



# Education on Transmission in the Reliability Pricing Model: Status Quo

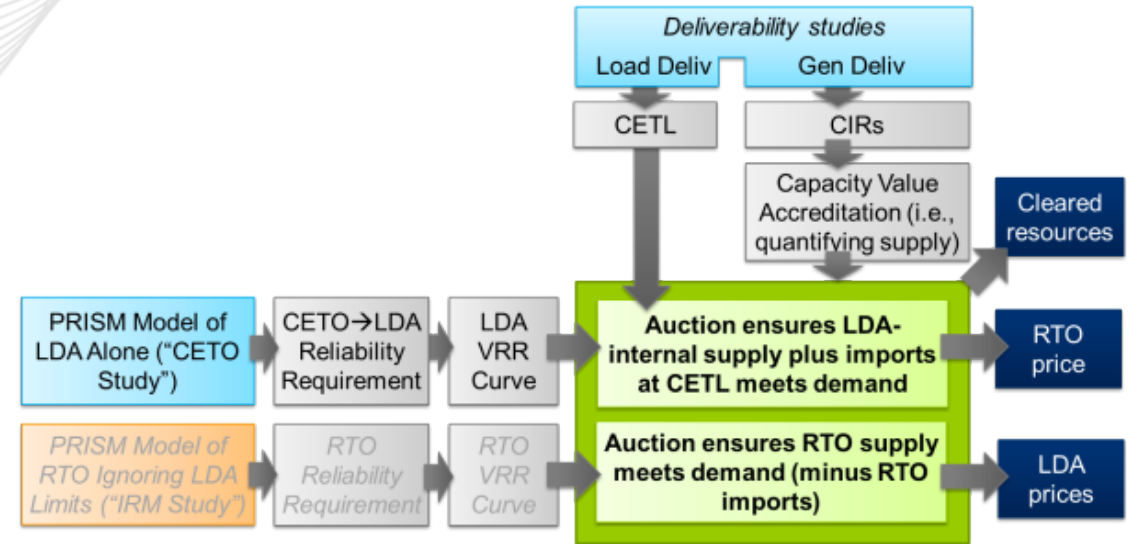
Andrew Levitt

Market Design & Economics Department

PJM Resource Adequacy Senior Task Force

September 22, 2022

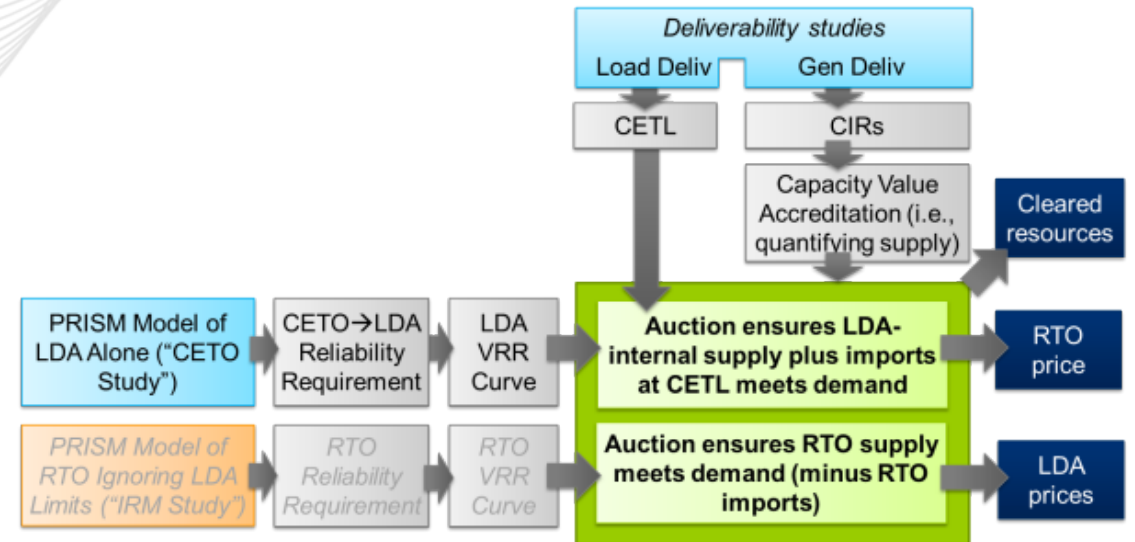
- Intent of education is to inform discussion of solution options related to transmission in the capacity auction\*.
  - *E.g., possible enhancements to the CETO study process.*
- Potential linkage to RASTF Key Work Activities:
  - *KWA#2: types of reliability risks and risk drivers*
  - *KWA#3: desired procurement metric and level*
  - *KWA#5: Qualifications.*
  - *KWA#8: remaining design details for a seasonal capacity market construct (as applicable).*
- The education defines various parameters (CETL, CETO, CIRs, and LDAs), their function in the auction, and how they are determined today.



