CLEAN ENERGY COUNCIL

ACCESS REFORM

RESPONSE TO ESB CONSULTATION PAPER

CLEAN ENERGY COUNCIL
JUNE 2022

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THE CLEAN ENERGY COUNCIL

The Clean Energy Council (CEC) is the peak body for the Australian clean energy industry. We represent more than 1,000 of the leading businesses operating in renewable energy, energy storage and renewable hydrogen. We are committed to accelerating the decarbonisation of Australia's energy system as rapidly as possible, while maintaining a secure and reliable supply of electricity for customers.

A key focus for the CEC is developing regulatory frameworks to support efficient investment in the large number of new renewable generation and storage projects that are needed to deliver secure, reliable and zero emissions energy for consumers. Given this, we see the Energy Security Board's (ESB) consultation on Transmission access reform as an opportunity to continue championing the case for efficient investment in renewable generation, storage and transmission.

We will continue to prosecute our work across the many other avenues outside of our work with the ESB; working with the market bodies and state and federal governments to achieve our objective of a safe and rapid decarbonisation of the NEM power system.

CEC PROGRESS AND NEXT STEPS FOR THE ESB

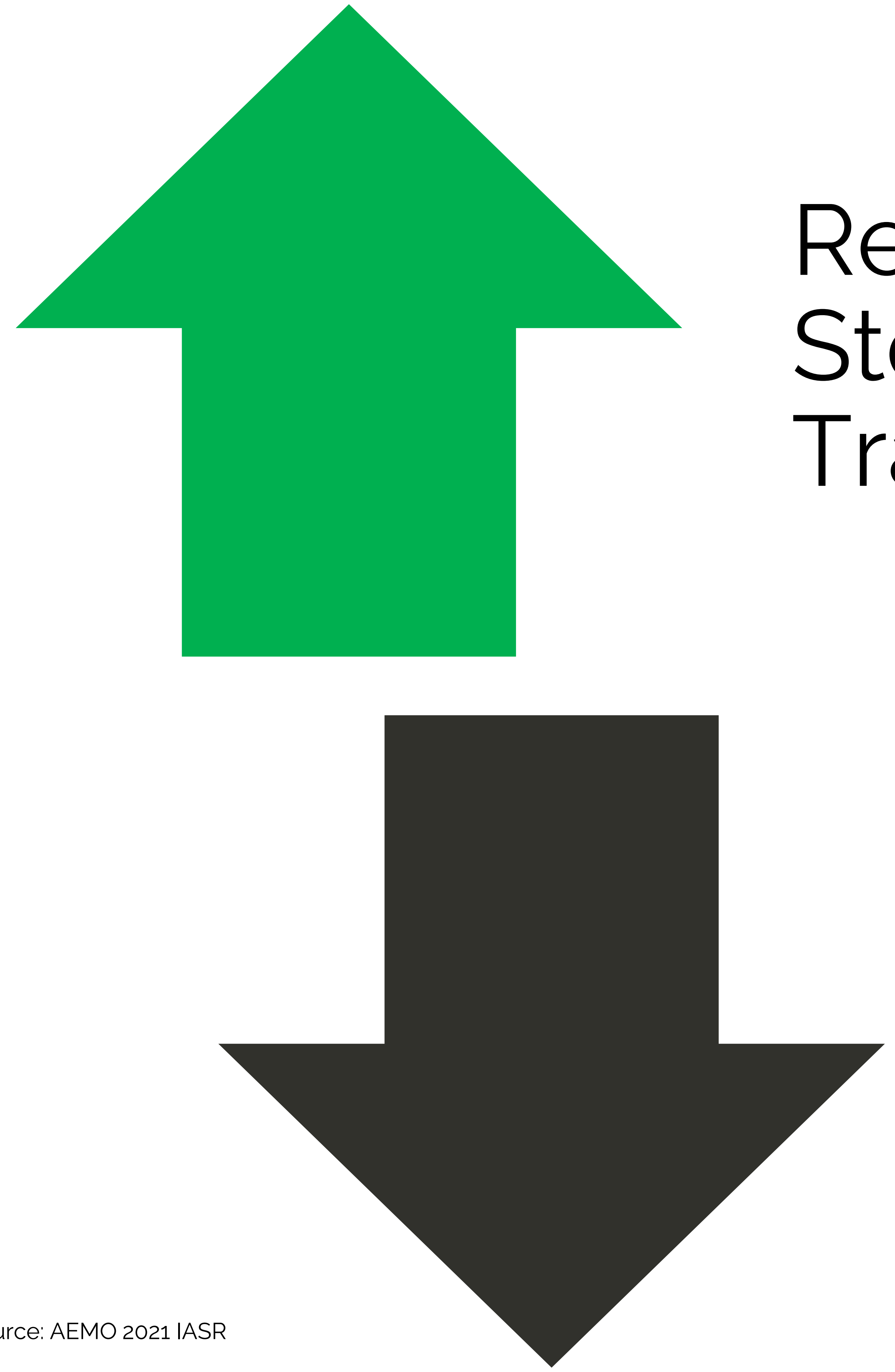
The CEC have worked extensively with our members to determine an approach that delivers the best outcomes in the operational and investment timeframe. This included undertaking extensive due diligence on the congestion relief market model, which we think warrants further development as an alternative to the CMM.

For the avoidance of doubt, the CEC does not currently support or endorse the CMM, in any form.

The ESB must now undertake full due diligence on all the proposed models, through rigorous dynamic market modelling and CBA analysis.

DRIVERS OF CHANGE

A FUNDAMENTAL ENERGY SYSTEM TRANSITION



Renewables
Storage
Transmission

Coal
Gas

Source: AEMO 2021 IASR

The NEM is rapidly transitioning…

- away from a centralised, fossil fuel dominated power system…
- …toward a more distributed, renewables-based fleet

As with the last major transition in the 80's and 90's, significant new investment is needed to deliver reliable, low-cost energy to consumers

To achieve this, we need efficient investment in a combination of renewable generation, storage and new transmission

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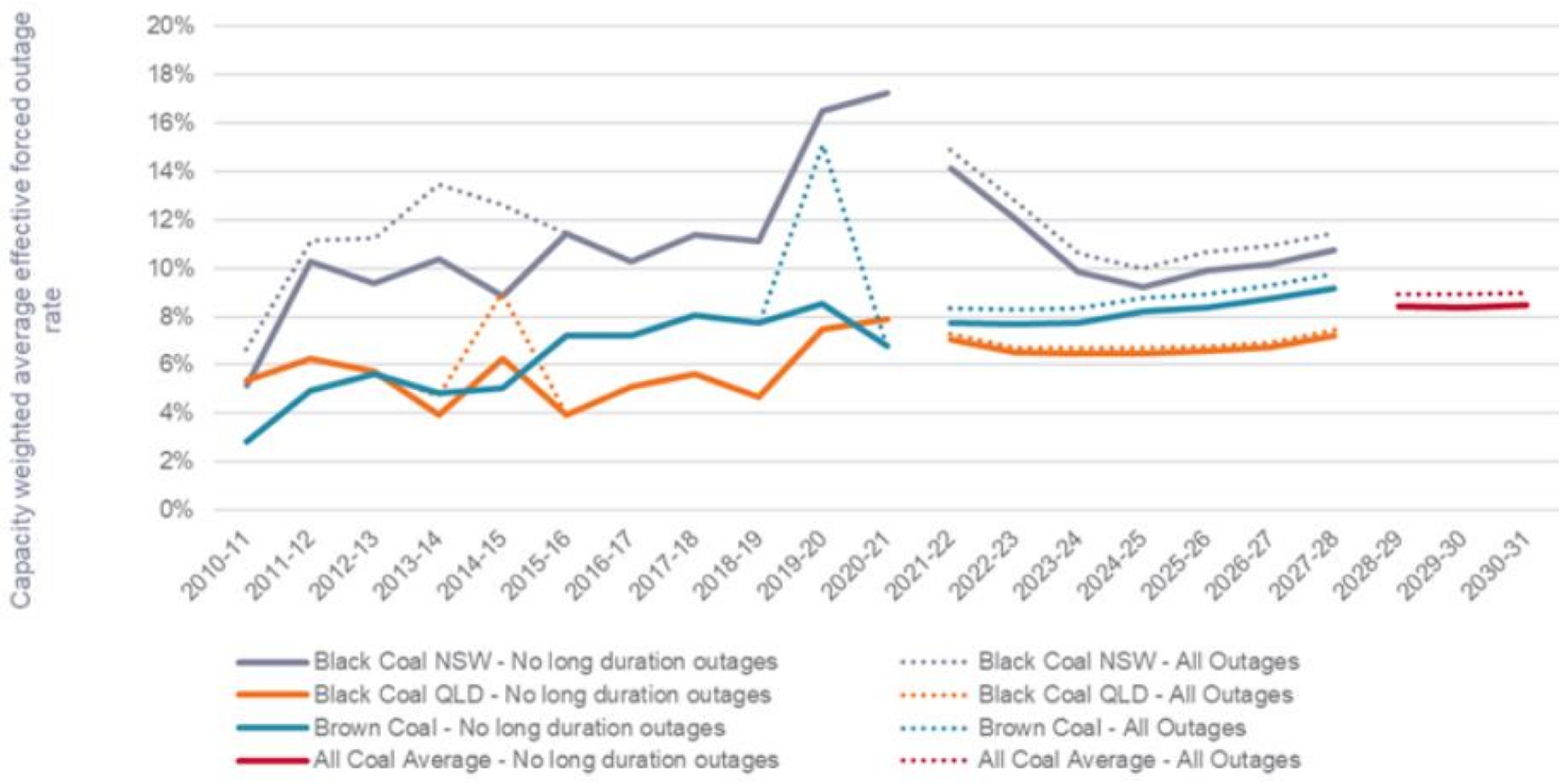
COAL GENERATION IS BECOMING LESS RELIABLE...



Source: AEMO 2021 IASR

As thermal coal generators reach the end of their operational life, they become less reliable

We have seen a steady increase in coal generation failure rates over the last decade

These bring with them wholesale price increases for customers

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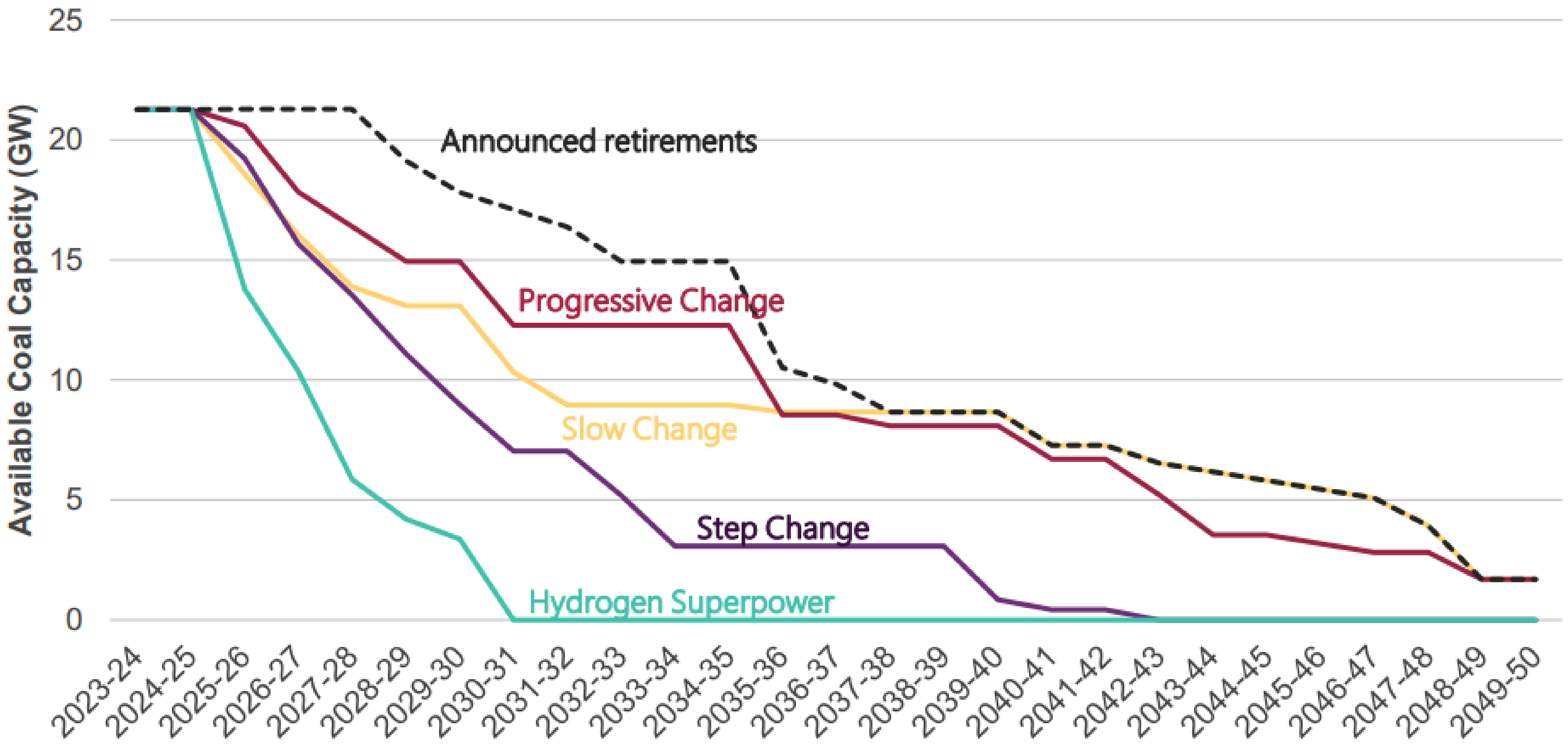
…AND IS LIKELY TO RETIRE SOONER THAN EXPECTED

Figure 18 Forecast coal retirements, all scenarios versus announced retirements



Source: AEMO 20212Draft ISP

Its likely that the retirement of thermal coal generation will happen quite quickly – probably faster than the announced retirement dates

This is driven by the increasingly poor economics of coal, as well as ESG / triple bottom line goals of owners of these assets

Its also likely that any catastrophic failures of ageing thermal coal units will mean they exit early and are not replaced

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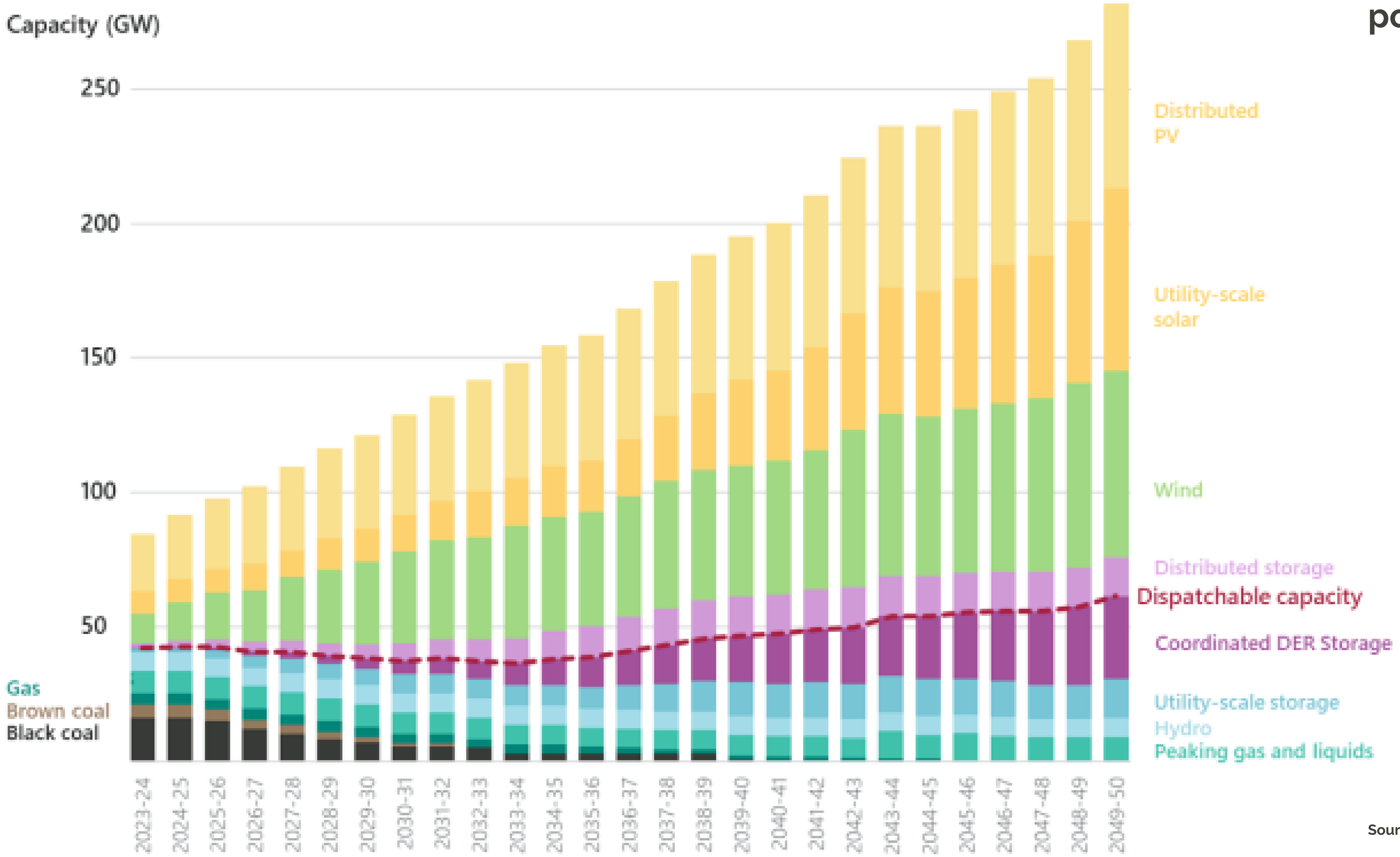
WE NEED A COMPLETE POWER SYSTEM TRANSFORMATION TO REPLACE EXITING COAL GENERATION…

Figure 1 Forecast NEM capacity to 2050, *Step Change* scenario, with transmission



A complete transformation of our power system is underway.

