Working paper on supporting investment in the national electricity market

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Inquiries

Australian Energy Market Commission
Level 15, 60 Castlereagh Street
Sydney NSW 2000

E aemc@aemc.gov.au
T (02) 8296 7800

Reference: EPR0093

About the AEMC

The AEMC reports to the energy ministers. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the energy ministers.

Acknowledgement of Country

The AEMC acknowledges and shows respect for the traditional custodians of the many different lands across Australia on which we all live and work. We pay respect to all Elders past and present and the continuing connection of Aboriginal and Torres Strait Islander peoples to Country. The AEMC office is located on the land traditionally owned by the Gadigal people of the Eora nation.

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FOREWARD

The Australian Energy Market Commission (AEMC) shared this report with state and federal governments in March 2024. We are now sharing it publicly as part of the Australian Government's review of the national electricity market (NEM) wholesale market settings by the Expert Panel.

This report provides valuable insights to advance the development and understanding of mechanisms that can navigate us through the energy market transition while leveraging the market's existing strengths and minimising distortions.

Please note that, given that the document was originally shared in early 2024, some elements may no longer be relevant for the Expert Panel's consideration. This includes the advice we provided on mechanisms to support the controlled exit of coal and gas. Energy Ministers have since agreed to an opt-in Orderly Exit Management (OEM) framework to allow governments to better manage the exit of thermal generators. The OEM Framework Act commenced on 5 December 2024 and governments will need to opt in for it to apply in their jurisdictions.

We also note that the review's terms of reference state that the Expert Panel will not consider options involving the implementation of carbon trading schemes or markets.

There have also been several other developments since we shared this report with jurisdictions that are not covered in this report, which include:

- The Reliability Panel has completed its work on the form of the reliability standard, finding that the current form remains fit for purpose for the future NEM.
- On 30 September 2024, we delivered our final report and recommendations on transmission access reform to Ministers. The final report advised against implementing the proposed hybrid model and made a series of recommendations that focussed on supporting jurisdictional schemes to drive efficient investment in the energy system.
- We have now published more preferable final rules for the Improving security frameworks for the energy transition and Enhancing reserve information (formerly Operating reserves) rule changes.
- AEMO Services have run five tender rounds for the NSW Roadmap, including for long duration storage, generation and firming.
- AEMO Services have also run three tender rounds for the Capacity Investment Scheme for capacity in South Australia-Victoria, dispatchable capacity in the Western Australia Wholesale Energy Market and generation in the NEM.
- The South Australian Government is consulting on its Firm Energy Reliability Mechanism to support long duration firm capacity in South Australia.

Executive summary

The national electricity market (NEM) is undergoing a significant transformation. Governments have clearly set out an ambitious shift to renewables which will require substantial new investment and the exit of aging thermal generation. A key requirement in the transition is to ensure new assets are in place before old assets retire. The alternative to this is a period of undersupply. Considering the scale and urgency of the investment challenge, a considered managed approach including government support mechanisms, is required. Our work has illustrated that a combination of mechanisms and a range of tools are required to manage the current, emerging and future needs of the wholesale market. There is no one elegant solution to the challenges of the transition.

We have done this work to provide insights for when we work with governments and stakeholders

The Australian Energy Market Commission (AEMC) has carried out this work in our role as expert energy advisers to governments in improvements to regulatory and energy market arrangements. Our work commenced following the July 2023 Energy and Climate Change Ministerial Council (ECMC) where Ministers agreed to publish the longer-term approach to how the Capacity Investment Scheme (CIS) would integrate with the NEM.

The market is evolving at pace and by working closely with governments, industry stakeholders, and the public, we can help to make sure the right market settings are in place for a smoother transition that will unlock the enormous benefits of cleaner, smarter, affordable, and reliable energy.

For this work, we wanted to better understand the nature of the challenges facing the NEM to meet its reliability, security and emissions reduction goals. This working paper outlines a framework to help understand what tools are available. Our goal was to draw out insights and preferences where these could be extracted as well as understand the options and risks.

In the next phase of our work, we will consider what changes may be required in the longer term, given the changing technological and economic characteristics of the industry. This will include how the design can solve for investment to ensure the market is not reliant on enduring government financial support, where support is provided, it creates the least distortion, and still delivers the operational signals for capacity to participate when needed.

We have shared this report with government and are now sharing it with stakeholders to advance the development and understanding support mechanisms that can navigate us through the energy market transition whilst leveraging existing strengths and minimising distortions.

We are not looking for feedback on the report, however, we welcome conversations about how we can better inform governments and use these findings in our ongoing work making the national rules support our energy future in the best way possible.

The NEM's strengths are worth preserving, but its challenges need to be addressed at lowest cost

The objective of energy markets worldwide is to deliver secure and reliable power at the lowest cost to customers. Delivering a net-zero energy system is an additional goal many markets are striving toward. There is no perfect market design for delivering on these goals. Energy markets across the world have selected different market designs based on their priorities, characteristics, and history. Notably, all markets face similar challenges when transitioning to a low or zero-emission energy system.

The current NEM is about encouraging technology-neutral investments in capacity and storage to enter and participate in market efficiently with risks largely borne by investors (who have traditionally been best placed to manage them). We want to maintain and leverage the strengths of the current market design but address features that may no longer, or cannot, deliver the outcomes needed.

A current strength of the market is that wholesale prices provide strong operational signals that reward good performance. The high market price cap (MPC) provides a strong incentive for generation and demand response to 'turn on' during peak system stress events. Conversely, when system needs and wholesale prices are low, generators are incentivised to 'turn off', and market participants have an opportunity to use cheap energy. This pricing dynamic incentivises retailers and large customers to manage their energy costs through efficient operational decisions and by purchasing contracts to hedge against this price risk.

While the operational signals of the current market are a strength, the AEMC considers there are some challenges with the current NEM design, particularly as the energy fleet shifts from coal to renewable energy sources.

- **The need for new assets to enter before coal generators retire**. Governments and industry have identified a need for new generation and storage assets to be in place before old generators retire. While putting new generation and storage in place ahead of coal generators leaving means we may pay for a period of over-supply in the market, this is preferrable to a period of under-supply and unmet energy needs for consumers and businesses. Nevertheless, the expectation of low prices when there is oversupply can stymie private investment.
- **Unpriced externalities impact exit decisions.** The unpriced cost of carbon emissions in the electricity sector means that there is no strong in-market signal for generators to exit to achieve lower emissions objectives.
- **The energy transformation is changing investor confidence.** This challenge is multi-faceted and includes that traditional contracting may not suit new technologies, and that the business case for some assets, such as pumped hydro, are difficult for the private sector to make.
- **Regional pricing does not provide locational incentives.** The NEM's regional pricing model does not incentivise generation and storage assets to locate in areas to optimise the transmission network, which creates inefficiencies and higher costs.
- **The current market does not value the range of system security services required to support a net zero emissions system.**

In aggregate, these challenges are impacting investment decisions for firming projects, bulk renewables, and coal exits. These challenges can be addressed through the targeted support mechanisms outlined in this working paper.

Targeted support can help manage the transition and build on the current market

Our working paper focuses on specific mechanisms that can be used with the current market design to ensure the entry of bulk renewables, firming capacity and the controlled exit of coal and gas. Targeted support mechanisms can help address the investment challenges facing the NEM at lowest cost, while also building on the operational strengths that are worth preserving.

We developed a decision framework that can be used by mechanism designers to select the optimal support mechanism that meets objectives at lowest cost. There is not necessarily a single 'best mechanism', rather a range of support mechanisms may be suitable depending on context and objectives.

We set up the decision framework to take policymakers through a series of questions to help identify what the key problems are to solve. The decision framework is characterised by the following decisions:

1. **Is the mechanism generalised or specific?** Are mechanism designers seeking a support mechanism that targets something specific (e.g. technologies, location) or is it generalised to enable the market to determine the technology, location, and type of service?
2. **What is the basis upon which assets are paid in the mechanism?** Are mechanism designers seeking to use the mechanism to pay assets to supply energy, make capacity available or to construct the asset? Each choice has implications for how new investment made under the mechanism may behave in the market.
3. **Is the mechanism volume- or price-based?** Are mechanism designers seeking to control the price paid for the service, set a volume target, or manage the total cost of the mechanism?
4. **How does the support mechanism assist projects in generating an economic return?** Mechanism designers should consider:
    a. What is the risk the support mechanism is seeking to mitigate?
    b. How is the risk being allocated between the asset and the mechanism designer?

For coal exit, the following additional decisions are relevant:

1. **Is the primary objective to close early or keep assets reliably operating until certain circumstances are met?**
2. **Is the mechanism in- or out-of-market when incentivising ongoing service delivery?** Are mechanism designers seeking:
    a. An out-of-market mechanism to preserve market price signals and incentivise new investment?
    b. An in-market mechanism to minimise total system costs?
3. **How does the support mechanism assist projects in generating the economic return required to deliver what is needed?** The working paper outlines a wide range of financial support options available, that can provide full or partial economic support. Each of the mechanisms is

described in broad terms including their advantages, as well as any trades-offs associated with the mechanism and how such trade-offs may be mitigated.

We need different tools to manage the different needs of the transition

What is apparent is the need for different tools to manage the different needs of the transition (bulk renewables, different forms of firming, thermal exit, balancing services, and system security). The work the Reliability Panel is currently undertaking on the form of the reliability standard is also highlighting the shifting nature of reliability risks in a system dominated by variable renewables. The Panel's draft modelling has found that reliability events, while still rare, are more likely to shift from the evening peak and be across the day, during winter rather than summer and there is potential for weather droughts to exist for extended periods.

Specifically, the Commission considered the following support mechanisms to address the challenges in the market. We focused our analysis and assessment on feasible options for the NEM:

- **For bulk renewable investment**: we considered as-generated contracts for difference (CfDs), Swaptions (like the generation Long-Term Energy Service Agreements (LTESAs) in NSW), index-based CfDs using a solar or wind profile, production credits (such as the Large-scale generations certificates (LGC) CfDs) and a renewable portfolio standard (the Large-scale Renewable Energy Target (LRET)).
- **For firming investment**: we considered build to own, regulated assets, swaptions (similar to the long duration storage LTESA in NSW), net revenue floors and ceilings, index-based CfDs using a volatility profile, cap contracts, reserve payments and advantaged financing measures (such as grants and concessional finance).
- **For controlled coal closures**: we considered managed transition vehicles, in- or out-of-market reserve payments, minimum revenue guarantees and fixed extension payment. However, we note the NSW government is undertaking more detailed work on controlled coal closures.

The packages of support mechanisms we have analysed highlight different needs and range from small changes to our current design to more significant design changes. We also consider both the implications for the physical wholesale market and contracts market.

While the bulk of our work focussed on the key issues in the wholesale market, we consider a liquid contracts market is critical to support retail competition and innovation. The Australian Competition and Consumer Commission's (ACCC's) December 2023 electricity inquiry report highlighted the increasing complexity for retailers to manage spot price risks in an environment where the sellers and types of contracts are changing.[1] The ACCC highlighted the inability for small and standalone retailers to get contracts to manage price risks and called upon governments to use government-funded renewable energy products to contribute to contract market liquidity.

As part of the paper, we did not explicitly consider the recently announced expansion of the CIS. The Commonwealth is currently consulting on this important reform to deliver renewable and dispatchable capacity in the NEM.

[1] ACCC Inquiry into the National Electricity Market, December 2023 Report, 1 December 2023.

A consistent approach is simpler and will provide certainty for the market

We considered how jurisdictions could bundle mechanisms for investment in bulk renewables and firming alongside mechanisms for exit to create an internally consistent approach. We considered a spectrum of bundling approaches and the support mechanisms that would be compatible with each approach. The options for bundling would:

1. **Absorb all project risk by regulating returns for all participants in the market**. This approach would be the most substantial shift from our current competitive market design.
2. **Remove project investment risk but preserve market signals for dispatch**. Suitable support mechanisms for this approach include CfDs, and reserve payments.
3. **Pay only when projects need it**. Swaptions, net revenue floor/ceiling and minimum revenue guarantees provide assets with the option to have certainty over minimum revenues.
4. **Replicate and extend market signals whilst protecting assets from the risk of capacity overbuild**. Suitable support mechanisms for this approach include index-based or LGC CfDs, and cap contracts.
5. **Set ambition (or targets) for the market to deliver**. This approach is closest to our existing market. Suitable support mechanisms for this approach include the LRET and the Retailer Reliability Obligation (RRO).

We also thought about how different support mechanisms might work across the NEM or within individual jurisdictions, with some support mechanisms better suited to a NEM-wide approach.

A common approach to selecting support mechanisms across the NEM would have benefits for all jurisdictions. Consistency across the NEM would help implement support mechanisms faster, reduce complexity and provide greater certainty for market participants. Collectively, we consider this would lead to better outcomes for consumers.

Stage 2 of our work – the longer-term market design

Electricity markets are designed to perform a series of core functions – wholesale market dispatch, investment in both bulk energy and firming capacity, manage energy imbalances, system security and provide locational services. However, the changing nature of the electricity system means there are new technical characteristics and economic challenges for the system to address at lowest cost. These challenges include:

- **Generation** that is more variable, weather-dependent, inverter based, distributed, and near-zero marginal cost.
- **Load** that is growing, more weather-dependent, and more flexible and controllable.
- **Storage** for higher volumes of energy supply to support an increase in variable and weather-dependent generation.

Our current work has highlighted how the market will need to change to address these challenges not only now but in any future market design post 2030. Underpinning this challenge is the scale of the investment required in the system both to and post 2030.

Any future design must support the achievement of the National Electricity Objective (NEO) and needs to solve for how we get:

- investment in the right mix of resources to deliver reliability and security
- investment that minimises the need for government support for entry, and, where government support is necessary, that it is done in a transparent and least distortionary way
- revenue sufficiency in a market where many participants will have near-zero or dynamic short-run marginal costs
- strong operational signals to incentivise participants to respond when needed
- a suitable secondary market so that retailers can adequately manage price risks.

There will not be one solution to address these issues. In our stage 2 work, we will consider how to achieve the core functions of energy markets in a different world to the current NEM design of the 1990s. To do this we will look to:

- have a nationally consistent framework
- move beyond this transitory period of government financial support
- ensure this market design is compatible with the new entry supported by the CIS.

Our work will draw from the ideas, initiatives, and experiences of different jurisdictions to consider how these learnings can support better national outcomes.

CONTENTS

1. Context

The national electricity market (NEM) is undergoing a significant transformation. Governments have clearly set out an ambitious shift to renewables which will require substantial new investment and the exit of aging thermal generation. However, the current challenges in the market, particularly for new entry of untested technologies and coordinated coal exit, necessitate some intervention.

The Australian Energy Market Commission (AEMC) has carried out a piece of work to provide insights on managing the current challenges, while also building on the strengths of the NEM to incentivise new investment, and the exit of coal.

1.1. The objective of energy markets is to deliver secure and reliable power

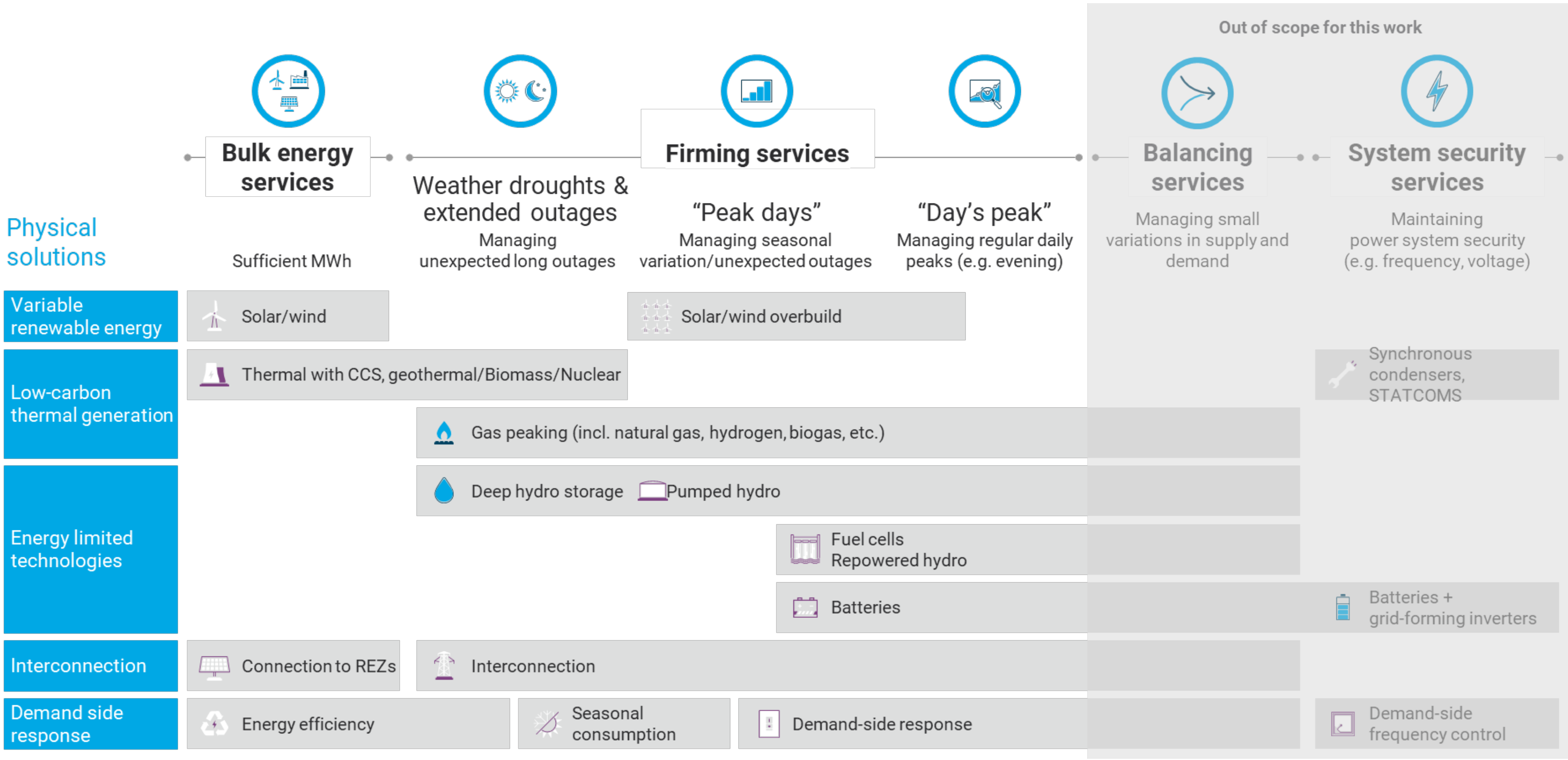
The objective energy markets around the world are to deliver secure and reliable power to customers at lowest cost. This involves energy markets performing a series of core functions – wholesale market dispatch, investment in both bulk energy and firming capacity, manage energy imbalances, system security and provide locational services.

In the immediate term, particularly as coal generators close, we consider there are six key services that the NEM must provide:

1. **bulk energy services** to provide enough low-carbon energy over an extended period
2. **firming services to manage weather droughts/extended outages** to manage long, unplanned shortages in renewable resources or extended outages
3. **firming services to manage peak days** for days of unusually high demand or plant outage
4. **firming services to manage day's peak** for regular daily peaks (e.g. early evenings)
5. **balancing services** to manage short-term imbalances in supply and demand due to variations from expected
6. **system security services** to manage power stability (including frequency, voltage) through short-term variations from expectation.

Different technologies will be required to provide these services (e.g. gas-fired generation provides all types of firming services while solar and wind typically provide bulk energy services). Figure 1 describes how each technology provides a range of services (to varying degrees). The focus of this working paper is on the bulk energy and firming services needed to meet demand and the controlled exit of coal.

Figure 1: Physical solutions for system needs (non-exhaustive)



1.2. We considered immediate changes to support the current transition

The market is going to need a mix of technologies to provide bulk energy, firming, and balancing services throughout the transition. In this report, we have considered targeted support mechanisms to help achieve new investment and the controlled exit of coal and aging gas. These mechanisms can address the immediate investment challenges facing the NEM at lowest cost, while also building on the operational strengths that are worth preserving. This working paper:

- sets out a framework to assist mechanism designers in choosing support mechanisms
- assesses the intended design features, trade-offs and potential adaptations for each mechanism
- identifies compatible bundling approaches for new investment in bulk renewable energy, firming and controlled exit
- identifies the cost recovery options for each support mechanism.

