Brief Introduction to Capacity Mechanisms

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Capacity Mechanisms: An Introduction

Facilitating Energy Transition in India

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Tonight: Quest for answers to these (and many other) questions

- What is a Capacity Mechanism?
- Why is it relevant for India?
- What are the core elements of a Capacity Mechanism?
- How Should Capacity be priced?
- How does it work in practise?
- ???

Capacity ‘markets’ are not a ‘natural’ market

- Excess reserve capacity has value – just as all capacity has value – because it contributes to a reduction in risk of supply shortage
  - But the perceived value of this reduction is a policy matter (not just economics)
  - The design choices required a complex and are often intended to manage risk as well as manage adequacy
- Accordingly, capacity markets are, by design, a regulated and targeted market
- There is no natural demand for capacity by end users – it is a reliability issue

Capacity MECHANISM is a more appropriate term rather than a “Market”.

Why the need for Capacity Mechanism

The current framework in India has its limitations. For example:

Inflexibility:

Long-Term Contracts**:** Traditional PPAs are often long-term (e.g., 25 years), locking in capacity and reducing flexibility to adapt to changing market conditions.

Take-or-Pay Constraints**:** Many PPAs require payment for capacity regardless of whether the power is needed or used, leading to inefficiencies.

Inefficiency:

Sub-Optimal Dispatch**:** PPAs often result in self-scheduling by Discoms, where each utility schedules its generation based on bilateral contracts rather than a system-wide optimal dispatch. This can lead to higher system costs and underutilization of cheaper generation resources.

Limited Market Participation**:** Generators bound by PPAs may not participate actively in the day-ahead or real-time markets, reducing liquidity and market efficiency.

Addressing Resource Adequacy:

- Variability of Renewables: With increasing RE, the power system faces challenges in ensuring a constant supply due to the intermittent nature of sources like solar and wind. Capacity markets ensure that there is sufficient backup capacity available during periods of low renewable generation.
- Incentivising Investment: By providing financial incentives, capacity markets encourage investments in new generation capacity and maintenance of existing plants, ensuring long-term reliability.
- Mitigating the "Missing Money" Problem: Energy-only markets may not provide sufficient revenue to cover the fixed costs of generating capacity, especially for plants that operate infrequently. Capacity payments help cover these costs, ensuring generators can stay online and available when needed.

Capacity Markets/Mechanisms Design that is Fit for Purpose

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Riffs on a theme: how to remunerate capacity to meet the reliability target

- **Energy-only** markets (Australia NEM, Singapore, New Zealand)
  - High enough energy (wholesale) prices to incentivise sufficient investment
- **Energy only** market with long-term contracting (California)
  - No capacity price, but LSE are required to contract or own capacity (supported by regulatory approvals)
- **Energy** market with supplemental prices (earlier Ireland, Oman)
  - A supplemental energy payment based on loss of load probability x value of lost load or other assessment of system stress
- Energy market with **quantity-based capacity mechanism** and centralized market (PJM, MISO, UK, NE-ISO, Alberta)
  - A centralized market where capacity can be procured via auction
  - Quantity function is set and auction or similar process discovers response.
- Energy market with **price-based capacity mechanism** (WA, Korea)
  - Price function is set and investors respond with quantity investment or retirement decisions
- **Reliability obligations**
  - Push burden to load serving entity to hold and contract for capacity, with various supporting and rebalancing mechanisms to deal with risk and market power

Quantity Auction as Centerpiece

Price Formulation as Centerpiece

Obligation as Centerpiece

Each “market” differs in the details

Energy					Transmission		Capacity
Offer Basis	Trading Basis	Start-up Costs	Trading Horizon	Ancillary Services	Market Definition	Access Rights	Capacity Pricing
Cost Based	Gross	Formula Basis	Real Time	Separate Markets	Regional	Physical	None
Bid Based	Net	Implicit via Bid	Day Ahead	Joint Markets	Zonal	Financial	Shortage Price
		Managed by Incumbent	Dual Market	Managed by Incumbent	Nodal		Capacity Ticket
			Managed by Incumbent				Contract Fee

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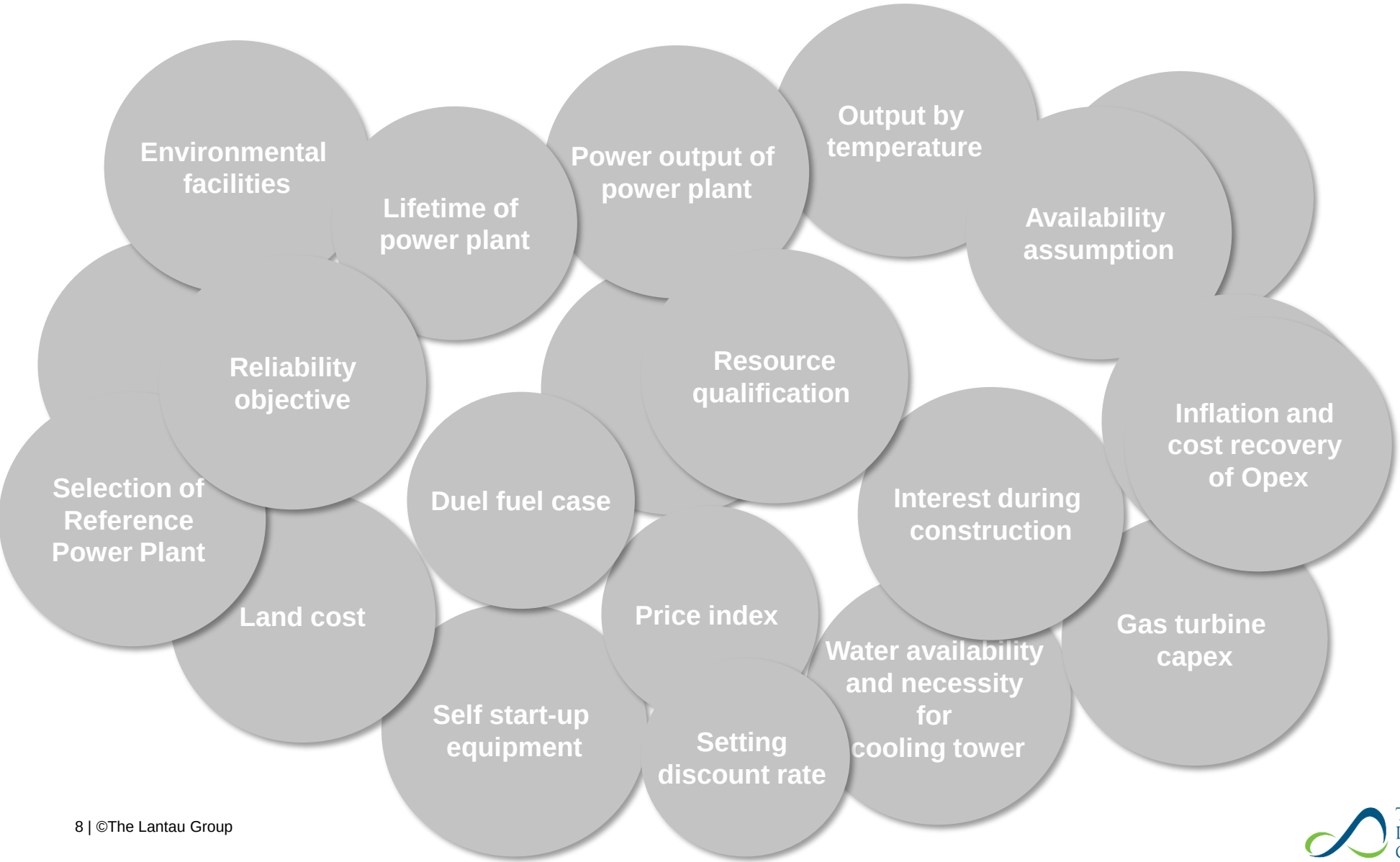
Amongst various aspects to consider in designing capacity remuneration mechanism…