- Nine times the utility-scale VRE capacity to be installed – approx. 140 GW
- 45 GW / 620 GWh (gigawatt hours) of storage, in all its forms
- Major REZs identified in QLD, VIC and NSW – the Central West Orana REZ in NSW already underway
- 9GW offshore wind…

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Source: AEMO Draft ISP

...AND A NEW NETWORK TO DELIVER ENERGY TO CUSTOMERS

No transition without transmission.

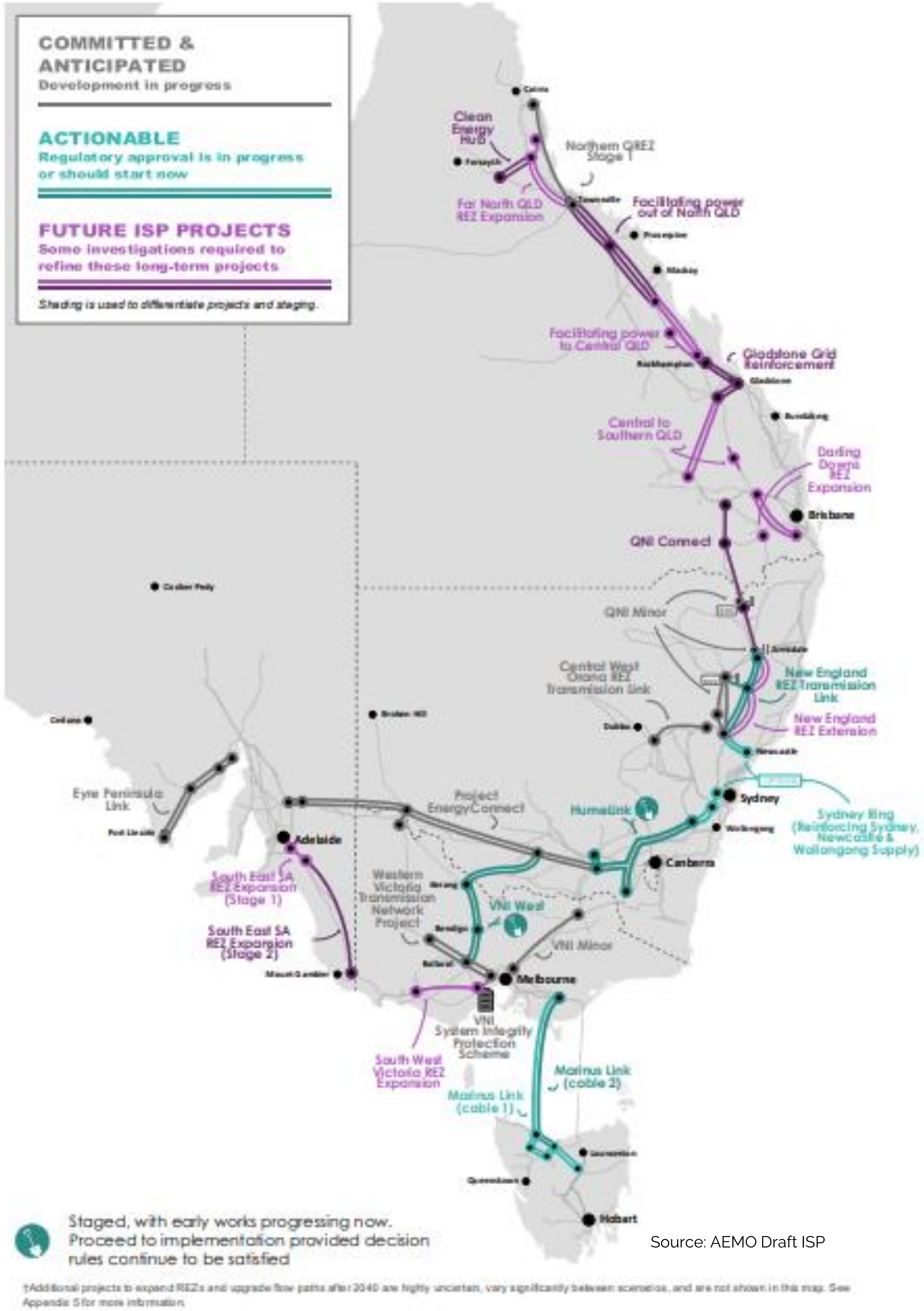
- 10,000kms of new transmission needed
- Delivering $29 billion of net market benefits
- Interconnectors critical to long term reliability

How do we get this transmission built in time?

How does it interact with generation and storage?

And how is this relevant to the ESB's work on Access reform?

Figure 2 Network projects in the optimal development path



Source: AEMO Draft ISP

THE INVESTMENT CHALLENGE

EFFICIENT INVESTMENT IN STORAGE, TRANSMISSION AND GENERATION

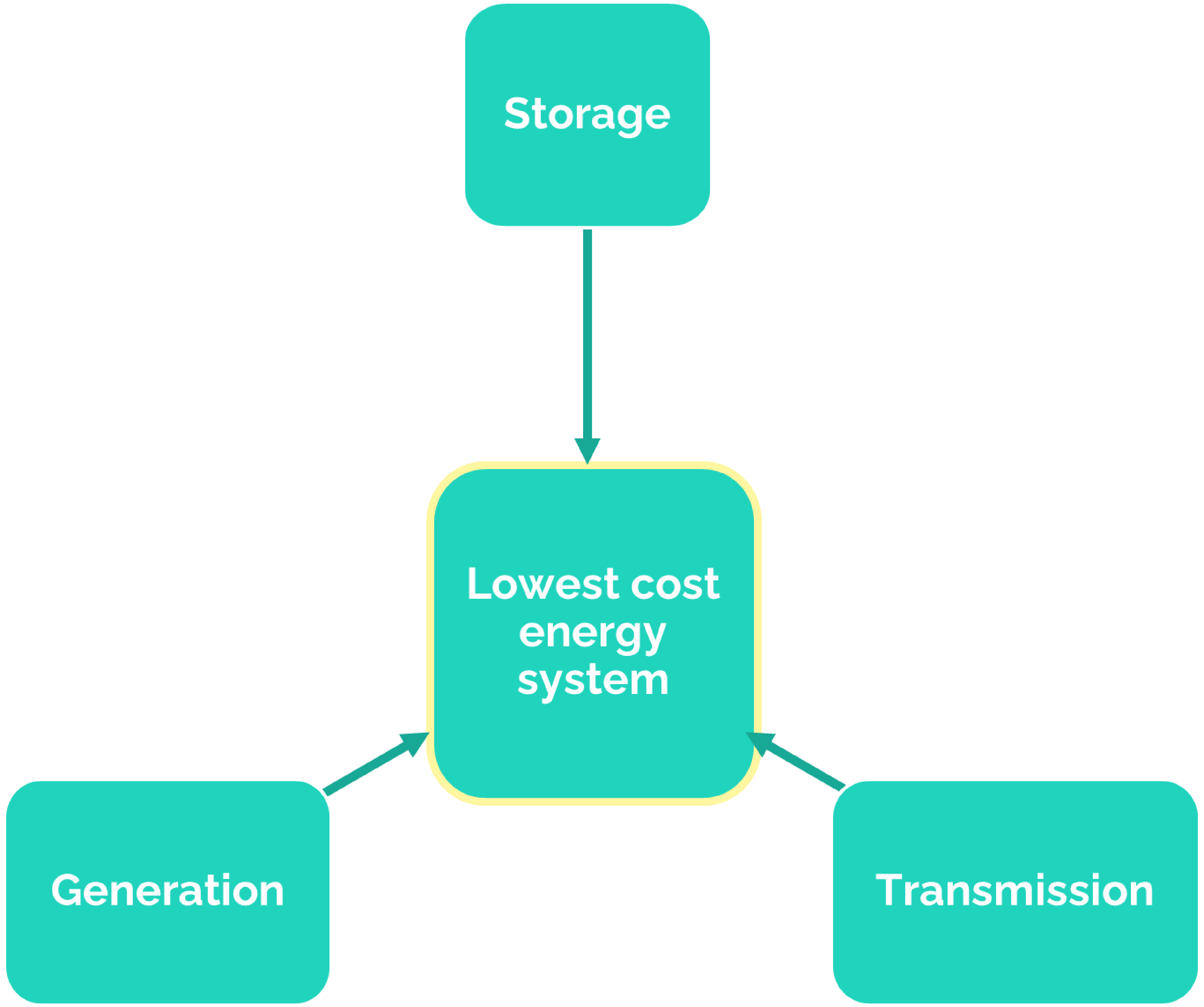
The only way we achieve a safe and stable transition, and keep prices down long term, is to enable significant volumes of new renewables investment

Coordinated investment in renewable generation, storage and transmission is key.

Too much of one, and not enough of the others, means the transition will be more expensive than necessary

So, **we need market and regulatory mechanisms that support effective and efficient investment** in the right mix of these solutions

Transmission investment is somewhat different to generation/storage investment however



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TRANSMISSION INVESTMENT

A key issue for transmission investment is how much cost and risk is held by which parties. TNSPs and AEMO are conscious of 'gold plating', and may be disincentivised from advocating for necessary transmission build

Furthermore, customers do not want to immediately pay for transmission assets through increased TUOS, before they see wholesale market benefits

How to address this:

- Improve information flows, so TNSPs and AEMO can run more effective planning and development of transmission networks – the 'improved information approach'
- Changes to the reg frameworks: reform the RiT-T, strengthen ISP processes
- Utilise government funding to share cost more effectively between customers and NSPs – such as through Rewiring the Nation, state based REZ development frameworks etc. These are not dealt with here, but are a key element of the CEC's ongoing work program

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TRANSMISSION INVESTMENT

A MORE DYNAMIC APPROACH TO TRANSMISSION INVESTMENT

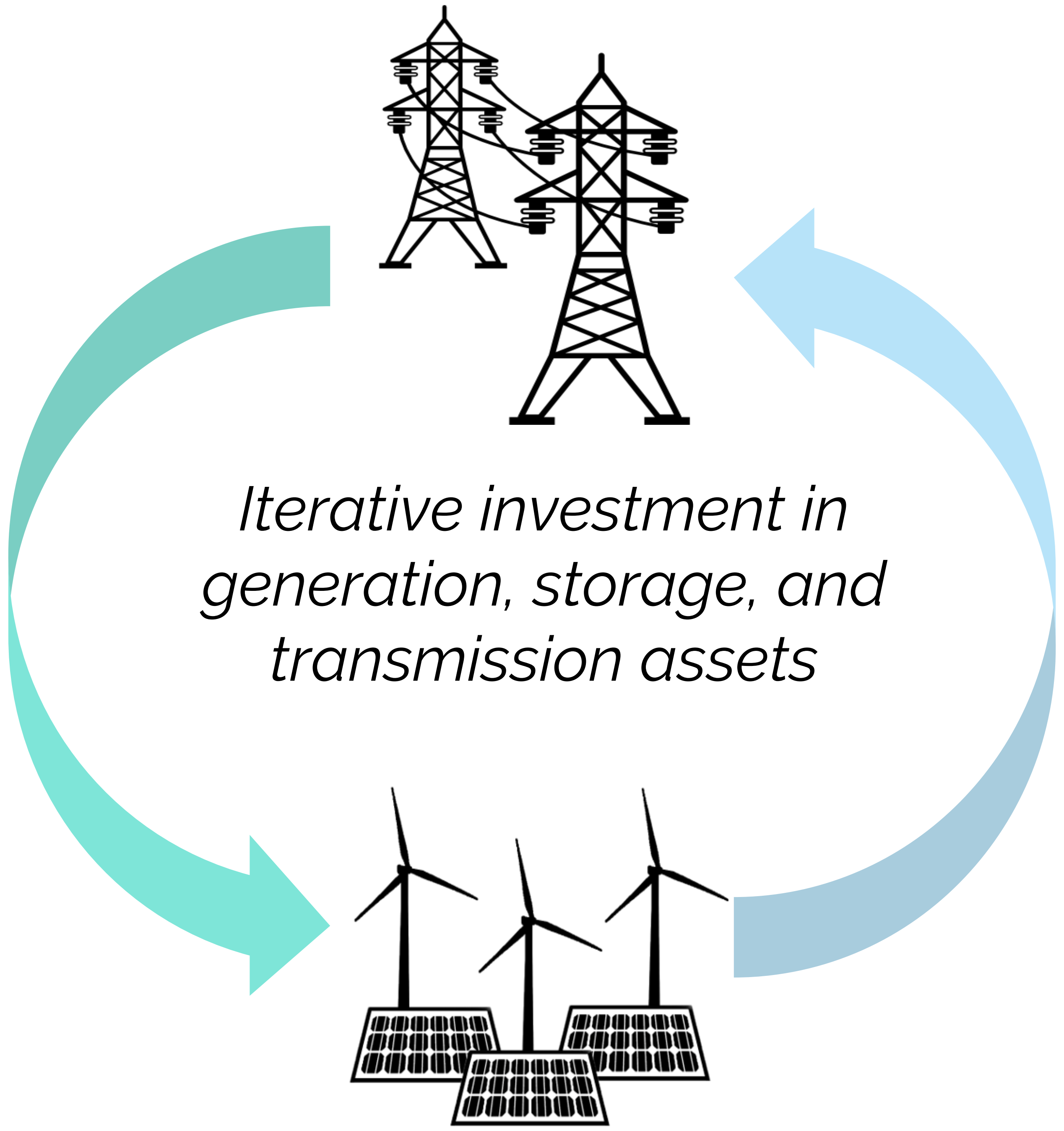
We need an iterative and dynamic interaction between decentralised market and centralised planning functions. This allows for iterative generation investment, and network augmentation, over the required long-term timeframes. This will provide generators, NSPs and market bodies with the ability to evolve with the needs of consumers, and most pertinently with the need to decarbonize the energy market.

The industry needs to avoid unnecessary gold plating and reduce white elephant risk – this model facilitates going in increments with market taking on some of that cost. **Improved information flows are central to enabling this kind of iterative transmission investment**

Build it, they will come!

Recognising the long lead times for transmission build, AEMO and TNSPs must be able to pre-emptively plan and build transmission networks, so this investment proceeds in tandem with generation investment.

Better information flows can assist in getting these investments built in time, coupled with changes to the broader planning and economic regulatory frameworks



Its likely that renewable generators will continue to connect to the power system on the basis of resource availability, even in the face of current congestion. AEMO and NSPs should have the capability to respond to the investment market, by making 'reactive' investments to unlock low-cost energy for consumers from already existing generators

This enables risk sharing, and reduces stranded asset risk

They have come, build it!

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GENERATION AND STORAGE INVESTMENT

ISSUE 1: INCUMBENCY AND NEW INVESTMENT

The investment challenge for generation / storage looks different to that for transmission. A key issue is how to balance the interests of new entrants vs incumbents

Market and regulatory mechanisms must be designed carefully, to not lean too far towards one end of the spectrum.