In the future, the energy system will consist of generation with different economic and technical characteristics. In Section 8, we describe the principles for a future market and the objectives that energy markets should aim to achieve in line with the National Electricity Objective (NEO). In 2024 we will build upon this work in stage 2 as we consider the future of the market beyond 2030.

2. Strengths and challenges in the current market

This section outlines the current state of the market in the NEM and covers the:

- strengths of the current market to be conserved (Section 2.1)
- challenges of the current market to be resolved (Section 2.2).

2.1. Strengths of the current market to be conserved

The AEMC has identified three key strengths of the NEM, in the context of operational and investment decisions, that mechanism designers should conserve when considering support mechanisms. These strengths can be improved through incremental reform but should broadly be conserved. These include:

1. **Strong operational signals for good performance ensures efficient dispatch**
    - The objective of the dispatch process is to dispatch the lowest cost mix of generators to meet expected demand.
    - The high market price cap provides a strong incentive for generation and demand response to 'turn on' during peak system stress events. This high market price cap incentivises retailers to purchase contracts to hedge against this price risk. However, in extreme circumstances, retailers who don't purchase sufficient contracts and generators who may face unplanned outages are protected by the cumulative price threshold (CPT) and administered price cap (APC).
    - Participants are rewarded for contributing to system needs by providing energy or frequency control ancillary services (FCAS).
2. **Market prices provide clear signals for parties to manage risk through efficient investment decisions and secondary markets**
    - Risks are appropriately allocated to projects that can control the risks (e.g. development risk, construction risk, market average price risk, price shape risk, production risks).
    - Market participants can manage price risk through secondary markets entering into contracts to manage their financial risks.
    - Participants have some locational signals to invest in regions with higher prices (via regional pricing) and strong network locations (to avoid being constrained) that are close to demand (to achieve a high marginal loss factor (MLF)).
3. **Market forecasting theoretically provides transparent signals for new investment**
    - Market forecasts provide a clear signal for new investment opportunities – centralised forecasting by the Australian Energy Market Operator (AEMO) through the Electricity Statement of Opportunities (ESOO) (10 years), the Integrated System Plan (ISP) and to a lesser extent, Medium Term Projected Assessment of System Adequacy (MT PASA) (three years), provides a view of potential investment opportunities to meet any predicted shortfalls in supply.
    - In theory, forecasts provide a transparent view of investment opportunities based on supply and demand.

2.2. Challenges in the current market to be resolved

The AEMC identified key challenges in the wholesale market affecting investment decisions.

1. **Desire for new assets to enter before coal retirement suppresses market prices**
    - The current market provides strong signals for investment and operational dispatch. However, substantial exit of capacity from coal retirements will likely result in periods of high and volatile prices between coal retirements and new capacity entering the market.
    - A key requirement in the transition is to ensure new assets are in place before old assets retire. To achieve this, governments may need to introduce mechanisms to support both asset entry and the reliable exit of aging thermal generation. This leads to a period where financial support is being provided to have renewables, firming and coal in the market. The overlap period should be minimised between new assets entering and coal retirement to reduce the cost of supporting all these projects.
    - New entry is challenged by supply chain, workforce, and transmission constraints.
2. **Unpriced externalities impact exit decisions**
    - The unpriced cost of carbon emissions in the electricity sector means that there is no strong in-market signal for generator exit to support emissions objectives.
    - In the absence of policies that explicitly value carbon, governments have chosen to intervene to achieve emissions targets.
    - For the remaining non-government-owned assets, such government interventions can potentially disrupt investment signals for the private sector and influence exit decisions.
3. **Energy transformation is changing investor confidence in long-term revenues**
    - Traditional contracting may not be suitable for new technologies such as storage.
    - Some asset types have economic sufficiency challenges (e.g. large-scale pumped hydro and hydrogen).
    - Market revenues for all asset types are highly sensitive to changes in gas prices, given the continued role of gas prices in setting electricity prices.
    - This creates a potential revenue 'sparsity' problem for merchant assets where most of their revenue is concentrated in a small number of high-revenue events (e.g. small number of high price dispatch intervals in a year, or a single year within a decade).
4. **Regional pricing does not reflect the value of locational services which can lead to sub-optimal locations for new investments**
    - Pricing in the wholesale market does not fully value the locational services of energy and is largely limited to region-based pricing and MLFs. This lack of locational value could potentially lead to sub-optimal locations for new investments, where projects could face adverse incentives or be regularly constrained due to new entrants.
    - The value of locational services is increasing as generation becomes more dispersed and variable with more transmission constraints. This issue is particularly acute for storage projects because they cannot be rewarded for locating and relieving constraints in areas of the NEM where congestion is occurring.
    - The AEMC, in collaboration with AEMO and the Australian Energy Regulator (AER), is considering transmission access reform to remove this weakness from the market.

5. **Unpriced value for system security services means assets do not have an incentive to provide these services**

- In the past, security services in the NEM were abundant and provided as a by-product of energy production by synchronous generators. Such a future state may occur in the future as technologies evolve. However, as the energy system transitions to such a future state of low emissions generation, scarcity of security services are arising in the following challenges:
  - the near-term, with synchronous generators retiring, reducing the supply of security services. and there are not yet appropriate substitutes for the supply of all security services, meaning there is scarcity. AEMO is having to manage the system through asset configurations, using directions to schedule out-of-merit plant to achieve system security.
  - the intermediate term, as grid-forming inverters and synchronous condensers start increasing but cannot fully cover security needs, meaning scarcity continues.
- Given current power system engineering knowledge, it is not possible to define all security services individually in real time. While changes are being made to enhance system security frameworks, this means there are some limitations as to what improvements can be made (e.g. individual markets to procure inertia cannot currently be introduced given that the services cannot be specified in operational timeframes).
- The AEMC is currently working through the *Improving security frameworks* (formerly Operational Security Mechanism) and *Enhancing reserve information* (formerly operating reserves) rule changes. These are looking to deliver simple, flexible solutions that streamline and align the existing frameworks, better recognise the benefits of different technologies, and increase AEMO's confidence in them.

3. How we considered support mechanisms for entry and exit

There are a wide range of possible options that jurisdictions could implement to support investment and the exit of coal. Energy markets all over the world have selected different market designs based on their priorities, characteristics, and history. Notably, they all face similar challenges when transitioning to a zero-emission energy system. However, there is no universal 'best mechanism. The most suitable mechanism will vary depending on the policy of objective and the particular circumstances of each policymaker.

Rather than coming up with a recommended 'best option', we have designed a framework to help policymakers determine what works for their particular context and objectives. As a starting point we believe that it is essential to build off the current market design, drawing on the strengths outlined in Section 2. Doing this will allow us to land solutions and achieve the transition faster.

This section outlines two key frameworks to assist with selecting support mechanisms:

- **Decision framework for new investment support mechanisms (**Section 3.1**)**. This lays out the range of potential support mechanisms and design choices for selecting support mechanisms for new investment and controlled exit. Mechanism designers can navigate these choices to decide which support mechanism is most appropriate for their needs.
- **How we assessed the shortlisted support mechanisms (**Section 3.2**)**. This includes the intended design features, resulting trade-offs and adaptations to consider for each mechanism.

We use these frameworks to consider new investment in bulk renewable energy (Section 4) new investment in firming (Section 5), and managed exit of aging thermal generators (noting the recent Orderly Exit Management framework published in December 2023) (Section 6).

We have also considered how you might choose to bundle the options to have a coherent approach to all three as needed. This is outlined in section 8.

3.1. Decision framework to help policymakers choose support mechanisms

We have identified four design choices that mechanism designers can make to identify a suitable support mechanism, relevant to their context and objectives. The framework is designed to work through each of the choices to lead to a more limited list of potential support mechanisms.

3.1.1. New investment decision framework

Support mechanisms for new investment can primarily be described by using four design choices.

1. **Generalised or specific mechanism**: Are mechanism designers seeking a mechanism that:
    - Targets something specific such as technology/location/firming service as determined by a central planner or government? The market would then compete for the funding assistance.
    - Is generalised, such that a competitive market determines the efficient selection of technology/location/firming service, rather than a central planner or government?
2. **Payment basis**: Are mechanism designers seeking a support mechanism that pays assets for:
    - MWh of energy supplied (i.e. paid to produce energy into the grid)?
    - MW of capacity available (i.e. paid to be 'available' when required)?

- MW of capacity constructed (i.e. paid to construct an asset with the intention that it will subsequently be available through the signals provided by the wholesale market)?

3. **Volume or price-based scheme[2]:** Are mechanism designers seeking a mechanism where they:
   - Control the price paid for the service supplied (e.g. a fixed credit for a MWh of supply)?
   - Set a firm volume target for the support mechanism (e.g. a MWh of renewable energy target)?
   - Elect to manage scheme costs through a combination of price and/or volume levers (e.g. a series of auctions)?
4. **Method for economic sufficiency:** How does the mechanism assist projects in generating an economic return for investors?
   - What kind of risk is the support mechanism trying to mitigate (e.g. market volatility, performance, utilisation or construction risk)?
   - How is the risk being allocated between the projects and the mechanism operator (e.g. is the risk being mitigated through a full revenue guarantee, partial revenue guarantee or an additional revenue stream where the project is still reliant on wholesale revenues)?

3.1.2. Controlled exit decision framework

There are three key design choices for coal exit mechanisms:

1. **Primary objective:** What is the main problem mechanism designers are seeking to address?
   - Get the asset to close early?
   - Keep the asset operating reliably until certain circumstances are met? These circumstances could be to operate reliably until a pre-agreed closure date or until sufficient new entry means the asset is not needed.
2. **Market participation:** How does the mechanism incentivise reliable service delivery on an ongoing basis?
   - Out of market to preserve price signals and incentivise new investment?
   - In market to minimise total system costs?
3. **Method of economic sufficiency:** How should the mechanism assist projects in generating an economic return?
   - Guaranteed revenue to provide the asset maximum certainty, minimal risk and remove incentives to respond to price signals?
   - Guaranteed minimum revenue provide the asset some certainty on revenue while maintaining some market signals?
   - Additional revenue stream limit projects certainty
   - Pricing externality to impart an external cost to drive out high-emitting generators such as coal?
   - Imposed by directly forcing the asset to close?

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[2] In this context, volume is defined as per the 'payment basis' question. That is, this may be setting a volume to be generated (in MWh, as per the Large-scale Renewable Energy Target), a volume capacity to be available (in MW) or a volume to be constructed (MW).

3.2. How we assessed the shortlisted support mechanisms

For each of the shortlisted support mechanisms, we did a detailed assessment which includes:

- **Description of the support mechanism** including how it functions and provides support to projects.
- **Applied decision framework**. This describes the decision made at each stage of the decision framework for each support mechanism.
- Intended design features, unintended trade-offs and adaptations. This provides three assessments:
    - *intended design features* at each decision in the decision framework
    - *unintended trade-offs* that should be considered at each decision in the decision framework
    - *adaptations* that mechanism designers could consider to address unintended trade-offs.
- **Implementation considerations.** This describes three factors for implementation we considered for each support mechanism:
    - *implementation difficulty* describes the challenges to implement the support mechanism and difficulty in ongoing management of the support mechanism
    - *interaction with other mechanisms* assesses whether the support mechanism can be implemented in conjunction with other support mechanisms to provide additional economic support for the project
    - *transparency* describes whether the support mechanism provides transparency in capital allocation to inform future system planning and funding allocation.
- **Previous examples**. This provides examples of similar support mechanisms that have been implemented in other jurisdictions or projects, and examples of these support mechanisms in literature.

4. Supporting new investment in bulk renewable energy

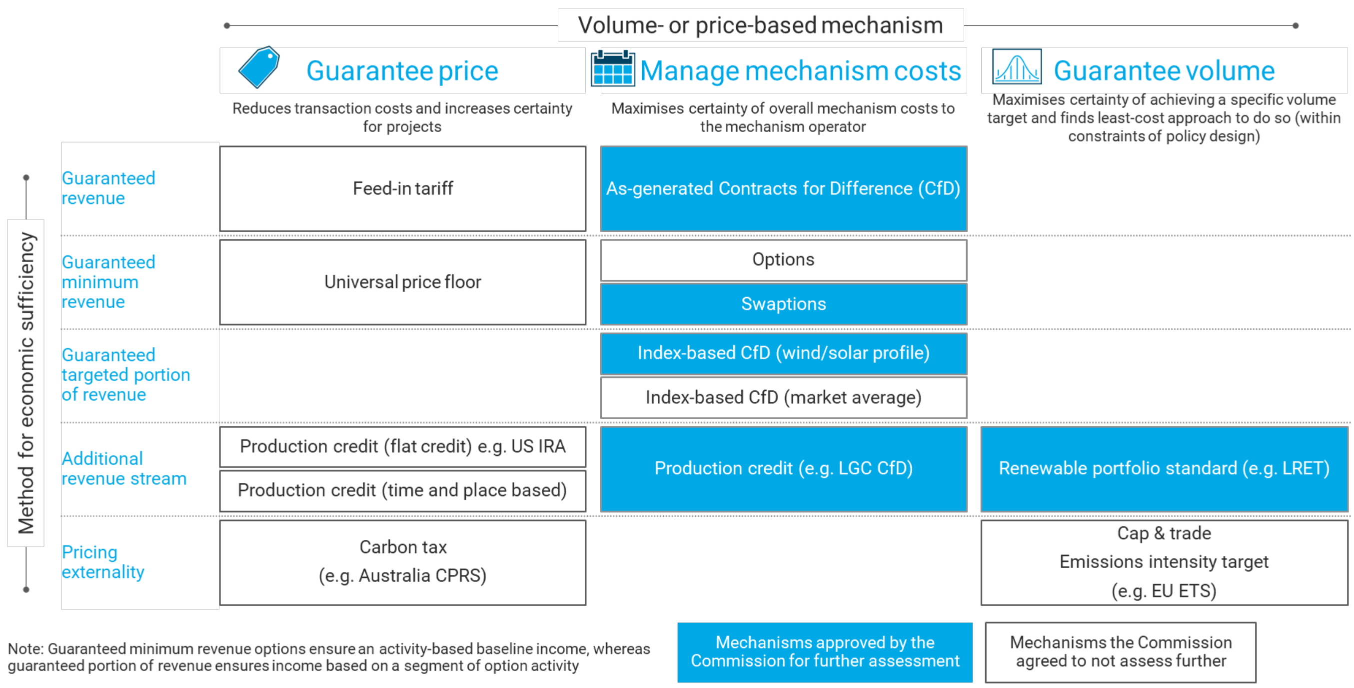
This chapter:

- **Outlines potential support mechanisms for bulk renewable energy** (Section 4.1). This section outlines the potential support mechanisms to incentivise bulk renewables, structured using the decision framework. It also describes the eight firming support mechanisms we assessed.
- **Applies the decision framework to bulk renewable energy** (Section 4.2)**.** The framework is used to assess potential support mechanisms to target specific bulk energy services.
- **Assesses support mechanisms for bulk renewable energy** (Section 4.3). Provides a detailed assessment of each of the support mechanisms including a description, the decision logic for selecting the mechanism, trade-offs and adaptations, implementation requirements and examples.

4.1. Options for support mechanism for bulk renewable energy

The AEMC has identified a range of potential mechanisms that could support bulk energy entry in the NEM. Figure 2 below maps these options against payment basis and the method for economic sufficiency.

Figure 2: Options for support mechanisms for new investment in bulk energy

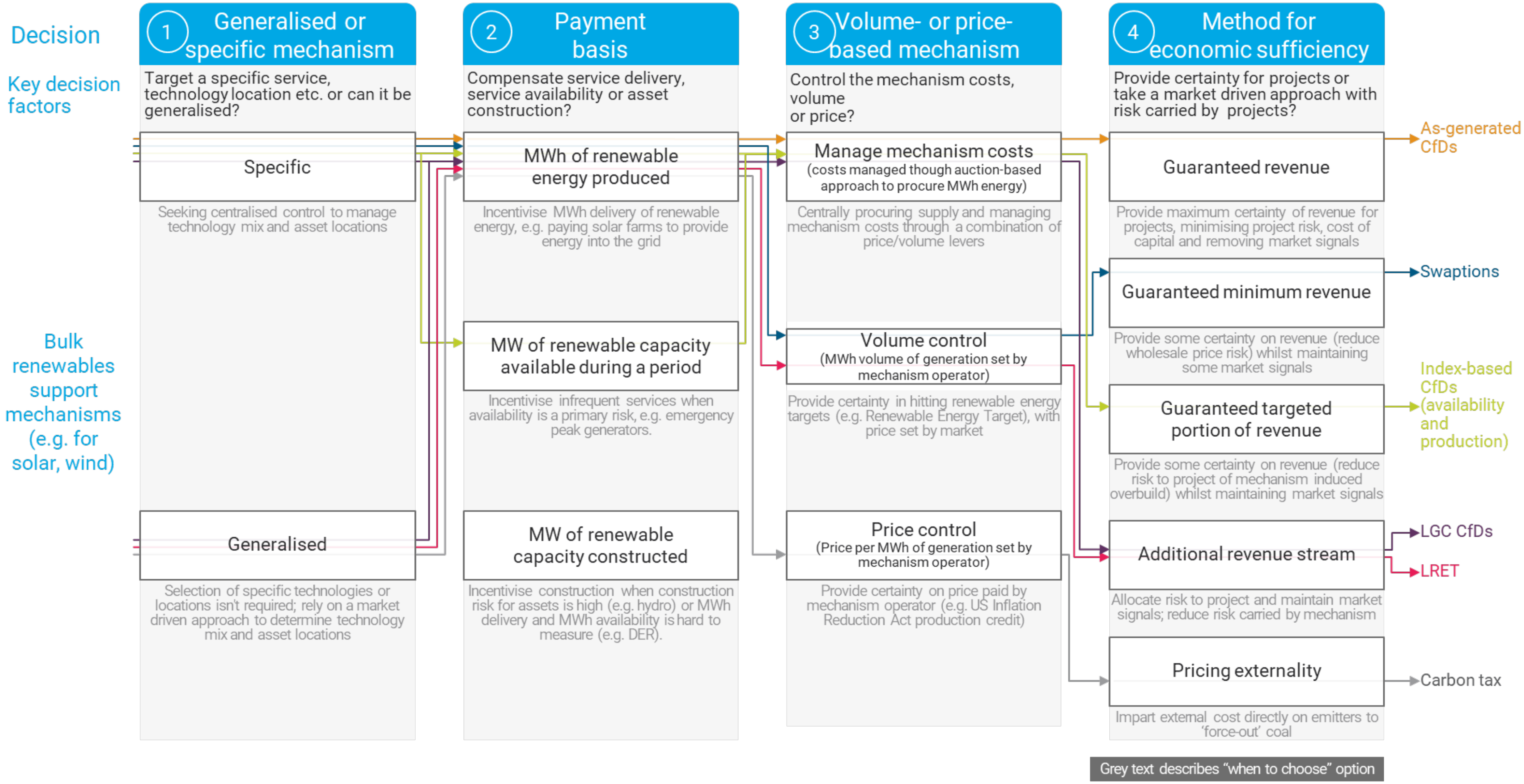


Of these support mechanisms, the AEMC selected five tailored to bulk energy services. These mechanisms have been used in Australia, internationally or studied extensively in academic literature. Examples or academic references are included in the one-page assessments in Section 4.3.

4.2. Applying the decision framework to bulk renewable energy

As coal exits the market, the wholesale energy market will require investment in bulk renewables. The large-scale renewable energy target (LRET) has been the support mechanism to date which has provided incentives to the market for investment in grid-scale wind and solar project. With the LRET due to end in 2030 we have applied the decision-making framework to provide new incentives for bulk renewable energy.

Figure 3: Decision framework for bulk energy services



The decision framework provides the reasoning for when mechanism designers might consider using each support mechanism to meet bulk energy investment objectives at lowest cost.

