect to cover in future meetings

BACKGROUND: CURRENT PROCESS

Current Process Seeks to Achieve Three Key Objectives

- **Reliability**: Procure sufficient capacity to satisfy the region's 1-day-in-10 annual resource adequacy objective
  - This capacity quantity that corresponds with a Loss of Load Expectation (LOLE) of 0.1 days/year is the Net Installed Capacity Requirement (NICR)
- **Sustainability**: Incent the levels of investment to meet this standard over time, as system and market conditions change
- **Cost-effectiveness**: Develop capacity market demand curves to meet the above objectives in a cost-effective manner
- The remainder of this section provides a conceptual overview of how this process is done in the current annual framework
  - Intended to be high-level and focus on the core logic and mechanics of this methodology

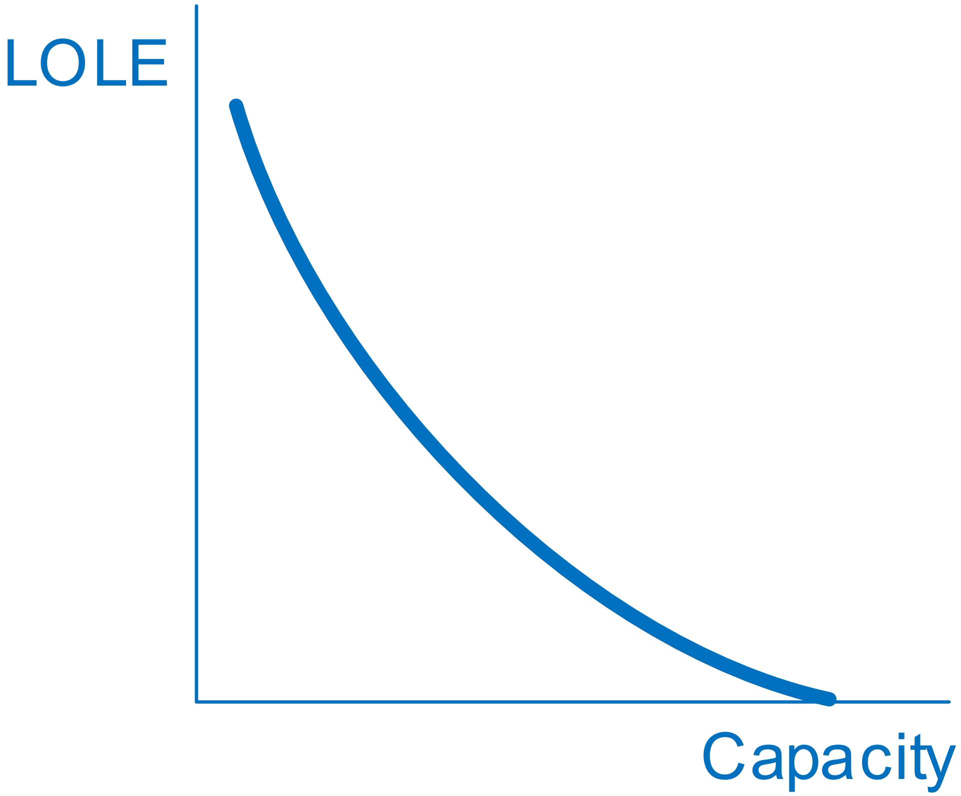
Current Rules: Five Step Overview

1. Run GE MARS at a range of capacity values to calculate reliability metrics – Loss of Loss Expectation (LOLE), Loss of Load Hours (LOLH), and Expected Unserved Energy (EUE) at each capacity level
2. (A) Find the capacity level that corresponds with a 0.1 LOLE, where this capacity quantity represents the NICR;
   (B) Develop the capacity demand MRI curve based on the EUE results from Step 1
3. Set the capacity demand curve price to Net Cost of New Entry (Net CONE) at NICR
4. Apply the scaling factor used in (3) to the capacity demand MRI curve from 2B to determine the capacity demand curve price for all capacity levels
5. Calculate zonal demand curves using the same process and apply the same scaling factor, where these calculations assume a total system quantity equal to NICR

