# Role of Performance Incentives in Capacity Construct

Walter Graf
Sr. Director – Economics

February 14, 2023

- Describe PJM's thinking on why performance incentives are a necessary part of our capacity construct
- Seek stakeholder feedback on enhancements to the current implementation of the performance incentive structure to better accomplish the objectives of such incentives

# High Level: Two Frameworks for Capacity Construct

- **Option 1.** Capacity as a product exists only before the delivery year.
  - Resources are assessed as having delivered the capacity product if they meet certain physical qualification requirements and meet obligations to make their capacity "available" in the delivery year. *"No resettlements"*
- **Option 2.** Capacity as a two-settlement market, with a forward sale of a physical and financial product, and financial implications (re-settlements) based on delivery of the product in the delivery year
  - Deviations between quantity of capacity sold forward and quantity of capacity delivered are re-settled at the "spot" price of capacity
  - Capacity deemed "delivered" may reflect performance and/or availability depending on specifics of design

# Where do Current and Proposed Performance Incentive Frameworks Fit In?

- **Capacity Performance** was adopted in 2015 is an example of a two-settlement market design, but is not the only way to design a two-settlement market
- **Both PJM and IMM proposals** on performance incentives are also examples of two-settlement market designs
  - **PJM proposal:** maintains high “real time” price of capacity during emergencies and scarcity conditions, and zero otherwise; *“high resettlements”*
  - **IMM proposal:** implements low “real time” price of capacity, equal to annual clearing price/8760 in all hours; *“low resettlements”*

# Need For, and Value Of, High Performance Incentives

- Both “no-resettlements” and “low-resettlements” designs have several adverse impacts on system reliability and efficiency compared to a “targeted, high-resettlements” design, including:
  1. Poor price signals
  2. Misaligned incentives
  3. Inefficient capacity commitments
     a. Compensation may not reflect value

- Next: discuss each of these adverse impacts in more detail

# 1. Poor Price Signals Do Not Reflect Value of Reliability

- The administrative demand curve, and resulting prices in the forward capacity market, imply high willingness to pay for reliability and avoided load shed
- This high willingness-to-pay for capacity stems from the incremental value of reliability that is not reflected in energy & AS prices; the “missing money”
- From which hours is the money missing? Those which would have load shed or load shed risk without the additional capacity revenues
- Neither the “no-resettlements” nor “low-resettlements” design targets these hours for incremental incentives
  - Hence, under these designs the delivery-year price signals do not reflect the same willingness to pay for reliability or resource adequacy
  - This is not the logically consistent nor economically sensible price signal

# 2. Misaligned Incentives Can Produce a Less Efficient and Less Reliable System

- Without high performance incentives, resources are not sufficiently compensated for providing reliability in the delivery year
- Incentives to invest in resources' ability to reliably provide energy in RT are inefficiently low
- Specifically: a resource that has been committed as capacity does not fully internalize the costs associated with its (potential) real-time non-performance
- Misaligned incentives produce a less efficient and less reliable system due to under-investment

# 2. Misaligned Incentives (Example Overview)

- We'll consider an example for a capacity resource that must make costly decisions in advance of the delivery year that will impact its ability to provide energy and reserves in real time
- We'll examine four states of the world:
  - **Costly action:** Resource chooses whether or not to make capital expenditure decision in advance of the delivery year (or, equivalently, costly maintenance decision during the delivery year in advance of emergency conditions)
  - **RT conditions:** System is either in load shed condition or not in emergency condition at all

# 2. Misaligned Incentives (Example Overview, *continued*)

- Example shows:
  - Misaligned incentives exist under the “no-resettlements” and “low-resettlements” designs, as the resource prefers not to invest, even though society is better off if it does, because the investment would be cost-effective from the system’s standpoint
  - Incentives are aligned with the “high-resettlements” design, because the resources’ private incentive is then to invest, and society is better off as a result