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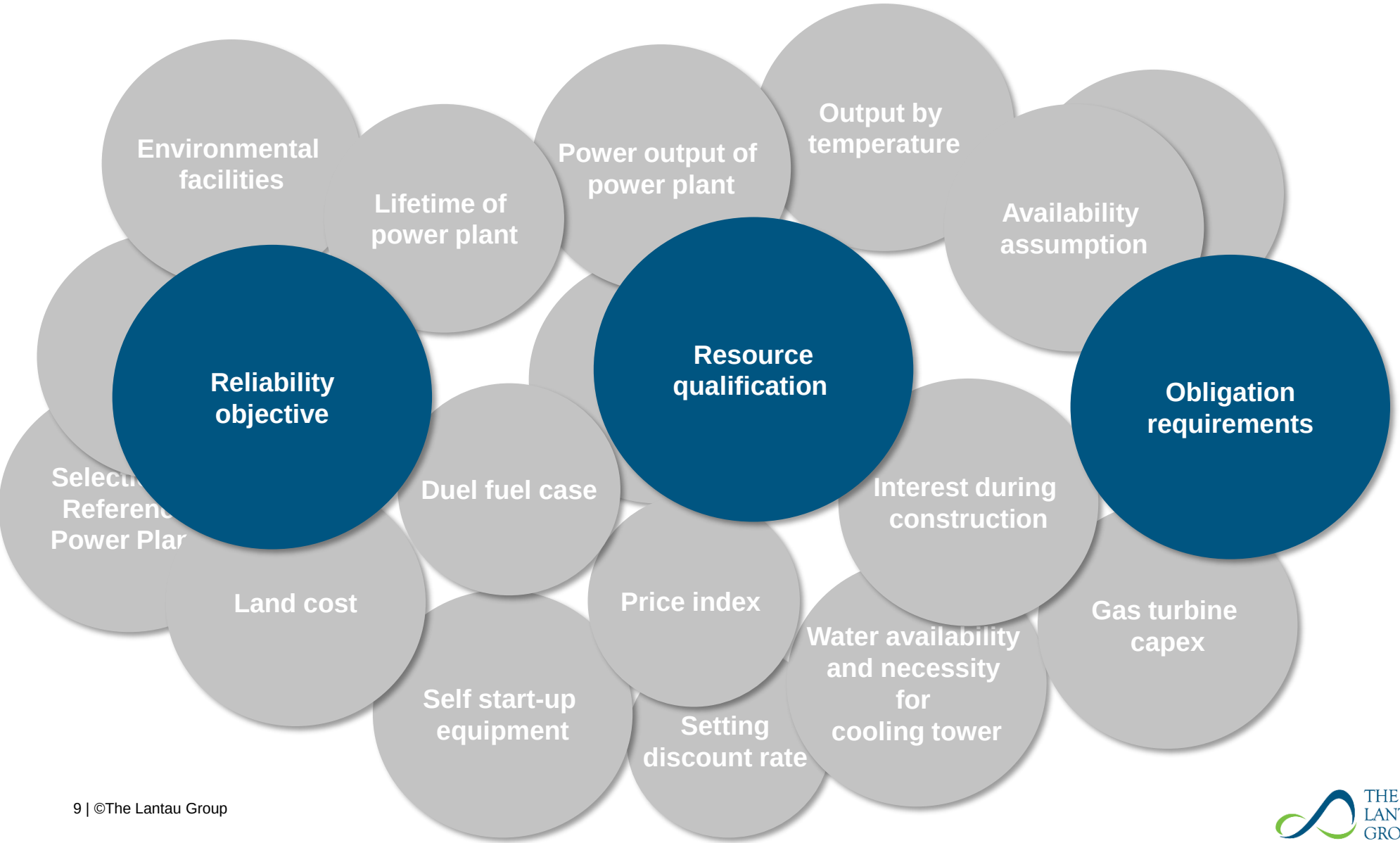
… there are three parts that determine the success of a capacity mechanism



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Key success drivers on a capacity mechanism

Reliability objective

Resource qualification

Obligation requirements

Key issues

- A capacity mechanism's fundamental purpose is to achieve reliability standards. We call this the reliability objective.
- Therefore, the natural starting point before contemplating capacity price demand curves, or whether to have use a capacity auction or an administered mechanism s to define those objectives clearly.
  - Is there a current defined reliability standard what can turned into a reliability objective?
  - The reliability objective can be to achieve the reliability standard:
    - Every year; or
    - Most years; or
    - On average over many years.
- The reliability objective can be established to serve a peak demand scenario or alternatively it be set set on a load serving basis. Each need to be considered based on the system needs and consumer expectations.
  - Will the reliability objective adapt to changes in system/consumer needs?
  - What type of backstop procurement process is required of the reliability objective is not achieved?
    - Is a backstop process even required?