- *Next*: Discuss each step in more detail

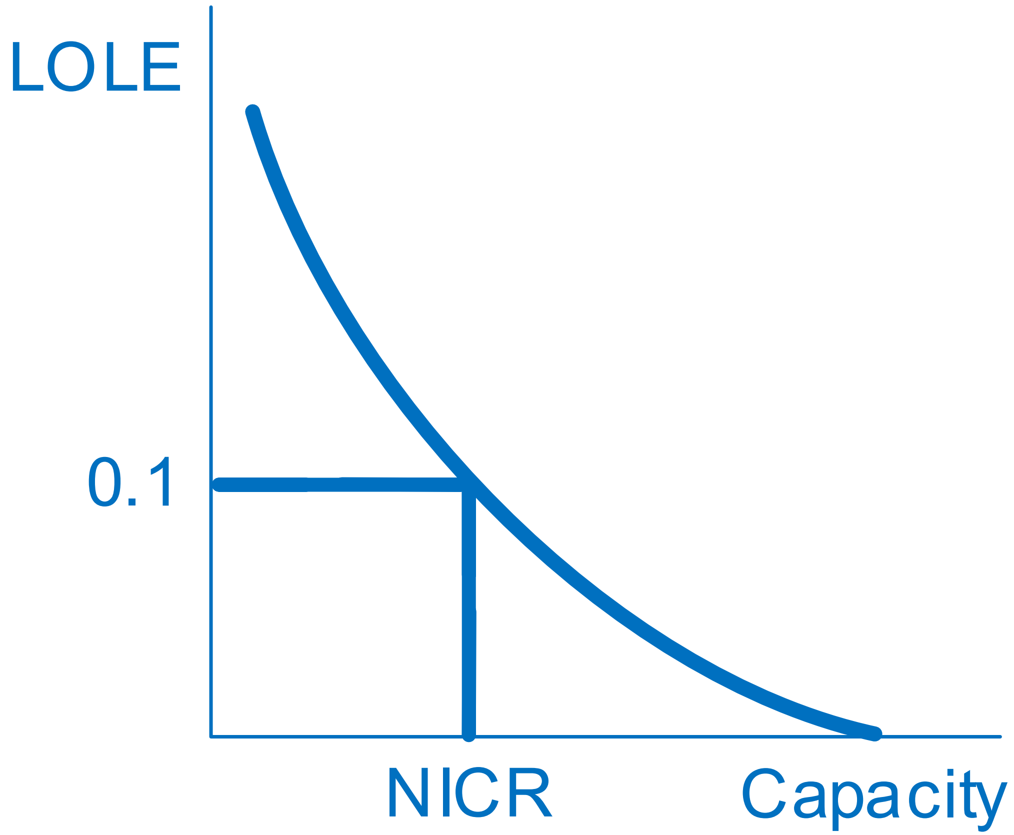
Step 1: Run GE MARS at a Range of System Capacity Quantities

- For each capacity level that is run in MARS, the ISO can calculate annual reliability metrics of LOLE, LOLH, and EUE
- These reliability metrics are calculated as average values taken across many simulations run in MARS
  - For more information on how this is done in MARS, see the materials presented at the technical sessions discussing this topic on October 21st and December 1st
- Each of these values will decrease as we assume additional capacity



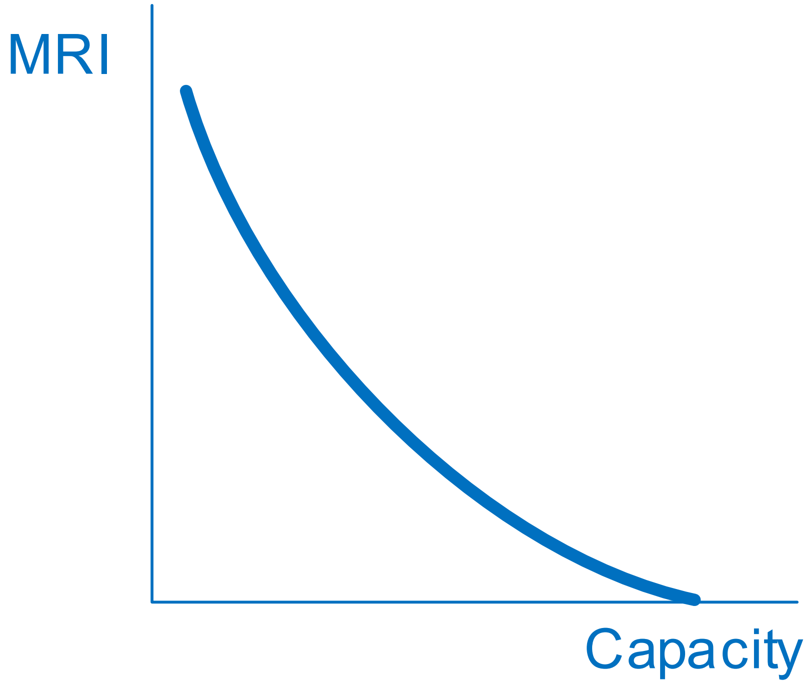
Step 2A: Solve for NICR

- Use these simulations to determine the NICR capacity level, which corresponds with a LOLE of 0.1
- This quantity, which aligns with the capacity market's reliability objective, represents the 'at criterion' case



Step 2B: Develop Capacity Demand MRI Curve

- Calculate the Marginal Reliability Impact (MRI) value at each capacity level based on the results from Step 1
- The MRI value corresponds with the reduction in expected unserved energy (EUE) in MWh associated with adding another MW of capacity
- Much like LOLE, MRI will be downward sloping to reflect the fact that another MW of capacity has a greater reliability impact when the system is relatively short and the quantity of EUE is larger than when the system is long