*This figure is from the final slide; it shows how the pieces of the transmission assessment fit together in the auction system.*

*\*For simplicity, this presentation omits Qualifying Transmission Upgrades (QTUs) and pseudotied external PJM capacity resources.*

- The overall goal of transmission assessment in the Reliability Pricing Model (RPM) is to efficiently quantify, account for, and manage potential reliability risks related to transmission capability.

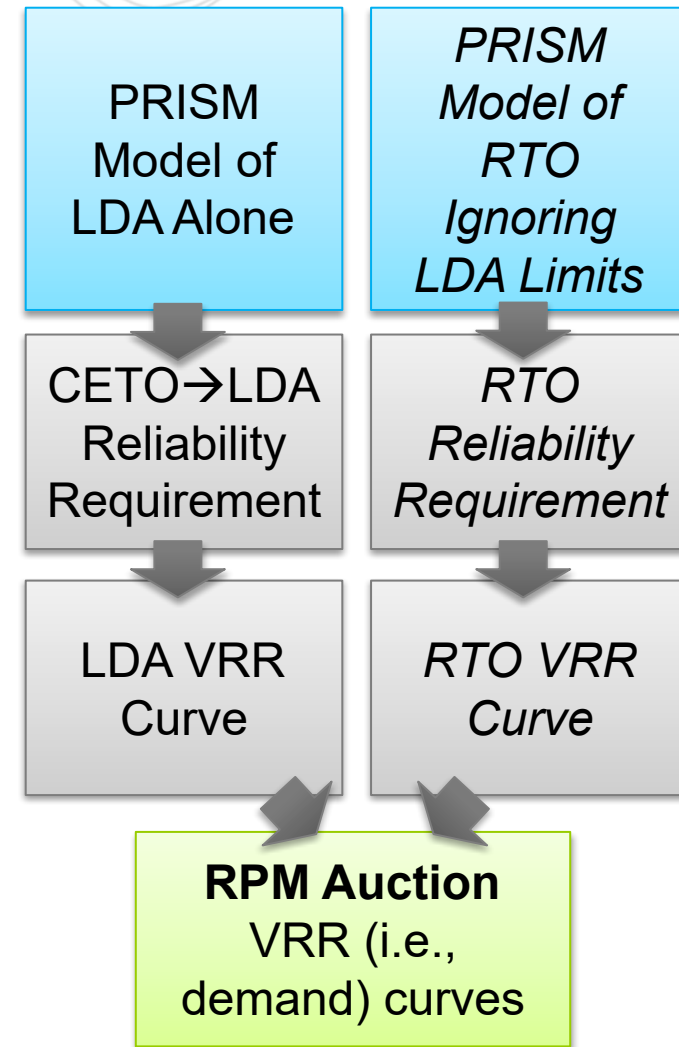


*This figure is from the final slide; it shows how the pieces of the transmission assessment fit together in the auction system.*

1. The **planning process** (interconnection Queue & Regional Transmission Expansion Plan) quantifies transmission capability via power flow tests, & identifies needed upgrades. **Outputs\***:
  - Capacity Interconnection Rights (CIRs) indicate the level of tested transmission capability relevant to the capacity value of a specific generator.
  - Capacity Emergency Transfer Limits (CETLs) indicate the level of imports the transmission system can deliver to a zone under peak, emergency outage conditions.
  - Separately, the Resource Adequacy Planning Department develops Capacity Emergency Transfer Objective (CETO) values using loss-of-load-expectation-type analysis, as well as Locational Deliverability Area (LDA) definitions.
2. The **capacity auction** features several LDA regions. The auction ensures enough LDA supply (given resource capacity values) such that LDA load is reliable given limits on transmission imports. The auction yields LDA & RTO price signals accordingly. **Inputs\***:
  - CETL, CIRs, CETO, and LDA definitions