- Focussing overly on enabling new generation entry could result in inefficient outcomes, with new generators crowding into an area and 'cannibalising' the access of existing assets. This can lead to inefficient use of resources across the economy.
- Equally, overly focussing on incumbency can make new investment non-viable, slowing down the transition, pushing up prices for consumers and potentially creating reliability issues

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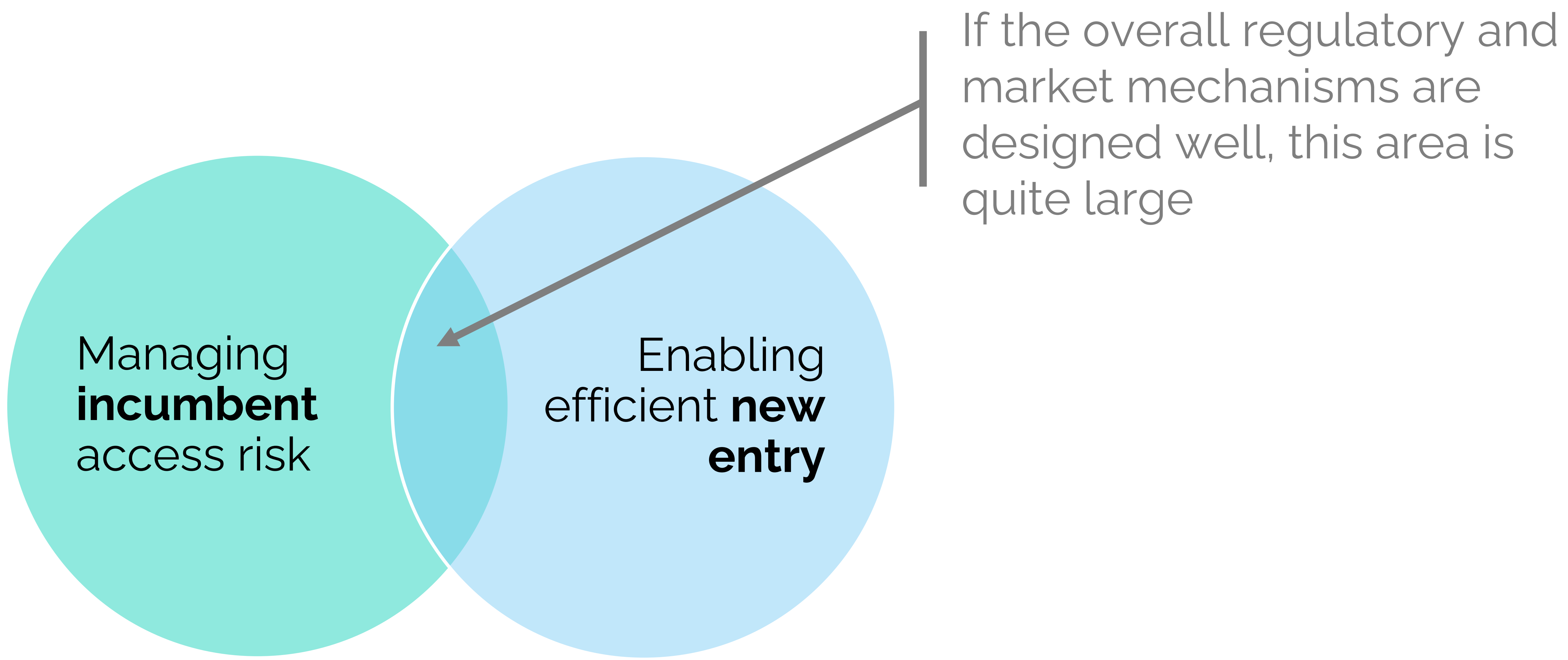
GENERATION AND STORAGE INVESTMENT

A COMPROMISE BETWEEN INCUMBENTS AND NEW ENTRANTS

Finding a middle ground between providing incumbents with a reasonable degree of certainty around their access to the system, while also supporting efficient new entry, is a complex task.
Better information availability to drive better locational decisions, coupled with a CRM to support efficient management of congestion, can benefit both



Solutions to address one-half automatically impact the other. Mechanisms that reduce risk for incumbents can also provide a signal to assist new connecting parties in making optimal investments.

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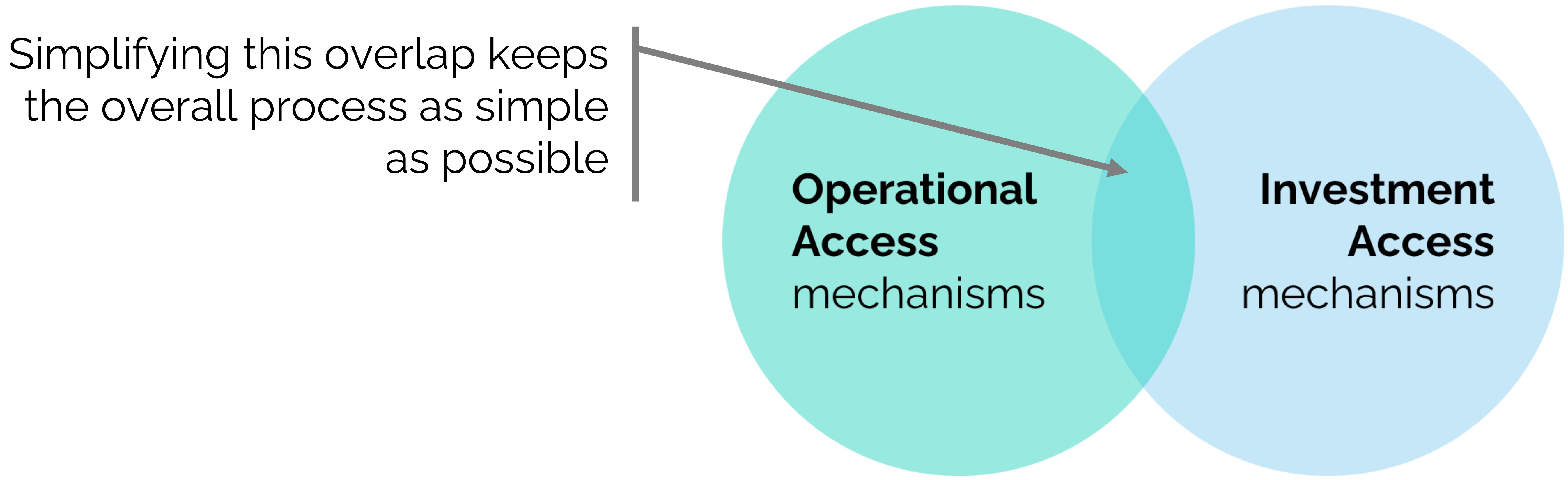
GENERATION AND STORAGE INVESTMENT
ISSUE 2: THE TWO TIMEFRAME PROBLEM

Developing a single access mechanism that covers both operational and investment timeframes is not viable. Better to solve for each timeframe separately, while allowing for overlap. This allows for each to be solved properly and simplifies decision making processes for investors



Both timeframes are still obviously connected and must be considered in conjunction. For example, parties looking to invest in new generation and storage will need to assess both investment and operational outcomes. However, separating these from a regulatory design perspective should make things more straight forward, as there is less risk of unintended interactions and outcomes

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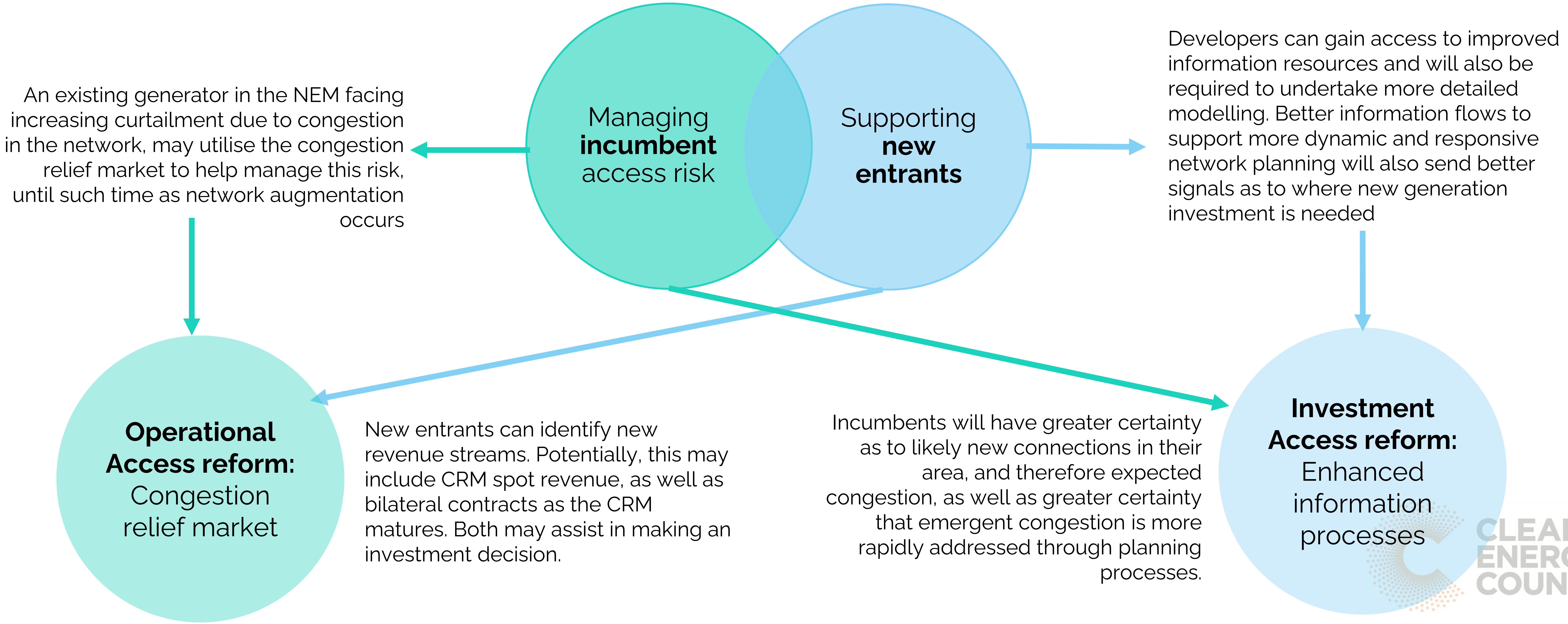
GENERATION AND STORAGE INVESTMENT

SOLVING FOR THESE TWO ISSUES

We consider that relatively incremental improvements to enhance information flows, coupled with a congestion relief market, can address both timescales, and balance new entry with incumbency



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CEC PREFERRED APPROACH

The CEC supports the ESB's proposal for two separate models. We consider that the enhanced information elements of the congestion zones approach, paired with the Congestion Relief Market (CRM), represents the optimal mix of solutions.

Access Reform

CRM as Operational access mechanism

- Allows parties to trade behind a constraint for 'congestion relief', if they elect to do so
- An 'opt-in' market model, that is based in the dispatch timeframe, rather than in the settlement timeframe as per CMM
- Provides clear and transparent signals in the operational timeframe, as well as some investment signals
- Allows for development of parallel market for trading behind the constraint

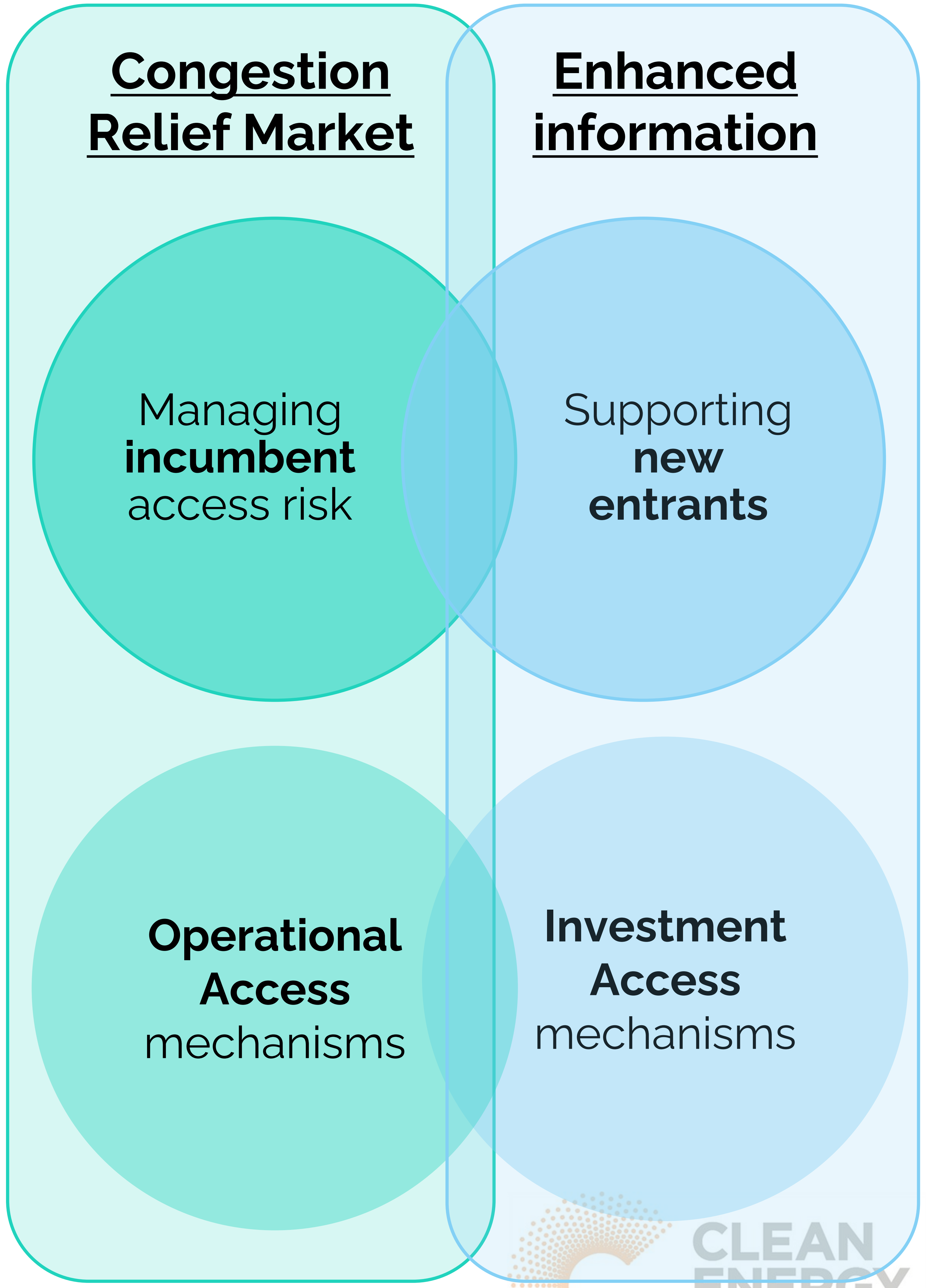
Enhanced information as Investment access mechanism

- By introducing several relatively incremental changes to information provision processes, existing locational signaling processes can be made more effective, for generators, storage and transmission investment
- Firstly, obligations for generators to undertake congestion modelling will improve locational decisions
- Secondly, obligations for NSPs and AEMO to deliver better network modeling processes, including development of a network modelling portal, and provision of detailed information to enable generators to undertake better analysis of potential connection locations
- Thirdly, tweaks to network and AEMOI planning processes, including standardization of project development criteria, and obligations for this information to be fed into the NSP and AEMO planning processes

CEC PREFERRED APPROACH

The alignment of the CRM and enhanced information model addresses all key questions presented by the dual challenge, while ensuring flexibility for current and future market participants:

- **Clearer signals as to where *not* to invest**, while maintaining as much **optionality for market efficiencies to determine good locations**.
- Allows for **retention of a free investment market** across the system – intent to get as close to an open market while still maintaining economic feasibility for market participants
- Allows for **integration with existing and soon to be implemented frameworks**:
  - **Alignment with State based mechanisms** already in development. Both information model and CRM are compatible with REZ design structures
  - **System strength** and **ISP frameworks** administered by AEMO are consistent and can be overlaid on this framework
  - **Batching processes** are a natural fit as well, both state driven as well as through post-CRI rule changes
- **Opt-in mechanism** for the CRM means that only those participants who wish to participate will do so, further supporting open market principles and delivering greater long term dynamic efficiencies.