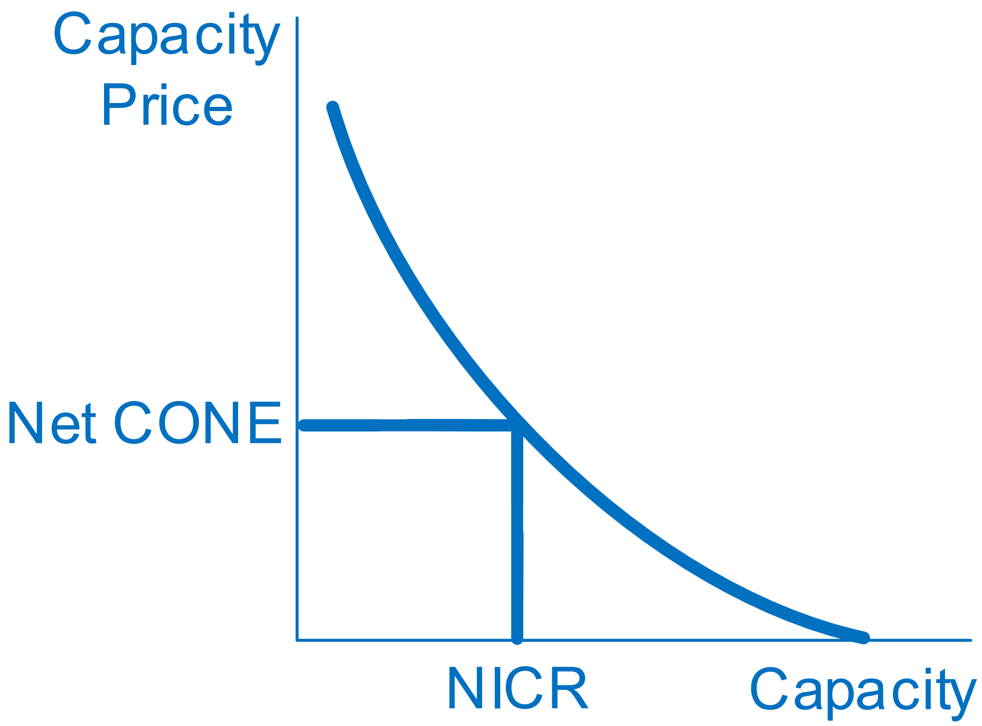


Step 3: Set the Capacity Demand Curve Price Equal to Net CONE at NICR

- Net CONE represents the estimated annual net revenue that a new competitive resource would need to recover to enter
  - In FCA 18, this value was $108,936/MW-year ($9.078/kW-month)
- To satisfy the reliability standard, the capacity market should pay a sufficiently high price to incent competitive new entry when it would otherwise fall short of this reliability standard (i.e., have a LOLE greater than 0.1)
- To do so, the capacity demand curve specifies a price equal to Net CONE at the NICR quantity, and prices above Net CONE at all quantities less than NICR
- Logic: When the region is short of the 0.1 LOLE standard, the capacity price will be higher to incent additional investment
- Mechanically, this is done by solving for the unique capacity scaling factor that converts the capacity demand MRI curve at NICR to a price of Net CONE

Step 4: Apply this Same Scaling Factor to Determine Capacity Demand at all Levels

- For each capacity level, multiply the MRI value from Step 2B by this scaling factor to derive the capacity demand curve
- Because the capacity's MRI value decreases in quantity, this produces a downward-sloping capacity demand curve
- The use of a constant scaling factor ensures that the demand curve assigns a consistent cost for each MWh of unserved energy
  - If another increment of capacity provides twice as much reliability at 25 GW as at 30 GW, the demand curves specify a price twice as high at 25 GW



Step 5: Derivation of Zonal Capacity Demand Curves

- In addition to the system curve, which is derived without consideration for zonal constraints, the ISO calculates demand curves for import- and export-constrained capacity zones
- These curves are additive to the system curve, and specify that capacity in import zones may provide more reliability value than in the rest-of-system, and those in export zones may provide less
- MRI values are derived by calculating the reliability impact of moving capacity between the rest-of-system and the capacity zone for varying levels of zonal capacity
  - These calculations assume that the total system capacity is equal to NICR
- Zonal MRI values are converted into capacity demand curves using the same scaling factor as is applied to the system level

Use of a Constant Scaling Factor Across Capacity Levels and Locations Ensures Cost-Effective Outcomes

- Define a set of system and zonal demand curves as cost-effective if, for each possible clearing price in each zone, there is no way to modify the cleared capacity levels among zones that achieves the same or better system reliability (in terms of EUE MWh) at lower total bid cost
- Multiplying MRI values by a constant scaling factor to set capacity demand allows the demand curves to satisfy this cost-effectiveness objective because it places a constant value on avoiding unserved energy at all capacity levels and in all locations
- If we were to deviate from this principle (by assigning different values of avoiding unserved energy between locations), it would not be possible to achieve the same level of reliability at lower cost by shifting capacity procurement from where it is more highly valued to where it is less valued