Key success drivers on a capacity mechanism

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Key issues

- The first decision is weather the capacity mechanism is mandatory or voluntary.
  - Mandatory increases competition and is better in manging market manipulation through market power.
  - Voluntary mechanism's tend to be simpler and quicker to establish and administer.
- Regardless if the capacity mechanism is mandatory or voluntary either will require a process of qualification prior to being a part of the mechanism. The resource qualification is the process by which an independent body determines how much capacity each resource can provide into the capacity mechanism.
  - Should all the capacity that's provided be treated on an equal footing?
  - Alternatively should the capacity mechanism treat capacity differently? For example based on technology or price or age or something else?
  - The trade-offs between the two are market dynamic's for capacity selection vs. central planning of capacity selection.
- The success of the resource qualification process is in it's transparency, independence and repeatability of outcomes.
  - Resource qualification should note the difference in value and technology of the capacity providers. This difference can be incorporated into the qualification process through capacity 'derating'.
- Resource qualification must align with the reliability objective.

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Key success drivers on a capacity mechanism

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Key issues

- Capacity is useful only when it's available. A capacity mechanism pays for capacity availability not capacity utilisation but in order for the capacity to be available the mechanism must include capacity offer obligations.
- Capacity availability and performance can either be encouraged through pricing or unavailability punished. Strong incentives for ability and performance are required to prevent:
  - Low quality and unreliably supply could displace high quality reliable supply.
  - Undermining system reliability.
- Generally, capacity that's receiving a capacity payment must be offered and available for dispatch. However, market specifics must be considered.
  - When must capacity be available? All day, part of the day, or seasonally?
  - Do different capacity types require different availability requirements?
  - Any exemptions from the obligation requirements.
  - How do the obligation requirements align with the reliability objective?

Different approaches – all intended to solve the same problem (adequacy)

START HERE!

How to meet reliability standard through market-driven investment?

Energy-only market with substantially **uncapped** wholesale market prices

Australian NEM
New Zealand
Philippine WESM
Singapore
Texas (ERCOT)

Energy market with **capped** prices **plus a capacity "market")**

approach

Set Quantity

Run **auction** or set LSE obligation to procure (thus determining price)

PJM, NYSIO, etc.
(Eastern America)

France

Set Price

Use pricing curve
(thus driving market response)

Australian WEM
(Western Australia)

South Korea

Original UK
(LOLP * VOLL)

OMAN Proposed
(Adder)

Two different approaches
but same underlying economic principles

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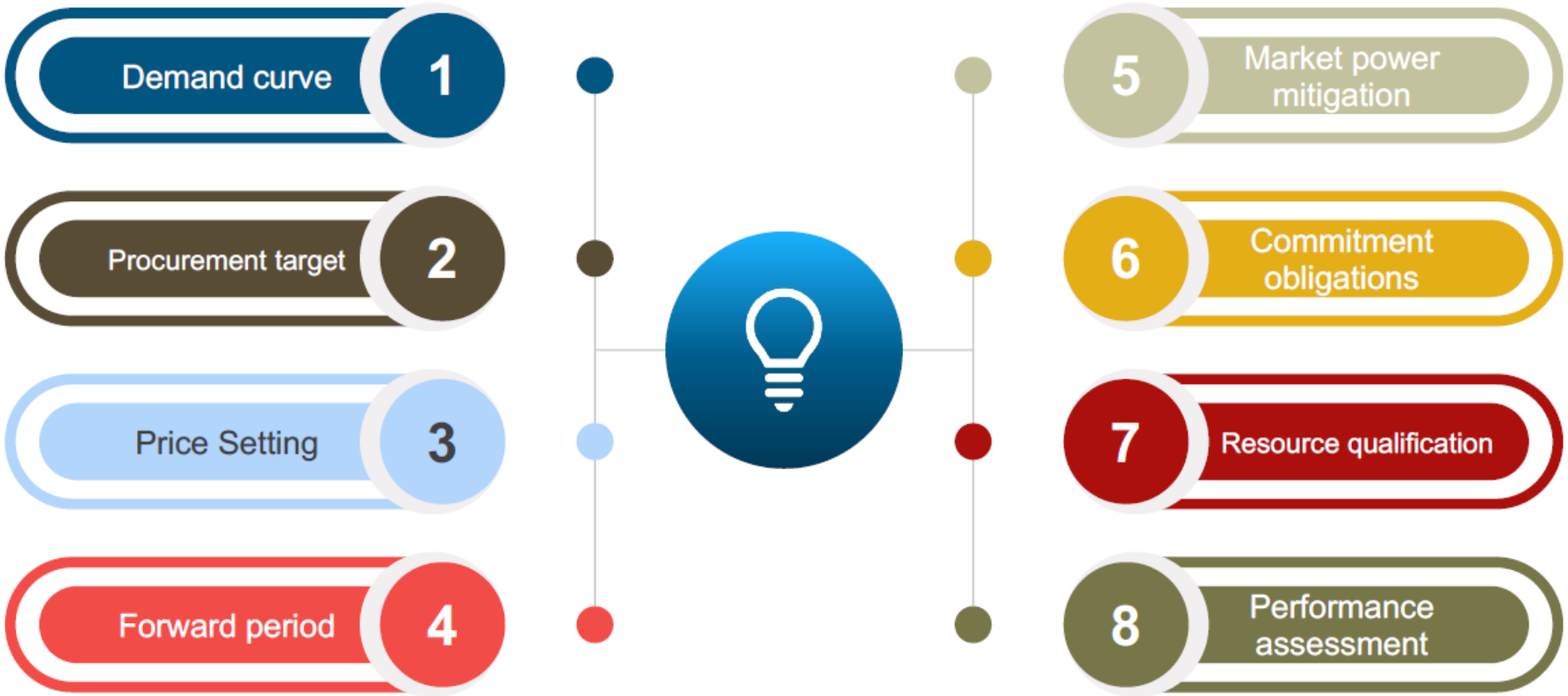
Core elements of a capacity market



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Pricing Capacity: The Economics of Capacity Value (Curve)