\* The capacity market also counts on a certain amount of capacity from our interaction with neighboring Planning Authorities, as quantified in the Capacity Benefit Margin (CBM) and Capacity Benefit Of Ties (CBOT). These are also outputs of the planning process and inputs to the auction system.

- **An LDA is an internal region w/ relevant limits on the ability of the transmission system to import to it during summer peak.**
- LDA Reliability Requirement is the level of internal supply (plus imports) needed to limit local loss-of-load risk (caused by import limits) to 1-in-25.
- The auction clears capacity to meet MULTIPLE reliability targets (w/ some elasticity via the Variable Resource Requirement (VRR) curve):
  1. *For the entire RTO, meets the 1-in-10 risk target from the target IRM.*
  2. *Separately, for each LDA, meets 1-in-25 risk target from “CETO study”.*
    - *A load in an LDA would theoretically face both risks. For LDA load, 1-in-25 is considered a sufficiently low addition to the 1-in-10.*
- An LDA is modeled in the auction when it meets any of these:
  - *Has a lower import limit ( $CETL < 1.15 * CETO$ ), or*
  - *Recently bound in auction, or subject to determination of reliability need, or*
  - *Is a predetermined LDA that is always modeled*





# PRISM Model of RTO: “The RRS”

*PRISM is PJM’s main tool for LOLE/resource adequacy analysis.*

*The Reserve Requirement Study “RRS” (which produces the Installed Reserve Margin or IRM) provides the RTO Reliability Requirement.*