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ALIGNMENT WITH ACCESS OBJECTIVES

Enhanced information model and the CRM are strongly aligned with the ESB transmission access reform objectives outlined in the latest access reform consultation paper:

Investment timeframes
The level of congestion in the system is consistent with the efficient level.

Operational timeframes
When congestion occurs, we dispatch the least cost combination of resources that securely meets demand.

1. Investment efficiency: Better long-term signals for market participants to locate in areas where they can provide the most benefit to consumers, considering the impact on overall congestion.

2. Manage access risk: Establish a level playing field that balances investor risk with the continued promotion of new entry that contributes to effective competition in the long-term interests of consumers.

3. Operational efficiency: Remove incentives for non-cost reflective bidding to promote better use of the network in operational timeframes, resulting in more efficient dispatch outcomes and lower costs for consumers.

4. Incentivise congestion relief: Create incentives for demand side and two-way technologies to locate where they are needed most and operate in ways that benefit the broader system.

OBJECTIVE 1 – facilitates increased information sharing in the short and long term in relation to connection capabilities at any connection point, not just in pre-established REZs.
It also considers the impact of new generation on incumbents, taking into account the impact of overall congestion

OBJECTIVE 2 – manages access risk by requiring increased due diligence for new connections and providing clear investment signals through increased transparency for intending participants on dispatchability/curtailment risks. The development of a CRM also provides a new tool for incumbents to manage curtailment, as and when it arises and affects their assets. Finally, improved information and planning processes provides greater certainty for incumbent generators that curtailment will be addressed through network development.

OBJECTIVE 3 promotes better use of existing network through creation of contracts around constraint costs. This creates more opportunity for existing and new generation

.

The CRM will reduce spilled energy and 'free-riding' in areas of congestion – overall it will create better operational efficiency

OBJECTIVE 4 – establishes a framework to alleviate congestion in both the operational and investment timeframes, promoting clear opportunity for new investment while also providing a mechanism for incumbents.. CRM encourages growth of BESS through increased ability to trade congestion

Source: Transmission access reform Consultation paper (2022, p. 6)

OPERATIONAL TIMESCALE

THE MODIFIED CRM

OPERATIONAL ACCESS APPROACH
THE MODIFIED CRM

The Congestion Relief Market (CRM) model initially created by Edify Energy presents a strong opportunity to enhance operational efficiencies. The CEC has led further development of the original CRM proposed by Edify - the Modified CRM. The Modified CRM includes the following key features that differ from the original model:

- **Transactions in the CRM are additional to (or adjustments to) the energy market transactions**: CRM represents enhanced trading opportunities to market participants.
- **Actual dispatch is the combination of energy and CRM dispatch, and actual dispatch remains within the technical limits of the equipment:** Market participants' actual physical dispatch is the combination of the energy and CRM dispatch.
- **The energy market is settled at the RRP**: Generators and retailers participating in the energy market continue to trade electricity at the RRP.
- **The congestion relief is settled at the CRM price**: If a participant trades congestion relief, then the quantity that it buys or sells is settled at the nodal CRM price.
- **Participation in the CRM is voluntary**: Market participants have the opportunity but not the obligation to participate in the CRM.

OPERATIONAL ACCESS APPROACH
THE MODIFIED CRM

Key changes proposed for Modified CRM Model:

- **Energy and CRM are co-optimised as 'single pass'**: energy and CRM bids/offers are concurrently considered, co-optimised, and dispatched.

- **Nodal CRM prices represent local transaction opportunities**: CRM prices reflect prices that are subject to 'CRM constraints' at the nodes (as well as all other security constraints) and they provide opportunities for willing buyers and sellers to transact.

- **CRM enables multiple 'constraint relief trades' to occur across the network:** because the CRM uses the same network model and security constraints as the NEM energy dispatch it can facilitate mutually beneficial trades across the network. These trades don't have to always balance at each location (node).

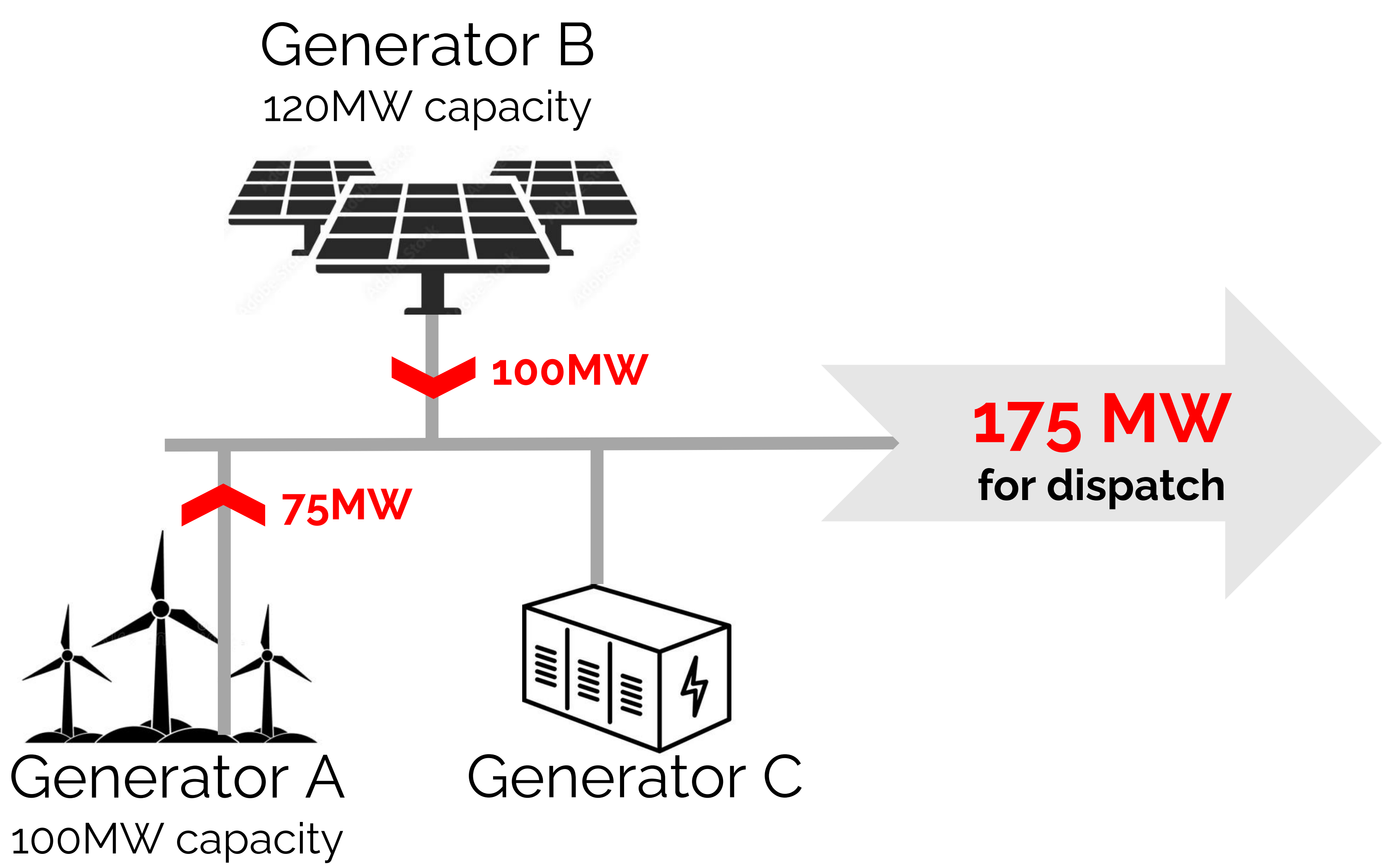
- **Holistic approach to all 'MWs term' constraints:** CRM constraints are all those constraints whose costs can be relieved through the changes to the energy dispatch targets of dispatchable generation and loads.

- **Clarification of settlement calculations**: CRM dispatch deviations are settled at nodal CRM prices, while CRM deviations from energy dispatch must be netted off actual metered generation at each node.

- **Participation in the CRM is controlled and flexible**: Market participants can decide the conditions under which they participate in the CRM and the extent to which they participate by setting their offered maximum dispatch deviations allowed in the CRM.

SIMPLIFIED CRM EXAMPLE

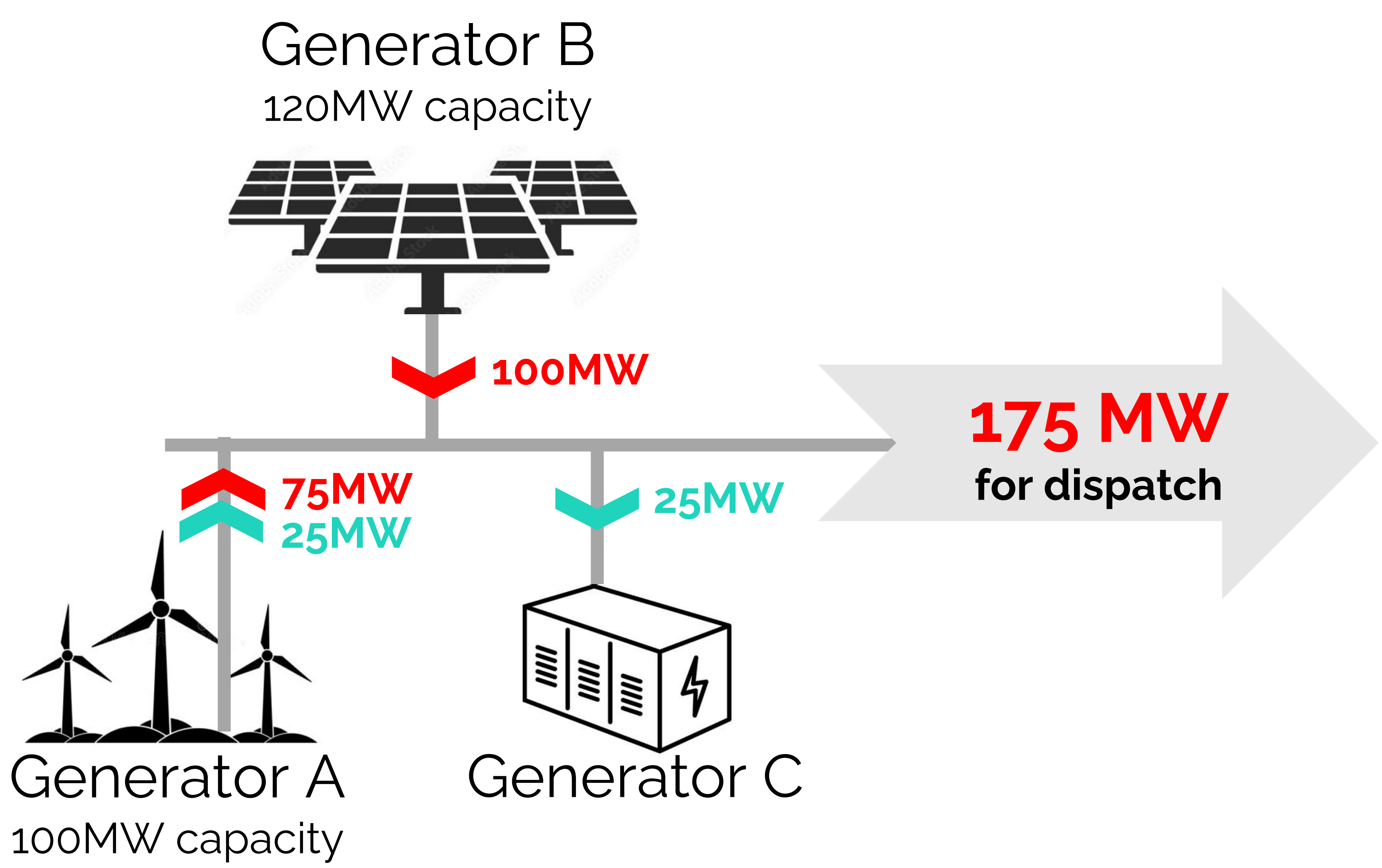
Constrained market *without* CRM →



Due to the constraint, **only 175MW of the available 220MW can be dispatched** - resulting in underutilisation of RE assets and spilled energy for both Gen A and B.

- Generator A has bid 100MW of generation at prices below the RRP and is constrained down to 75MW
- Generator B has bid 120MW of generation at prices below the RRP and is constrained down to 100MW
- Generator C (a hybrid plant, or standalone battery) can place a load in the system and absorb some of the otherwise spilled energy – however it has no incentive to do so

Constrained market *with* CRM →



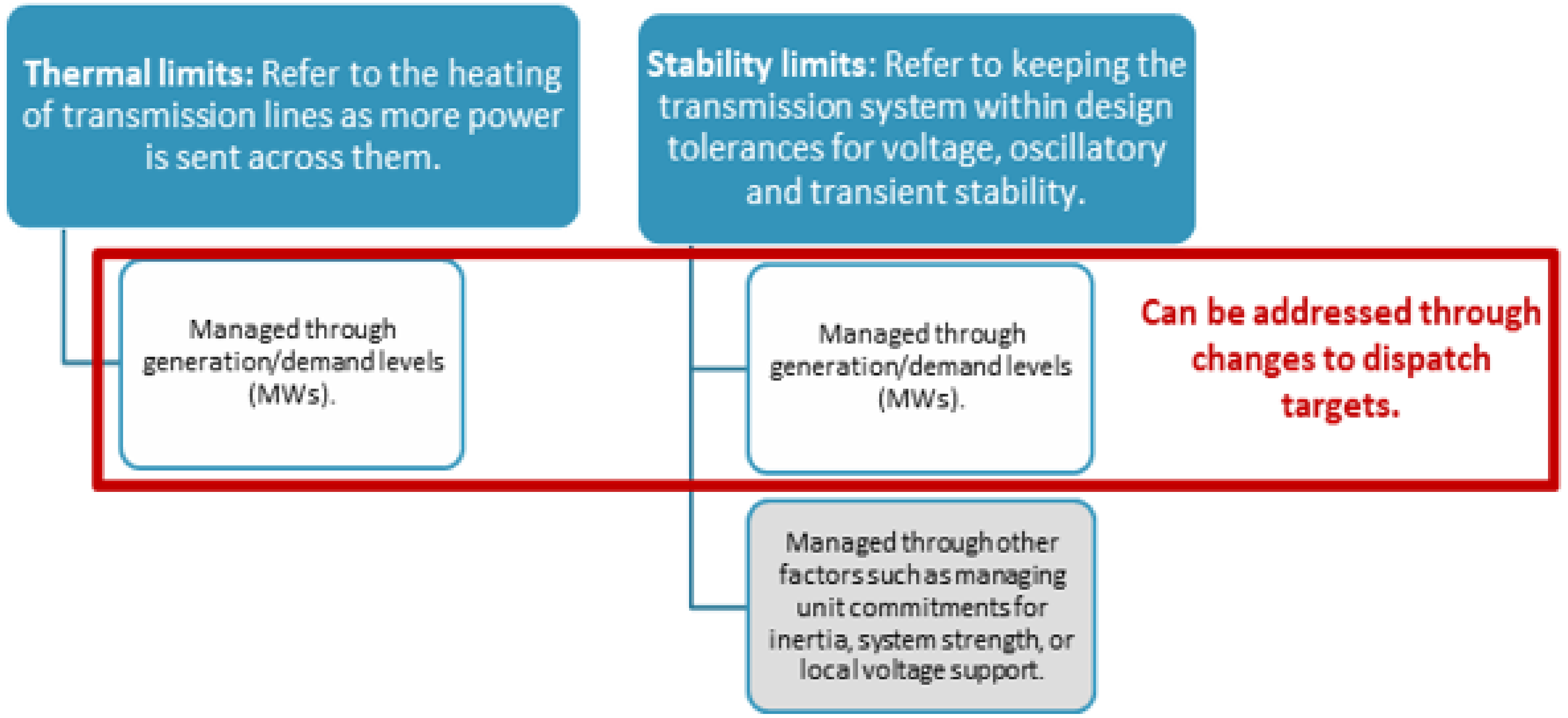
CRM facilitates **trading of additional capacity behind the constraint** and, in this example, allows Generator A to put an additional 25MW into the grid which it otherwise would not have been able to.