Additional Information

- The ISO's 2016 filing that proposed MRI-based demand curves includes considerable detail on the process by which the annual demand curves are derived, and the reliability attributes and economic properties of the current (annual) methodology
  - Section VI of the Geissler/White testimony provides additional detail on how the current rules produce cost-effective outcomes
- The FCA 18 auction parameters illustrate these values for the most recent Forward Capacity Auction
- The ISO plans to cover the process by which it derives MRI-based capacity demand curves in more detail at the January 20th GE MARS training session

PROPOSED APPROACH UNDER CAR-SA

Background: ISO is Proposing Six-Month Summer and Winter Capacity Delivery Periods

- As discussed with stakeholders at the March MC, the ISO is proposing to have a summer period that runs from May to October and a winter period from November to April
- Design Rationale:
  - Allows the ISO to separately accredit and procure capacity for each of the core resource adequacy risks observed: (i) summer peak conditions, and (ii) winter cold spells that may present fuel limitations
  - Aligns with seasons used in neighboring control areas

Introduction of Seasons Necessitates Changes to the Process by Which NICR and Related Values are Determined

- The proposed seasonal process seeks to use a similar approach to the current annual process to procure capacity in a manner that continues to meet the region's reliability standard in a sustainable and cost-effective manner
- However, procuring capacity separately for the summer and winter seasons necessitates some changes to the NICR process and derivation of its related values relative to current rules
- For example, we'll now need to establish LOLE targets and NICR values for each season

Proposed CAR-SA Process: Six Step Overview

1. Run GE MARS at a range of seasonal capacity values to calculate seasonal reliability metrics – LOLE, LOLH, and EUE
2. (A, Modified) Find the seasonal capacity levels that evenly split LOLE across seasons at 0.05 days/year, these capacity quantities represent the seasonal NICR
   (B) Develop the seasonal capacity demand MRI curve based on seasonal EUE results from Step 1
3. Find the scaling factor that ensures capacity payments at the seasonal NICR values will sum to Net CONE across the year

Proposed CAR-SA Process: Six Step Overview (con't)

4. Apply the scaling factor used in Step 3 to the seasonal capacity demand MRI curve from Step 2B to determine the seasonal capacity demand curve price for all capacity levels

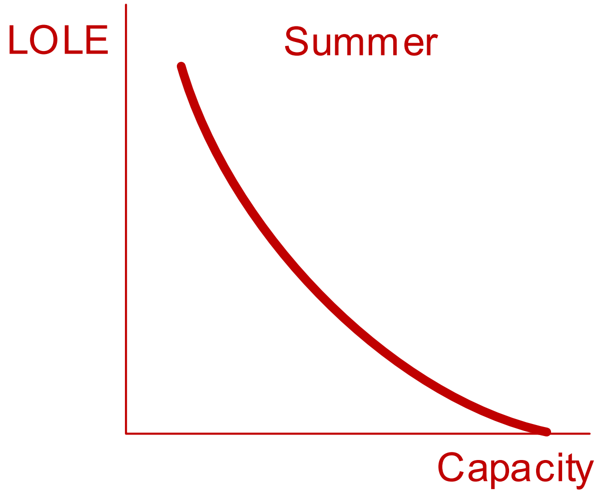
5. Calculate zonal demand curves using the same process, and apply the same scaling factor, where these calculations assume a total system quantity equal to the seasonal NICR

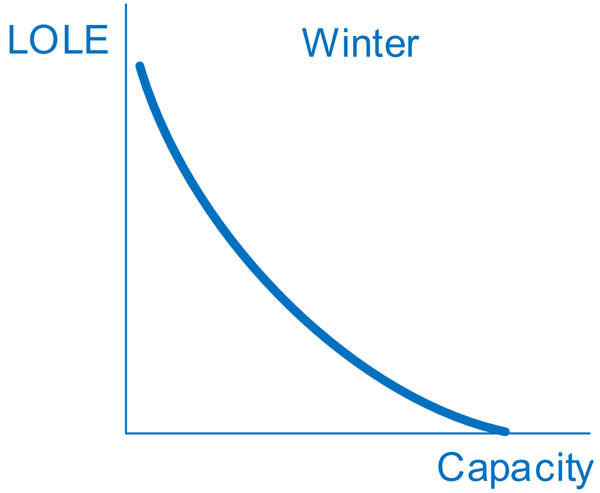
6. (New) Calculate seasonal accreditation values, assuming the total system quantity is equal to each seasonal NICR

- *Next*: Discuss each step in more detail

Step 1: Run GE MARS at a Range of Capacity Levels for Each Season

- This is similar to today, with a couple of practical differences due to the seasonality
- LOLE, LOLH, and EUE values at different capacity levels are now associated with the quantity of capacity for the relevant season, rather than the whole year
- *Implication*: We are likely to have different values for the 25,000th MW of summer and winter capacity