- **As-generated Contract for Difference (CfD)**: Consider using when seeking to minimise the cost-of-capital for projects by removing all market-price risk. However, the mechanism takes on all market risk which removes incentives for optimal asset design.
- **Swaptions**: Consider using when seeking to reduce cost-of-capital for projects by removing some market-price risk whilst preserving some incentives for optimal plant design by exposing projects to wholesale price and shape risk when the option isn't exercised. However, the design is complex and does not provide comparability of outcomes for mechanism operators during the auction process.
- **Index based CfD**: Consider using when seeking to insure projects against periods of oversupply driven by support mechanisms (e.g. solar oversupply) whilst preserving market signals and incentives for optimal plant design. However, projects retain shape risk leaving them exposed to a significant CfD pay-out during periods of wind/solar drought (i.e. if spot prices are high and they are not generating).
- **Extended LRET**: Consider using when seeking to guarantee achieving renewable energy targets and de-risk implementation (given mechanism is known and trusted by investors). However, this results in limited control over mechanism costs and no control over the technology mix.
- **Extended LRET + Large-scale generation certificates (LGC) CfDs**: Consider using when seeking to de-risk LGC price risk for projects (to lower project risk and cost of capital) or incentivise specific locations & technologies under an extended LRET mechanism.

4.3. Assessment of support mechanisms for bulk renewable energy

This section provides an explanation and assessment of each of the support mechanisms for bulk renewable energy. See Figure 4 to Figure 8 for the assessments of each support mechanism.

Figure 4: Assessment of as-generated contracts for difference (CfDs)

Option description

- An as-generated CfD is a financial contract between a project and mechanism operator. The CfD guarantees revenue ($/MWh) for projects.
- The project and mechanism operator agree a strike price per MWh of generation. When the spot price is above the strike price, the project pays the difference between spot and strike. When the spot price is below the strike price, the project receives the difference between spot and strike.
- CfDs are typically auctioned through a series of tranches and are often issued to projects with the lowest strike price.

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations through an auction process
2. Pay per MWh of renewable energy produced (Payment basis): Pay to produce MWh of electricity into the grid (as opposed to paying for MW to be available or construct MW)
3. Manage mechanism costs (Volume- or price-based mechanism): Mechanism designer has greater over costs by running auctions to award CfDs (e.g. select lowest strike price to minimise cost)
4. Guaranteed revenue (Method for economic sufficiency): Provides a guaranteed price at the strike price for projects; mechanism operator takes on project risk, lowering cost of capital and project cost

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Provides mechanism operator control over technology and location mix	• Increases administrative costs and risk of planning error as the central body must select the technology/location mix	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding projects
2 Payment basis	• Incentivises projects to maximise production as CfDs are settled per MWh	• Can blunt wholesale price signals when projects bid below short run marginal cost	• Prevent projects bidding below short-run marginal cost to prevent price signals from being distorted (e.g. New Zealand does not allow VRE to bid negative prices)
3 Volume- or price-based mechanism	• Manages mechanism costs through auction process. Auctions set MW targets to be procured in each tranche giving (some) volume control.	• Can lead to a boom bust cycle (i.e. periods of high / low investment or construction corresponding to funding cycles)	• Set the cadence and number of auctions to manage investment and construction cycles and limit sustained low wholesale prices (e.g. UK CfD scheme initially ran 2 yearly auctions; reduced to 1 yearly to smooth investment / construction cycles)
4 Method for economic sufficiency	! Guarantees a minimum price for projects by consumers absorbing all market average price, shape and production risk, minimising project risk, lowering cost of capital	• Removes market signals for good asset design meaning assets aren't incentivised maximise production at times of peak demand	• Establish excellent planning to guide technology and location mix and run targeted competitive auctions to deliver low cost value adding assets • Do not pay projects if curtailed to provide some location signals for good design (e.g. UK CfD scheme)

Implementation

- Implementation difficulty: Moderate set-up difficulty relative to index CfDs and swaptions, given simple contract structure and need to set-up administration body; Moderate ongoing management difficulty given need to run auction tranches
- Compatibility with other mechanisms: A national mechanism would need to consider auction, technology and location strategy relative to state based mechanisms to manage investment and construction cycles
- Transparency: High transparency because as-generated CfDs provide certainty over realised costs to customers

Previous examples

- UK, first introduced in 2014 with 5 auction tranches, procuring 22GW capacity
- Auctions 'ringfenced' technologies of similar maturity
- UK scheme faced curtailment challenges

! Key considerations

Figure 5: Assessment of Swaptions

Option description

- A financial contract a project and mechanism operator that gives the project an 'option' to activate a 'swap' contract. If the option is exercised, a swap contract allows the project to sell their electricity at an agreed strike price. If the spot price is above strike, the project pays the mechanism operator. If the spot price falls below the strike price, the project receives the difference between strike and spot price.
- For example, the generation LTESA is a form of swaption that also has a repayment mechanism and is auctioned in a series of tranches.

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations through auction process
2. Pay per MWh of renewable energy produced (Payment basis): Pay to produce MWh of electricity into the grid when option is activated (as opposed to paying for MW to be available or construct MW)
3. Manage mechanism costs (Volume- or price-based mechanism): Mechanism operators has some control over costs by running auctions and selecting projects to award CfDs
4. Guaranteed minimum revenue (Method for economic sufficiency): Provides projects a minimum fixed price when option is activated

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Provides mechanism operator control over technology and location mix	• Increases administrative costs and risk of planning error as the central body must select the technology/location mix	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding assets
2 Payment basis	• Incentivises assets to maximise production (e.g. settled per MWh when option is activated)	• Can blunt wholesale price signals when assets bid below short run marginal cost. Occurs when option activated, limiting trade-off relative to as-generated CfDs	• Prevent assets bidding below short-run marginal cost to prevent price signals from being distorted (e.g. New Zealand don't allow VRE to bid negative prices). Evaluate whether it should apply to all VRE in system or just those under the mechanism
3 Volume- or price-based mechanism	• Manages mechanism costs through auction process. Auctions set MW targets to be procured in each tranche giving (some) volume control.	• Can lead to a boom bust cycle (i.e. periods of high / low investment or construction corresponding to funding cycles)	• Set the cadence, number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	(!) Mechanism operator takes on shape and market average price risk (when option is activated), lowering cost of capital and project cost. • Maintains market signals for optimal asset design in periods when option isn't activated.	• Option design creates design and auction complexity for projects • Projects receive wholesale price upside revenues when option isn't activated	• Simplify and standardise project selection process in tender • Incorporates a 'repayment' mechanism to ensure projects excess profits in non-exercise years are paid back to customers

Implementation

- Implementation difficulty: High implementation cost relative to as-generated CfDs, given complex contract structure and need to set-up administration body; High ongoing transaction costs (higher than for as-generated LGCs) given complex contract structure
- Compatibility with other mechansims: A national mechanism may need to consider auction, technology and location strategy relative to state based mechanisms to manage investment and construction cycles
- (!) Transparency: Low transparency given optionality of payouts and limited clarity on selection of projects

Previous examples

NSW Government introduced LTESAs in 2022 via an auction process for new projects. NSW's first auction achieved a wind/solar strike price of $50/$35 MWh respectively.

(!) Key considerations

Figure 6: Assessment of Index-based CfD (solar and wind profile)

Option description

- A financial swap contract between an project and mechanism operator, based on the volume generated by a pre-defined shape profile. The solar or wind profile may be tailored to suit each project, adjusted for seasonality, maintenance and degradation. CfD payout to project = $V_{fixed}*(p_{strike} - p_{spot})$
- This incentivises the project to operate an asset more 'optimally' than the reference plant (e.g. incentivises assets to produce when prices are high)[1]
- These can be part of a tradeable market, as per the Renewable Energy Hub's Solar Shape Contract[2] (note: multiple design variations exist)

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides control over technology mix and locations through auction process
2. Pay per MW of renewable energy available (Payment basis): Pay based on the volume assets expect to produce (based on a pre-defined shape profile); could also theoretically be linked to production payments
3. Manage mechanism costs (Volume- or price-based mechanism): Mechanism operator has some control on mechanism costs by running auctions and selecting projects to award CfDs
4. Guaranteed portion of revenue (Method for economic sufficiency): Insures projects against overbuild (e.g. excess solar) with risk borne by mechanism

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Provides mechanism operator control over technology and location mix	• Increases complexity & administrative costs as mechanism operator needs to select shapes (seasonal, location and technology based)	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding assets
2 Payment basis	• CfD payment is independent of actual production	• Does not guarantee MWh of production	• Link CfD payment to an actual volume of production, rather than a fixed volume
3 Volume- or price-based mechanism	• Manages mechanism costs through auction process. Auctions set MW targets to be procured in each tranche giving (some) volume control.	• Can lead to a boom bust cycle (i.e. periods of high / low investment or construction corresponding to funding cycles)	• Set the cadence, number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	! Maintains market signals for optimal asset design (location and operation). Mechanism operator takes on risk of renewables overbuild.	• Projects retain shape risk (e.g. pay spot price when shape isn't met), leaving them exposed to a significant CfD pay-out during periods of wind/solar drought (i.e. if spot prices are high and they are not generating)	• Consider basing index profile on an operating 'yardstick' plant, rather than a fixed profile. That way if the 'yardstick' plant also doesn't produce (because of a wind / solar drought), then the project is not financially penalised.
Other	• More efficient allocation of access rights and use of REZ network infrastructure		

Implementation

- Implementation difficulty: High implementation cost relative to as-generated CfDs, given complex contract structure and need to set-up administration body; High ongoing transaction costs (comparable to swaptions) given more complex contract structure
- Compatibility with other mechansims: A national mechanism would need to consider auction, technology and location strategy relative to state based mechanisms to manage investment and construction cycles
- Transprarency: High transparency as the fixed profile provides volume certainty for the mechanism desginer

Previous examples

ARENA trialled a firm shape and fixed price contract against the solar profile, with the shape varying by month[1]

Spain has considered a mechanism that sets min. operating hours by tech. (the benchmark). Projects are paid when the benchmark is exceeded and lose support if below[2]

[1] Source: ARENA, Renewable Energy Hub Contract Performance

[2] Source: Efficient Renewable Electricity Support: Designing an Incentive-compatible Support Scheme; David Newbery, The Energy Journal; 2023

Figure 7: Assessment of Large-Scale Renewable Energy Target (LRET)

Option description

- LRET is a renewable energy certificate mechanism which issues large-scale generation certificates (LGCs) to renewable projects (above their 1997 baseline production) for each MWh of generation they produce.
- Electricity retailers are legally required to purchase and surrender a certain number of LGCs each year, corresponding to the percentage of their total electricity sales, in line with a national (or state) renewable energy target.
- Retailers incur a shortfall charge if they do not surrender the correct number of LGCs. LGCs are tradeable.

Applying the decision framework

1. Generalised mechanism (Generalised or specific mechanism): Optimised for least cost technology mix by market
2. Pay per MWh of renewable energy produced (Payment basis): Pays projects for producing MWh of electricity into the grid
3. Volume-based mechanism (Volume- or price-based mechanism): Guarantees renewable energy volume targets and allows the market to set prices
4. Additional revenue stream (Method for economic sufficiency): Allocates risks to projects to optimise performance and maintain market signals

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Generalised mechanism where the market optimises for least cost	• Prevents mechanism operator's ability to control specific technology mix; may lead to overbuild of some technology with supply chain constraints	• Separate LRET targets for solar and wind to allow planners to optimise resource mix and prevent incentivising technologies with the lowest 'market price to LCOE gap' (e.g. solar)
2 Payment basis	• Incentivises projects to maximise production as LGCs are issued per MWh • Forces coal generators to ride negative prices, incentivising coal exit	• Can blunt wholesale price signals when projects bid below short-run marginal cost • Requires extra financial support if coal generators need to stay open	• Prevent projects bidding below short-run marginal cost to prevent price signals from being distorted (e.g. New Zealand does not allow VRE to bid negative) • Assess whether to apply some or all existing VRE projects • Pair LRET with a mechanism to manage coal exits
3 Volume- or price-based mechanism	(!) Ensures renewable targets are achieved (e.g. 82% renewable energy target) and allows the market to set prices	• Offers limited control on mechanism costs as prices are set by the market with limited intervention from the mechanism operator (unless they reach the penalty price)	• Limit eligibility of existing projects, such as allowing only new projects to produce LGCs, or allowing projects to only produce LGCs for X years (e.g. currently, projects receive LGCs for production above their 1997 baseline) • Reduce the LGC penalty price (as the LCOE of wind and solar is now below the current penalty price) and review current LGC banking rules
4 Method for economic sufficiency	(!) Preserves market signals for projects to optimise performance and minimises risk carried by consumers	• Results in a higher cost of capital as risk is borne by project	• Run LGC CfD auctions to reduce the market price risk from projects (e.g. Nelson et al.). This may also allow mechanism operators to incentivise new entry of specific locations and technologies. See *figure 8*.
Other	• Increases investor comfort and confidence with a mechanism that has been previously used		

Implementation

- Implementation difficulty: Low implementation cost relative to as-generated CfDs, given exsiting party to manage the mechanism is in place (Clean Energy Regulator); Moderate ongoing transaction costs (comparable to as-generated LGCs)
- Compatibility with other mechanisms: The support mechansim is compatible with state-based auction mechanisms (e.g. LGCs should theoretically decrease LGC strike-price in CfD auctions). However, this could risk overinvestment in renewables
- Transparency: High transparency as fixed volumes provide volume certainty for the mechanism designer

Previous examples

- Australia, established in 2001, drove investment in 33TWh energy by 2020
- California Renewable Portfolio Standards requires utilities and electricity service providers to acquire a percentage of RECs for each MWh they procure

(!) Key considerations

Figure 8: Assessment of Large-Scale Renewable Energy Target + LGC CfDs

Option description

- To complement the Large-Scale Renewable Energy Target (LRET), mechanism operators run auctions for large-scale generation certificate (LGC) Contracts for Difference (CfDs). This provides LGC price certainty for the project.
- Projects and the mechanism operator agree on an LGC strike price in the financial contract. If the LGC spot price is below the strike price, the mechanism operator pays the project the difference between strike and spot. If the LGC spot price is above the strike price, the project pays the mechanism operator the difference between strike and spot.

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides some control for mechanism operator to run LGC CfD auctions for specific technologies or specific locations (e.g. REZs)
2. Pay per MWh of renewable energy produced (Payment basis): Pays projects for producing MWh of electricity into the grid
3. Manage mechanism costs (Volume- or price-based mechanism): Mechanism operator has greater control on mechanism costs by running auctions and selecting projects to award CfDs
4. Additional revenue stream (Method for economic sufficiency): Removes LGC price risk from projects. Allocates non-LGC price risk to projects to optimise performance and maintain market signals

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Provides mechanism operator control over technology and location mix	• Increases administrative costs and risk of planning error as the central body must select the technology/location mix	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding projects
2 Payment basis	• Incentivises projects to maximise production as LGCs are issued per MWh • Forces coal generators to ride negative prices, incentivising coal exit	• Can blunt wholesale price signals when projects bid below short run marginal cost • Requires extra financial support if coal generators need to stay open	• Prevent projects bidding below short-run marginal cost to prevent price signals from being distorted (e.g. New Zealand does not allow VRE to bid negative) • Assess whether to apply some or all existing VRE projects • Pair LRET with a mechanism to manage coal exits
3 Volume- or price-based mechanism	(!) Auction process gives mechanism operators control over mechanism costs. Auctions set LGC MW targets to be procured for (some) volume control	• Can lead to boom bust cycles (i.e. periods of high / low investment / construction corresponding to auction cycles)	• Set the cadence and number of auctions to provide relevant price signals for future investment • Auction LGCs to liable entities (retailers) to reduce mechanism exposure and add liquidity to the LGC market
4 Method for economic sufficiency	(!) Removes LGC price risk for projects. Market average price, shape and production risk is allocated to the project to optimise performance, preserving market signals	• Consumers insure LGC price risk, if a carbon price is introduced, LGC price reduces, and potential payout from the mechanism operator to the project increases. • Risk reduction for projects is less than for CfDs	• None identified

Implementation

- Implementation difficulty: Moderate implementation cost relative to index CfDs and swaptions, given simple contract structure; Moderate ongoing transaction costs (higher than for LGCs but lower than swaptions) given need to run auctions
- Compatibility with other mechanisms: The support mechansim is compatible with state-based auction mechanisms (e.g. LGC CfDs should theoretically decrease LGC strike-price in CfD auctions), compatible with LRET
- Transparency: High transparency as fixed volumes (of LRET) provide volume certainty for the mechanism desginer

Previous examples

- Mechanism has not been implemented. Design proposed by Nelson et al[1]

(!) Key considerations

[1] Source: What's next for the Renewable Energy Target – resolving Australia's integration of energy and climate change policy? Tim Nelson, Tahlia Nolan, Joel Gilmore; Agricultural and Resource Economics; October 2021

5. Supporting new investment in firming services

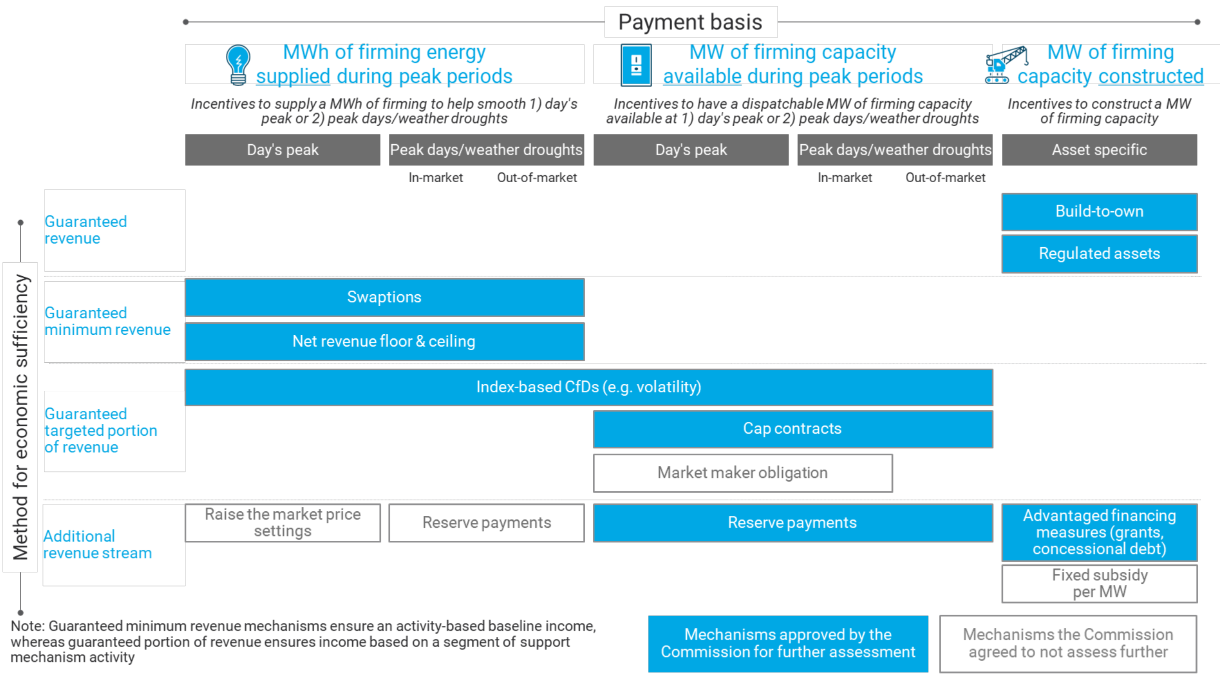
This chapter:

- **Outlines potential support mechanisms for firming services** (Section 5.1). This section outlines the potential support mechanisms to incentivise firming services, structured using the decision framework. It also describes the eight firming support mechanisms that we assessed.
- **Applies the decision framework to firming services** (Section 5.2). The framework is used to assess potential support mechanisms to target specific firming services (weather droughts, peak days and day's peak).
- **Assesses support mechanisms for firming services** (Section 5.3). Provides a detailed assessment of each of the support mechanisms including a description, the decision logic, trade-offs and adaptations, implementation requirements and examples.
- **Considers procurement options to use GOCs** (Section 5.4). This section proposes four options for how funding may be allocated between GOCs and the private sector.

5.1. Options for support mechanisms for new investment in firming services

The AEMC has identified a range of potential mechanisms that could support demand- or supply-side firming entry in the NEM. Figure 9 below maps these options against the payment basis, method for economic sufficiency, and whether it targets a specific firming service.