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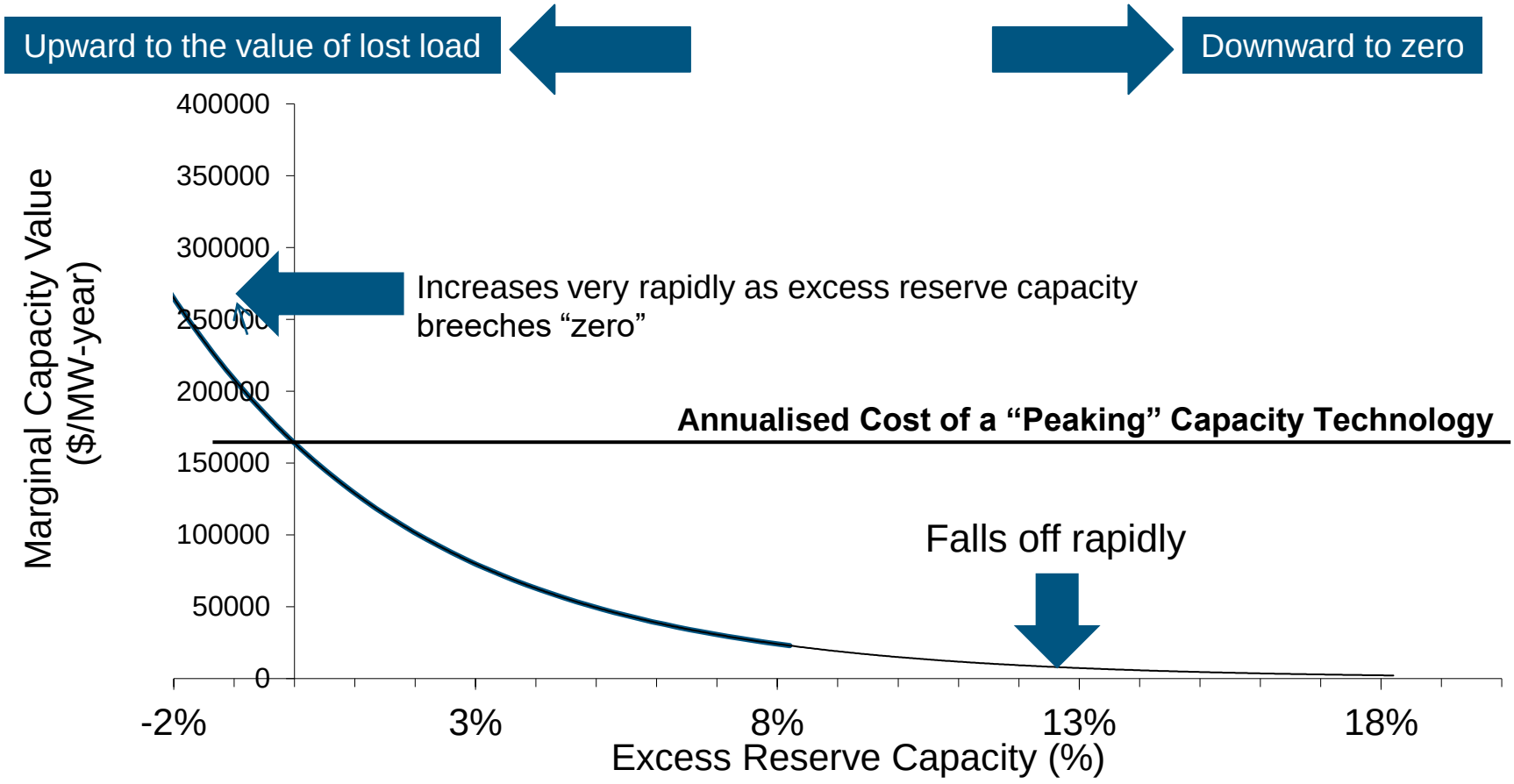
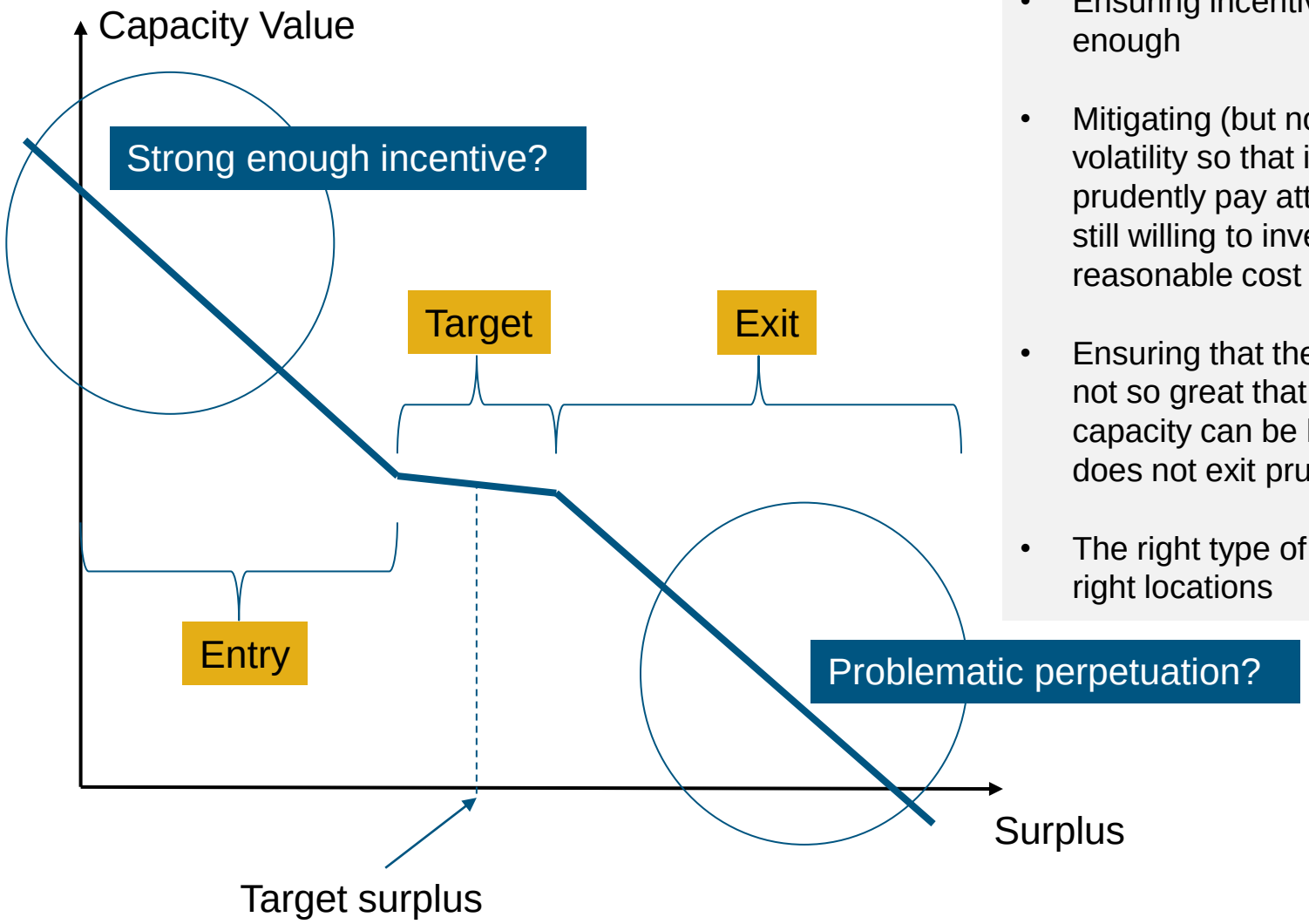
Incremental capacity has value if it reduces unserved energy. However, the 'marginal' value of incremental capacity is a very steeply sloped curve