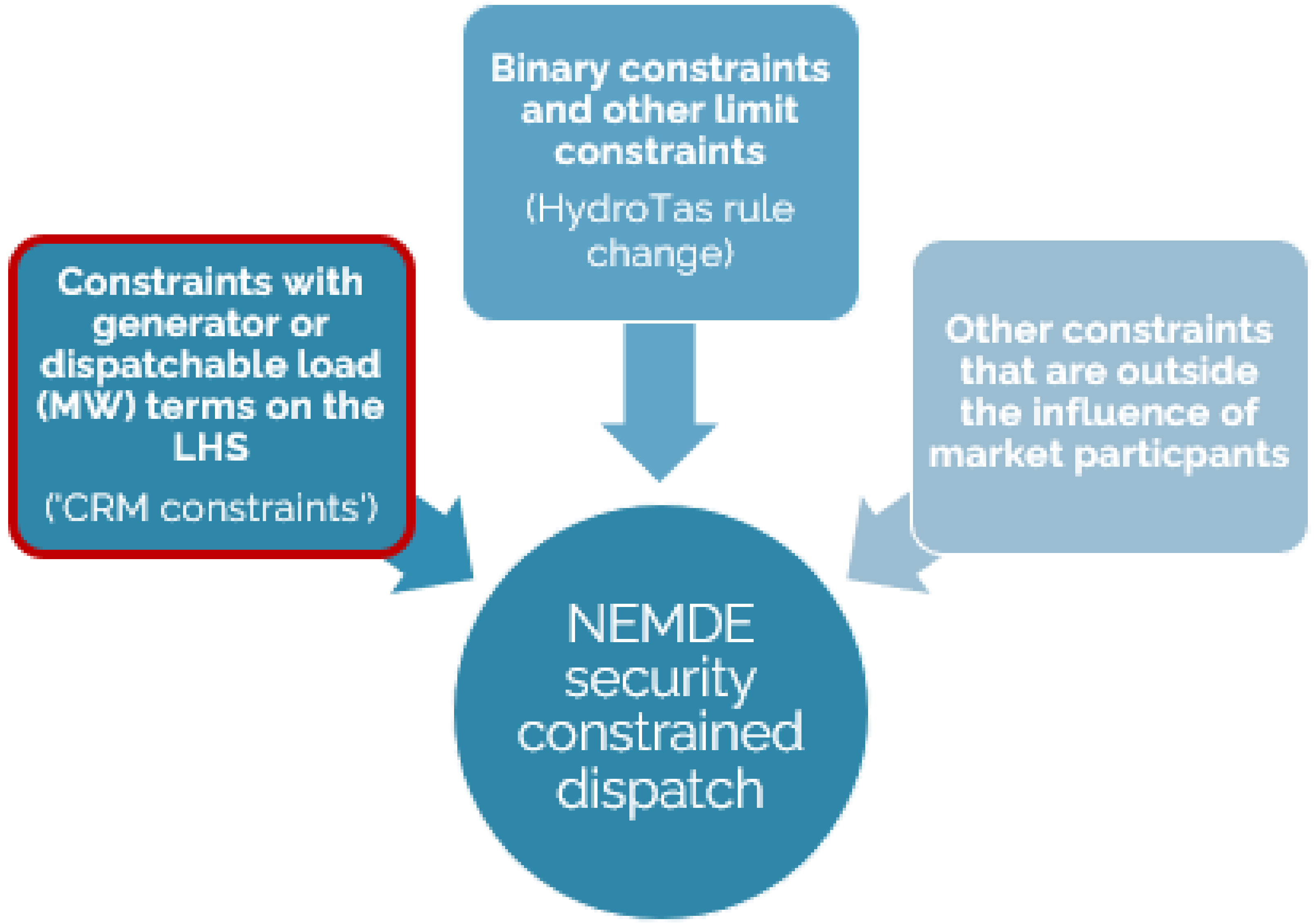
- Generator A has bid to sell 25MW into the CRM. Generator C has also bid to charge (place a load) using a hybrid plant or standalone battery at a price that is above Generator A's CRM bid. The market clears 25MW congestion relief.
- Generator C pays whereas Generator A receives payment for congestion relief.
- The CRM cleared an additional 25MW of power, which otherwise would have been spilled.

Note: More detailed examples in Appendices

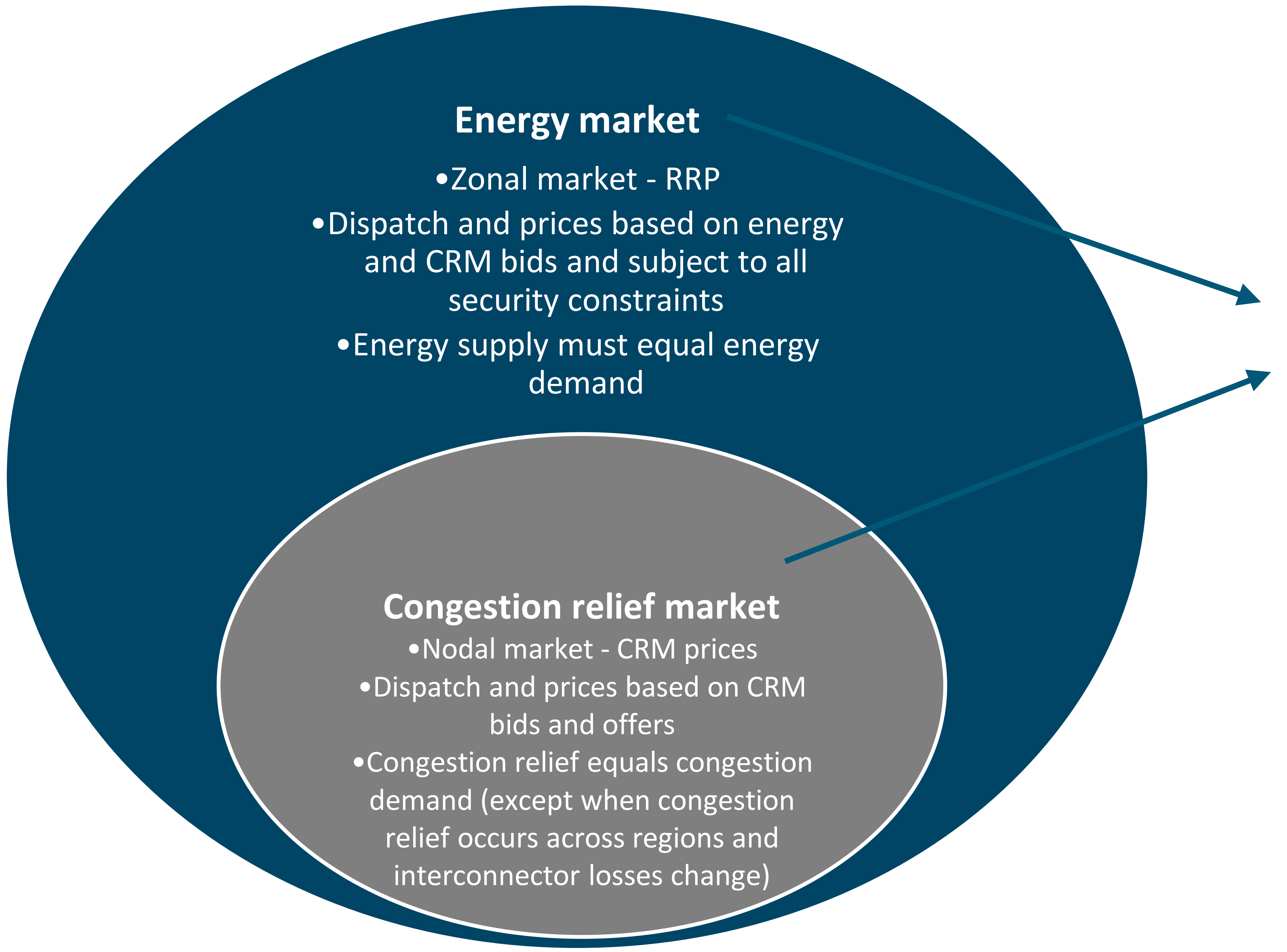
HOLISTIC APPROACH TO ALL 'MW TERM' CONSTRAINTS

An important characteristic and a key benefit of the CRM is that the concept can be applied to any constraints that includes 'generator or dispatchable load terms' (or 'MW terms') on the left-hand side (LHS) and thus the constraint costs can be relieved through changes to dispatch targets. The Modified CRM does not intend to isolate individual constraint equations. Instead, it is aimed at addressing all relevant 'MW term' constraints all at once at each node across the whole network. Therefore, the Modified CRM can be considered as a more holistic solution than the original CRM model.





JOINT ENERGY AND CONGESTION RELIEF MARKET OPTIMISATION WITHIN A DISPATCH INTERVAL



The difference between the two dispatch targets is considered a 'deviation from energy dispatch target' which is taken to be the congestion relief provided/received.

This deviation is settled at the CRM price.

Two dispatch target determinations (regional energy dispatch target and nodal CRM dispatch target) are put into one optimisation. These dispatch target determinations are coupled due to some common elements that shape them, such as:

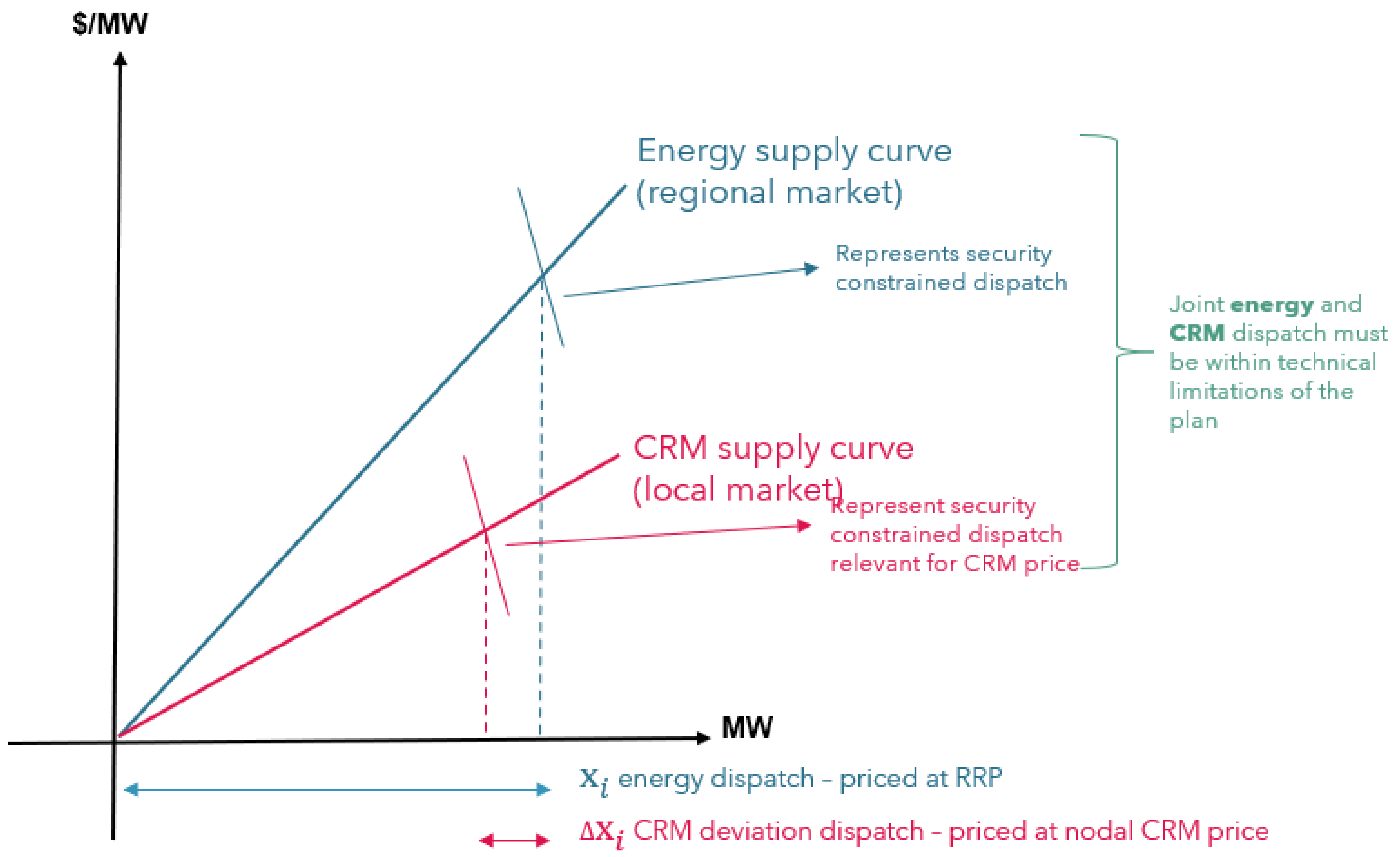
- All security constraints that are applicable for the normal energy dispatch model are used for the CRM dispatch; the technical operating envelope of the plant is applicable to the combined energy, frequency control ancillary service (FCAS) and CRM dispatch,
- Costs must be minimised across all three markets while maintaining system security and supply must meet demand.

SINGLE PASS DISPATCH – TWO OUTCOMES

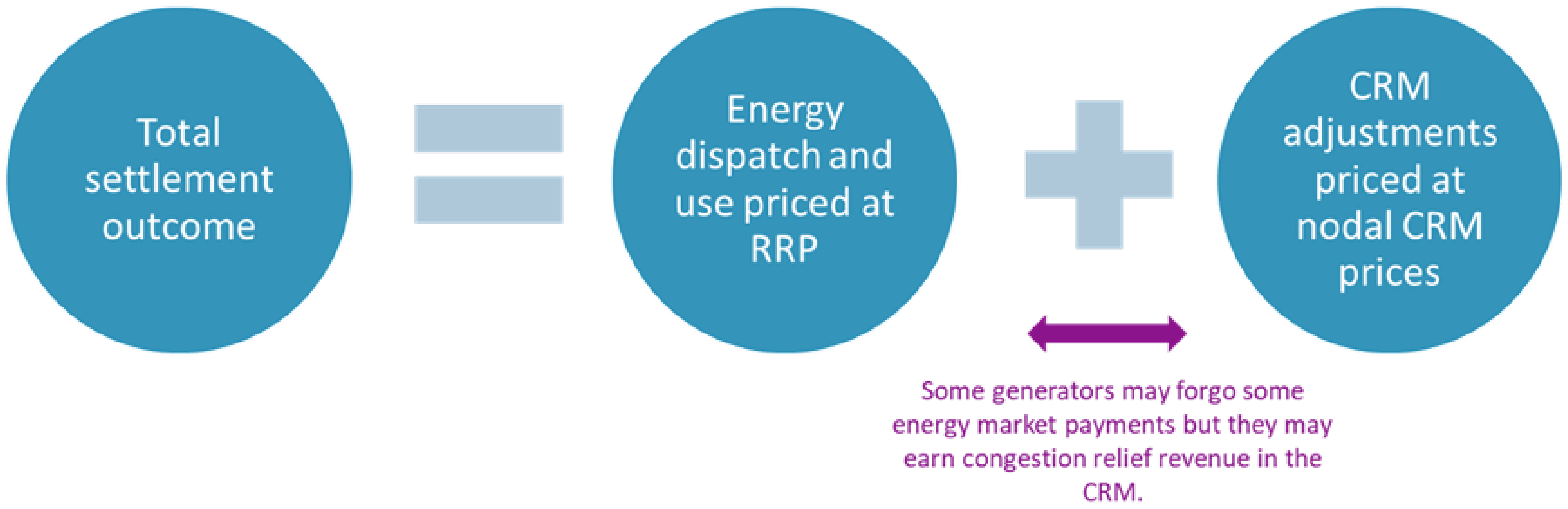
In order to co-optimise CRM with energy, the energy and congestion relief market optimisations (objective functions and constraints) are combined.

The objective is to minimise total cost of dispatch, subject to:

- CRM deviation limits set by CRM market participant
- Technical limitations of the generator
- Regional energy balance requirements
- Capacity and security constraints for both the energy and CRM dispatches to ensure that dispatches are secure.



ENERGY AND CRM SETTLEMENT



The energy dispatch is based on RRP and the CRM revenues are based on the CRM marginal prices for each node (the nodal CRM price or CRP) times the deviation quantities, Δx_i.

- **Total settlement outcome = Energy and CRM revenue = x_i x RRP + Δx_i x CRP**
- Even though the congestion relief market is settled by AEMO, a useful way of thinking about it is that congestion relief buyers pay congestion relief providers the local congestion relief price for the volume of congestion relief provided. This thinking can be illustrated by rearranging the settlement calculation above to the one below:
- **Energy and CRM revenue = $(x_i + \Delta x_i)$ x RRP + Δx_i x (CRP - RRP)**
- Deviation quantities can be either positive or negative. If we assume that the RRP is greater than the CRP then if a generator increases its output, Δx_i is positive then it will have to pay Δx_i x (CRP - RRP) for congestion relief. If a generator decreases its output, Δx_i is negative then it will get paid Δx_i x (CRP - RRP) for congestion relief.