# 2. Misaligned Incentives (Example Setup)

- For simplicity, assume 100 MW ICAP, 90 MW UCAP resource:
  - If resource invests, it can firm up its expected performance during hour of load shed risk from 50% to 100% probability
  - Such investment would have negligible impact on accreditation (under EFORd and EAF accreditation methods)
- For this simple example, we look only at capacity market incentives, and during only a single hour
  - In practice, capital expenditure decisions would need to consider expected capacity, energy, and AS revenues across all hours, relative to total costs associated with capital expenditures

# 2. Misaligned Incentives (Example Setup, *continued*)

| | Resource invests | | Resource does not invest | | |
|---|---|---|---|---|---|
| | **Emergency, resource operates** | **No emergency, resource available** | **Emergency, resource operates** | **Emergency, resource does not operate** | **No emergency, resource available** |
| Investment cost ($) | $50 | $50 | - | - | - |
| Scenario Likelihood | 2% | 98% | 1% | 1% | 98% |
| Capacity Price ($/MW-d) | $300 | $300 | $300 | $300 | $300 |
| Second Settlement Prices | | | | | |
| - "No-resettlement" | - | - | - | - | - |
| - "Low-resettlement" ($/MWh) | $12.50 | $12.50 | $12.50 | $12.50 | $12.50 |
| - "High-resettlement" ($/MWh) | $625 | $0 | $625 | $625 | $0 |

# 2. Misaligned Incentives (Example With No Resettlements)

| | Resource invests | | Resource does not invest | | |
|---|---|---|---|---|---|
| | Emergency, resource operates | No emergency, resource available | Emergency, resource operates | Emergency, resource does not operate | No emergency, resource available |
| Investment cost ($) | –$50 | –$50 | - | - | - |
| Capacity sold forward (MW) | 90 MW | 90 MW | 90 MW | 90 MW | 90 MW |
| Capacity delivered (MW) | 100 MW | 100 MW | 100 MW | 0 MW | 100 MW |
| 2nd settlement price ($/MWh) | - | - | - | - | - |
| Penalty/bonus ($) | - | - | - | - | - |
| Net revenues | –$50 | –$50 | $0 | $0 | $0 |
| Scenario likelihood (%) | 2% | 98% | 1% | 1% | 98% |
| Expected net revenues | –$50 | | **$0** | | |

Bottom line: resource maximizes profits by choosing ***not to*** undertake reliability-enhancing investment

# 2. Misaligned Incentives (Example With Low Resettlements)

| | Resource invests | | Resource does not invest | | |
|---|---|---|---|---|---|
| | **Emergency, resource operates** | **No emergency, resource available** | **Emergency, resource operates** | **Emergency, resource does not operate** | **No emergency, resource available** |
| Investment cost ($) | –$50 | –$50 | - | - | - |
| Capacity sold forward (MW) | 90 MW | 90 MW | 90 MW | 90 MW | 90 MW |
| Capacity delivered (MW) | 100 MW | 100 MW | 100 MW | 0 MW | 100 MW |
| 2nd settlement price ($/MWh) | $12.50 | $12.50 | $12.50 | $12.50 | $12.50 |
| Penalty/bonus ($) | +$125 | +$125 | +$125 | –$1,125 | +$125 |
| Net revenues | +$75 | +$75 | +$125 | –$1,125 | +$125 |
| Scenario likelihood (%) | 2% | 98% | 1% | 1% | 98% |
| Expected net revenues | +$75 | | **+$112.50** | | |

Bottom line: resource maximizes profits by choosing ***not to*** undertake reliability-enhancing investment