The "LOLE" or "LOLP" curve has proven too steep for any market – if the capacity price varies that much, then just have an energy-only market

Note: Based on WEM data

Most capacity markets introduce the concept of a demand curve which needs to address several universal challenges



- Ensuring incentive is strong enough
- Mitigating (but not overly so) volatility so that investors prudently pay attention but are still willing to invest at reasonable cost
- Ensuring that the payments are not so great that non-performing capacity can be locked in and does not exit prudently
- The right type of capacity in the right locations

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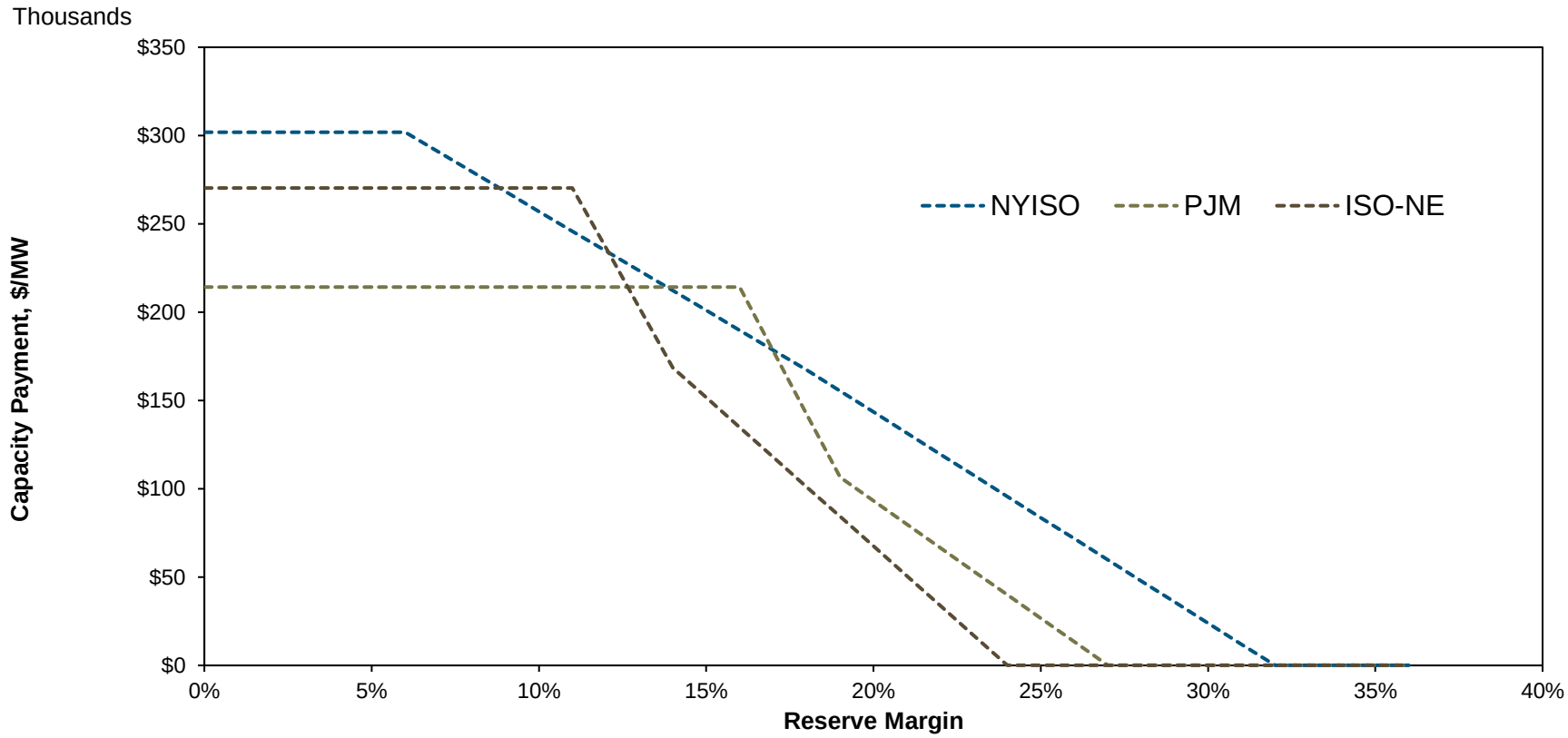
Example demand curves



Every capacity market requires customisation to local conditions due to differences in market size, rate of growth, demand forecast uncertainty, supply-side performance, and so forth

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Finishing Thoughts/ Questions

- Does India need a capacity mechanism?
- What is the definition of “Capacity” (Resource Adequacy)? Is all “Capacity” the same?
- Can multiple Capacity products exist and how do they interplay
- How does it co-exist with PPAs, CfDs Energy and Ancillary Markets?
- How does it help with Energy Transition?