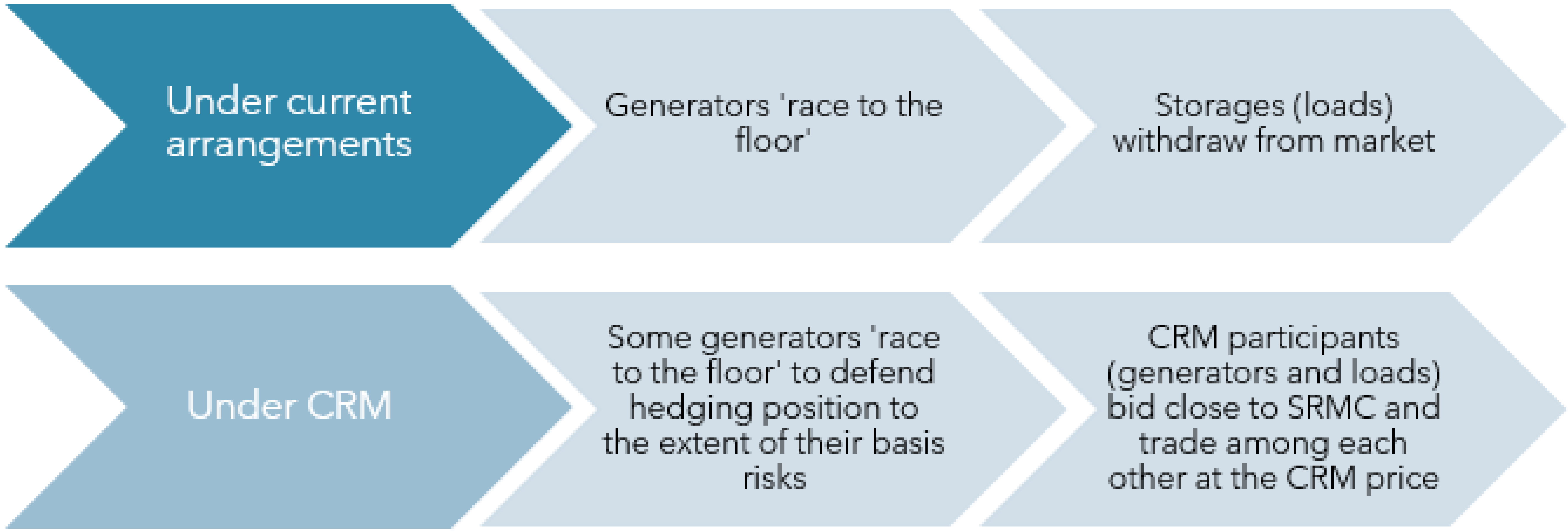
MODIFIED CRM ACHIEVES ESB CRITERIA

Criteria	The modified CRM achieves these by…
Efficient market outcomes – dispatch	• Improved dispatch efficiency • New ancillary service co-optimised with energy
Appropriate allocation of risk	• Individual participants are able to manage their own risk through deciding whether to participate in the market, as well as through development of hedging contracts • Allows for informed risk management through pre-dispatch and bid adjustments
Manage access risk	• 'Access' is taken as dynamic and not static • This enables more efficient utilisation of the network
Effective wholesale competition	• Market-based rather than administrative solution. • This enables more efficient competition in the wholesale market
Efficient market outcomes – Investment in generation and storage	• Provides locational price signals in line with the physical needs of the NEM • Technology agnostic, and allows all technologies with a coefficient to participate
Efficient market outcomes – Investment in transmission infrastructure	• The price signals created through the CRM provide greater transparency around the value of transmission augmentation • More efficient operational decisions by storage and generators through the CRM increases load factor of the network

POTENTIAL BIDDING BEHAVIOUR

Potential bidding behaviour in constrained areas under current market arrangements and the CRM.

- When there are no network constraints, market participants can continue to bid and trade at the RRP.
- When constraints occur, however, they have further opportunities to buy and sell “behind the constraints” which means they are more likely to make CRM bids/offers that reflect their SRMCs/opportunity costs.



BENEFITS OF CRM

- **The CRM improves dispatch efficiency:** The CRM enables additional 'constraint relief' transactions which are not possible in the NEM today; the CRM transactions only occur if they reduce the total system costs relative to the energy-only dispatch hence they can be considered 'no regrets' from the point of view of an economic dispatch.
- **Allows for additional revenue and cost savings:** The CRM extends the market participants' decision space and allows additional revenue (and cost saving) opportunities while concurrently improving the efficient operation of the market. This will help increase productive efficiencies, by facilitating the most efficient resource mix and asset utilisation.
- **CRM services are co-optimised with energy and other ancillary services:** This allows for the most efficient allocation of resources across multiple markets, to ensure that total system costs are minimised.
- **The CRM allows flexible management of financial risk exposure:** Market participants can select their level of involvement in the wholesale energy market and set limits to their involvement in the CRM at an operational timescale. Contractual positions can change annually, quarterly, or even from one trading interval to the next. The CRM allows market participants to adjust their energy market and CRM market position at a granular scale.
- **The nodal CRM price provides a much better and stronger locational signal than the status quo:** creating long term locational price signals for investors and technology providers
- **CRM is technology agnostic:** any participant can participate in the market
- **The CRM facilitates the economic location of storage resources:** the CRM provides incentives for batteries or other storage facilities to locate in areas with substantial amounts of VRE generation periodically constrained down or off.
- **The CRM supports more efficient utilisation of the network**, by encouraging storage to charge at efficient times and then discharge when VRE assets are not available. This increases the load factor of the network, and will help reduce TUOS costs for customers by reducing the need for transmission investment

COMPARISON OF CRM AND CMM

The CRM differs from the CMM and other 'locational marginal pricing' models that have been previously considered in several ways, including:

- Participation in the CRM is voluntary whereas participation in the CMM is mandatory.
- The CMM relies on regulatory decisions and administrative processes to establish, allocate, potentially trade, and extinguish rebate rights, whereas no such process is required for the operation of the CRM.
- It remains opaque and ambiguous how storage providers may participate in congestion management under the CMM, whereas the CRM provides clear avenue for dispatchable load and storage to participate and provide value.
- Whilst both the CMM and the CRM require additional payments and settlement, in the CMM these payments are based on largely arbitrarily and administratively set rebates that can distort price signals whereas in the CRM the payments relate to enhanced price signals reflecting 'congestion relief' opportunities among market participants.
- The CMM does not cater for market participants' needs to hedge their generation (or dispatchable load) profile and it is not conducive to the development of new derivative markets. Contrary to this, the CRM allows market participants to hedge at the granularity of a dispatch interval.
- The CMM does not appear to incentivise efficient utilisation of the power system. The rebates in the CMM are based on an artificial and conservative representation of the power system whereas in the CRM the dynamic nature of the power system is "price into" the CRM.

NEXT STEPS FOR THE CRM

The Clean Energy Council has worked extensively with industry and other members of the ESB to undertake due diligence on the CRM. We have developed the CRM to a point at which we are confident it offers significant promise as a way to enhance operational and investment efficiency, while also improving outcomes for market participants.

The next stage of analysis will be the responsibility of the ESB. The ESB must submit both the Congestion Management Model *and* the CRM to equally rigorous cost benefit analysis. This must include:

- Accurately quantifying the basis of any implementation costs of both the CRM and CMM, including providing a breakdown of what the costs are and who bears them

- Subject both the CRM and the CMM to dynamic market modelling, under multiple scenarios, to assess extent of likely benefit and risk of unintended consequences.

The CMM, in its current formulation, remains a significantly inferior model to the CRM, The Clean Energy Council does not support it, and we do not consider that tweaks to the CMM, such as through changing rebate allocation mechanisms, will change our view of this.

To be clear, the CMM, or any other form of centralised, non-market, regulatory LMP, is ***not equivalent to the CRM***, and will not be accepted by the CEC as a substitute

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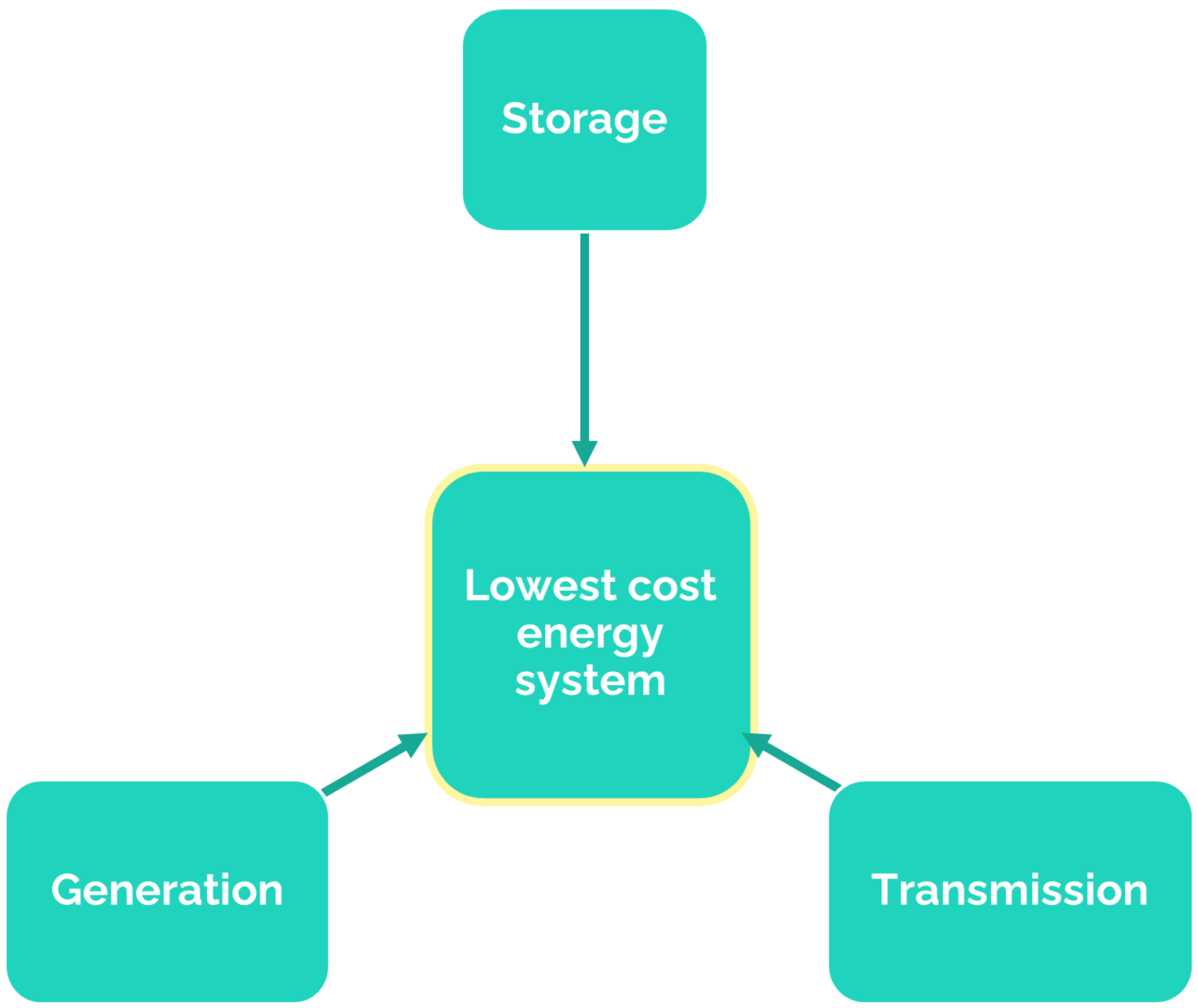
INVESTMENT TIMESCALE

ENHANCED INFORMATION

ENHANCED INFORMATION APPROACH

ENHANCED INFORMATION PROVISION TO SUPPORT INVESTMENT



Standardised and consistent flows of information between generators, TNSPs and AEMO will go a long way to supporting more efficient investment outcomes overall.

This information can be fed into the planning processes to deliver more efficient outcomes.

We don't need to overcomplicate an already complicated system – we need to take a good look at the system and capabilities we already have and find ways to streamline and increase transparency.

- How can we create better information flows between generators and transmission?
- How can we facilitate clear market signals for new investment?
- What **information do we already have available** that can be better utilized to ensure more efficient outcomes overall?

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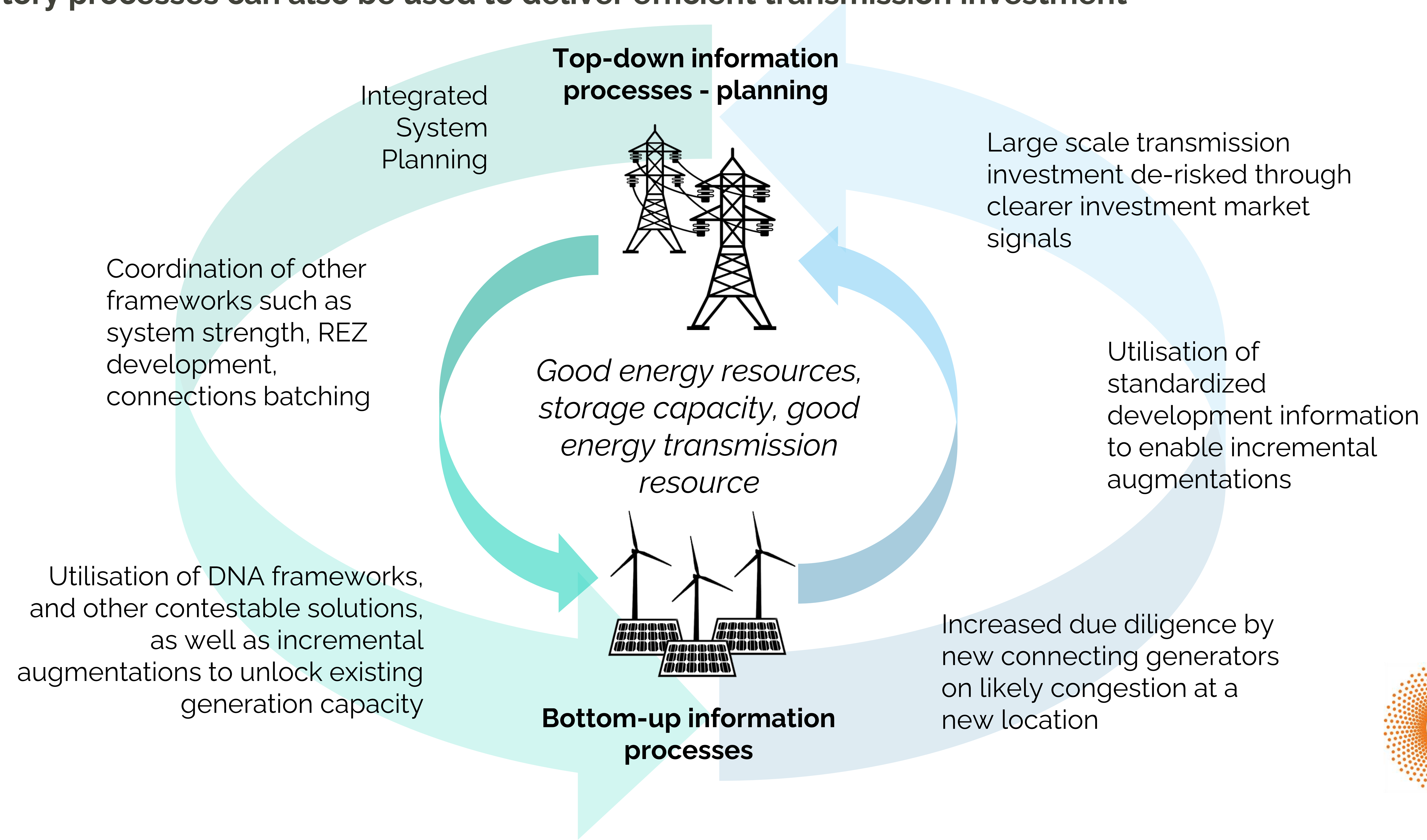
STANDARDISATION OF INFORMATION SHARING

Improved information flows, and feeding that information into the network planning and development process, will go a long way to share risk more efficiently between TNSPs and private investors, such as generators and storage. Better coordination of existing regulatory processes can also be used to deliver efficient transmission investment



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INVESTMENT ACCESS APPROACH

There is a lot that can be done to enhance information availability for connecting generators and storage, and to feed investment market information back through the planning processes. In conjunction, these measures will send much stronger locational signals, as well as helping to identify (and de-risk) high value new transmission investments.