Figure 9: Options for support mechanisms for new investment in firming



Of these support mechanisms, the AEMC selected eight tailored to firming services. These support mechanisms have been used in Australia, internationally or studied extensively in academic literature. Examples or academic references are included in the one-page assessments.

5.2. Applying the decision framework for firming services

Different firming services and the assets that provide them are best suited to different support mechanisms. The AEMC has applied this decision framework in two ways:

- firming services suited to short durations with high frequency, such as daily peaks (see Figure 10)
- firming services suited to longer durations that take place less frequently, such as peak days or in response to unplanned outages or weather droughts (see Figure 11).

Some jurisdictions have published plans for the technology mix required to meet emissions reduction objectives. As such, specific support mechanisms could be tailored to a particular technology type or location.

A worked example to show how the decision framework can be applied to select support mechanisms for a large pumped hydro project is demonstrated in Appendix C. This example does not lead to a clear 'winner', instead demonstrating that different design choices can favour different support mechanisms for the same technology.

While the following section highlights mechanisms to support firming, there are NEM-wide market reforms being considered that would increase the profitability, efficiency, and emissions reduction value of firming assets. If implemented these would reduce the need for support mechanisms.

The AEMC, in collaboration with AEMO and the AER, is working on a transmission access reform and has proposed a hybrid model of a congestion relief market and priority access model. For storage assets, the congestion relief market is likely to increase profitability. It allows them to earn revenue for relieving transmission constraints when there is excess renewable energy available in their area. As the storage assets are incentivised to charge off renewable energy that would otherwise be spilled, this reduces emissions. Furthermore, by relieving transmission constraints, less transmission needs to be built, decreasing costs to energy consumers.

Figure 10: Decision framework for day's peak firming services

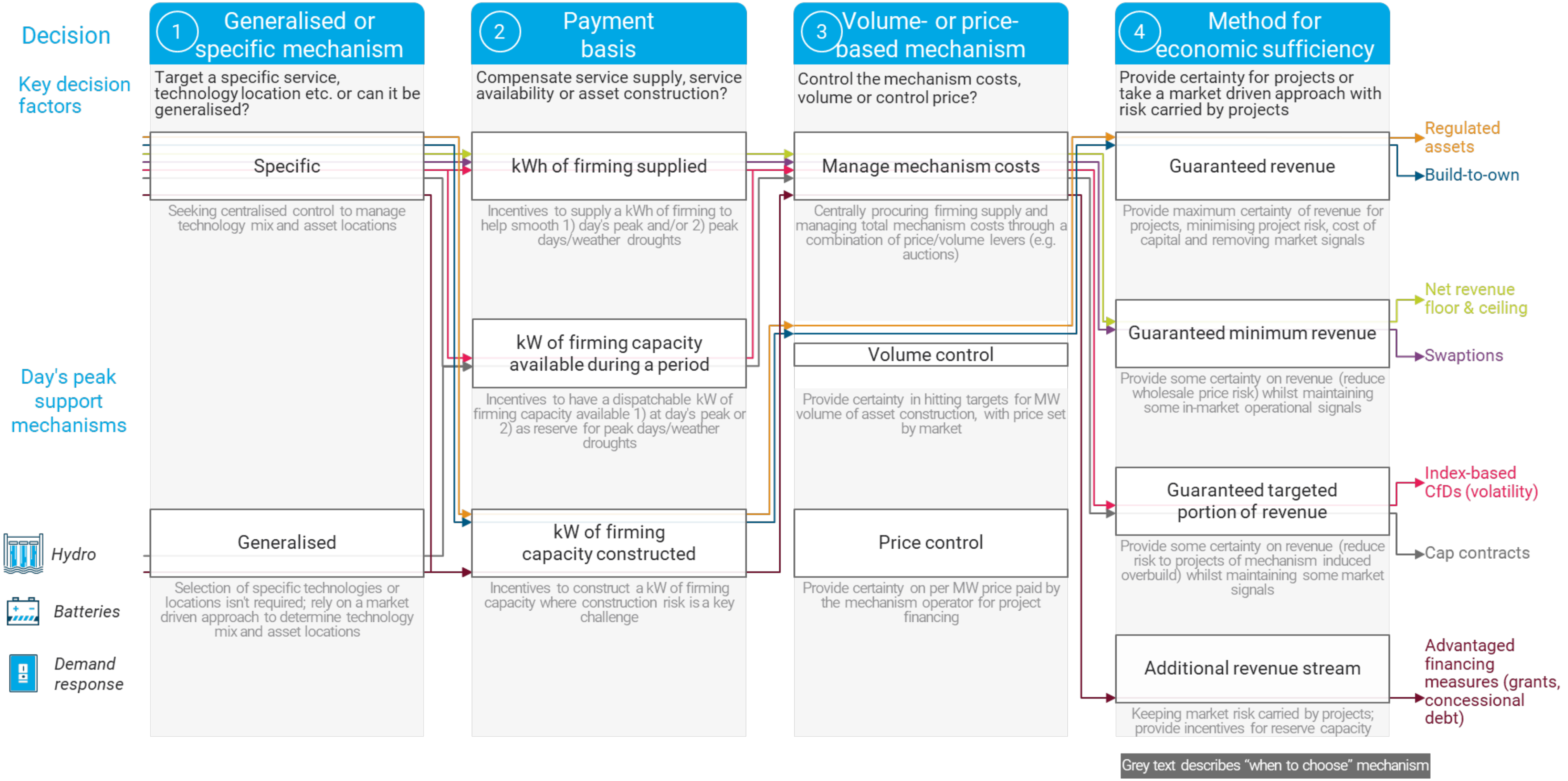
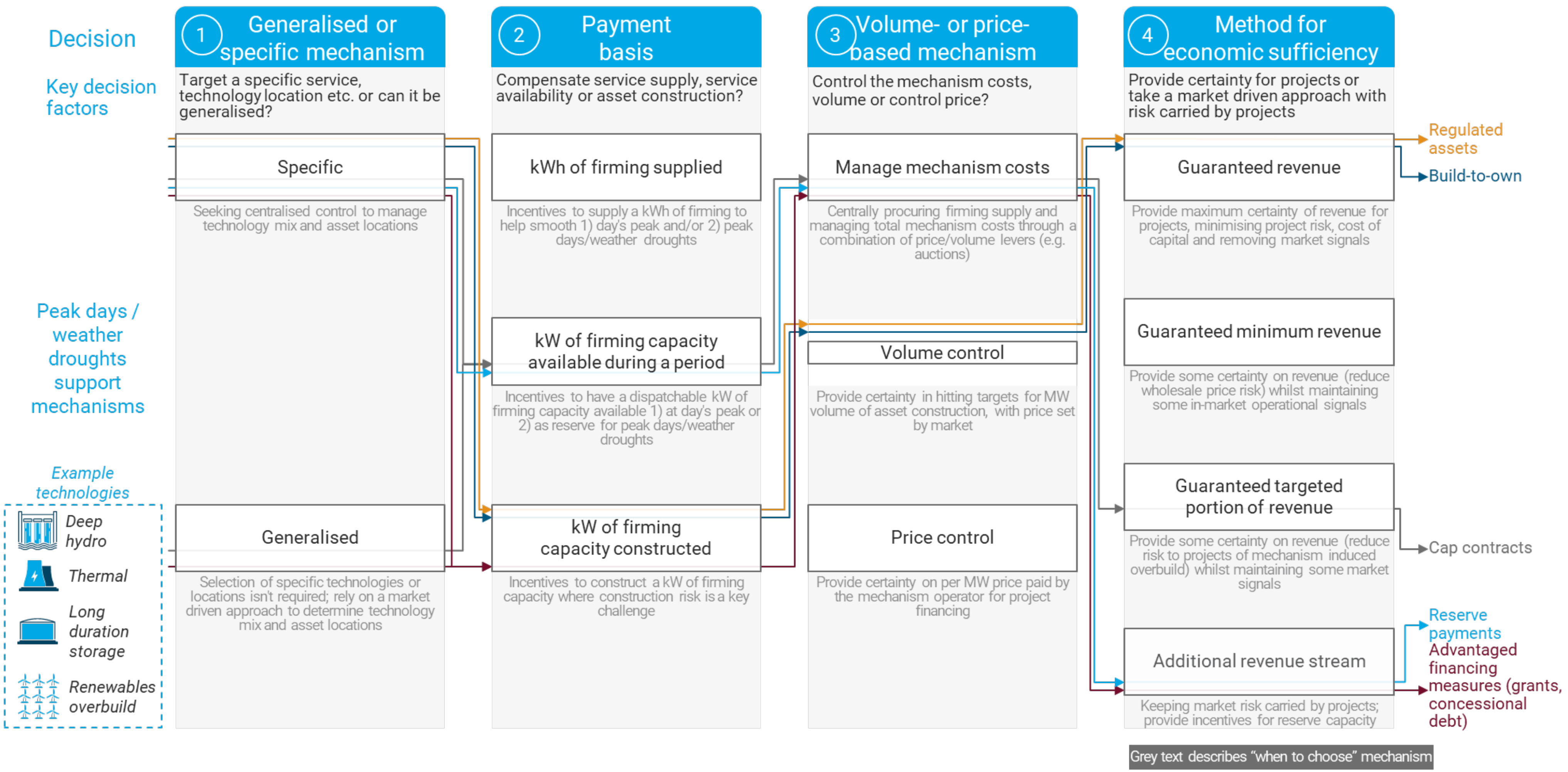


Figure 11: Decision framework for peak days and weather drought firming services



The decision framework provides the reasoning for when mechanism designers might consider using each support mechanism to meet firming investment objectives at lowest cost. Our high-level analysis of the core objectives of each support mechanism is set out below.

- **Advantaged financing measures:** Consider using if mechanism designers are looking to minimise ongoing support and preserve all market signals for optimal operation and plant design.
- **Reserve payments:** Consider using to incentivise firming availability and preserve market signals for optimal plant design and dispatch.
- **Cap contracts:** Consider using to incentivise firming availability with strong signals for non-performance and preserve market signals for technologies that are not energy constrained (e.g. gas peakers, deep storage). These technologies can physically back the cap contract because they can generate continuously for as long as market prices are above the cap contract strike price.
- **Index-based CfDs:** Consider using to mitigate volatility risk from firming overbuild (before coal exits) for energy-limited assets (e.g. batteries) while preserving all market signals for optimal operation and plant design.
- **Swaptions + net revenue floor & ceiling:** Consider using to remove downside market risk for projects when the mechanism operator is willing to bear market risk and share some upside with projects.
- **Build-to-own:** Consider using to shift market risk and construction risk to the mechanism operator when the private sector is unwilling to bear it (e.g. very high development costs, high construction risk, unproven technology, highly volatile revenues).
- **Regulated assets:** Consider using to remove all market risk for projects and to guarantee construction of a particular sized asset.

A detailed example for the rationale behind why a mechanism designer may choose a support mechanism, either from a technology or mechanism lens, can be found in Appendix D (battery storage) and Appendix E (cap contracts).

5.3. Assessment of support mechanisms for firming

See Figure 12 to Figure 18 for the assessments of each support mechanism.

Figure 12: Assessment of advantaged financing measures (grants, concessional debt)

Option description

- Advantaged finance measures can include grants or concessional debt financing.
- Mechanism operators can provide:
  - Capital grants to lower the fundings needs for a project.
  - Concessional debt financing to lower the cost of capital for the project, allowing the project to be economically viable at a lower rate of return. This is also used when securing financing for projects with risks private markets are not willing to bear.

Applying the decision framework

1. Can be generalised or specific (generalised or specific mechanism): Technology mix/location can be determined by market or central body via a generalised or specific mechanism respectively
2. Firming capacity constructed (payment basis): Pay to construct a MW of firming capacity
3. Manage mechanism costs (Volume- or price-based mechanism): Mechanism operator can control mechanism costs by running auctions and selecting projects to award capital grants / concessional financing
4. Guaranteed revenue (Method for economic sufficiency): Mechanism operator lowers construction risk by reducing costs for new projects. However, market and performance risk continues to be borne by projects

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Can be generalised for the market to determine the optimal technology/location mix	• If generalised, projects may seek locations/technologies most suitable for profitability and not least cost of system design	• If generalised, add performance-based criteria in procurement process
	• Can be made specific to target technology/location mix	• If specific, increases administrative costs and risk of planning error as the mechanism operator must select the technology/location mix	• If specific, implement a planning process and forecast market firming capacity needs to decide service mix (e.g. technology, location)
2 Payment basis	(!) Mechanism operator provides capital to support asset construction	• Does not ensure asset performance	• Introduce performance-based metrics, where the funding is linked to the actual energy savings or emissions reductions targeted by the mechanism, rather than the upfront capital costs
3 Volume- or price-based mechanism	• Manage mechanism costs by allocating from a fixed funding pool	(!) Can lead to a boom bust cycle (i.e. periods of high / low investment / construction corresponding to funding cycles)	• Set the cadence (e.g. quarterly vs annual), number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	(!) Preserves wholesale market signals to incentivise efficient asset operation • Concessional debt finance allows mechanism operator to bear risks the private sector may not	• Project maintains exposure to market risk, impacting cost of capital and ability to secure financing • Concessional debt financing can crowd out private financing	• Consider bundling grant and concessional debt financing • Ensure concessional debt financing is limited to assets the market is unlikely to fund

Implementation

- Implementation difficulty: Moderate implementation difficulty as grant/debt financing is tyically tailored per project; existing bodies can act as the mechanism operator (e.g. CEFC, ARENA); Low ongoing management difficulty once capital has been deployed
- Interaction with other mechanisms: Requires audit of existing incentive mechanisms to ensure no 'double dipping' from capital investments that would have been undertaken by the private market without additional support
- Transparency: High transparency when results of funding rounds are published

Previous examples

- CEFC, in 2021, committed $50M in senior debt, in addition to $8M in ARENA grant funding, to a 50MW extension of the Hornsdale Power Reserve. The objective of this funding was to enable emerging technology to demonstrate grid-stabilising capabilities[1]

(!) Key considerations

[1] Source: CEFC Insights

Figure 13: Assessment of reserve payments

Option description

- The mechanism operator pays the project for being available to provide 'reserve capacity'. The project receives the payment regardless of whether its capacity is called upon.
- Reserves can be in-market (capacity which can participate in the wholesale market) or out-of-market (capacity procured for specific purposes which does not participate in the wholesale market e.g. the RERT).
- The revenue received by the project for providing reserve capacity can be either fixed or determined through an auction process.

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations through auction process or out-of-market procurement
2. Firming available (payment basis): Pay to have a MW of firming capacity available
3. Manage mechanism costs (Volume- or price-based mechanism): mechanism operator has greater control over mechanism costs by running competitive funding rounds or procuring out-of-market reserves
4. Additional revenue (Method for economic sufficiency): Mechanism operator supports revenue sufficiency and mitigates some utilisation risk by paying for firming capacity

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Flexibility in technology and location mix	• Increases administrative costs and risk of planning error as the mechanism operator must select the technology/location mix	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding assets
2 Payment basis	! Incentivises availability of firming capacity	! Does not necessarily ensure delivery of firming supply when needed at peak times	• Enforce performance penalties if there is failure to deliver firming supply when called upon
3 Volume- or price-based mechanism	• Manage mechanism costs by allocating from a fixed funding pool	• Can lead to a boom bust cycle (i.e. periods of high / low investment / construction corresponding to funding cycles)	• Set the cadence (e.g. quarterly vs annual), number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	! Supports revenue sufficiency and mitigates some utilisation risk, while maintaining market signals for optimal operation and plant design	• Projects maintain exposure to market risk, impacting cost of capital and ability to secure financing	• Combine with concessional debt financing to lower cost of capital from the project's perspective

Implementation

- Implementation difficulty: Low to moderate implementation difficulty due to simple contract structure; Moderate ongoing management as requires contractual monitoring
- Interaction with other mechanisms: Can be bundled with advantaged financing etc.; can maintain flexibility in contract terms (e.g. duration of contract term to align with dual run cost periods)
- Transparency: High transparency for project when contract structures are kept simple; high transparency for public when results of auction rounds are published

Previous examples

- The Hornsdale Power Reserve receives $50m from the SA Government's Renewable Technology Fund to provide a 70 MW out-of-market reserve (this does not bid into the wholesale market). The remaining 90 MWh of storage capacity participates in the wholesale market

! Key considerations

Figure 14: Assessment of cap contracts

Option description

- The mechanism operator pays the project an option fee (i.e. a fixed annual payment). When the spot price exceeds the strike price, the project must pay the mechanism operator the difference between the spot price and the strike price.
- The project has no payment obligations for periods when the spot price is below the strike price.
- To support economic sufficiency, the cap contract may be for a higher option fee or longer duration than can be achieved on the market.

Applying the decision framework

1. Generalised or specific (generalised or specific mechanism): Technology mix/location can be determined by market or central body via a generalised or specific mechanism respectively
2. Firming available (payment basis): Pay to have a MW of firming capacity available
3. Manage mechanism costs (Volume- or price-based mechanism): mechanism operator has greater control over mechanism costs by running auctions and selecting projects to award contracts
4. Guarantee portion of revenue (Method for economic sufficiency): Mechanism operator supports revenue sufficiency and mitigates some utilisation risk by providing a fixed annual payment for firming capacity

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Can be generalised for the market to determine the optimal technology/location mix	• If generalised, projects may seek locations/technologies most suitable for profitability and not least cost of system design	• If generalised, add performance-based criteria in procurement process
	• Can be made specific to target technology/location mix	• If specific, increases administrative costs and risk of planning error as the mechanism operator must select the technology/location mix	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding assets
2 Payment basis	(!) Incentivises availability of firming capacity when its needed	• Does not necessarily ensure delivery of firming supply when needed at peak times	• Consider enforcing performance penalties if there is failure to deliver firming supply when called upon
3 Volume- or price-based mechanism	• Manages mechanism costs through auction process. Auctions set MW targets to be procured in each tranche giving (some) volume control.	• Can lead to a boom bust cycle (i.e. periods of high / low investment or construction corresponding to funding cycles)	• Set the cadence (e.g. quarterly vs annual), number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	• Supports revenue sufficiency and mitigates some utilisation risk, while maintaining market signals for optimal operation and plant design	• Project maintains exposure to market risk, impacting cost of capital and ability to secure financing	• Combine with concessional debt financing to lower cost of capital from the project's perspective

Implementation

- Implementation difficulty: Low to moderate implementation difficulty due to simple contract structure, though more effort is required to set up a tradeable market for cap contracts; Moderate ongoing management as requires contractual monitoring
- Interaction with other mechanisms: A national mechanism would need to consider auction, technology and location strategy relative to state-based mechanisms to manage investment and construction cycles
- Transparency: High transparency for project when contract structures are kept simple; high transparency for public when results of auction rounds are published

Previous examples

- ASX Energy Futures Cap Contracts are structured as cash-settled contracts for difference, settled against regional spot prices in the mainland regions of the NEM.
- Irish Reliability Options incentivises plant to generate capacity or reduce load at peak times based on their expected ability to respond.

(!) Key considerations

Figure 15: Assessment of index-based CfDs (volatility)

Option description

- An agreement between the project and the mechanism operator that supports economic sufficiency by replicating the market signal to provide firming services (e.g. the intraday wholesale price spread) and guarantees a portion of revenue by de-risking variability in this market signal.
- If the intraday spread (in $/MWh) is higher than contracted strike price, the project pays the mechanism operator the difference (multiplied by the contracted volume); If the intraday spread is lower than contracted strike price, the inverse applies.
- The contracted volume may either be fixed (i.e. availability based) or based on actual supply. This can be part of a tradeable market.