# 2. Misaligned Incentives (Example With High Resettlements)

| | Resource invests | | Resource does not invest | | |
|---|---|---|---|---|---|
| | Emergency, resource operates | No emergency, resource available | Emergency, resource operates | Emergency, resource does not operate | No emergency, resource available |
| Investment cost ($) | –$50 | –$50 | - | - | - |
| Capacity sold forward (MW) | 90 MW | 90 MW | 90 MW | 90 MW | 90 MW |
| Capacity delivered (MW) | 100 MW | n/a | 100 MW | 0 MW | n/a |
| $2^{nd}$ settlement price ($/MWh) | $625 | $0 | $625 | $625 | $0 |
| Penalty/bonus ($) | +$6,250 | $0 | +$6,250 | –$56,250 | $0 |
| Net revenues | +$6,200 | –$50 | +$6,250 | –$56,250 | $0 |
| Scenario likelihood (%) | 2% | 98% | 1% | 1% | 98% |
| Expected net revenues | **+$75** | | –$500 | | |

Bottom line: resource maximizes profits by choosing ***to*** undertake reliability-enhancing investment

# 2. Misaligned Incentives (Example Key Takeaways)

- **Society is better off if resource invests in improving performance…**
  - Societal cost of $50 to avoid 100 MW of load shed with 1% probability, or $50/MWh of avoided expected unserved energy
  - Clear net winner given willingness to pay of $300/MW-day for capacity
- **… But "no/low-resettlement" designs don't incent those investments, while "high-resettlements" design aligns incentives appropriately**
  - Resource does not make the investment under market designs with low performance incentives because it does not internalize the high cost of load shed, and has little compensation for doing so
  - Resource does make the investment under market design with high performance incentives, because it has efficient incentives to make performance-improving costly investments

# 3. Inefficient Capacity Commitments Threaten Reliability

- A “no-resettlements” or “low-resettlements” design, in combination with a capacity must offer obligation and the use of an accreditation method that does not reflect resources’ marginal reliability contributions threaten reliability
  - Occurs under status quo thermal resource accreditation, and under IMM proposed Modified EAF accreditation design
- A resource would be required to offer all their accredited capacity, and incentivized to maximize accreditation. PJM would be required to clear such capacity even knowing that its accredited value is inconsistent with its reliability contribution
- Could result in an unreliable portfolio of resources

# 3a. Capacity Resources Compensation May Not Reflect Value

- A resource that does not perform when needed during emergencies or load shed, due to correlated outages or otherwise, would still be substantially compensated under both “no-resettlements” and “low-resettlements” approaches
- There is minimal financial risk if the resource does not perform when needed

# 3a. Compensation May Not Reflect Value (Example Setup)

- Clearing price is $100/UCAP MW-day
- Resource A is 100 MW ICAP
- Expected to be "available" during 80% of delivery year, yielding accreditation based on EAF of 80%
- During delivery year
  - Resource A is only dispatched on 1% of hours
  - PJM experiences load shed during 1% of hours, during which Resource A is dispatched and experiences forced outage due to correlated outage drivers
  - Resource offers and is "available" during 79% of hours (one percentage point less than expected)

# 3a. Compensation May Not Reflect Value (Example Results)

- Expected compensation based on forward clearing outcomes:

  *80 MW UCAP x $100/MW-day x 365 days = $2.92 Million*

- Compensation based on delivery year outcomes:

  *80 MW UCAP x $100/MW-day x 365 days x (79/80) = $2.88 Million*

- Compensation adjustment reflecting delivery year outcomes:

  *1 MW UCAP x $100/MW-day x 365 days = $36,500*

- Takeaway: based on delivery year outcomes, Resource A did not contribute to system reliability, yet collected bulk of capacity revenues

# Key Takeaways: The details of the market design play a critical role in determining if the design effectively addresses adverse impacts identified

- A range of two-settlement designs could improve upon aspects of the current Capacity Performance Framework
- However, not all designs will create efficient incentives for resources selling capacity to incur costs to reliably provide energy or reserves when it is socially beneficial to do so
- We request feedback from RASTF stakeholders regarding enhancements to the current two-settlement capacity construct to better accomplish the objectives of such a design and align resource incentives with society’s best interests