Capacity Mechanism in Western Australia – A Case Study

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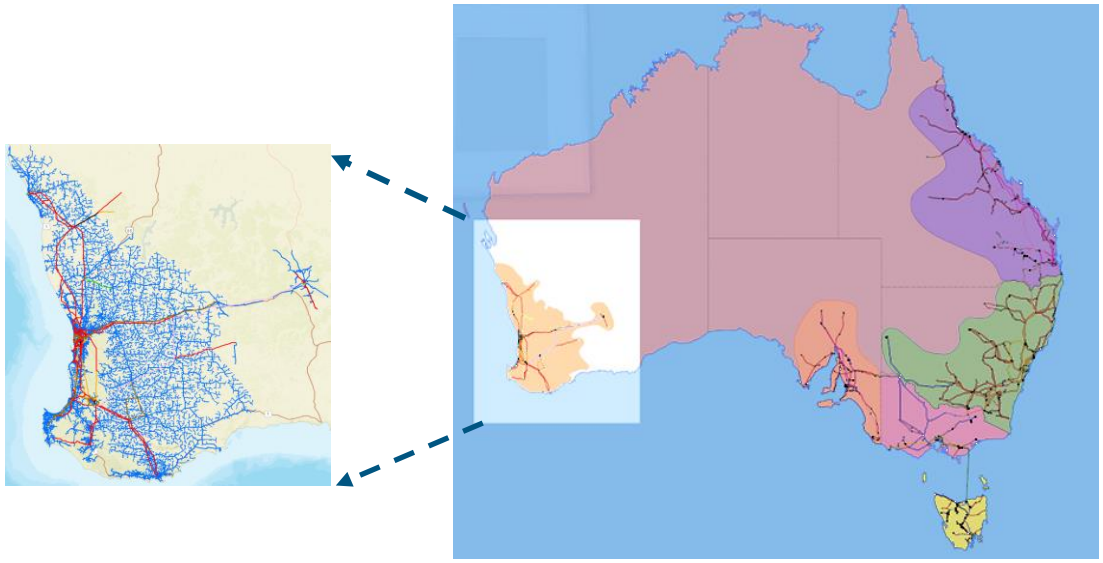
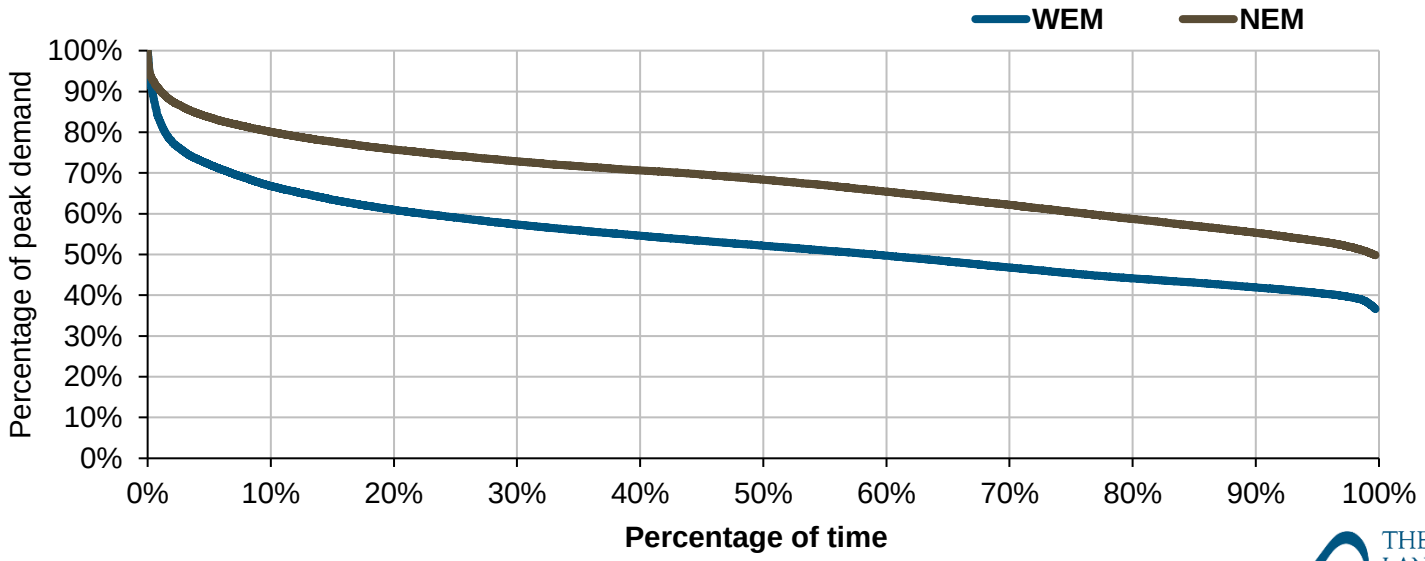
Why did Western Australia Choose to go with Capacity Market (different to the Energy Only Market in the Eastern States)

Isolation (Risk)



Peaking Load Profile (Steeper Load Duration Curve)



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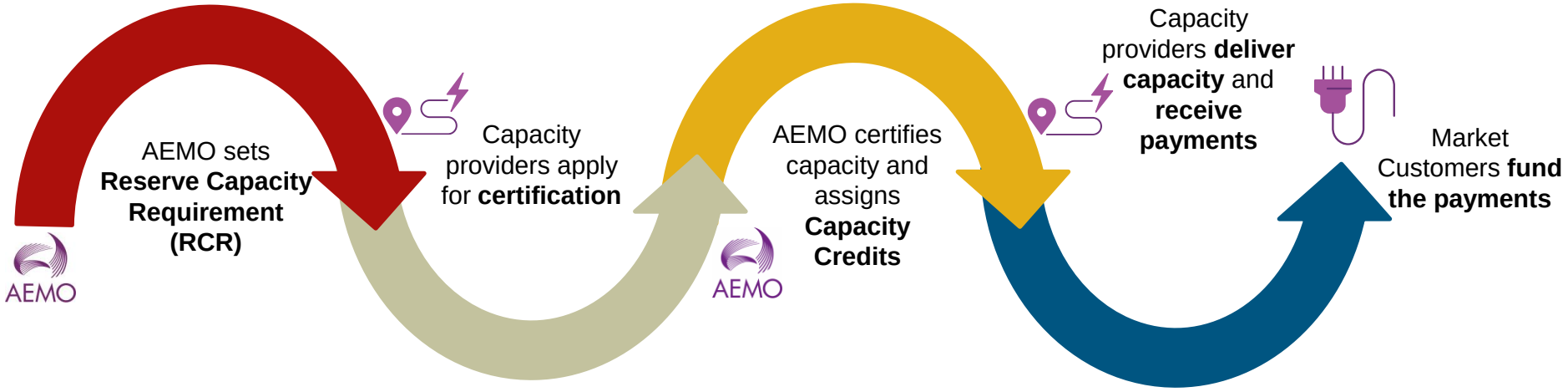
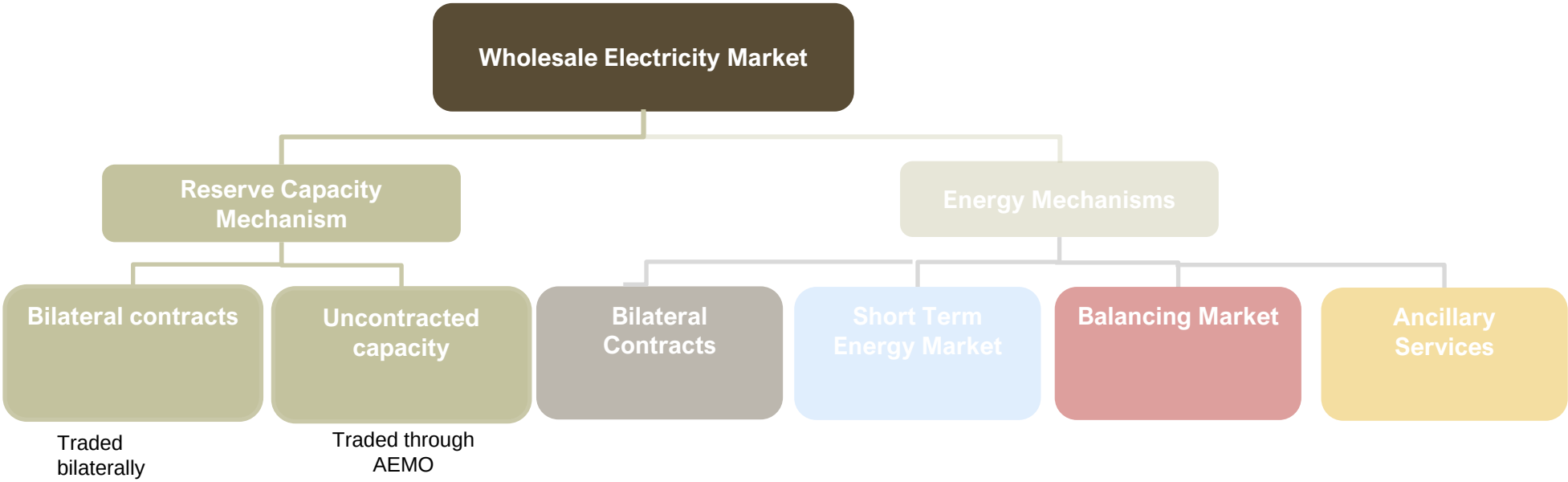
The Reserve Capacity Mechanism (RCM) Process