Rest Of World

## PJM pool

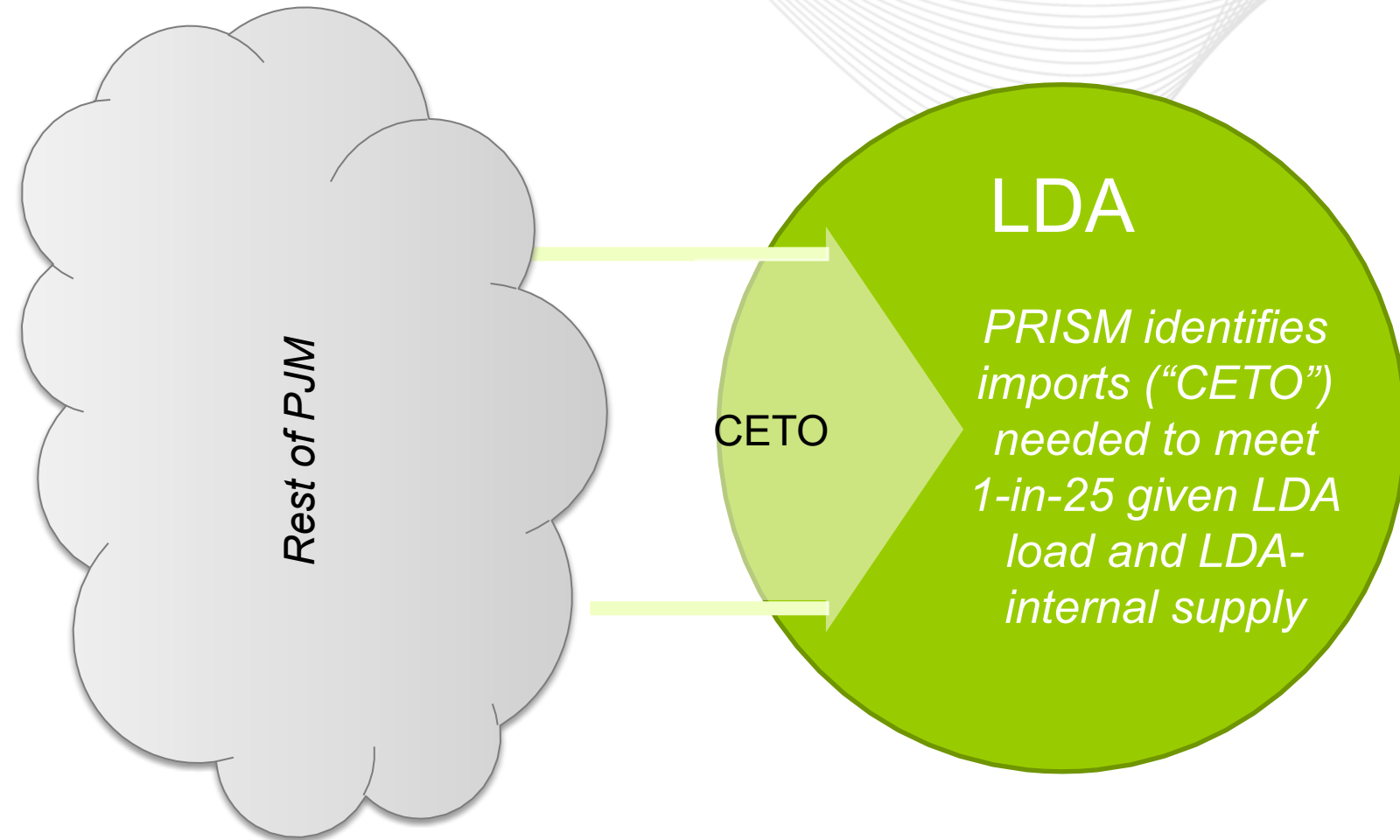
Imports from outside PJM\*

*PRISM identifies supply needed to meet 1-in-10 given load and system imports (“capacity benefit of ties”)*

- PRISM has 2 big areas (PJM and rest of world) and no transmission (except imports to PJM).
- It simply assesses whether supply in the PJM area (plus imports) meets/exceeds demand in a scenario.
- PRISM’s complexity derives from examination of numerous scenarios.

*\*Capacity benefit of ties*

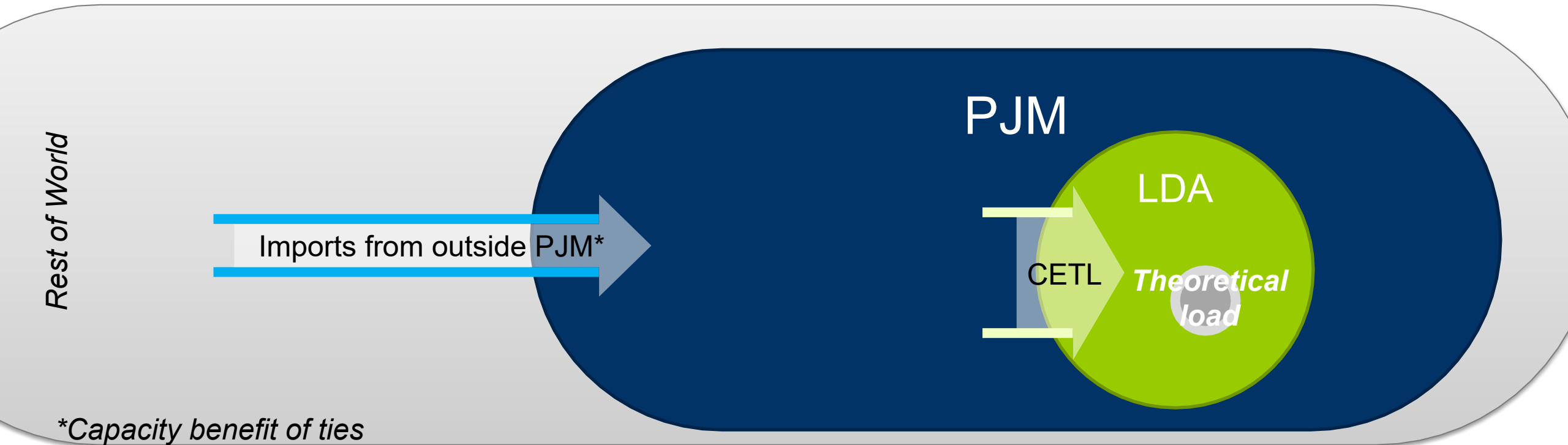
# PRISM Model of an LDA (“The CETO Study”) & Calculating the LDA Reliability Requirement