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations through auction process
2. Firming supplied or available (payment basis): Pay to deliver a MWh of firming supply or to have a MW of firming capacity available
3. Manage mechanism costs (Volume- or price-based mechanism): mechanism operator has greater control over mechanism costs by running auctions and selecting projects to award contracts
4. Guarantee portion of revenue (Method for economic sufficiency): Mechanism operator bears volatility risk (i.e. risk of overbuild of firming assets) to support economic sufficiency, but project retains exposure to in-market operational signals

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Provides mechanism operator with control over technology and location mix	• Increases administrative costs and risk of planning error as the mechanism operator must select the technology/location mix	• Implement a planning process and forecast market firming capacity needs to decide service mix (e.g. 2hr vs 4hr intraday volatility)
2 Payment basis	• Incentivises either firming supply or availability (depending on the specific design)	• If compensating supply: does not necessarily ensure firming availability when needed (and vice versa for compensating firming availability)	• If compensating supply: condition payment to asset being available over a specified number of periods • If compensating capacity: enforce performance penalty for failure to deliver when called upon
3 Volume- or price-based mechanism	• Manages mechanism costs through auction process. Auctions set MW targets to be procured in each tranche giving (some) volume control.	• Can lead to a boom bust cycle (i.e. periods of high / low investment or construction corresponding to funding cycles)	• Set the cadence, number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	! Removes volatility risk but retains market signals for optimal operation and plant design	! Counterparty is exposed to volatility risk, and will need to make more payments if the volatility reference is set too low	• Select appropriate volatility benchmark to ensure mechanism operator is well-placed to manage the performance risk (e.g. 2hr volatility spread for a 2hr battery)

Implementation

- Implementation difficulty: Low-med implementation difficulty due to simple contract structure, though more effort is required to set up a tradeable market for CfDs; Moderate ongoing management difficulty as contractual monitoring is required
- Interaction with other mechanisms: A national mechanism would need to consider auction, technology and location strategy relative to state-based mechanisms to manage investment and construction cycles
- Transparency: High transparency over mechanism costs and outcomes

Previous examples

- ARENA-funded Renewable Energy Hub report proposed a Virtual Storage Contract that sets a spread between the 'charge' and 'discharge' price for battery operators, de-risking energy arbitrage revenue[1]

! Key considerations

[1] Source: ARENA, Renewable Energy Hub Lessons Learnt Report 2

Figure 16: Assessment of swaptions and net revenue floor & ceiling

Option description

- There are two main options that have the same overarching response to the decision framework, despite having different detailed designs. These may include repayment thresholds and value sharing above/below the revenue thresholds. These options are:
  - Swaptions: The project enters into a financial contract with the mechanism operator that provides the project an 'option' to activate a 'swap' contract. Once activated, a swap contract will guarantee a fixed annuity revenue.
  - Net revenue floor and ceiling: Net revenue is underwritten by a mechanism operator via a net revenue 'floor' and 'ceiling'. Where actual revenue is below the floor, the mechanism operator pays the difference between the revenue and floor to the project (and vice versa for the revenue ceiling).

Applying the decision framework

1. Specific mechanism (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations through auction process
2. Firming supplied (payment basis): Pay to deliver a MWh of firming supply
3. Manage mechanism costs (Volume- or price-based mechanism): mechanism operator has greater control over mechanism costs by running auctions and selecting projects to award contracts
4. Guarantee minimum revenue (Method for economic sufficiency): Mechanism operator provides some certainty on revenue by removing market risk for projects below the net revenue floor and above the net revenue ceiling; in-market operational signals are retained for the project outside of these revenue thresholds

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	• Provides mechanism operator control over technology and location mix	• Increases administrative costs and risk of planning error as the mechanism operator must select the technology/location mix	• Establish an excellent planning body to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding assets
2 Payment basis	(!) Incentivises firming delivery by compensating supply	• Does not ensure supply is available at the peak times it is needed the most	• Condition payment to the project being available for a specified percentage of periods
3 Volume- or price-based mechanism	• Manages mechanism costs through auction process. These set MWh targets to be procured in each tranche giving (some) volume control.	• Can lead to a boom bust cycle (i.e. periods of high / low investment or construction corresponding to funding cycles)	• Set the cadence (e.g. quarterly vs annual), number and volume of funding rounds to manage investment and construction cycles and limit sustained low wholesale prices
4 Method for economic sufficiency	(!) Mitigates some market risk by providing some revenue certainty	• Blunts in-market signals as the mechanism operator bears market risk below the net revenue floor and above the net revenue ceiling	• Choose revenue floor/ceiling and upside/downside sharing to retain some of the project's market exposure

Implementation

- Implementation difficulty: Moderate to high implementation difficulty due to more complex contract structures relative to CfDs; High ongoing management difficulty due to optionality in contract structures and ongoing administrative requirements of option payouts
- Interaction with other mechanisms: A national mechanism would need to consider auction, technology and location strategy relative to state-based mechanisms to manage investment and construction cycles
- Transparency: Low transparency given optionality of payouts and limited clarity on selection of projects

Previous examples

- Capacity Investment Scheme: Government (e.g. Cwlth + SA + Victoria) agreed (in principle) for mechanism operator to underwrite revenue floors and ceilings for dispatchable generation and storage
- Long-duration storage LTESAs: NSW government introduced LTESAs in 2022 via an auction process for new projects. NSW has run two tender processes for long-duration storage LTESAs and awarded over 4,500MWh across 4 projects.

(!) Key considerations

Figure 17: Assessment of build-to-own

Option description

- Government builds new facilities with the intent to own (and option to operate).
- Government bears the risk of economic sufficiency.
- Government can choose to share revenues and risk with the private sector by structuring the project as a public-private partnership (PPP).

Applying the decision framework

1. Specific (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations by building asset to own
2. Firming capacity constructed (payment basis): Pay to construct a MW of firming capacity
3. Volume control (Volume- or price-based mechanism): Provide certainty in targets for MW volume by constructing assets, with price set by market
4. Guarantee revenue (Method for economic sufficiency): Mechanism operator bears market, performance and construction risk as builder and owner of the asset

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Generalised or specific mechanism	Provides mechanism operator control over technology and location mix	Onus on regulator to assess types of services they want to regulate; risk of planning error	Establish an excellent mechanism operator to guide technology and location mix and run targeted competitive auctions to deliver low-cost, value adding assets
2 Payment basis	(!) Mechanism operator ensures new capacity is built	Mechanism operator bears construction risk	Structure elements of project as a PPP (e.g. competitive construction tender with performance incentives) to share risk with private sector
3 Volume- or price-based mechanism	Mechanism operator ensures volume targets are met	Mechanism operator bears all mechanism costs	Limit to assets critical to the system that the private market will not construct
4 Method for economic sufficiency	(!) Mechanism operator gains exposure to project profitability	Mechanism operator bears market and asset performance risk	Consider entity structures with commercial mandates to improve asset performance

Implementation

- Implementation difficulty: High implementation difficulty due to constructing the asset; Moderate to high ongoing management difficulty due to owning the asset (option to outsource operational responsibility)
- Interaction with other mechanisms: Government-owned assets typically operate without the support of other mechanisms
- Transparency: Mechanism operators have transparency over mechanism costs and outcomes

Previous examples

- QLD Gov joint venture to build, own and operate a 200MW hydrogen-ready gas peaker at Kogan Creek. The power station will be developed by CS Energy in partnership with Iberdrola as part of the QEJP.

(!) Key considerations

Figure 18: Assessment of regulated assets

Option description

- An independent regulator approves the construction of an asset. Under this process, the volume of firming assets to be built must be justified (e.g. based on the economic benefit to the system or customers). These revenues are recovered from customers through a regulated process (e.g. setting a regulated tariff)
- The regulator approves aspects such as tariffs, price levels, expenditure, and return on investment. This process often includes other considerations such as quality standards, safety and asset performance.

Applying the decision framework

1. Specific (generalised or specific mechanism): Provides mechanism operator control over technology mix and locations by selecting these characteristics as part of the regulatory process
2. Firming capacity constructed (payment basis): Pay to construct a MW of firming capacity
3. Volume control (Volume- or price-based mechanism): Provide certainty in targets for MW volume by setting a volume to be constructed
4. Guarantee revenue (Method for economic sufficiency): Mechanism supports economic sufficiency by setting an allowable return on investment through the regulation process

	Intended design feature	Unintended trade-offs	Adaptations to consider
Generalised or specific mechanism	Provides mechanism operator control over technology and location mix	Onus on regulator to assess types of services they want to regulate; risk of planning error	Limit regulation to project types where a known volume/capacity is required
Payment basis	(!) Removes construction risk for new capacity by guaranteeing an allowable ROI	Ongoing regulatory burden for mechanism operator after construction	Agree on oversight level (e.g. price-setting review frequency) to lower administrative burden
Volume- or price-based mechanism	(!) Regulates volume by requiring an economic justification of the asset need	Risk of overbuild at cost to consumer	Conduct economic evaluations to ensure optimal volume is constructed
Method for economic sufficiency	(!) Supports economic sufficiency by setting an allowable ROI	Removes some in-market signals for optimal operations	Run a competitive procurement process to determine who owns/constructs the regulated asset's ongoing revenue stream

Implementation

- Implementation difficulty: High implementation difficulty as an economic evaluation of the asset need is required; High ongoing management difficulty due to the regulatory burden of setting, monitoring and reviewing the project's allowable return on investment
- Interaction with other mechanisms: Regulated assets typically operate without the support of other mechanisms
- Transparency: High transparency through publication of assets' economic evaluations and financial results

Previous examples

- Following an Economic Evaluation Report, the AER provided regulatory approval in 2019 for Electranet to construct synchronous condensers to address system strength in South Australia[1]

(!) Key considerations

[1]Source: ElectraNet

5.4. Procurement options to use GOCs to drive new investment

Some jurisdictions in the NEM have government-owned corporations (GOCs) which can be used to execute projects on behalf of government. This may be useful in instances where projects have a substantial revenue sufficiency gap, high project development and construction risks.

The AEMC has identified four approaches to determine the allocation of funding between GOCs and the private sector, provided in Table 1 below. The AEMC's initial view is that it is commercially feasible to choose any funding allocation option for any of the support mechanisms.

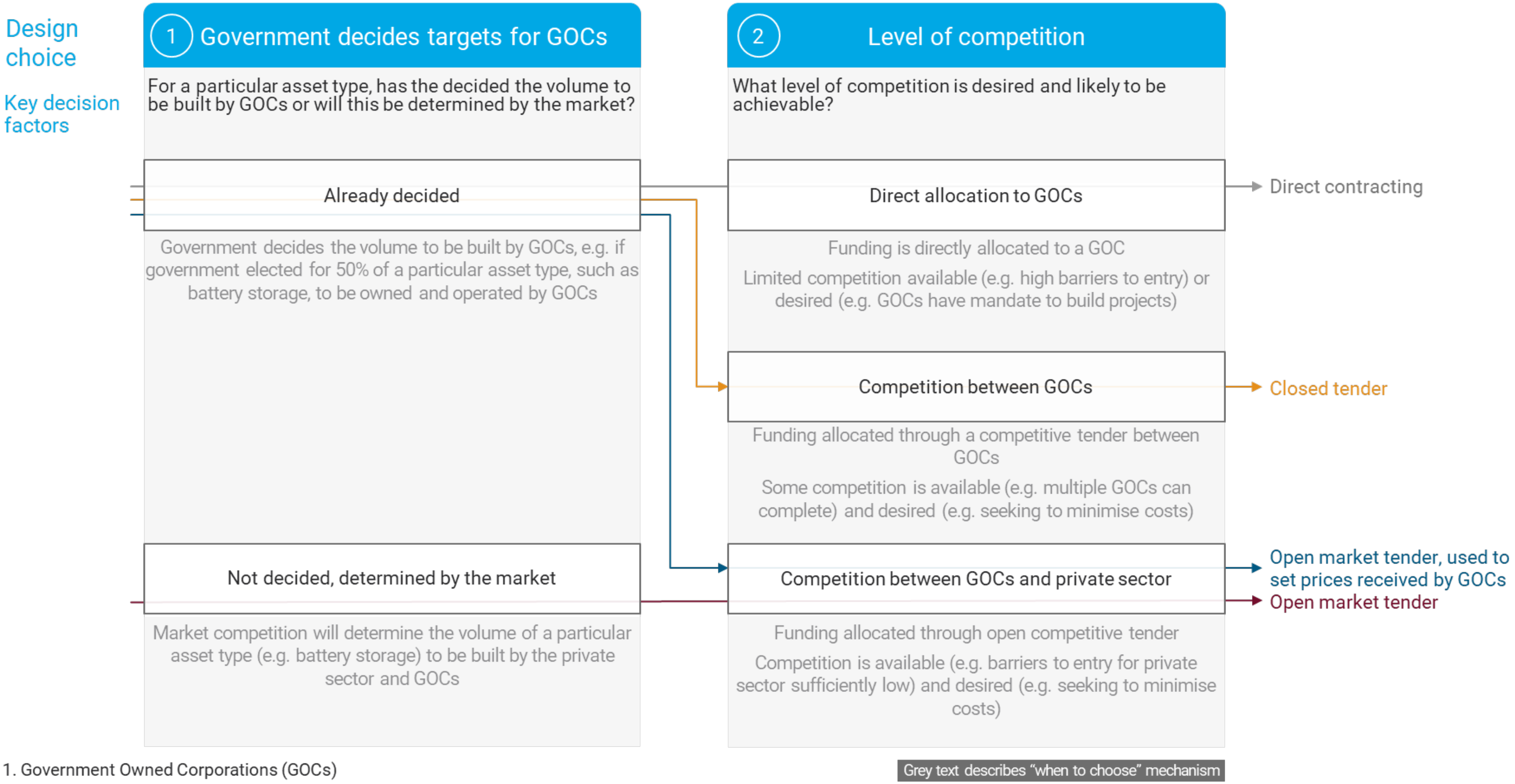
Table 1: Procurement options to allocate funding between private sector or GOCs

Procurement options	Description
Direct contracting	The mechanism operator directly contracts with a GOC.
Closed tender	The mechanism operator runs a tender process which only GOCs compete in.
Open market tender, used to set prices received by GOCs	The private sector (without GOCs) competes for funding in an open market tender process. GOCs separately receive funding which is priced at a level determined by the open market tender (e.g. if the tender determines a clearing price for a cap contract premium of $[x]/MW/year, GOCs also receive $[x]/MW/year). This may be suitable in circumstances where a government wishes to use a GOCs to execute a particular project but is also running an open market tender for comparable projects (e.g. multiple gas investments).
Open market tender	The mechanism operator runs a tender process which both GOCs and the private sector compete in. This could include a requirement for a minimum amount of funding to be awarded to GOCs.

Selecting the most appropriate procurement options can be characterised by two design choices (set out in Figure 19):

- **Pre-determined support for GOCs.** For a particular asset type, has the government decided the volume to be built by GOCs or will this be determined by the market?
  - Decided by government?
  - Determined by the market?
- **Level of competition**. What level of competition is desired and likely to be achievable?
  - Direct allocation to GOCs
  - Competition between GOCs (e.g. restricted to a small number of participants)
  - Competition between GOCs and private sector.

Figure 19: Decision framework for procurement options to allocate funding between the private sector or GOCs



1. Government Owned Corporations (GOCs)

The potential benefits and trade-offs to consider for each funding allocation options are captured in Table 2.

Table 2: Potential benefits and trade-offs of funding allocation options

Design choice	Options	Intended design feature	Unintended trade-off
Direct contracting	1. Pre-determined	Pre-determined a specific volume of a particular asset type for GOCs to build	May not result in a least cost mix of GOC and private sector projects
	2. Direct allocation	Directly allocate funding to a specific GOC, where a GOC has a specific mandate or there are high barriers to entry	May not identify the best projects and could result in the need for higher levels of support
Closed tender	1. Pre-determined	Pre-determined a specific volume of a particular asset type for GOCs to build	May result in an economically sub-optimal mix of GOC and private sector projects
	2. Competition between GOCs	Use competition between GOCs to identify the best GOC projects	May not identify the best projects (develop by the private sector), requiring higher levels of funding Requires enough GOCs projects for competition
Open market tender, used to set prices received by GOCs	1. Pre-determined	Pre-determine a specific volume of a particular asset type for GOCs to build	May result in an economically sub-optimal mix of GOC and private sector projects
	2. Competition between GOCs and private sector	Set the level of funding to GOCs at price determined by an open tender with the private sector to reduce the funding requirements and incentivise GOCs to develop efficient projects.	Support may be insufficient to ensure economic sufficiency for GOCs, reducing dividends paid to the shareholder
Open market tender	1. Not Pre-determined	Allow the market to determine the economically optimal mix of private sector and GOC projects	Provides less control for achieving a specific level of Government ownership of generation assets
	2. Competition between GOCs and private sector	Identify and select the best projects through a competitive process, reducing funding requirements	May be unachievable where barriers to entry prevent private sector participation

6. Support mechanisms to control thermal generator exit

As bulk renewables and firming enter the market, the wholesale energy market will require coal assets to deliver reliable generation until new assets capable of delivering the same services are online.

In November 2023, Energy Ministers agreed to consult on the detailed design of an Orderly Exit Management (OEM) Framework. The OEM framework was released for public consultation in December 2023 with a view to a bill being passed by the South Australian Parliament in mid-2024. We are providing a framework of possible support mechanisms for jurisdictions who may not opt into the OEM framework.

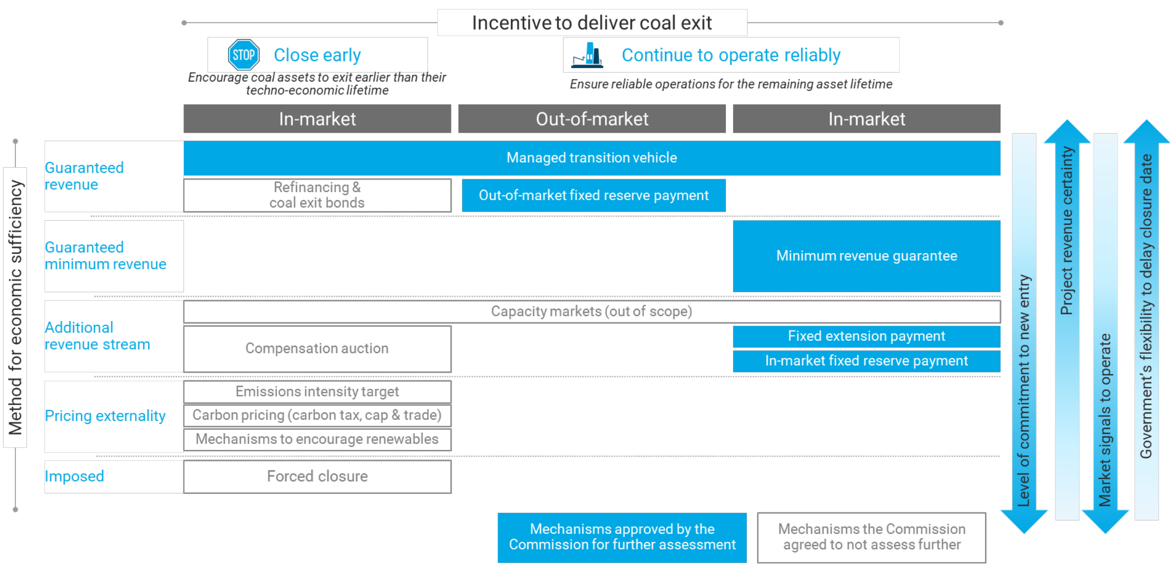
This chapter:

- **Outlines potential support mechanisms to control thermal generator exit** (Section 6.1**).** This section outlines the potential support mechanisms to incentivise firming services, structured using the decision framework. It also describes the eight firming support mechanisms assessed in this advice.
- **Applies the decision framework to control thermal generator exit** (Section 6.2**).** The framework is used to assess potential support mechanisms to target specific coal exit.
- **Assesses support mechanisms** (Section 6.3). Provides a detailed assessment of each of the support mechanisms including a description, the decision logic for selecting the mechanism, trade-offs and adaptations, implementation requirements and examples.

6.1. Options for support mechanisms to control thermal generator exit

The AEMC identified a range of potential mechanisms that could support coal exit NEM. Figure 20 below maps the key design choices based on whether the incentive to deliver is for early closure or to continue to operate reliably either in- or out-of-market.