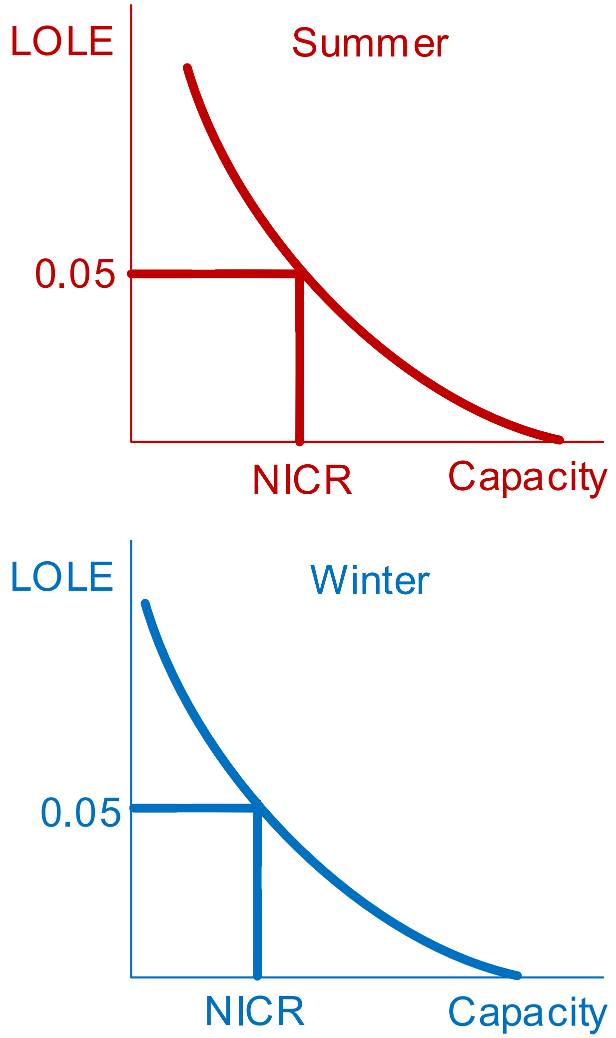


Step 2A: Determine Seasonal NICR Values

- To satisfy the 1-in-10-year annual LOLE, we will set seasonal values so that their corresponding LOLE values sum to 0.1
- Then, if we procure capacity in each season consistent with the corresponding seasonal NICR value, we will meet the annual 1-day-in-10-years resource adequacy standard
  - The seasonally derived EFORd values will be utilized as described in October
- Observe that multiple pairs of seasonal NICR values could achieve this objective

The ISO Proposes to Set the Seasonal NICR at Values that Evenly Split the LOLE Between Seasons

- Under this approach, the seasonal NICR values for each season would correspond with the capacity quantity that yields a LOLE of 0.05
- These represent the seasonal 'at criteria' cases
- *Next*: Reasoning behind this proposed 50/50 LOLE split

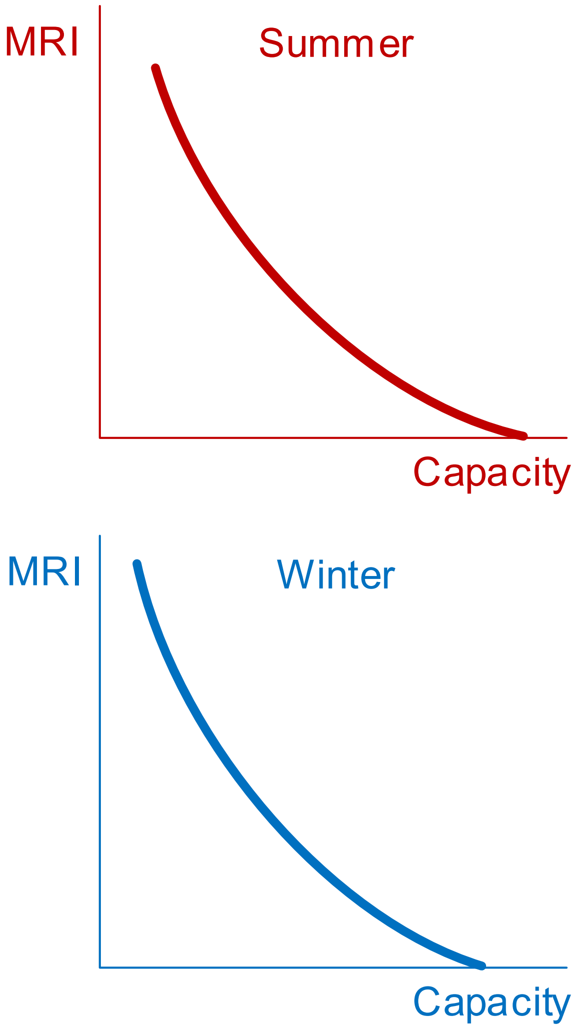


Reasoning for Proposed 50/50 LOLE Split

- Targets the same reliability, as measured in LOLE, for the summer and winter
- With transition to seasonal capacity procurements and the various changes proposed under CAR, an even split represents a simple, transparent, and stable approach by which to satisfy the capacity market's (annual) reliability objective
- As the region gains more experience with seasonal procurements under CAR, the ISO may consider whether refinements to the LOLE split methodology are appropriate