- The CETO study is a 1-area PRISM run: it models just the LDA and imports PJM→LDA.
- **CETO is the LDA import level required to meet the reliability needs of an LDA (i.e., 1-in-25), assuming a certain set of LDA internal resources.**
- CETO sets the LDA Reliability Requirement.
  - *CETO also input in determination of LDAs modeled in auction*
- **LDA Reliability Requirement = CETO + total UCAP of LDA-internal resources**

# The Theoretical Modeled Load Inside an LDA

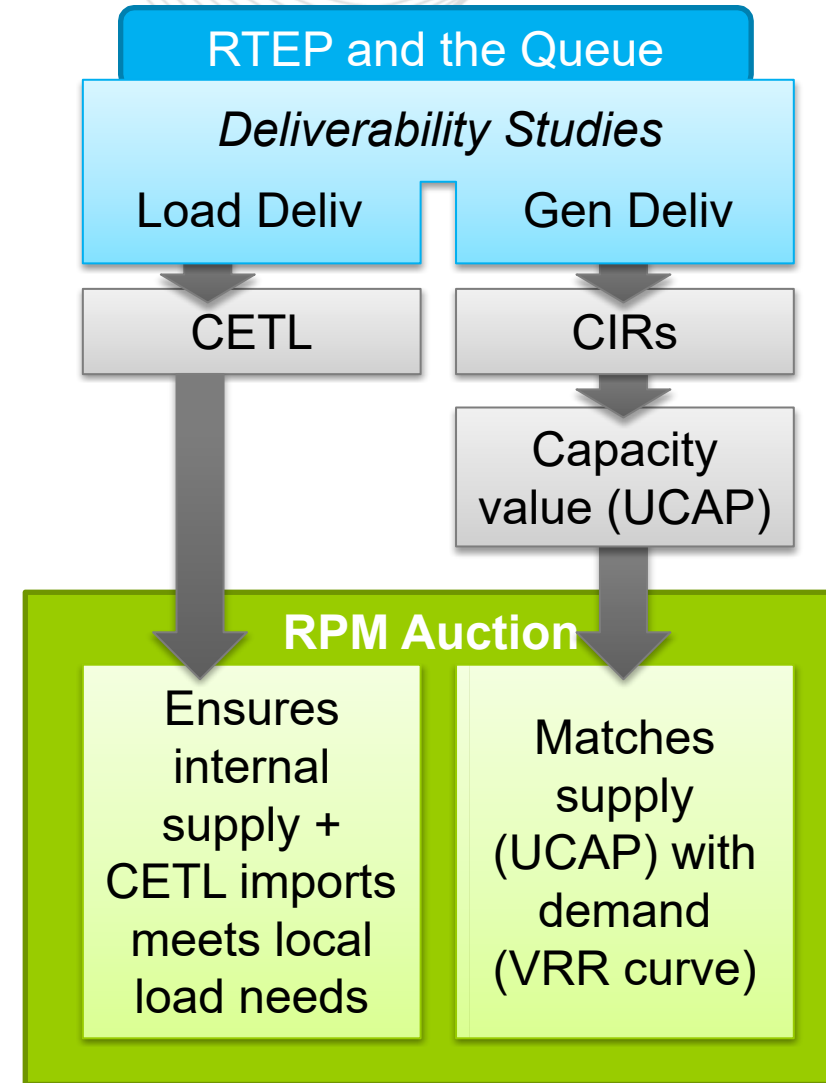
- PRISM does not simultaneously model LDAs and the RTO.
- Nonetheless, the theory of the model suggests that, at target reliability, the theoretical load shares the reliability risk of 1-in-10 at the RTO level, plus up to an extra 1-in-25 from limits on LDA import capability (per nested LDA).