Figure 20: Options for support mechanisms for controlled thermal generator exit

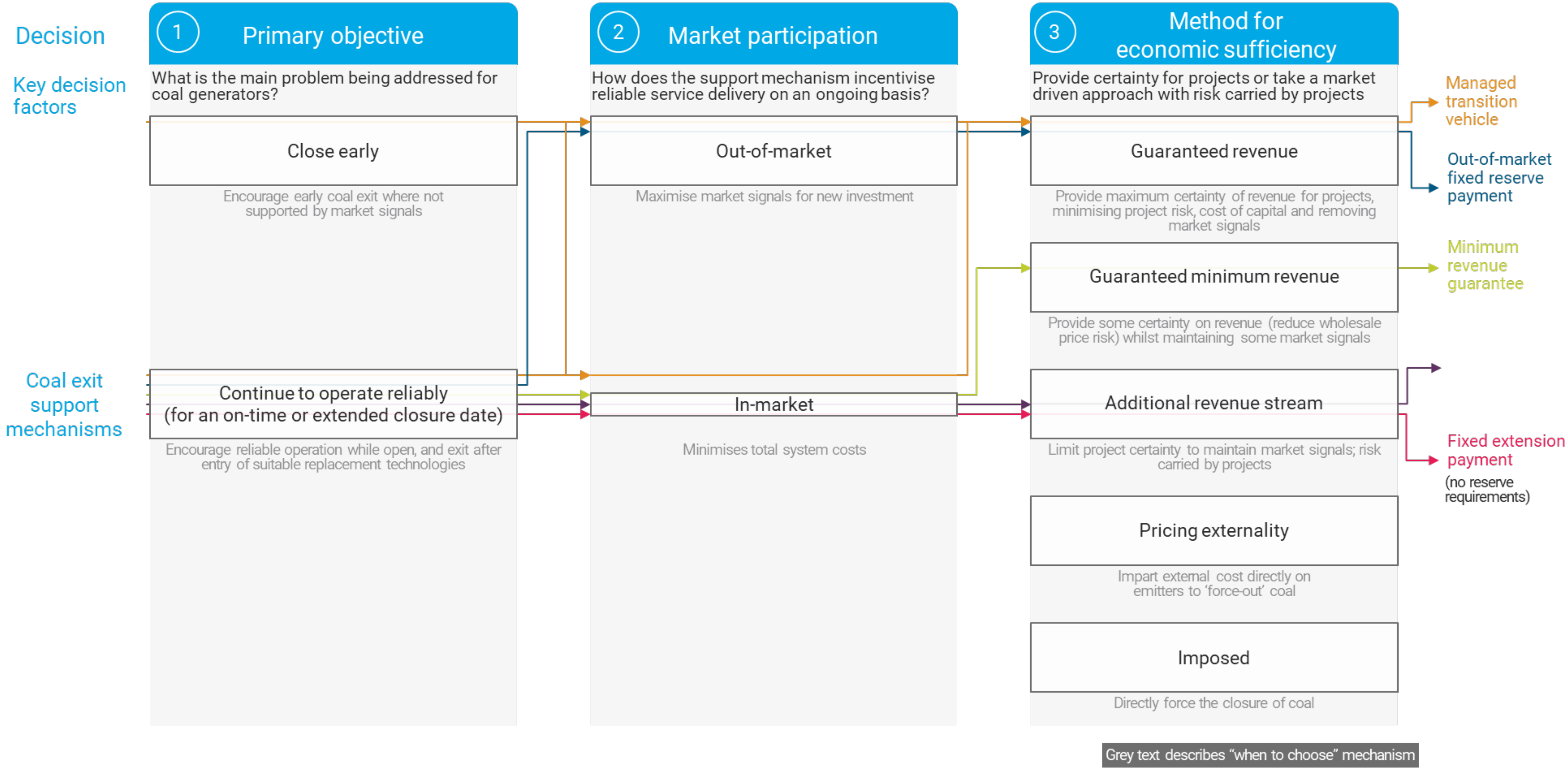


Of these support mechanisms, the AEMC selected five tailored to the NEM's current experience where the primary need is for aging generators to continue to operate reliably until certain criteria is met. Examples or academic references are included in the one-page assessments in Section 6.3.

6.2. Applying the decision framework for controlled exit

As bulk renewables and firming enter the market, the wholesale energy market will require coal assets to deliver reliable generation until reliable replacement assets are online.

Figure 21: Decision framework for coal exits



The decision framework provides the reasoning for when mechanism designers might consider using each support mechanism to meet coal exit objectives at lowest cost.

- **Managed transition vehicle**: Consider using when seeking to maximise direct control over exit timing or repurposing of assets, such as for very early closure of newer assets.
- **Out-of-market fixed reserve payment**: Consider using when seeking to maintain strong signals for new investment.
- **Minimum revenue guarantee**: Consider using when seeking to minimise risk of payments to projects for decisions they would have made anyway.
- **In-market fixed reserve payment**: Consider using when seeking confidence in reserve availability for peak periods.
- **Fixed extension payment**: Consider using only when there is a very high degree of confidence that the asset will reliably perform the desired services.

6.3. Assessment of support options for controlled exit

See Figure 22 to Figure 26 for the assessments of each support mechanism for controlled exit.

Figure 22: Assessment of managed transition vehicle

Option description

- A managed transition vehicle involves governments (via a mechanism operator) acquiring coal generation assets to either:
  - Control coal exit timing and operations until closure. This gives governments the flexibility to optimise the transition from existing assets to replacement assets.
  - Close early, with the purchase price of the asset accounting for foregone revenue by the asset from closing early.
- *We have focussed the assessment on controlled exiting timing and operations as it is the most likely use-case in the Australian context.*

Applying the decision framework

1. Continue to operate reliably until closure (Primary objective) or close early: Pay assets to stay reliable up until an agreed closure date
2. In-market (Market participation): Minimise total system costs whilst preserving signals for market operation
3. Guaranteed revenue (Method for economic sufficiency): Provide maximum certainty of revenue for projects, minimising project risk and removing market signals

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Primary objective	(!) Full control over closure timing, especially if the mechanism designer seeks to close assets earlier than indicated by market signals	(!) Mechanism operator can adjust closure timing, which creates market uncertainty and limits investment signals	• Provide clarity to the market on planned exit dates and/or operating protocols, such as ensuring asset does not bid below short-run marginal cost
2 Market participation	• Makes the best use of existing projects to minimise system cost	• Removes wholesale market signals for new investment	• Ensure there are complementary mechanisms in place to support new asset entry
3 Method for economic sufficiency	• Certainty over economic sufficiency for projects through purchasing asset and guaranteeing operations and maintenance prior to closure	• Greater risk of overpaying for assets which are unable to provide services when required or for decisions the project would have made anyway	• Restrict eligibility to assets which plan to close due to economic circumstances • Conduct due diligence on asset condition, remaining technical lifetime, and future capital plan • Ensure sufficient planned maintenance is conducted to maintain reliability

Implementation

- Implementation difficulty: High set-up difficulty to negotiate the asset sale; high ongoing management difficulty given need to manage asset operation and closure (e.g. via a government owned corporation or new mechanism operator)
- Compatibility with other mechanisms: Generally compatible
- Payment sizing: Negotiated based on expected generator costs, market revenues, and value provided to the system
- Transparency: High transparency is possible if planned exit dates and operating protocols are published, but low if not

Previous examples

- ASEAN Energy Transition Mechanism is a public-private finance vehicle to accelerate retirement of coal. Coal assets were purchased prior to their expected business-as-usual retirement, with the lower cost of capital used to repay investors quickly to retire assets early and invest in the transition.

(!) Key considerations

Figure 23: Assessment of out-of-market fixed reserve payment

Option description

A minimum revenue guarantee is a payment that guarantees a minimum level of revenue to coal projects to ensure they can continue to operate reliably over a fixed term (e.g. to fund major maintenance works). When project market revenues fall below an agreed threshold, the mechanism operator pays the gap between the threshold and market revenues.

Applying the decision framework

1. Continue to operate reliably until closure (Primary objective): Pay assets to stay reliable up until an agreed on-time or delayed closure upon renewables entry
2. In-market (Market participation): Minimise total system costs whilst preserving signals for market operation
3. Guaranteed minimum revenue (Method for economic sufficiency): Provide some certainty around project revenue (by mitigating utilisation risk) whilst maintaining market signals for operations

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Primary objective	• Ensures asset is maintained sufficiently to operate reliably until closure	• May distort wholesale market signals for new investment	• Provide clarity to the market on specific dates or circumstances for planned exit
2 Market participation	• Makes the best use of existing assets to minimise system costs	• Reduces clear wholesale market signals for new investment	• Include contractual obligations to conduct sufficient planned maintenance to maintain reliability
3 Method for economic sufficiency	(!) Ensures project has sufficient revenues to stay in the market by removing downside price risk for project, particularly if mechanism designers plan to provide support for new investments • Maintains some market signals for efficient operation at critical times	(!) Mechanism operator bears utilisation and availability risks due to lack of clear economic signals for asset to operate below the revenue threshold	• Agree on clear operating protocols for instances where the spot market returns could drive market revenues below the revenue threshold, e.g. ensuring asset does not bid below short-run marginal cost
Other	(!) Lowers likelihood of unnecessarily paying for services which would have been provided anyway by only removing downside utilisation risk for the project	• Challenging to set minimum revenue threshold at right level due to information asymmetries between the project and the mechanism operator	• Set the revenue threshold to cover fixed costs to ensure the coal generator is only being paid when operating at low capacity factor

Implementation

- Implementation difficulty: Moderate set-up difficulty given the burden of negotiating and administering the contract; moderate management difficulty around monitoring ongoing asset maintenance. Can be implemented through existing bodies (e.g. GOCs or a newly established government body)
- Compatibility with other mechanisms: Generally compatible
- Payment sizing: Negotiated based on expected generator costs, market revenues, and value provided to the system
- Transparency: Moderate transparency when planned exit dates and operating protocols are published, with threshold not transparent to wider market

Previous examples

- No recorded examples where such a mechanism is in place.

(!) Key considerations

Figure 24: Assessment of Minimum revenue guarantee

Option description

A minimum revenue guarantee is a payment that guarantees a minimum level of revenue to coal projects to ensure they can continue to operate reliably over a fixed term (e.g. to fund major maintenance works). When project market revenues fall below an agreed threshold, the mechanism operator pays the gap between the threshold and market revenues.

Applying the decision framework

1. Continue to operate reliably until closure (Primary objective): Pay assets to stay reliable up until an agreed on-time or delayed closure upon renewables entry
2. In-market (Market participation): Minimise total system costs whilst preserving signals for market operation
3. Guaranteed minimum revenue (Method for economic sufficiency): Provide some certainty around project revenue (by mitigating utilisation risk) whilst maintaining market signals for operations

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Primary objective	• Ensures asset is maintained sufficiently to operate reliably until closure	• May distort wholesale market signals for new investment	• Provide clarity to the market on specific dates or circumstances for planned exit
2 Market participation	• Makes the best use of existing assets to minimise system costs	• Reduces clear wholesale market signals for new investment	• Include contractual obligations to conduct sufficient planned maintenance to maintain reliability
3 Method for economic sufficiency	(!) Ensures project has sufficient revenues to stay in the market by removing downside price risk for project, particularly if mechanism designers plan to provide support for new investments • Maintains some market signals for efficient operation at critical times	(!) Mechanism operator bears utilisation and availability risks due to lack of clear economic signals for asset to operate below the revenue threshold	• Agree on clear operating protocols for instances where the spot market returns could drive market revenues below the revenue threshold, e.g. ensuring asset does not bid below short-run marginal cost
Other	(!) Lowers likelihood of unnecessarily paying for services which would have been provided anyway by only removing downside utilisation risk for the project	• Challenging to set minimum revenue threshold at right level due to information asymmetries between the project and the mechanism operator	• Set the revenue threshold to cover fixed costs to ensure the coal generator is only being paid when operating at low capacity factor

Implementation

- Implementation difficulty: Moderate set-up difficulty given the burden of negotiating and administering the contract; moderate management difficulty around monitoring ongoing asset maintenance. Can be implemented through existing bodies (e.g. GOCs or a newly established government body)
- Compatibility with other mechanisms: Generally compatible
- Payment sizing: Negotiated based on expected generator costs, market revenues, and value provided to the system
- Transparency: Moderate transparency when planned exit dates and operating protocols are published, with threshold not transparent to wider market

Previous examples

- No recorded examples where such a mechanism is in place.

(!) Key considerations

Figure 25: Assessment of in-market fixed reserve payment

Option description

A fixed reserve payment is an annual availability-based payment to coal generators to be available to provide an agreed MW of reserve capacity. This is intended to provide the project with sufficient revenue (e.g. to cover fixed costs) to ensure reliable operation in peak periods in response to market prices.

Payment for in-market reserve services involves the asset operating in the wholesale market at low capacity factors, with the availability to ramp up in peak periods to reduce reliance on peaking gas until reliable replacement firming services are operable.

Decision logic

1. Continue to operate reliably until closure (Primary objective): Pay assets to stay reliable up until an agreed on-time or delayed closure date
2. In-market (Market participation): Minimise total costs of maintaining reserves whilst preserving signals for market operation
3. Additional revenue stream (Method for economic sufficiency): Limit project certainty to maintain market signals whilst covering baseline operational costs

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Primary objective	(!) Ensures asset is maintained sufficiently to operate reliably until closure	• May distort wholesale market signals for new investment	• Provide clarity to the market on operating protocols prior to and/or specific dates or circumstances for planned exit
2 Market participation	• Makes the best use of existing assets to minimise system costs	• Reduces clear wholesale market signals for new investment	• Ensure there are complementary mechanisms in place to support new asset entry
3 Method for economic sufficiency	(!) Directly rewards the availability of desired reserves • Preserves some market signals for operation	• Mechanism operator bears some availability risk, with no inherent guarantee that reserves will reliably perform during peak periods • Removes some revenue certainty for projects	• Link payments to actual reserve availability and performance during peak periods • Include contractual obligations to conduct sufficient planned maintenance to maintain reliability
Other		(!) Greater risk of paying for services which would have been provided regardless	• Restrict mechanism eligibility to assets planning to close due to economic circumstances • Conduct due diligence on asset condition and remaining technical lifetime

Implementation

- Implementation difficulty: Moderate set-up difficulty given the burden of negotiating and administering the contract; low management difficulty around monitoring ongoing asset maintenance. Can be implemented through existing bodies (e.g. AEMO)
- Compatibility with other mechanisms: Generally compatible. Introducing carbon price would impact profitability, may result in the need for a higher payment. The support mechanism could be expanded into a broader firming capacity payment
- Payment sizing: Negotiated based on expected generator costs, market revenues, and value provided to the system
- Transparency: High transparency is possible if planned exit dates, operating protocols, and payment amounts are published

Previous examples

- No known examples of a similar coal-specific mechanism, however there are many technology-neutral capacity mechanisms in place. For example, the Reseve Capacity Mechanism in WA is a technology-neutral credit system designed to adequately meet a predicted reserve requirement, with a declining payment ($/MW) for reserve capacity surplus to requirements

(!) Key considerations

Figure 26: Assessment of fixed extension payment

Option description

A fixed extension payment is a payment to coal generators to maintain operation beyond the original closure date. The payment is intended to provide the project with sufficient revenue to incentivise reliable operation until closure, e.g. to fund major maintenance.

Decision logic

1. Continue to operate reliably until closure (Primary objective): Pay assets to stay reliable up until an agreed on-time or delayed closure date
2. In-market (Market participation): Minimise total system costs whilst preserving signals for market operation
3. Additional revenue stream (Method for economic sufficiency): Limit project certainty to maintain market signals whilst covering baseline operational costs

	Intended design feature	Unintended trade-offs	Adaptations to consider
1 Primary objective	• Ensures asset continues to operate reliably until closure	• Distorts wholesale market signals for investment	• Provide clarity to the market on operating protocols prior to and/or specific dates or circumstances for planned exit
2 Market participation	• Makes the best use of existing assets to minimise system cost	• Reduces clear wholesale market signals for new investment	• Ensure there are complementary mechanisms in place to support new asset entry
3 Method for economic sufficiency	• Supports economic sufficiency (!) Maintains some market signals for operation	(!) • Mechanism operator bears some utilisation risk, with no inherent guarantee that reserves will be reliably provided during peak periods • Removes some revenue certainty for projects	• Distribute payments at regular intervals to incentivise and reward ongoing service delivery • Include contractual obligations to conduct sufficient planned maintenance to maintain reliability
Other		• Greater risk of paying for services which would have been provided regardless	• Restrict mechanism eligibility to assets planning to close due to economic circumstances • Conduct due diligence on asset condition and remaining technical lifetime • Consider backending payments for the final years prior to the agreed exit date when revenues alone would not be sufficient for reliable service delivery

Implementation

- Implementation difficulty: Moderate set-up difficulty given the burden of negotiating and administering the contract; low management difficulty around monitoring ongoing asset maintenance. Can be implemented through existing bodies (e.g. AEMO)
- Compatibility with other mechanisms: Generally compatible. Introducing carbon price would impact profitability, may result in the need for a higher payment
- Payment sizing: Negotiated based on expected generator costs, market revenues, and value provided to the system
- Transparency: High transparency is possible if planned exit dates, operating protocols, and payment amounts are published

Previous examples

- No known examples where such a mechanism is in place.

(!) Key considerations

7. Bundles for a consistent approach to investment and exit

This chapter describes approaches for bundling support mechanisms. Support mechanisms for bulk renewables, firming, and coal exit can theoretically be combined in almost any way. However, these mechanisms may not have internally consistent objectives. They range from mechanism operators taking on all investment and dispatch risk through to allocating investment and dispatch risk to the market.

Figure 27 describes a spectrum of five compatible approaches for bundling mechanisms and the support mechanisms best suited to each. For each bundling approach, we:

- Provide a brief description of the bundle's objectives.
- Describe the market structure for how bulk renewables and firming earn revenue – either from the wholesale market or from the support mechanism(s).
  - This identifies the role of the support mechanism in providing revenue sufficiency and the ease or difficulty of governments to phase out support later.
  - Support mechanisms that result in a relatively small proportion of revenue from the wholesale market are more difficult to phase government support out of.
- Identify the support mechanisms for bulk renewables investment, firming investment and controlled coal exit that are compatible with the bundle's objectives.

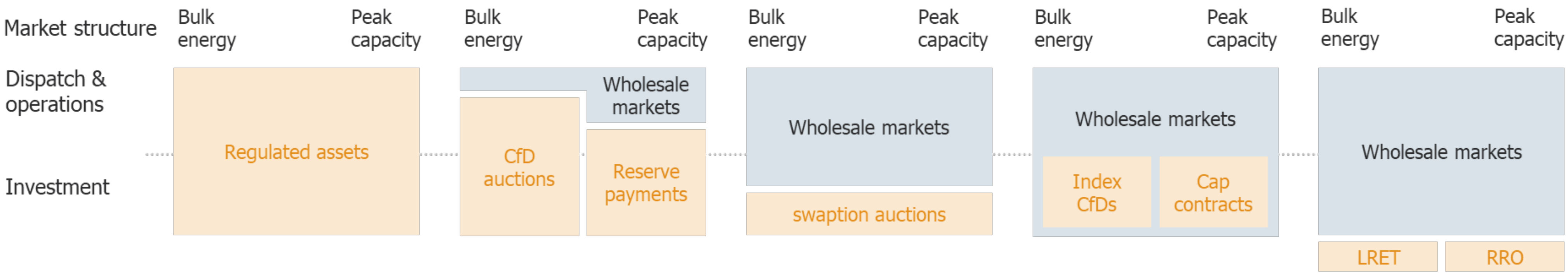
Each bundling approach would have different implications for features of the NEM. We assessed the implications of each bundling approach on the following issues:

- **Capacity overbuild risk**: As you move through the bundling approaches, the impact of possible bulk renewables overbuild shifts from being borne by the mechanism designer and consumers (bundles 1-4), to being borne by the project (bundle 5).
- **Possible introduction of a carbon price**: Each approach would be compatible with any possible future introduction of a carbon price.

Mechanism designers can choose compatible bundles of support mechanisms to meet their objectives at lowest cost. However, designers should also have regard to their long-term objectives.