Step 2B: Develop Seasonal Capacity Demand MRI Curve

- Calculate the Marginal Reliability Impact (MRI) value at each seasonal capacity level based on the results from Step 1
- Much like LOLE, MRI will be downward sloping in each season to reflect the fact that another MW of capacity has a greater reliability impact when the system is relatively short, and the quantity of EUE is larger than when the system is long

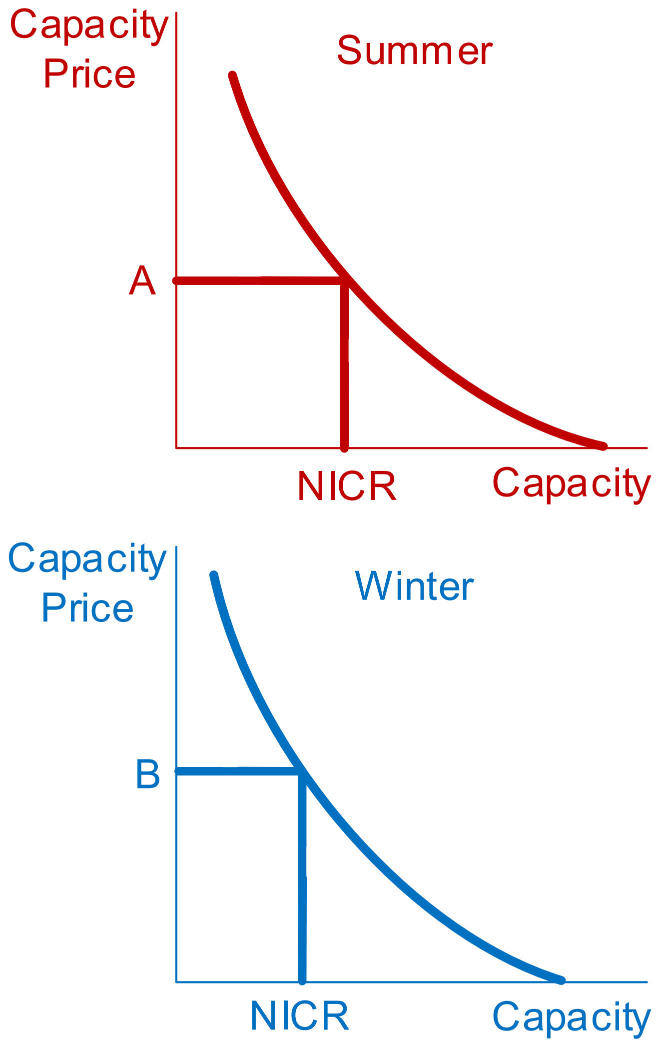


Paying Net CONE Across Seasonal NICR Values

- Recall: To satisfy the reliability objective, the capacity demand curves should pay Net CONE when the system is at its 1-in-10-years resource adequacy standard
- When the system is short of this standard, it should specify a higher price to reflect that the capacity's reliability value is greater, thereby inducing additional investment
- Mechanically, this is done by ensuring that when the system is at the seasonal NICR values, total capacity compensation (across each season) is equal to Net CONE
- Observe: There are multiple ways that this can be done, as Net CONE is an estimate of the annual cost of new entry
  - For example, can divide Net CONE into equal monthly payments (as is done in today's capacity market), pay the entire amount in the summer and none in the winter, etc.

Step 3: Solve for the Scaling Factor that Ensures a Total Annual Payment of Net CONE at Seasonal NICR Levels

- Determine the single scaling factor that, when applied to the MRI values associated with the seasonal NICR values, produces an annual payment of Net CONE
  - In the figure on the right, a payment of A for the six summer months and B for the six winter months would yield a total payment of Net CONE over the course of the year
- This methodology is consistent with the approach today, except that we now must consider two seasons



Observation: The Seasonal NICRs May Have Different Demand Curve Prices

- The seasonal NICR values correspond with the capacity quantities that yield equal LOLE values of 0.05 in each season
  - This means at the corresponding NICR values, the resource adequacy model predicts the same number of expected loss-of-load events in summer and winter
- However, as shown in the example that follows, the MRI values associated with capacity at these seasonal NICR values can differ
- Such a difference can occur if loss of load events in one season tend to be longer than in the other
  - In such cases, an increment of capacity in the season with longer events provides more reliability value per event (in terms of reducing EUE)
  - It is therefore appropriate (and cost effective) to specify a higher price at the NICR value for the season where incremental capacity reduces EUE more significantly

Step 3: Numerical Example - Assumptions

Parameter	Value
Net CONE	$120,000 per MWh-year (average $10.00 per kW-month)
Summer NICR	30,000 MW
MRI @ Summer NICR	0.6 hours per season
Winter NICR	25,000 MW
MRI @ Winter NICR	0.9 hours per season (50% higher than summer value)

Step 3: Numerical Example – Solving for the Scaling Factor and Capacity Prices at the Seasonal NICR Values

- Need total payment equal to $120,000 / MW-year at seasonal NICR values
- Equation that satisfies this condition, where *SF* represents the scaling factor:

$$\$120{,}000 = 0.6 \text{ hours} \times SF + 0.9 \text{ hours} \times SF$$

- Rearranging and solving for *SF* yields:

$$SF = \$80{,}000 \,/\, MWh$$

- Applying *SF* yields the following demand curve prices at NICR for each season:

Summer: $8.00 / kW-month (0.6 × $80,000 / 6,000)

Winter: $12.00 / kW-month (0.9 × $80,000 / 6,000)

- Observe: Average annual price is $10 / kW-month and winter price is 50 percent higher than summer, consistent with relative MRI values at NICR

*Divide by 6,000 to convert from seasonal-MW rate to monthly-kW rate

Step 4: Apply this Scaling Factor to All Capacity Levels Across Both Seasons

- As with current rules, this single scaling factor is used to translate the MRI values for capacity in each season from Step 2B to derive downward-sloping capacity demand curves
- These MRI values, which do not depend on the LOLE split, largely determine the demand curve shape
- The seasonal capacity auctions continue to assign a constant value to reducing EUE by an MWh, regardless of the season

Use of a Constant Scaling Factor Across Capacity Levels and Seasons Ensures Cost-Effective Outcomes

- By setting demand for capacity in a manner that is proportional to its reliability value at all capacity levels across seasons using a constant scaling factor, the MRI-based demand curves are cost-effective
- In other words, the demand curves ensure that the seasonal auctions apply a constant value to reducing unserved energy across capacity levels and seasons
- It is not possible to develop seasonal demand curves that buy less capacity in one season and more in the other and achieve the same level of reliability (as measured in EUE) at a lower cost
  - Same logic as that under current rules supporting cost-effective capacity procurements across zones

Step 5: Derive Zonal (and Gas) Constraint Demand Curves

- Use the same scaling factor that is applied to the seasonal system curve, which is derived without considering these constraints, for the seasonal zonal (and gas) curves
- Much like current rules, these curves are additive to the seasonal system curve
- MRI values are calculated by moving capacity between the system and the corresponding location
- As with current rules, the MRI values are calculated holding the system capacity constant at the seasonal NICR values in these calculations

Step 6 (New): Calculate Seasonal Accreditation Values

- For each season, assume an unconstrained system at NICR to calculate each resource's seasonal rMRI value
- From this rMRI value and other related parameters (e.g., resource MCap values), calculate resource-level capacity accreditation values
- An overview of this methodology was provided in the ISO's September MC and RC materials, with additional details on the process for various resource types being shared in subsequent technical committee meetings