\*Capacity benefit of ties



- **Capacity Interconnection Rights (CIRs) represent transmission capability that supports the capacity value of a generator under summer peak conditions.**
- The capacity value of a resource reflects their CIRs.
  - *Status quo for 2022/23 delivery year: UCAP cannot exceed CIRs for wind and solar, ICAP cannot exceed CIRs for other generator types.*
- **The Capacity Emergency Transfer Limit (CETL) is the capability of the actual transmission system to import from PJM to the LDA (under summer peak conditions).**
- For each LDA, the auction ensures that cleared LDA-internal supply (plus imports up to CETL) meets the LDA Reliability Requirement.
- CIRs (“gen deliv”) and CETL (“load deliv”) are outputs of the overall deliverability power flow study process.

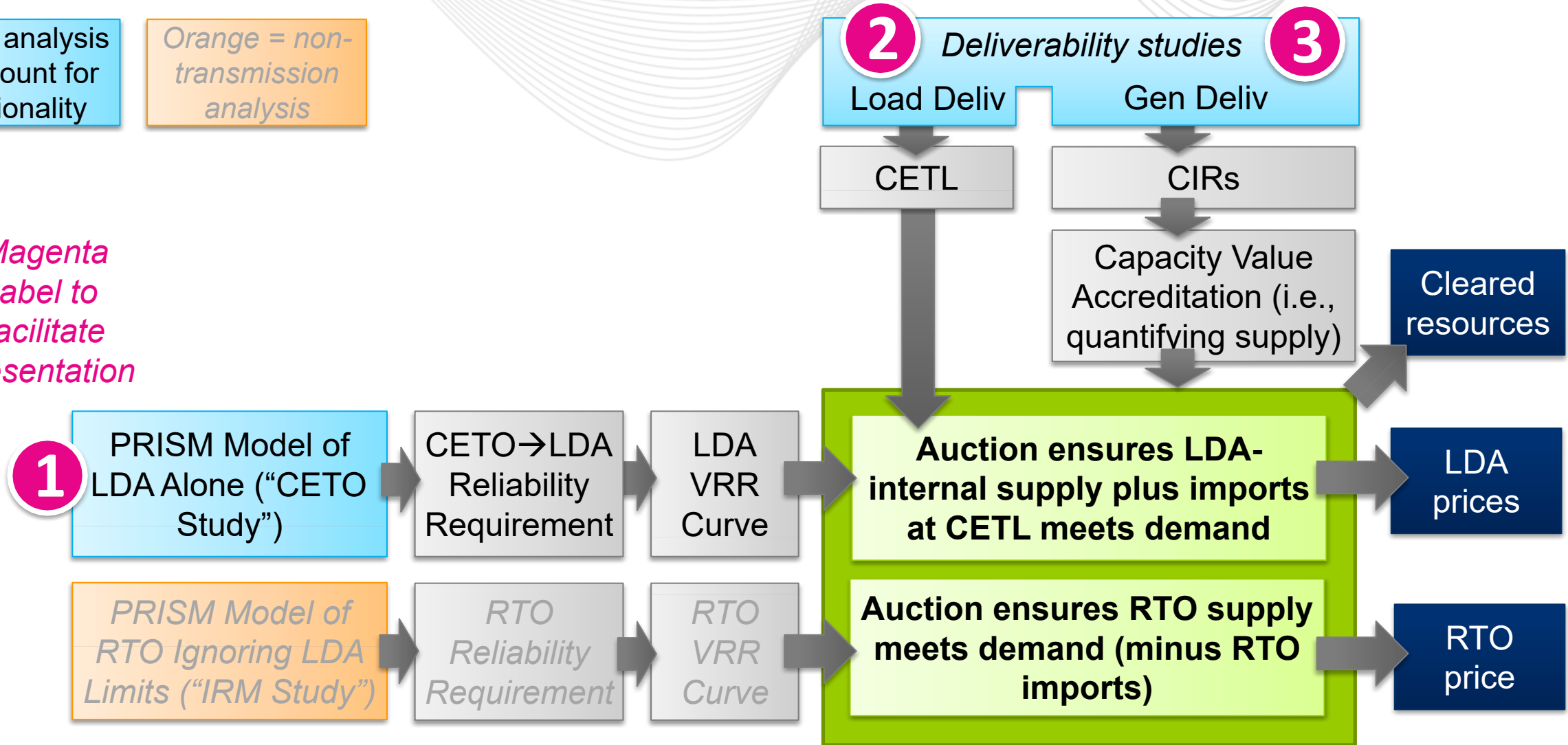


# Overall Transmission/Locationality in the Auction System

Blue = analysis to account for locationality

Orange = non-transmission analysis

Magenta label to facilitate presentation

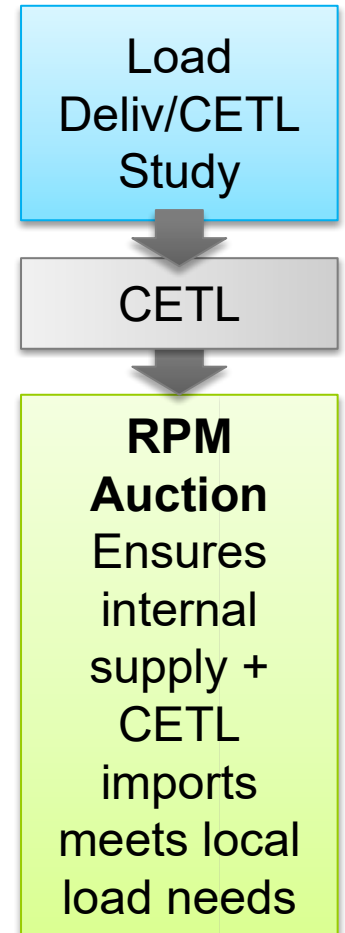


- LDA price separation results in “congestion” surplus revenues
  - Typically, with a price-separated LDA, more load pays the LDA price than supply is paid that price.
- This surplus is allocated according to the relevant provisions.
  - Capacity Transfer Rights (CTRs) play an important role in the allocation\*.
  - CTRs are quantified and allocated to Load Serving Entities (LSEs).
  - Incremental CTRs (ICTRs) are quantified and allocated to appropriate parties associated with certain transmission upgrades (including e.g., generators or other customers in the Queue).

\* <https://pjm.com/-/media/committees-groups/committees/mic/2021/20210407/20210407-item-05a-rpm-capacity-transfer-rights-pjm-education.ashx>

# Appendix: deliverability study model details

- CETL is the transmission capability to support imports to an LDA from PJM's overall system.