A mechanism to ensure there is sufficient capacity available in the SWIS to meet peak demand two years in the future.



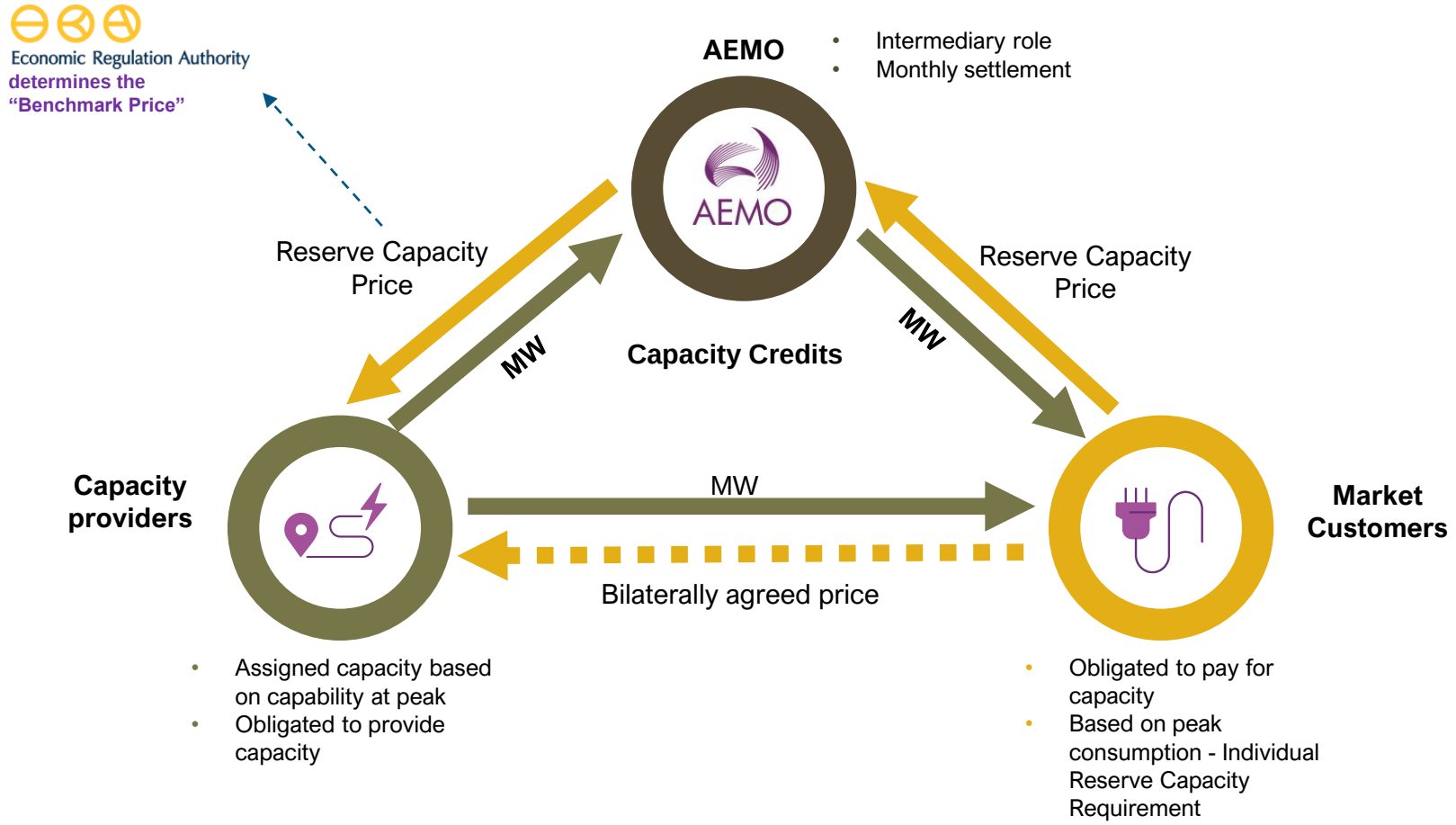
Source: AEMO

RCM and Energy Markets



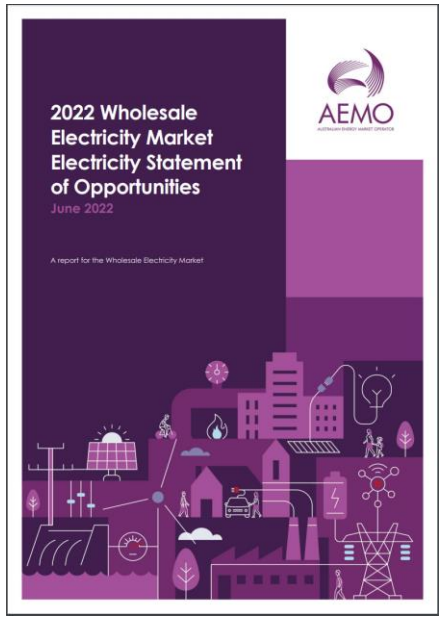
Source: AEMO

How is capacity traded in the RCM?