Figure 27: Five approaches for how support mechanisms could be bundled

Approach	1 "Absorb all project risk"	2 "Remove project investment risk"	3 "Pay only when projects need it"	4 "Replicate and extend market signals"	5 "Set ambition for market to deliver"
Description	Regulate returns for all participants in the market	Preserves market signals for dispatch whilst removing project investment risk in order to lower cost of capital	Provides projects the option to have certainty over minimum revenues to help with financing. Minimises frequency participant is paid under the mechanisms	Extend market signals for investment/dispatch whilst protecting projects against mechanism induced risks (e.g. capacity oversupply)	Set the ambition (targets) and let the market to find the best way to deliver it



Example support mechanisms

	1	2	3	4	5
Bulk energy	• Regulated assets	• CfDs	• Swaptions	• Index-based CfDs, LGC CfDs	• LRET
Firming	• Regulated assets	• Reserve payments	• Swaptions • Net revenue floor/ceiling	• Cap contracts • Index-based CfDs	• Retailer reliability obligation
Coal exit	• Managed transition vehicle	• In-market reserves	• Minimum revenue guarantee	• In- or out-of-market reserves	• Retailer reliability obligation

Wholesale market | Support mechanism

8. Long-term market design principles

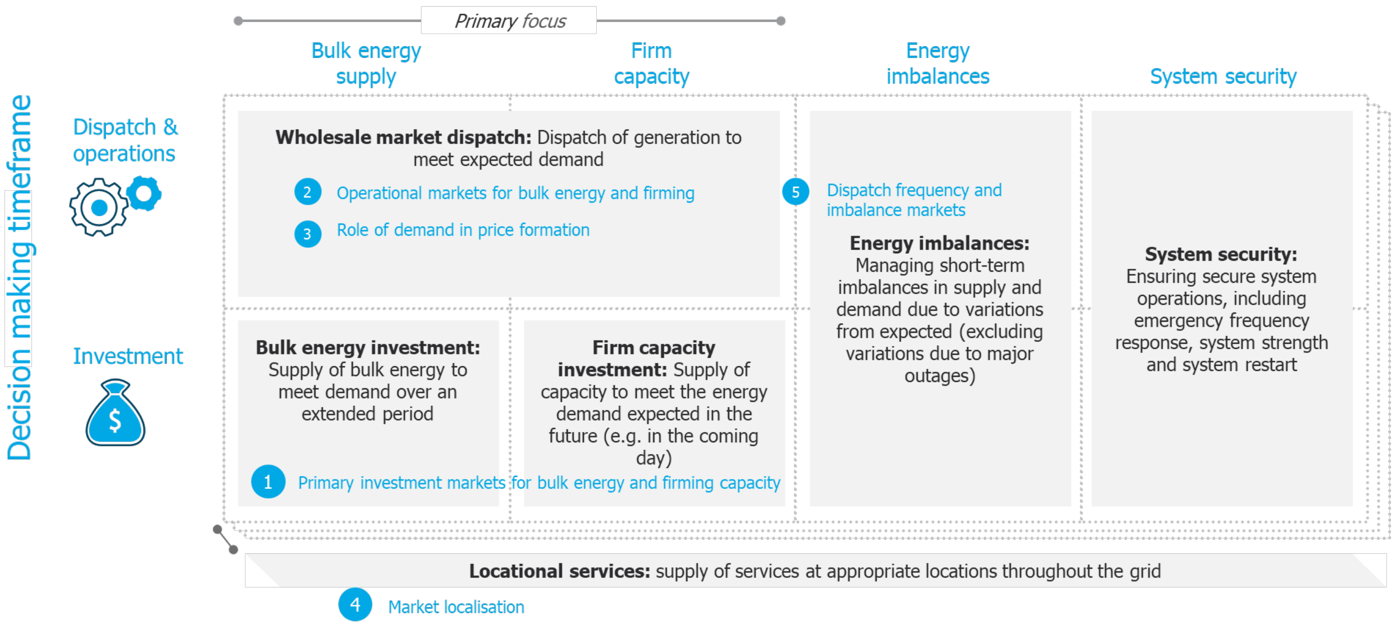
This section describes our early work on principles for a long-term future electricity market design. In particular, the:

- likely future technical and economic challenges in our changing energy system
- target outcomes we should be working to achieve in line with the NEO and adhere to principles of good regulatory practice
- key design choices that market designers have and what options are and are not suitable in the Australian context.

8.1. The technical and economic characteristics of a future energy system

The future wholesale energy market must perform six key functions described in Figure 28. These functions include wholesale market dispatch, investment in bulk energy and firming capacity, management of energy imbalances and system security and supply of energy services at appropriate locations throughout the grid.

Figure 28: Electricity markets are designed to perform six functions



The nature of electricity system is changing (see Table 3):

- **Generation**: more variable, uncertain, inverter based, distributed, zero marginal cost
- **Load**: Growing, more flexible and controllable
- **Storage**: for higher volumes of energy supply to support an increase in variable and weather-dependent generation.

Table 3: The technical and economic characteristics of the NEM is changing

Generation	Variable	Production depends on the sun shining or the wind blowing; generation is not available on demand. *In 2040, 91% of generation capacity in the NEM will be inverter based*
	Uncertain	Generation remains challenging to predict perfectly, despite increasingly accurate weather-forecasting tools
	Inverter based	More generation is inverter-based rather than synchronous generation, meaning critical system security services such as inertia are not inherently provided by many assets *In 2040, 92% of generation capacity in the NEM will be inverter based.*
	Distributed	Generation assets are typically small in scale, and distributed broadly across the electrical grid. *Number of generation assets will increase from 340 large generation assets in 2020 to ~460 transmission connected generation assets and 5.5m consumer energy resources in 2040*
	Zero marginal cost	Cost structures are almost entirely fixed, with few if any variable running costs *In 2040, 94% of generation capacity in the merit order will have zero marginal cost*
Load	Growing	Electricity demand will be far higher and growing faster than today, driven by electrification and growth on 'green industries' *Between 2022 and 2040, load will increase by 57% (ISP step-change AEMO)*
	Flexible and controllable	A large portion of customer loads are flexible in both when they consume energy and how much. Many of these can be controlled directly or respond to market signals
Storage	Storage duration	Storage assets can time-shift large volumes of energy to meet critical grid demand *By 2040, there will be 576 GWh of storage capacity in the NEM*

8.2. Target outcomes aligned with the NEO

We consider the future design of the NEM should target outcomes which support the NEO which can be summarised by the following objectives:

- **Price**. Low system cost whilst meeting the needs of the power system (including costs for provision of all system services) and consumers.
- **Reliability**. Ensures the system is reliable and resilient in line with consumer value (VCR) and government values.
- **Quality, safety, and security**. Maintains quality, safety, and security of the power system.
- **Emissions reduction.** Reduces greenhouse gas emissions from the electricity system and related sectors which supports the achievement of jurisdictional greenhouse gas reduction targets.[3]

[3] The targets statement, available on the AEMC website, lists the emissions reduction targets to be considered, as a minimum, in having regard to the NEO, NGO and NERO. See Section 32A(5) of the NEL, Section 72A(5) of the NGL and Section 224A(5) of the NERL.

In addition to target outcomes that align with the NEO, we consider the market should adhere to principles of good regulatory practice set out in Table 4.

Table 4: Principles of good regulatory practice

Decision making	Risk allocation	Allocate risks to the party who is best placed to manage them (both for investment and operations)
	Clarity	Establish clear rules which provide participants the confidence to make decisions
	Information asymmetry	Provide market participants transparent, timely information to make decisions
Costs	Funding	Ensure the market is internally funded by market participants
	Transaction costs	Seek to minimise the transaction costs of participating in the market and of operating the market
	Transition costs	Consider the cost of transitioning to a new market design for regulatory bodies and market participants
Competition	Liquidity	Establish competitive markets where there is sufficient liquidity
	Market power	Seek to minimise the ability of participants to exert market power

8.3. Key design choices for a future wholesale market

Market designers therefore have five key design choices to make when creating an electricity market:

1. Primary investment market for bulk energy and firming
2. Operational markets for bulk energy and firming
3. Role of demand in price formation
4. Market localisation
5. Dispatch frequency and imbalance markets.

We highlighted these design choices in Figure 28 above where they are relevant particular core functions.

Figure 29 describes the spectrum of possible options for each independent design choice, ranging from centrally determined on the left to decentralised or market-based on the right. We have identified where the current NEM broadly sits in each of these design choices in blue and what is unlikely to be suitable in Australia in red. We are undertaking further work to explore what is most suitable in a future market with different technical and economic characteristics.

Figure 29: Key design choices for market designers

1 Primary investment market for bulk energy and firming What is the primary market mechanism to bring on new investment? *Note: choice can be independent for bulk energy and firming*	Centrally procured	Contracting markets e.g. CfD auctions, capacity markets	Energy-only wholesale market (plus derivative markets)
2 Operational markets for bulk energy and firming Are bulk energy and firming resources dispatched as part of a single market?	Separate markets for operating bulk energy and firming	Single market but with 'infra-marginal' price cap[1]	☆ Single wholesale spot market for bulk energy and firming
3 Role of demand in price formation What role does demand play in setting wholesale market prices	Procured in advance	☆ Bids into the wholesale market in real-time via an aggregator	Directly bids into the wholesale market in real-time
4 Market localisation How localised are markets to specifical locations?	✖ Central	☆ Zonal	Nodal
5 Dispatch frequency and imbalance markets How frequently does the wholesale market dispatch?	✖ Day-ahead dispatch, extensive balancing mechanisms	☆ Near real time dispatch (5-30min), with other balancing mechanisms to support	Real-time dispatch, no balancing mechanism

✖ Unlikely to suit the NEM ☆ Current NEM

9. Options for cost recovery

This section covers the options for recovering costs for different support mechanisms and the channels available to recover costs:

- **Basis for cost recovery and flexibility for the mechanism designer to choose** (Section 9.1). This section lays out four options for support mechanisms' basis for cost recovery. It also highlights which support mechanisms are flexible - allowing mechanism designers to choose the basis for cost recovery - and three factors that can help them select the best approach.
- **Channels for recovery support mechanism costs** (Section 9.2). This section identifies five channels to recover support mechanism costs, alongside Australian examples of when these channels have been applied. Considerations are then laid out for when each of the channels might be suitable to recover support mechanism costs.
- **Cost sharing between the government budget and customers** (Section 9.3). This section describes initial options for how mechanism designers can share the cost of support mechanisms between taxpayers and customers.

9.1. Basis for cost recovery and flexibility for mechanism designers to choose

There are two key factors for mechanism designers when determining the basis for cost recovery for a support mechanism (summarised in Figure 30):

- **Basis for cost recovery**. How are customers or taxpayers charged to recover support mechanism costs (such as $ by usage or time)?
- **Flexibility to choose the basis for cost recovery**. Does the support mechanism allow mechanism designers to select different approaches for the basis of cost recovery?

Mechanism designers can have some flexibility to choose the basis of cost recovery, however, this varies depending on the support mechanism. Some support mechanisms have the basis for cost recovery intrinsically linked to the design of the support mechanism, which leaves little to no flexibility for mechanism designers to choose the basis for cost recovery.

There are three categories which determine how much choice mechanism designers have in the basis for cost recovery (see the first column of Figure 30):

1. **Separable**. There are several options for mechanism designers to choose from (e.g. cap contracts).
2. **Partially separable**. The liable entity[4] under the support mechanism can choose the basis for cost recovery (e.g. regulated asset).
3. **Not separable**. There is only one approach to how costs can be recovered (e.g. build-to-own).

[4] The liable entity is the entity with obligations under the support mechanism. For example, under the Large-scale Renewable Energy Target retailers are liable for purchasing a percentage of their electricity from renewable sources

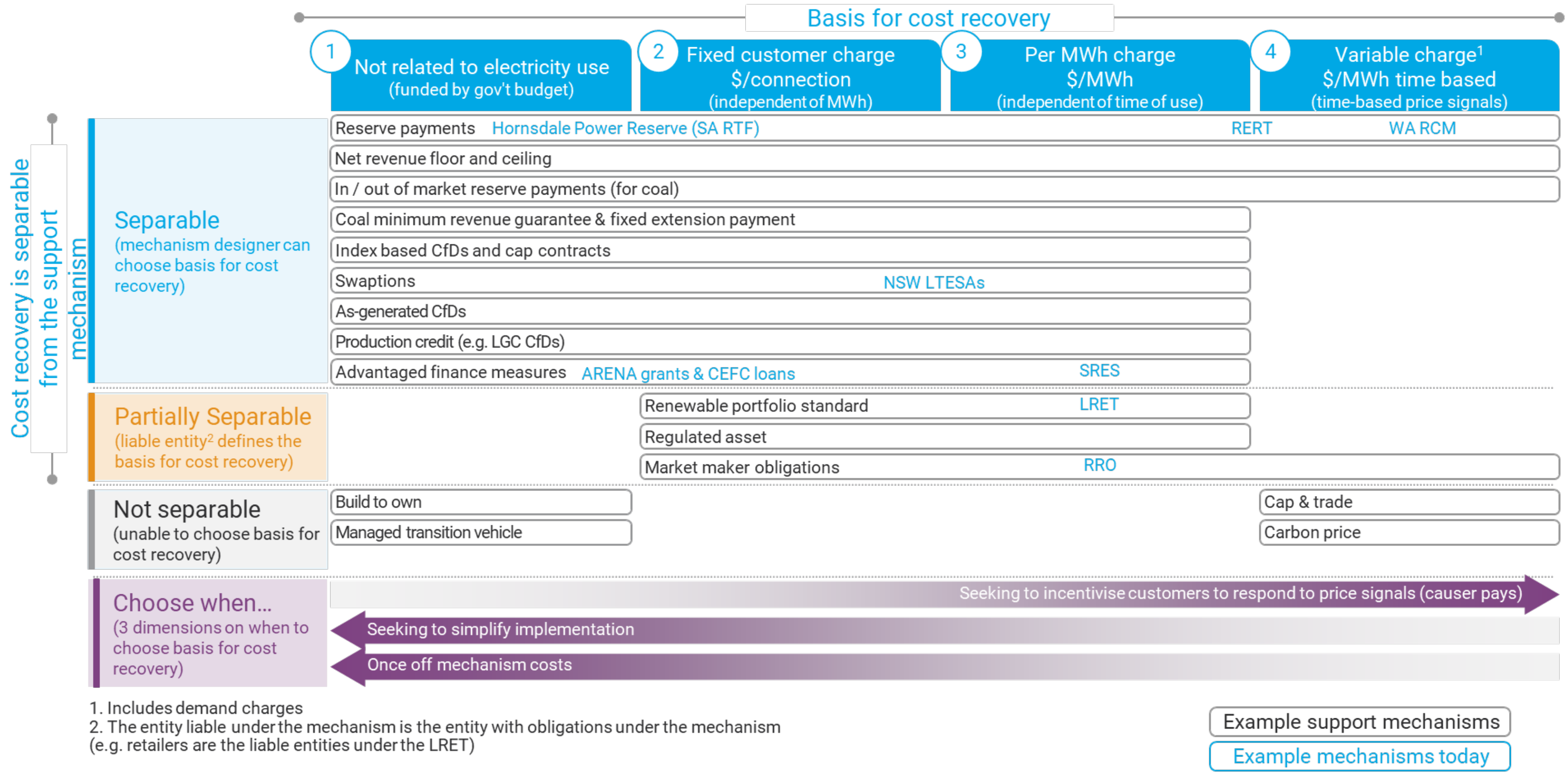
The AEMC considers four main options for the basis of cost recovery (i.e. how the support mechanism costs are shared among customers or taxpayers (Figure 30)):

- **Charges not related to electricity use**: where costs are recovered through taxpayers via government budgets, independent of electricity use
- **Fixed customer charge:** where costs are recovered through customers on a per customer connection basis
- **Per MWh variable charge**: where costs are through customers and charged at a per MWh basis, independent of time of use
- **Variable charge**: where costs are recovered through customers based on time-based signals (i.e. peak charges are paid by users at peak times). For example, this could include demand charges or critical peak charges.

There are three dimensions that mechanism designers may consider if they have the flexibility to choose the basis for cost recovery. These are whether mechanism designers are:

- seeking to incentivise customers to respond to price signals (e.g. to reduce usage at peak times to reduce need to firming capacity)
- seeking to simplify implementation (e.g. share charges over customers at a per MWh basis)
- considering one-off or ongoing scheme costs (e.g. mechanism operators providing one-off capital grants).

Figure 30: Basis for recovering support mechanism costs

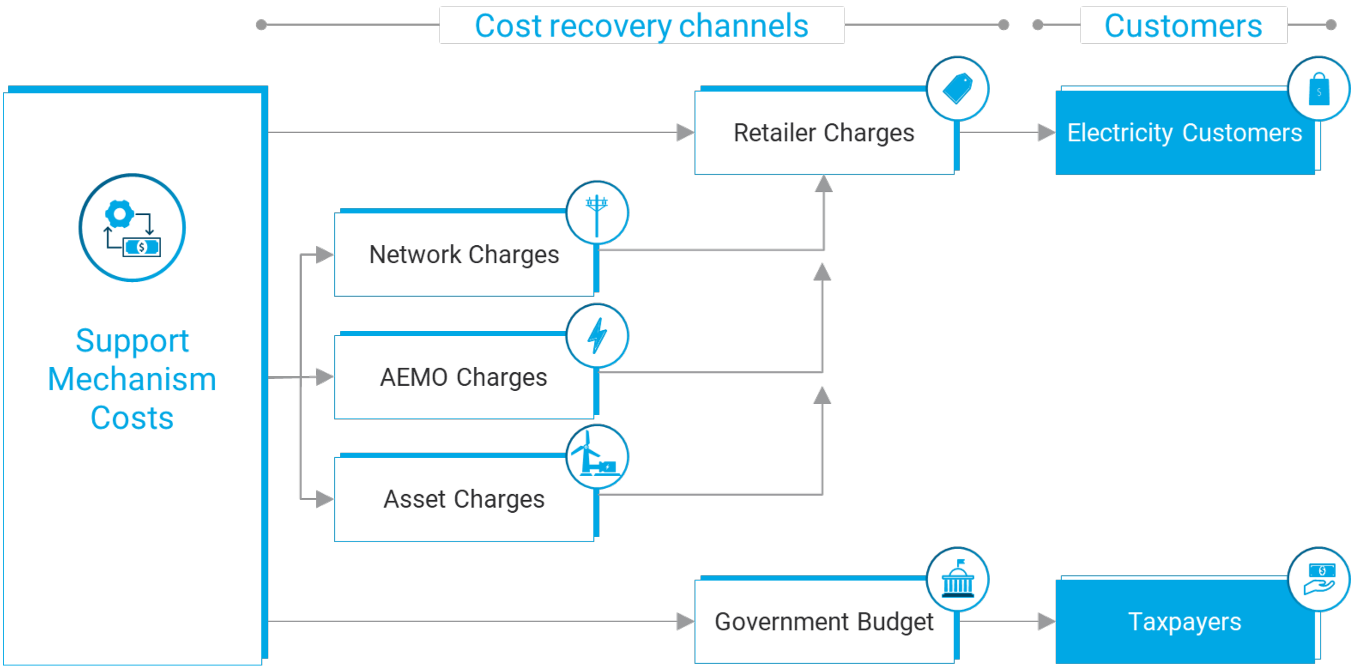


9.2. Channels for recovering support mechanism costs

There are five main channels available to recover support mechanism costs. However, ultimately all of these are either paid for by energy consumers or taxpayers (see Figure 31):

- **Retailer charges:** costs incurred by retailers buying and selling energy on the wholesale market (includes retailers' environmental obligation to surrender renewable energy certificates) and passed onto customers
- **Network charges:** network service charges, which are set through a regulatory process and charged to energy retailers who pass on those costs to customers
- **AEMO charges:** costs incurred by AEMO who passes on the cost to retailers and then customers
- **Asset charges:** costs incurred by assets who recover their costs through the sale of energy, purchased by retailers, who then pass on those costs to customers
- **Government budget:** costs funded directly from the government budget and passed onto taxpayers.
- Australian examples that have used each channel can be found in Appendix F.

Figure 31: Five main channels for recovering support mechanism costs



Once the basis of cost recovery has been selected, mechanism designers can choose the channel for cost recovery. This decision should be guided by the following questions (see Table 5):

- What channels are compatible with the basis of cost recovery available for a selected support mechanism?
- When is the channel most suitable?
- What are the incentives in each channel to manage the costs of the support mechanism?