- The auction assumes both CETL and LDA-internal cleared supply can be used to meet the internal LDA Reliability Requirement.
- CETL is an output of the overall deliverability power flow studies:
  - a) *CETL studies for each LDA begin with two separate dispatch scenarios in which the LDA is importing the CETO, including both a discrete generator outage scenario and a mean generation outage scenario based on Monte Carlo to capture random thermal outages.*
  - b) *Thermal generators are modeled up to ICAP minus probabilistic outage modeling.*
  - c) *Under today's rules, wind and solar modeled at their CIR value.*
  - d) *CETLs are calculated from the above dispatch scenarios by uniformly scaling down the generators inside the LDA under study and increasing PJM generation outside the LDA in order to maximize imports into the LDA.*
  - e) *PJM calculates both summer and winter CETLs as part of the annual RTEP. Summer CETLs support RPM.*





# Capacity Interconnection Rights and Accreditation

- CIRs represent transmission capability that supports the capacity value of a generator.
- The capacity value of a resource reflects their CIRs
  - *ICAP cannot exceed CIRs for Unlimited Resources, and UCAP cannot exceed CIRs for renewables and storage (starting with the 2023/24 delivery year).*
- CIRs are an output of the overall deliverability study process:
  - a) Power flow studies of a snapshot scenario of the summer peak.*
  - b) The scenario features countless bottled generation stress test variations.*
  - c) Thermal generators are modeled up to ICAP minus probabilistic outage modeling.*
  - d) Wind and solar (lacking outage data) are always modeled at their CIR value today. PJM proposes a significant change at the PC that both increases the wind/solar CIR value and incorporates more stress-test dispatch scenarios.*
- PJM proposes an enhanced approach to incorporating generator deliverability studies into the capacity value accreditation of renewables and storage:

[PC Special Sessions on CIRs for ELCC Resources](#)