This can be delivered through a series of relatively incremental obligations on AEMO, TNSPs and private developers

ROLE OF AEMO

- A missing element of the existing information architecture is the difficulty faced by developers in undertaking detailed, wide area analysis related to system stability – to assess transient, oscillatory limits etc. Aside from modelling complexity, issues related to generator model confidentiality mean that AEMO is really the only party capable of undertaking this analysis

- For this reason, we consider AEMO should be obligated, under the NER, to formally develop the 'connections-portal' / 'digital twin' that has been discussed for several years. Defining this in the NER will allow AEMO to allocate resources to the project as well as providing a clear set of guiding principles to assist in design.

- We also consider the NER might be amended to require AEMO to develop a standardised set of criteria for assessing the various stages of the generation / storage development pathway, building on the 'committed' / 'anticipated' criteria already developed by AEMO.

- Formalising this definition would be a useful input into the AEMO modelling processes described above, as well as the TNSP analysis described in the next slide. This would also likely improve the effectiveness of the planning processes, by making it easier for TNSPs and AEMO to utilize 'bottom up' investment market information to help de-risk new transmission augmentations or repex.

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INVESTMENT ACCESS APPROACH

ROLE OF TNSP

- Provide much more detailed information on the state of the information, to enable generators to undertake their own congestion modelling, noting this may be focused more on load flow / thermal congestion analysis. This could include
  - Full network data (network topology, branch resistances and reactances, bus information etc.),
  - Committed, expected and proposed network augmentations and their parameters
  - Forecast and historical load and generation information for each node (bus).
- Undertake and publish detailed forecasts on current and expected congestion in networks, potentially utilizing CRM data. At a high level, this could be turned into a 'traffic light' signaling approach, or potentially more granular, detailed forecast information.
- Utilising the standardised project development criterion developed by AEMO, apply these criterion to projects being developed in their network area, to assess likely magnitude and probability of completion of new connections and subsequent congestion impacts on incumbents
- Publish this analysis in the TAPR and explain how these have been fed into RIT-T processes.
- This analysis would also be required to be fed up into the AEMO ISP and system strength node declaration processes

INVESTMENT ACCESS APPROACH

ROLE OF PRIVATE DEVELOPERS

In addition to new information obligations on NSPs and AEMO, private developers of generation and storage assets could also face enhanced information / modelling obligations.

- Undertaking basic load flow analysis to assess expected thermal congestion (and associated network effects, such as MLFs), already represents best practice for many developers
- However, enforcing this internal best practice is likely one of the more powerful locational signals we can send to incentivise connection in optimal parts of the power system
    - Developers could be required to undertake preliminary congestion analysis as part of the connection enquiry process. This would likely be in the form of load flow type analysis
    - As part of connection application, more detailed and extensive analysis could be required - dynamic PSSE etc
    - Developers could be required to share this information with the TNSP and AEMO on connection application

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RESPONSE TO OTHER INVESTMENT TIMESCALE MODELS

We note that the ESB has proposed other investment timescale models in their consultation paper. At this stage we do not support either of those models.

Queuing model:

- While this model would likely bring a degree of protection for incumbents, it brings with it several risks. Key amongst these is the perverse incentives created by a queue, where no one wants to be 'first in line' to bear the cost of a large network investment. This would lead to perverse outcomes.

- There is a risk that options that are efficient in the investment timescale might be less so in the operational – its unlikely a queue position determined in the investment timescale could be easily 'traded' with another party in the operational, even if this resulted in a far more efficient operational outcome.

Connection zone charging

- There are already several charges levied on new connecting parties, whether in the form of disadvantageous MLFs or congestion. Furthermore, the system strength regime already levies a charge that has a strong locational component. Connection charges are also levied through the NSW Roadmap, while other state led REZ developments will shortly be in place. These render an additional connection charge superfluous

- It is also unclear how such a charge could be realistically developed. Would it be based on LRMC/LRAC? How do you account for parties that actually reduce congestion? Is it fixed at connection, or does it vary over time?

- Also, what do developers get for paying the charge? This is entirely unclear at present.

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INVESTMENT TIMESCALE NEXT STEPS

Next steps for ESB:

- We urge the ESB to consider how the information flow models described here might be implemented
- The CEC is willing to work collaboratively with the ESB, as well as with the market bodies and other agencies, to develop this mechanism.
- Regarding progression of the other models, the ESB must do significant additional work on the congestion charging mechanism, to address the multiple queries we have identified. Further explanation must be provided as to how this charge might be structured, what any revenue raised would be used for, and how this would benefit new developers
- For the queuing model, the ESB must subject to model to rigorous analysis to understand what perverse incentives might be created in the investment timeframe and how these might be addressed. The ESB must also consider potential inefficiencies associated with translating an investment timescale mechanism to the operational.

Currently, we do not endorse or support either the queuing or connection charge models.

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APPENDIX I:
MODIFIED CRM MODEL

Assessment of the CRM

There are several benefits to the CRM – 1/3

- **The CRM improves dispatch efficiency** – The CRM enables additional ‘constraint relief’ transactions which are not possible in the NEM today; the CRM transactions only occur if they reduce the total system costs relative to the energy-only dispatch hence they can be considered ‘no regrets’ from the point of view of an economic dispatch.
- **Allows for additional revenue and cost savings** – The CRM extends the market participants’ decision space and allows additional revenue (and cost saving) opportunities while concurrently improving the efficient operation of the market. This will help increase productive efficiencies, by facilitating the most efficient resource mix and asset utilisation.
- **CRM prices are economically meaningful** – The CRM transactions and payments are economically meaningful, the nodal CRM prices reflect the cost and value of services provided and received.
- **CRM services are co-optimised with energy and other ancillary services** – This allows for the most efficient allocation of resources across multiple markets, to ensure that total system costs are minimised.
- **The CRM allows flexible management of financial risk exposure** – Market participants can select their level of involvement in the wholesale energy market and set limits to their involvement in the CRM at an operational timescale. Contractual positions can change annually, quarterly, or even from one trading interval to the next. The CRM allows market participants to adjust their energy market and CRM market position at a granular scale.

There are several benefits to the CRM – 2/3

- **Market participants can set limits to their involvement in the CRM** – Market participants select their level of involvement in the energy market and the CRM through submitting their bid and offer quantities and their offered maximum dispatch deviations allowed in the CRM from their energy market dispatches targets.

- **The incentive provided by the CRM is to bid the short-run marginal costs (SRMC)** – Relative to the bidding behaviour observed in the current energy market, market participants' bidding behaviour will be more closely aligned with their SRMCs and/or opportunity costs in the CRM.

- **The nodal CRM price provides a much better and stronger locational signal than the status quo** – The double-sided nature of the market facilitates price discovery and helps reveal the marginal value of congestion relief. This creates long term locational price signals for investors and technology providers. Nodal CRM prices would become available for each node and for each dispatch period. The nodal CRM prices would provide a granular and in-depth locational information for investors across the NEM.

- **The CRM is technology agnostic** - The Modified CRM is a technology agnostic approach to congestion management; any market participant can participate in the market.

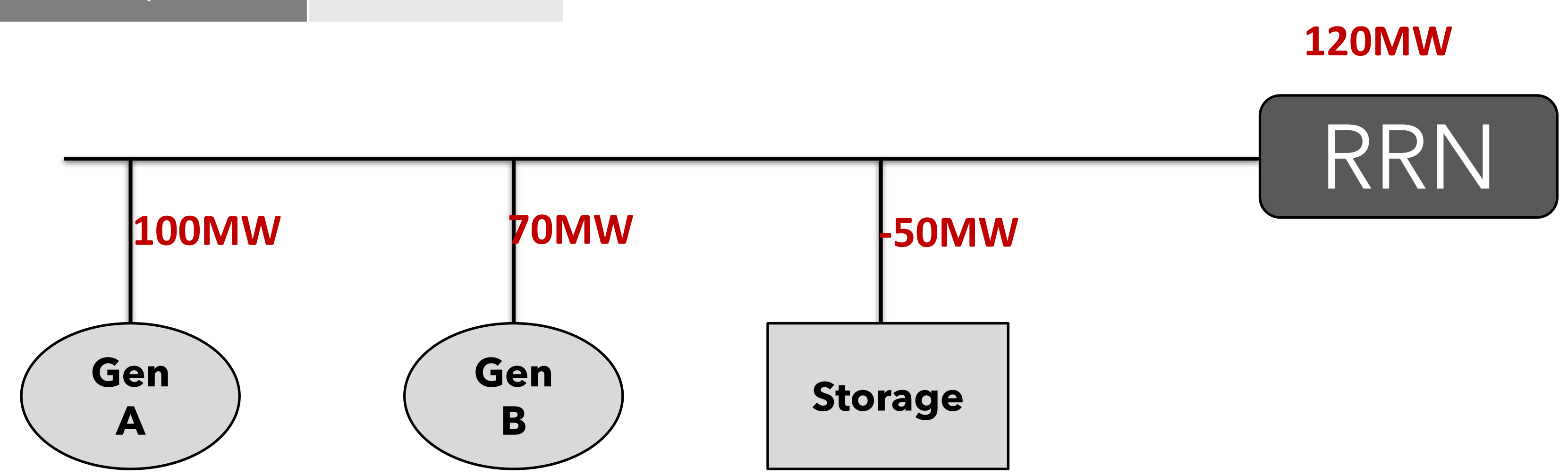
There are several benefits to the CRM – 3/3

- **The CRM facilitates the economic location of storage resources** – the CRM provides incentives for batteries or other storage facilities to locate in areas with substantial amounts of VRE generation periodically constrained down or off.
- **The CRM enhances the congestion information and leads to better informed operational and investment decisions** – The CRM results in a range of information and price signals that can enable existing and intending market participants to make more informed investment and operational decisions.
- **The CRM allows for a more efficient utilisation of the network by increasing the economic transactions that can occur using the same amount to network capacity** – The CRM increases the economic value of transactions between generation and load.
- **The CRM minimises additional administrative processes and also minimises the risk of political or regulatory interference in the market.** – The CMM does not require the ongoing management of a separate right when generators enter or exit the power system or when there is a network augmentation. No separate right needs to be issued, allocated, or extinguished.

Worked examples – Simple "bid true costs"

Status Quo – "bid true costs"

RRP	**$100**
Network capacity (Radial network)	**120MW**



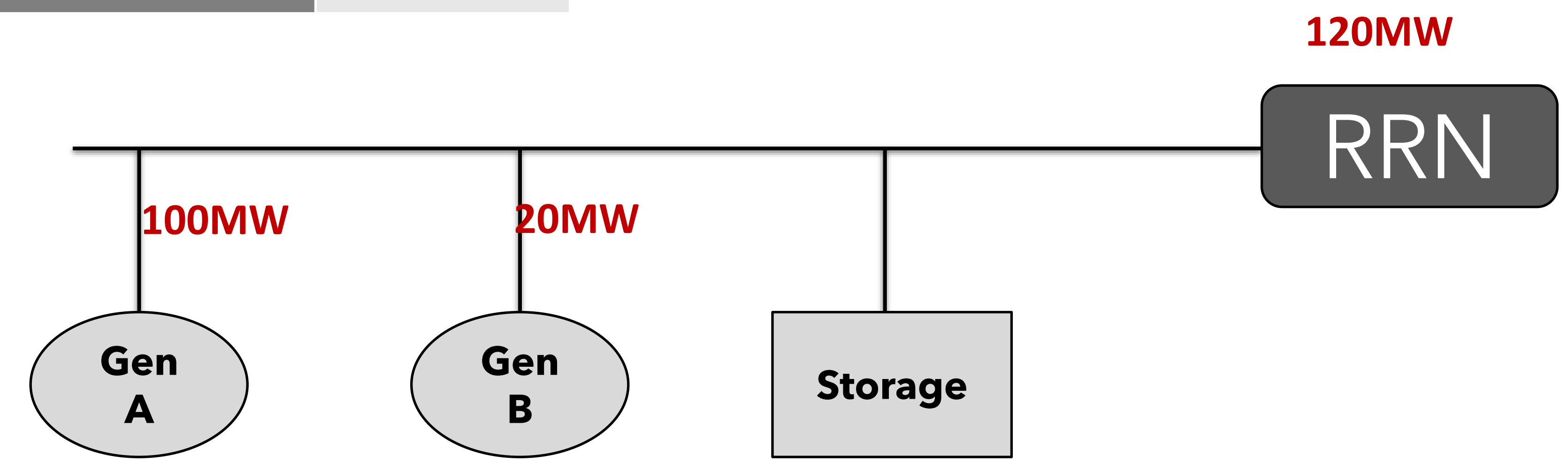
		Gen A	Gen B	Storage	Total
Costs	**SRMC**	$50 to generate	$60 to generate	$70 to charge $150 to discharge	
Bids and offers	**Energy market bids and offers**	100MW @ $50	100MW @ $60	-50MW @ $70	
				50MW @ $150	
Dispatch	**Dispatched**	100MW	70MW	-50MW	
Financial settlement	**Energy market revenue/payment**	100 x $100 = **$10,000**	70 x $100 = **$7,000**	-50 x $100 = **-$5,000**	
	Costs	100 x $50 = **$5,000**	70 x $60 = **$4,200**	-50 x $70 = **-$3500**	
	Net revenue	**$5,000**	**$2,800**	**-$1,500**	**$6,300**

Comments

If generators bid their true costs, then they will be dispatched in order of their SRMCs. When the storage provider is dispatched to charge (place a load) then it has to pay the RRP. As a result it makes a loss. Therefore, under current circumstances storage will be incentivised to withdraw from the market when the RRP is above its willingness to pay.

Storage provider withdraws load from market

RRP	**$100**
Network capacity (Radial network)	**120MW**



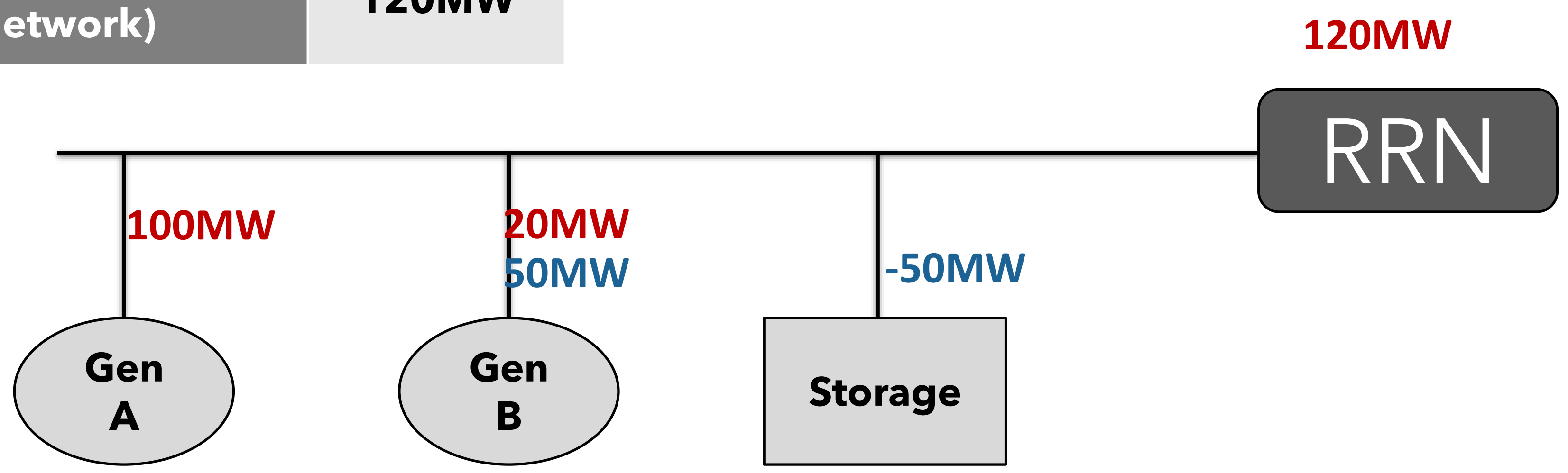
		Gen A	Gen B	Storage	Total
Costs	**SRMC**	$50 to generate	$60 to generate	$70 to charge $150 to discharge	
Bids and offers	**Energy market bids and offers**	100MW @ $50	100MW @ $60	~~50MW @ $70~~	
				50MW @ $150	
Dispatch	**Dispatched**	100MW	20MW		
Financial settlement	**Energy market revenue/payment**	100 x $100 = **$10,000**	20 x $100 = **$2,000**		
	Costs	100 x $50 = **$5,000**	20 x $60 = **$1,200**		
	Net revenue	**$5,000**	**$800**		**$5,800**

Comments

When storage provider withdraws from the market, the economic value of dispatch is reduced from $6,300 to $5,800.