Table 5: Factors to determine the most suitable cost recovery channel

Recovery channel	When is the cost recovery channel most suitable?	What are the incentives to manage the support mechanism?	Which basis for cost recovery options are compatible with this channel?
Retailer charges	Retailers are liable for support mechanism costs (e.g. LRET)	Incentivised to procure services at least cost for customers (e.g. finding lowest cost LGCs)	• Fixed customer charge • Per MWh charge • Variable charge
Network charges	Seeking transparency of cost recovery option There isn't a sensible alternative channel	Mandated to manage support mechanism costs through regulated process	• Fixed customer charge • Per MWh charge • Variable charge
AEMO charges	AEMO is the primary party running the support mechanism (e.g. Reliability and Emergency Reserve Trader (RERT))	Incentivised to maintain system reliability (including firming) with ability to control costs	• Fixed customer charge • Per MWh charge • Variable charge
Asset charges	Assets are directly incurring the cost (e.g. carbon price)	Incentivised to minimise operational costs, including externalities	• Variable charge
Government budget	Support mechanism is one-off or short-term and/or separating energy use and cost recovery (e.g. Snowy 2.0 equity funding)	Incentivised to manage approvals for one-off costs in budget cycles	• Not related to electricity use

9.3. Cost-sharing between the government budget and energy consumers

While not the primary focus of this work, the AEMC has some initial views regarding options to share the cost of support mechanisms between Government and customers. This section outlines some initial considerations on this issue that we believe could be viable. However, this is neither comprehensive nor supported by the same depth of analysis (e.g. informed by a literature review) as the rest of our work to date.

If jurisdictions were concerned about one party bearing all the cost to fund a support mechanism, they could elect to share support mechanism costs between government and customers. This may be appropriate if the cost of a single mechanism or the aggregate cost across multiple support mechanisms (e.g. for bulk renewable energy, firming and coal exit) is very high.

The AEMC considers that there are two options for how costs could be shared between government (and ultimately taxpayers) and customers, noting that the assessment below is commercial rather than legal advice:

- **Split support mechanism costs:** Establish a single support mechanism that recovers a portion of support mechanism costs from taxpayers (via the government budget) and a portion from customers. This is possible for support mechanisms where the mechanism designer can choose from multiple cost recovery mechanisms (as described in Section 6.1).
- **Bundled mechanisms:** Provide economic support for projects through two different support mechanisms: one support mechanism where costs are recovered through taxpayers (off the government budget); and costs are recovered from customers. We anticipate that this could achieved through one advantaged financing measure (e.g. concessional debt) funded by Government. This would be complemented by a revenue support mechanism (e.g. cap contracts, reserve payments, index-based CfDs) that is funded by customers. This bundling approach allows both private sector and government-owned projects, to be assessed on a comparable basis.

Appendix

A. Abbreviations

Abbreviation	Terminology
ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
APC	Administered price cap
ARENA	Australian Renewable Energy Agency
CfD	Contract for difference
CIS	Capacity Investment Scheme
CPT	Cumulative price threshold
DNSP	Distributed network service provider
ECMC	Energy and Climate Change Ministerial Council
ESOO	Electricity Statement of Opportunities
FCAS	Frequency control ancillary services
GOC	Government-owned corporation
LGC	Large-scale generation certificate
LRET	Large-scale Renewable Energy Target
LTESA	Long-Term Energy Service Agreement
MLF	Marginal loss factor
NEM	National electricity market
RERT	Reliability and Emergency Reserve Trader

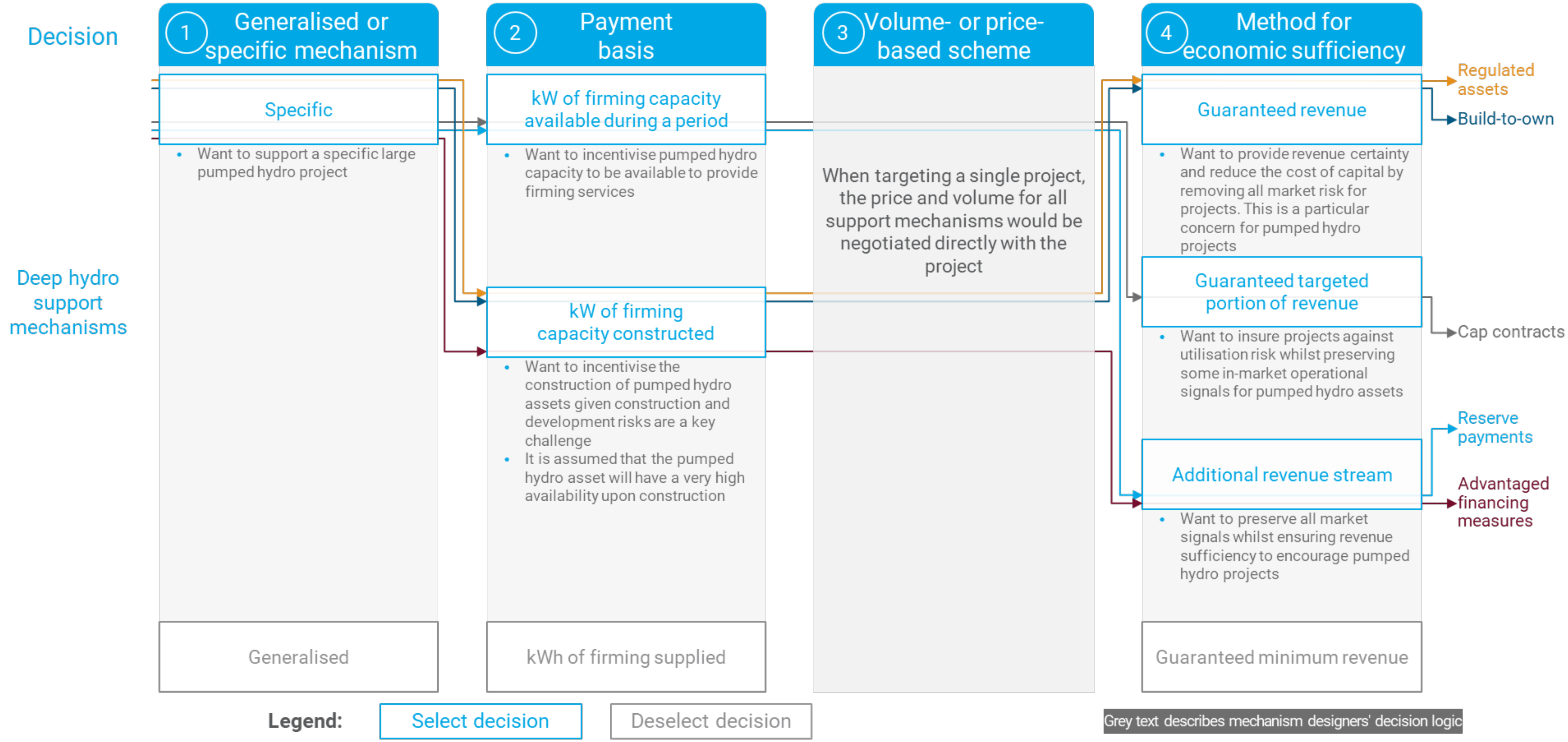
B. Glossary of terms

Terminology	Definition
Asset	An electricity generation or storage facility.
Advantaged financing measures (grants and concessional debt)	Advantaged financing measures include: Capital grants, which provide a once-off, upfront payment to lower the funding needs for a project Concessional debt financing, which provides debt financing to a project at a lower rate than would be achievable in the market.
Build-to-own	Governments build new assets with the intent to own (and option to operate).
Bulk renewable energy	Generating sufficient kWh of renewable energy over the course of each season.
Cap contracts	A financial contract where the mechanism operator pays the project an option fee (a fixed annual payment). When the wholesale spot price exceeds the agreed strike price, the project must pay the mechanism operator the difference between the spot price and the strike price. The project has no obligations for periods where the spot price is below the strike price.
Firming services	Ensuring there is enough kW of generation capacity to ensure supply instantaneously, in response to variations in both demand and generation by variable renewable energy sources. This includes the provision of services to meet three different needs: weather droughts / extended plant outages, peak days, day's peak.
Firming services: weather drought / extended outages	Firming services to address long, unplanned shortages in generation. This includes shortages in variable renewable energy due to medium-term weather effects (e.g. weeks in winter with little sunshine and low wind speeds) and extended outages of large assets (e.g. interconnectors, single large assets).
Firming services: Peak days	Firming services to manage days of unusually high demand or plant outages.
Firming services: Day’s peak	Firming services to manage regular daily peaks (e.g. early evening after the sun has set).
Index-based CfDs	A financial agreement between the project and the mechanism operator that supports economic sufficiency by replicating a market volatility price signal to provide firming services (e.g. the wholesale spot price spread over a day or week) and guarantees a portion of revenue by de-risking variability in this market signal. If the price spread (in $/MWh) over a period is higher than strike price, the project pays the mechanism operator the difference (multiplied by the contracted volume); If the price spread is lower than contracted strike price, the inverse applies.
Mechanism designer	The entity, usually government, which decides on which support mechanism to use and conducts the detailed design

Terminology	Definition
Mechanism operator	The entity which is responsible for ongoing operations and management of the support mechanism. This includes collecting and distributing money, entering into financial contracts with projects and managing the performance under these contracts. For example, NSW EnergyCo, with the support of AEMO Services, is the mechanism operator for the NSW LTESA scheme.
Net revenue floor and ceiling	A financial contract where if the project net revenues are below the agreed floor, the mechanisms operator pays the project an agreed portion of the difference. If the net revenues are above the agreed ceiling, the inverse applies.
Option canvas	Structured summary of potential mechanisms to support asset entry and/or exit. These may be tailored to a specific service (e.g. the firming 'option canvas’).
Project	Commercial enterprises which develop, construct and/or operate energy generation or storage assets.
Regulated assets	An independent regulator approves the construction of an asset. The regulator approves aspects such as tariffs, price levels, expenditure and return on investment.
Reserve payments	The mechanism operator pays the project for being available to provide ‘reserve capacity’. The project receives the payment regardless of whether its capacity is called upon.
Support mechanism	Policy mechanisms which support asset entry and exit outside of the wholesale market.
Swaptions	A financial contract that gives a project the ‘option’ to activate a ‘swap’ contract which guarantees the project a fixed annual revenue. The swap is settled based on the annual net operational revenue of the project.
System security services	Managing power stability (including frequency, voltage,) through short term variations from expectations.

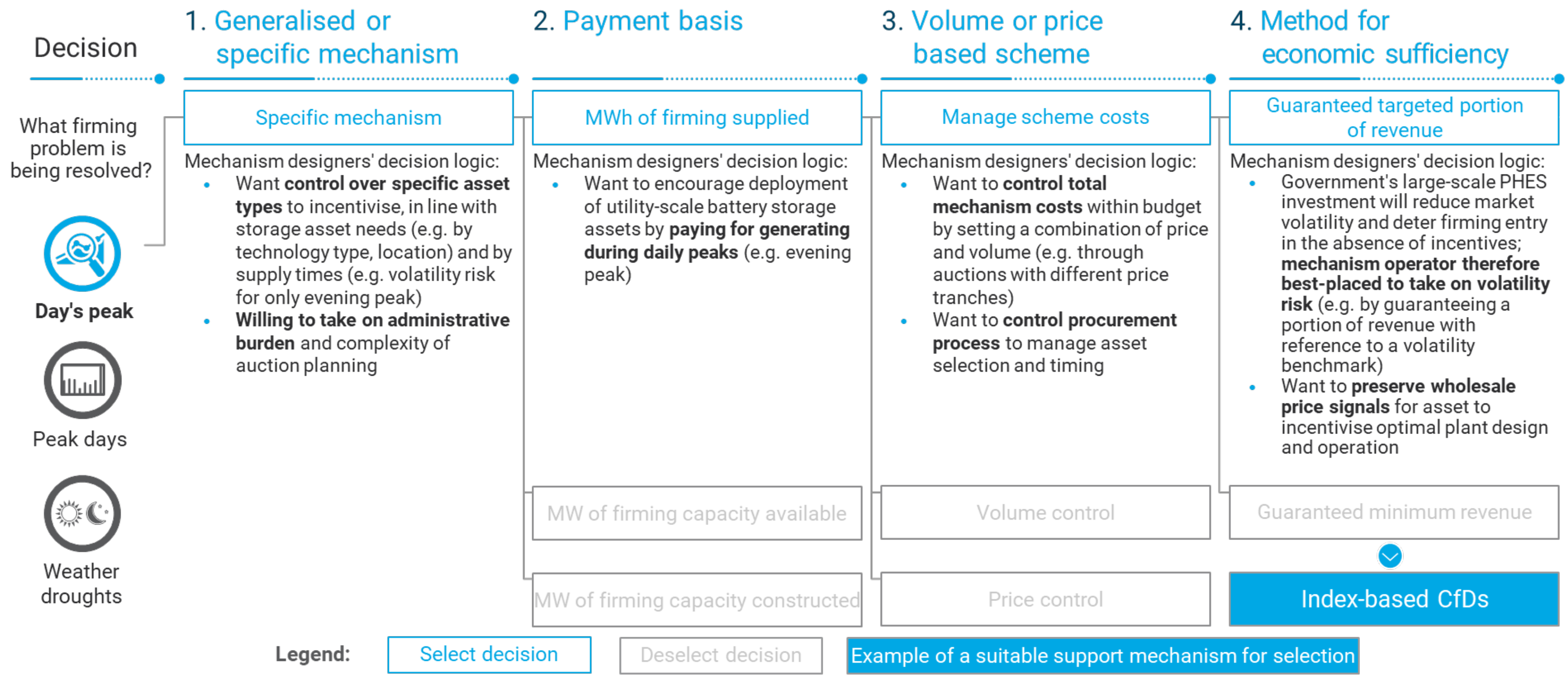
C. Illustrative example of decision framework applied for pumped hydro

The following figure provides an example decision framework for how mechanism designers could potentially select a support mechanism to incentivise investment in pumped hydro to generate during peak days and weather droughts.



D. Illustrative example of decision framework applied for battery storage

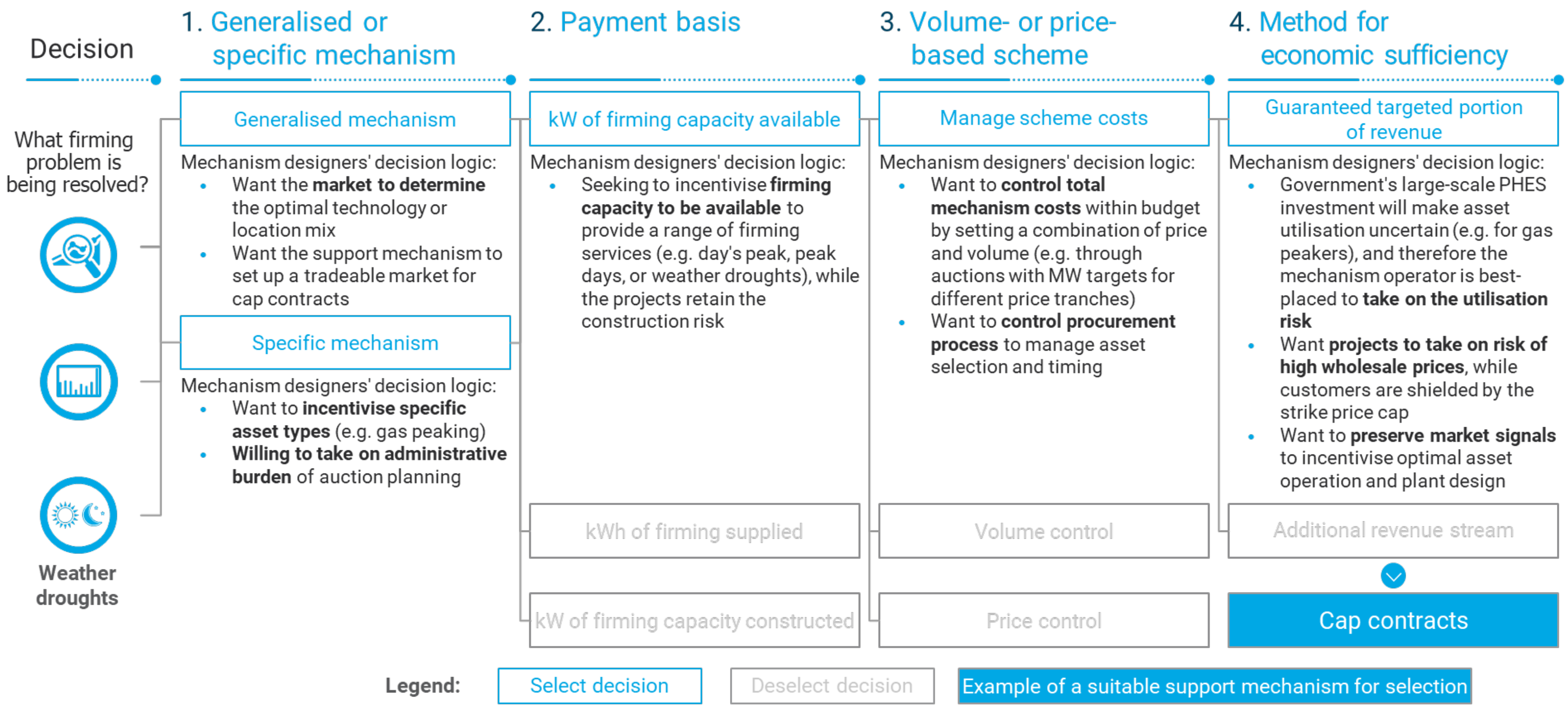
The following figure provides a worked example of how a mechanism designer may use the decision framework to potentially select an index-based CfD as a support mechanism to incentivise investment in battery storage to generate during day's peak.



E. Illustrative example of decision framework applied for cap contracts

The following figure provides a worked example of how a mechanism designer may use the decision framework to potentially select a cap contract as a support mechanism to incentivise investment in firming capacity to generate during day's peak, peak days, or weather droughts.

A financial agreement where the mechanism operator pays the project a fixed payment, over an agreed period, to provide firming capacity. This fixed payment is independent of the asset's production. In addition, when the spot price exceeds the strike price, the project must pay the mechanism operator the difference between the spot price and the strike price, with the settlement being the incentive to produce. The project has no payment obligations for periods when the spot price is below the strike price.



F. Australian examples where cost recovery channels have been used

Recovery channel	Australian example
Retailer charges	**Large-Scale Renewable Energy Target** • Electricity retailers are legally required to purchase and surrender a certain number of LGCs each year, corresponding to percentage of their total electricity sales • Retailers purchase LGCs directly from renewable assets or from the open market • A shortfall charge is incurred if the correct volume is not surrendered
Network charges	**NSW LTESAs** • Recover costs paid from the Scheme Financial Vehicle (SFV) through distribution network service providers (DNSPs) • Australian Energy Regulator makes annual contribution determinations, setting out liabilities to be paid by each DNSP each year • DNSPs recover costs from retailers as "MWh" and "peak demand" charges
AEMO charges	**Reliability and Emergency Reserve Trader** • AEMO calculates the total costs incurred for procuring emergency reserves through the RERT mechanism • RERT is calculated based on purchased load by energy retailers, • Costs are passed through to consumers based on their MWh consumption • Charges are received by the retailers in line with AEMO's calendar which operates in arrears
Generator charges	**Carbon tax** • Generators are taxed based on their emissions • Generators have several options to pass costs onto customers; directly absorb the cost or seek to recover the costs through increasing the price they bid into the wholesale market
Government budget	**Australian Renewable Energy Agency (ARENA) grants** • ARENA was funded with a budget of $1.43B in 2022 for the ten years to 2032 • ARENA under their mandate to improve competitiveness of renewable energy technologies and increasing the supply of renewable energy in Australia can provide capital grants to strategic projects • ARENA costs are recovered through government budget processes **Clean Energy Finance Corporation (CEFC) loans** • CEFC was funded with a budget of $10B in 2012, with an additional $20.5B allocated to the CEFC between the October 2022 and May 2023 Federal Budgets • CEFC under their mandate as Australia's 'green bank' use their capital to invest in activities which support the transition to net zero emissions by 2050 through direct debt or equity, listed and unlisted funds, sustainability-themed bonds, or project finance • CEFC costs are recovered through government budget processes and through a return on prior investments