Source: AEMO

The Reserve Capacity Requirement

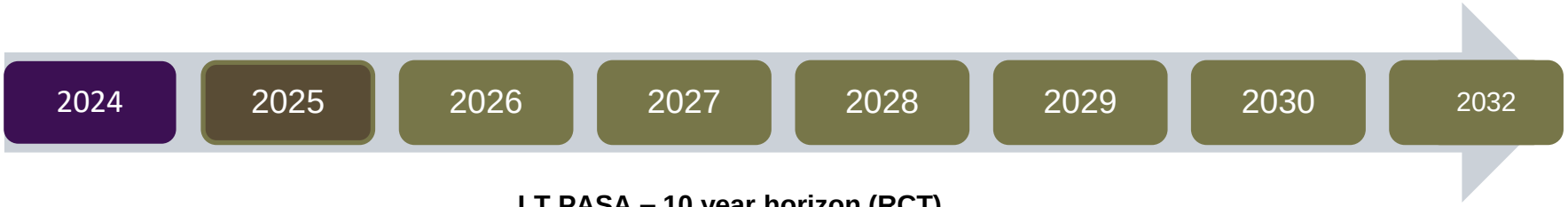


The Reserve Capacity Requirement sets the ‘demand’ Capacity Credits is determined two years in advance by either the:

- Peak demand requirement - 10% POE, intermittent load allowance, reserve margin and minimum frequency keeping capacity;

or

- Expected unserved energy requirement - 0.002% of annual energy consumption.



LT PASA – 10 year horizon (RCT)

Source: AEMO

Benchmark Reserve Capacity Price Varies each year – sometimes substantially

Source: AEMO

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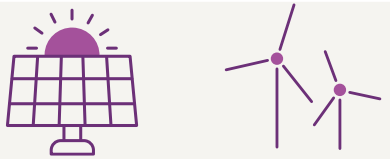
Facility Class and Facility & Technology Type

Facility Class	Facility Technology Type	
Scheduled Facility (≥ 10 MW)	Non-Intermittent Generating System (NIGS)	
Semi-Scheduled Facility (≥ 10 MW)	Intermittent Generating System (IGS)	
Non-Scheduled Facility (MW)	Electric Storage Resource (ESR)	
Demand Side Programme (DSP)	Non-Dispatchable Load	

Source: AEMO

Reserve Capacity Price

Transitional price

- For Facilities that were assigned Capacity Credits in the 2018 Reserve Capacity Cycle.
- Cap of $140,000 and floor of $114,000 (CPI adjusted) for 10 years.

Fixed price

- Set as the Reserve Capacity Price calculated in the first year the Facility enters the market.
- Locked in for 5 years (adjusted by CPI).
- Facilities must be new and meet certain conditions to be eligible for the fixed price.

Reserve Capacity Price (floating price)

- Can vary between $0 (when excess capacity =>30%) and a max of 1.3 x BRCP (when surplus is zero or less).
  [Economic zero is determined to be 0.5 x BRCP where excess capacity = 10%]
- Applies to all DSPs and generators that are not eligible for the fixed or transitional prices.
- Calculated using the formula in the WEM Rules.

See: https://www.wa.gov.au/government/document-collections/improving-reserve-capacity-pricing-signals

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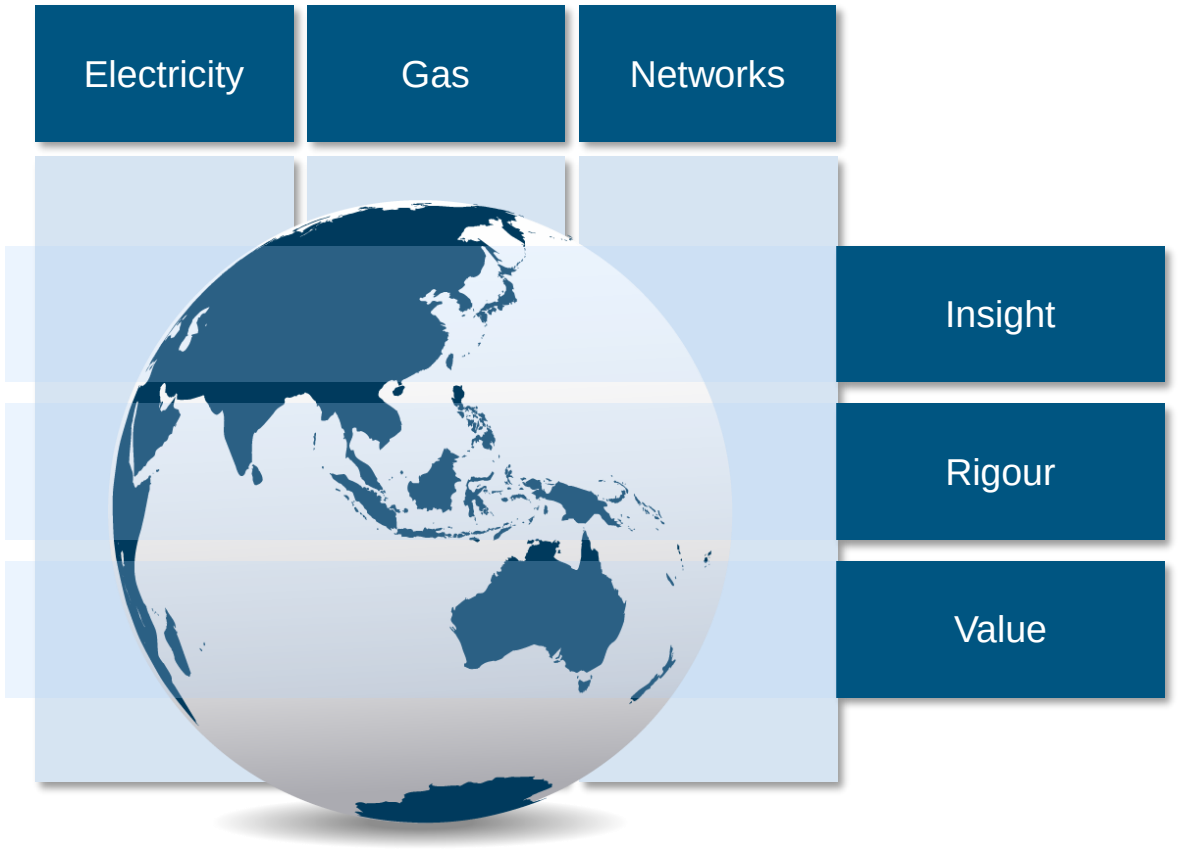

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