CRM is introduced, storage participates in CRM

RRP	**$100**
CRM price	**$65**
Network capacity (Radial network)	**120MW**



		Gen A	Gen B	Storage	Total
Costs	**SRMC**	$50 to generate	$60 to generate	$70 to charge $150 to discharge	
Bids and offers	**Energy market bids and offers**	100MW @ $50	100MW @ $60	~~-50MW @ $70~~	
				50MW @ $150	
	CRM bids and offers		100MW @ $60	-50MW @ $70	
Dispatch	**Energy market**	100MW	20MW		
	CRM		50MW	- 50MW	
Financial settlement	**Energy market revenue/payment**	100 x $100 = **$10,000**	20 x $100 = **$2,000**		
	CRM revenue/payments		50 x $65 = **$3,250**	50 x $65 = -**$3,250**	
	Costs	100 x $50 = **$5,000**	70 x $60 = **$4,200**	50 x $70 = **$3,500**	
	Net revenue	**$5,000**	**$1050**	**$250**	**$6,300**

Comments

In order to avoid having to pay the RRP when charging, the storage provider does not participate in the energy market with its charging (load) but participated in the CRM during this dispatch interval. When the storage provider is dispatched to charge (place a load) then it only has to pay the CRM, not the RRP. Similarly, Gen B would be constrained down in the energy market but it has an additional opportunity to sell energy at CRM price in the local market. Under these circumstances storage will place a load on the system and it will be matched with Gen B at the CRM price.

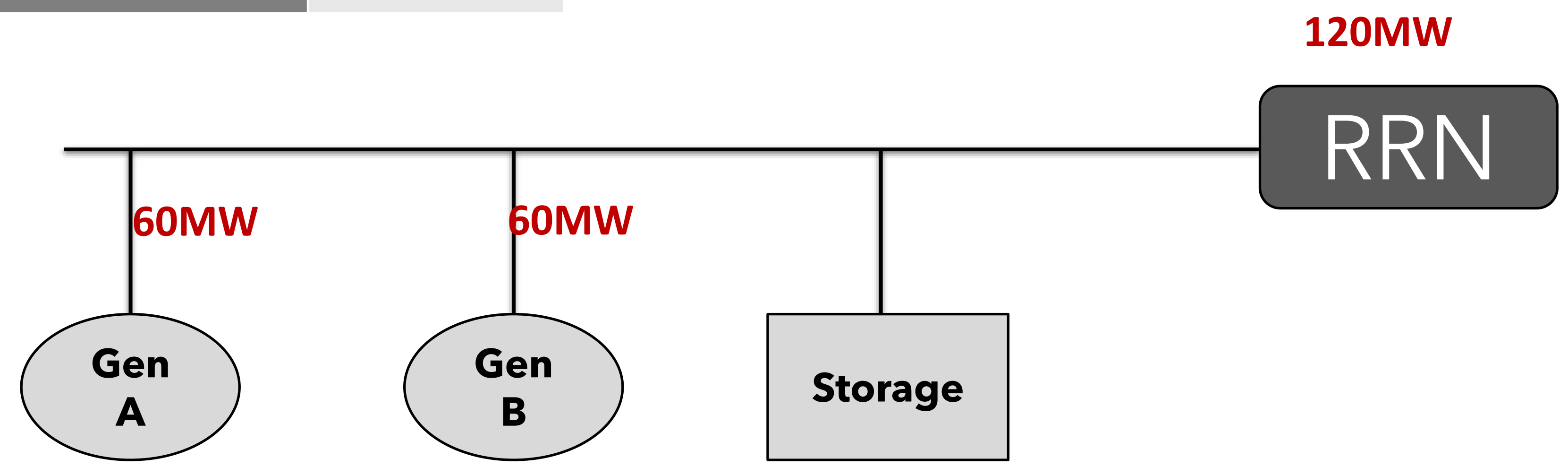
The CRM price will be determined based on CRM bids and offers. In this example, it is assumed to be $65.

The economic value of dispatch is again $6,300.

Worked examples – Simple “race to the floor bidding”

Status Quo – "race to the floor" and profit maximise

RRP	**$100**
Network capacity (Radial network)	**120MW**



		Gen A	Gen B	Storage	Total
Costs	**SRMC**	$50 to generate	$60 to generate	$70 to charge $150 to discharge	
Bids and offers	**Energy market bids and offers**	100MW @ -$1000	100MW @ -$1000	~~50MW @ -$70~~	
				50MW @ $150	
Dispatch	**Dispatched**	60MW	60MW		
Financial settlement	**Energy market revenue/payment**	60 x $100 = **$6,000**	60 x $100 = **$6,000**		
	Costs	60 x $50 = **$3,000**	60 x $60 = **$3,600**		
	Net revenue	**$3,000**	**$2,400**		**$5,400**

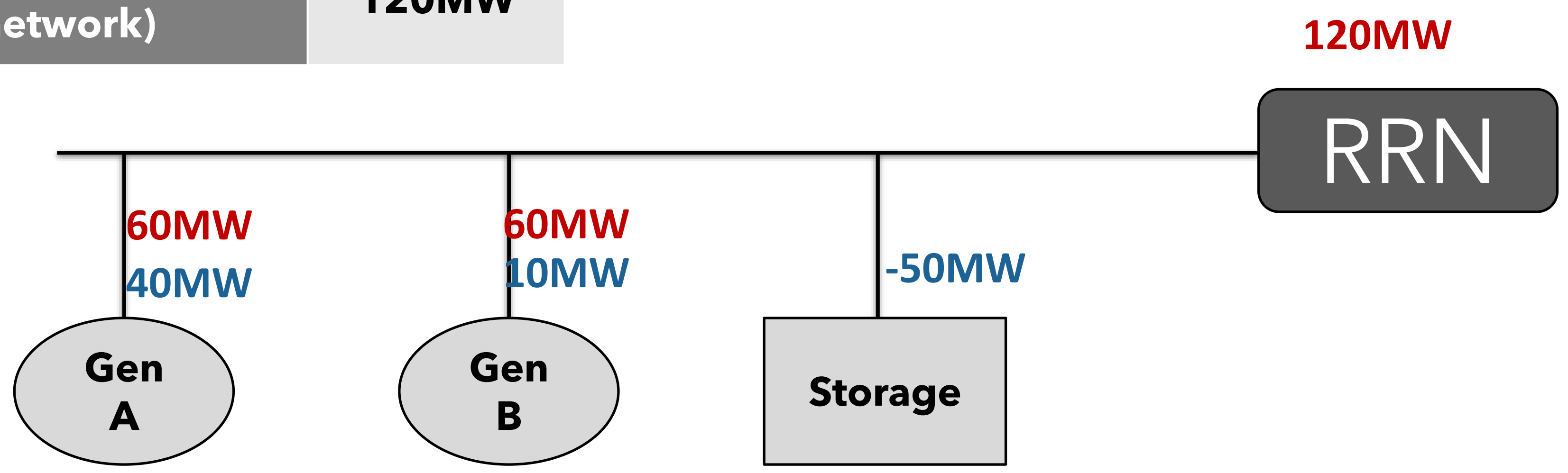
Comments

Under current incentives, generators have an incentive to 'race to the floor' when there is congestion and the RRP is above their SRMC. Storage has an incentive to withdraw its charging (load) from the market.

In the radial part of the network, generators will share the network capacity and will be rationed. In this case, both generators are dispatched for 60MW.

CRM is introduced, storage participates in CRM

RRP	$100
CRM price	$65
Network capacity (Radial network)	120MW



		Gen A	Gen B	Storage	Total
Costs	SRMC	$50 to generate	$60 to generate	$70 to charge $150 to discharge	
Bids and offers	Energy market bids and offers (SRMC)	100MW @ -$1000	100MW @ -$1000	~~-50MW @ -$70~~	
				50MW @ $150	
	CRM bids and offers	100MW @ $50	100MW @ $60	-50MW @ $70	
Dispatch	Energy market	60MW	60MW		
	CRM	40MW	10MW	- 50MW	
Financial settlement	Energy market revenue/payment	60 x $100 = **$6,000**	60 x $100 = **$6,000**		
	CRM revenue/payments	40 x $65 = **$2600**	10 x $65 = **$650**	-50 x $65 = **-$3,250**	
	Costs	100 x $50 = **$5,000**	70 x $60 = **$4,200**	50 x $70 = **$3,500**	
	Net revenue	$3,600	$2,450	$250	$6,300

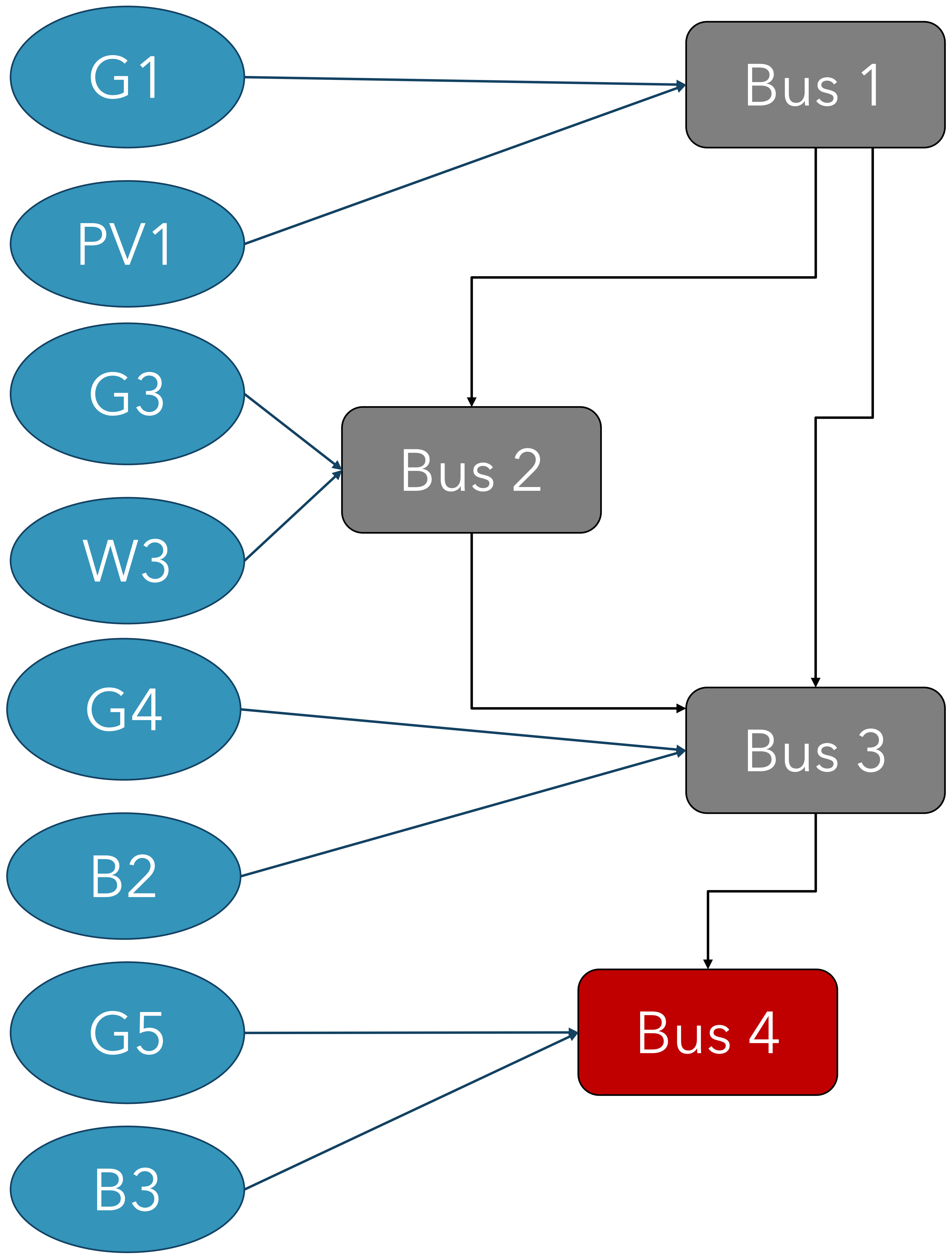
Comments

Under the CRM, generators may sill pursue a 'race to the floor' bidding incentive. In addition, however, they may also compete in the CRM. Given that storage providers will have an incentive to participate in the CRM, there are potential mutually beneficial trades that can be made.

Gen A and Gen B will provide a bid into the CRM, in addition to the energy market bid. As a result, the storage provider will be dispatched to charge, Gen A will be dispatched to sell an additional 40MW and Gen B to sell an additional 10MW.

The economic value of dispatch is again $6,300.

Worked examples – Four bus example based on Excel model provided by SW Advisory



In this example, there are four buses (nodes) and 7 generators located across the four buses. The generators are a mix of dispatchable, PV, wind, and batteries and their characteristics are presented in the table below.

Name	Type	Node/bus	Minimum power (Pmin)	Maximum power (Pmax)	Participates in CRM
G1	Dispatchable generator	1	0	100	1
G3	Dispatchable generator	2	0	100	0
G4	Dispatchable generator	3	0	100	0
G5	Dispatchable generator	4	0	100	1
PV1	PV generator	1	0	100	1
W3	Wind generator	2	0	100	1
B2	Battery	3	-100	100	1
B3	Battery	4	-100	100	1

In this example the regional reference node is at bus 4 and there is congestion between bus 1 and 3 and bus 3 and 4. The RRP is $1000/MWh (the nodal price for bus 4) and the bus (nodal) energy and CRM marginal prices are presented

Market participants energy and CRM offers

Name	Type	SRMC/opportunity cost	Energy offer 1	Energy offer 2	CRM offer 1	CRM offer 2
G1	Dispatchable generator	60	50MW @ 40	50MW @ 42	60MW @60	40MW @ 65
G3	Dispatchable generator	75	50MW @ 80	50MW @ 82	60MW @75	40MW @75
G4	Dispatchable generator	76	50MW @ 100	50MW @ 250		
G5	Dispatchable generator	77	50MW @ 300	50MW @ 1000	60MW @77	40MW @86
PV1	PV generator	-40	50MW @ -1000	50MW @ -960		
W3	Wind generator	-44	50MW @ -1000	50MW @ -960	60MW @-44	40MW @-44
W4	Wind generator	-60	50MW @ -1000	50MW @ -960		
B2	Battery	82	100MW @ 96	100MW @101	100MW @81	100MW @86
B3	Battery	83	100MW @ 97	100MW @100	100MW @83	100MW @84

Comments

All market participants expect G4, PV1 and W4 participate in the CRM.
The energy and CRM offers are presented in the table below.
Market participants submit a supply schedule in the energy and in the CRM market.
No CRM participant sets a limit to its CRM participation, i.e. no upper and lower dispatch deviation bounds are set by the MPs.

Dispatch outcomes

RRP	CRM price
300	86

In this example, the CRM price is the same at all four nodes, it is $86.

Name	Type	SRMC/opportunity cost	Energy dispatch (adjusted for Pmin)	CRM deviations dispatch	Total dispatch	Energy revenue (energy dispatch x RRP)	Energy short run cost	Energy profit	CRM revenue	Total profit	Total profit - energy profit
G1	Dispatchable generator	60	100	0	100	30,000	6,000	24,000	0	24,000	0
G3	Dispatchable generator	75	100	0	100	30,000	7,500	22,500	0	22,500	0
G4	Dispatchable generator	76	100	0	100	30,000	7,600	22,400	0	22,400	0
G5	Dispatchable generator	77	40	60	100	12,000	3,080	8,920	5,160	9,460	540
PV1	PV generator	-40	100	0	100	30,000	-4,000	34,000	0	34,000	0
W3	Wind generator	-44	100	0	100	30,000	-4,400	34,400	0	34,400	0
W4	Wind generator	-60	100	0	100	30,000	-6,000	36,000	0	36,000	0
B2	Battery	82	100	-60	40	30,000	8,200	21,800	-5,160	21,560	-240
B3	Battery	83	100	0	100	30,000	8,300	21,700	0	21,700	0
			840	**0**	**840**	**252,000**	**26,280**	**225,720**	**0**	**226,020**	**300**