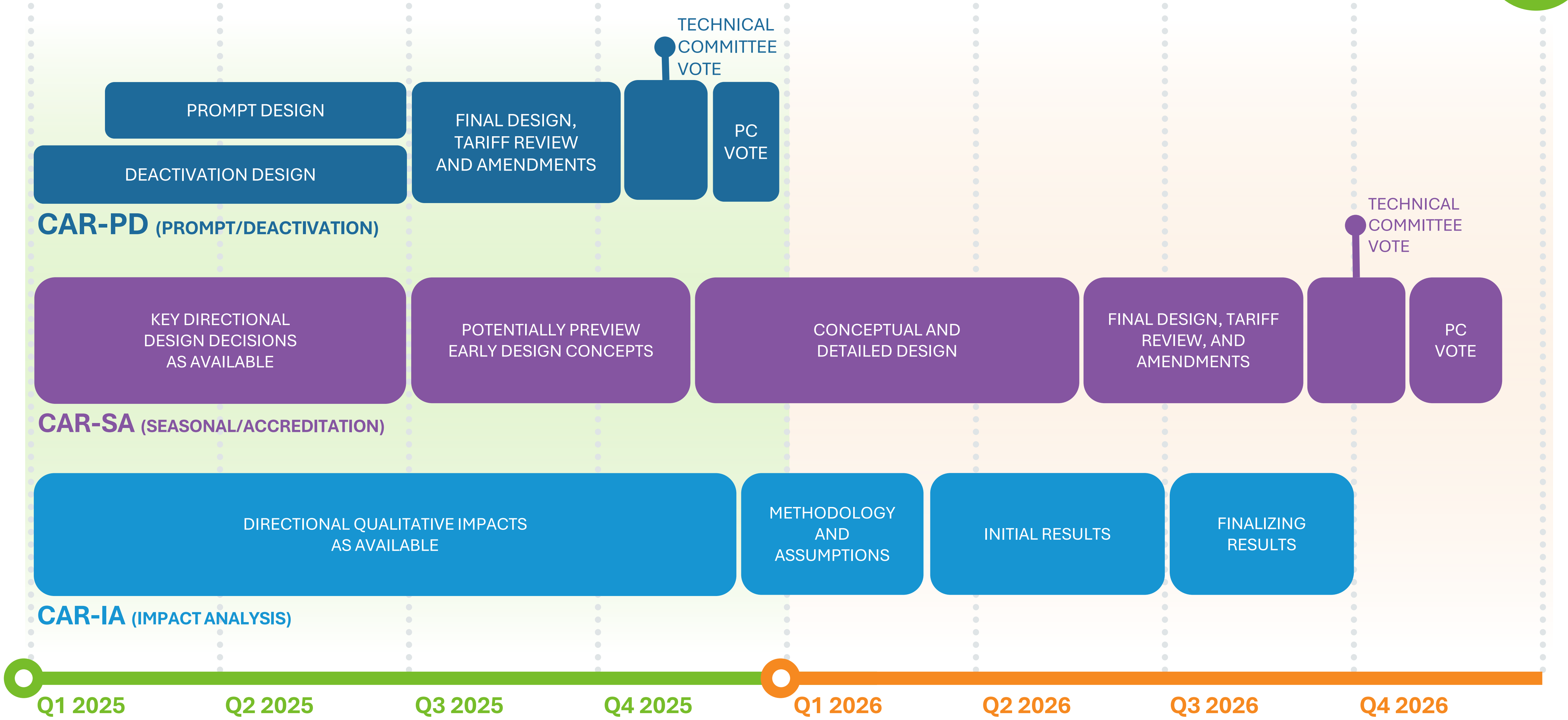
Key Takeaways

- The ISO proposes to employ a similar approach to setting seasonal NICR values and the corresponding demand curves under CAR-SA as is currently used with an annual delivery period, including:
  - Calculating seasonal NICR values that yield an annual LOLE of 0.1
  - Applying a single scaling factor to convert capacity MRI values to demand curve prices for all capacity levels, zones, and seasons
- This will help ensure that the capacity market continues to meet its reliability and sustainability objectives in a cost-effective manner
- The ISO proposes to set the seasonal NICR values in a manner that evenly splits the LOLE at 0.05 in each season

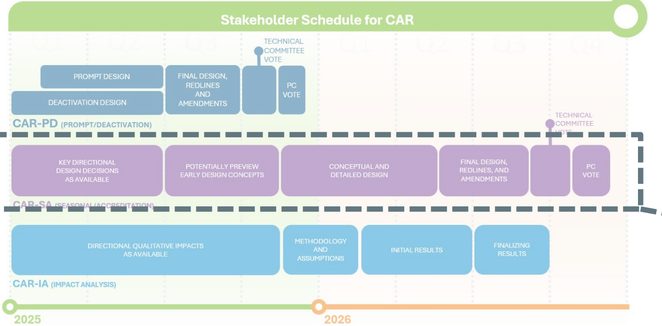
Questions

STAKEHOLDER SCHEDULE

Stakeholder Schedule for CAR



CAR-SA



Stakeholder Schedule for CAR-SA

CORE MODELING AND ACCREDITATION CONCEPTS

SEASONAL/ACCREDITATION MODELING AND MARKET DESIGN

CONFORMING DESIGN DETAILS

FINAL DESIGN, TARIFF REVIEW AND AMENDMENTS

TECHNICAL COMMITTEE VOTE

PC VOTE

CAR-SA (SEASONAL/ACCREDITATION)

PROVIDE QUESTIONS AND FEEDBACK ON DESIGN

CONCEPTUAL AMENDMENTS

PRESENT AMENDMENTS

Stakeholder Activity

PRESENT DESIGN & RESPOND TO FEEDBACK

ISO Activity

PROVIDE QUESTIONS AND FEEDBACK ON AMENDMENTS

Q4 2025 | Q1 2026 | Q2 2026 | Q3 2026 | Q4 2026

CAR-SA Schedule Projection

- **December**
  - Seasonal Market Design Concepts and Risk Split (MC timeframe)
  - Gas Availability Study Follow-up with Analysis Group (MC timeframe)
  - Gas Market Constraint Conceptual Introduction (MC timeframe)
  - Overview of Impact Analysis Plan (MC timeframe)
  - Energy Storage Resource Modeling and Accreditation (Includes Pumped Hydro) (RC timeframe)
  - Seasonal Tie Benefits (RC timeframe)
- **January**
  - Gas Market Constraint Design Detail and Gas-only Resource Modeling and Accreditation (MC timeframe)
  - Intermittent Power Resource Modeling and Accreditation (includes run-of-river hydro) (MC timeframe)
  - Energy Limited Resource Modeling and Accreditation, Continued (Dual Fuel) (MC timeframe)
  - Q4 Follow-up Medley (MC timeframe)
  - Seasonal Tie Benefits (RC timeframe)

All NEPOOL members are invited to attend meetings where CAR topics are discussed

CAR-SA Preliminary Topic Schedule: February and Beyond

- The list below provides a projection of when core accreditation committee discussions will begin:

Topics	Projected Committee Discussions
Import Resource Modeling and Accreditation	February
Modeling Deliverability: Summary of All Resource Types	February
Hybrid Resource Modeling and Accreditation	February – March

CAR-SA Preliminary Topic Schedule: February and Beyond (Continued)

- The list below provides a projection of when core accreditation committee discussions will begin:

Topics	Projected Committee Discussions
ICR and Seasonal Demand Curve Estimation	February – March
Impact Analysis Initial Results	March – June
Q1 Follow-up Medley	April
Gas-only Resource Contract Requirements	April – May