Transmission access reform TWG #3

29 May 2024

AEMC

Meeting agenda

	Introduction and acknowledgement of country	Slides 1 – 7	Victoria Mollard | EGM
1.	Co-optimisation	Slides 8 – 16	Jessie Foran | Senior Adviser
2.	Dynamic grouping	Slides 17 – 22	Phillip Munro-Laylim | Adviser
3.	Open discussion	Slides 23 – 24	Jessie Foran | Senior Adviser
4.	Survey	Slides 25 – 26	Jessie Foran | Senior Adviser
	Meeting close		

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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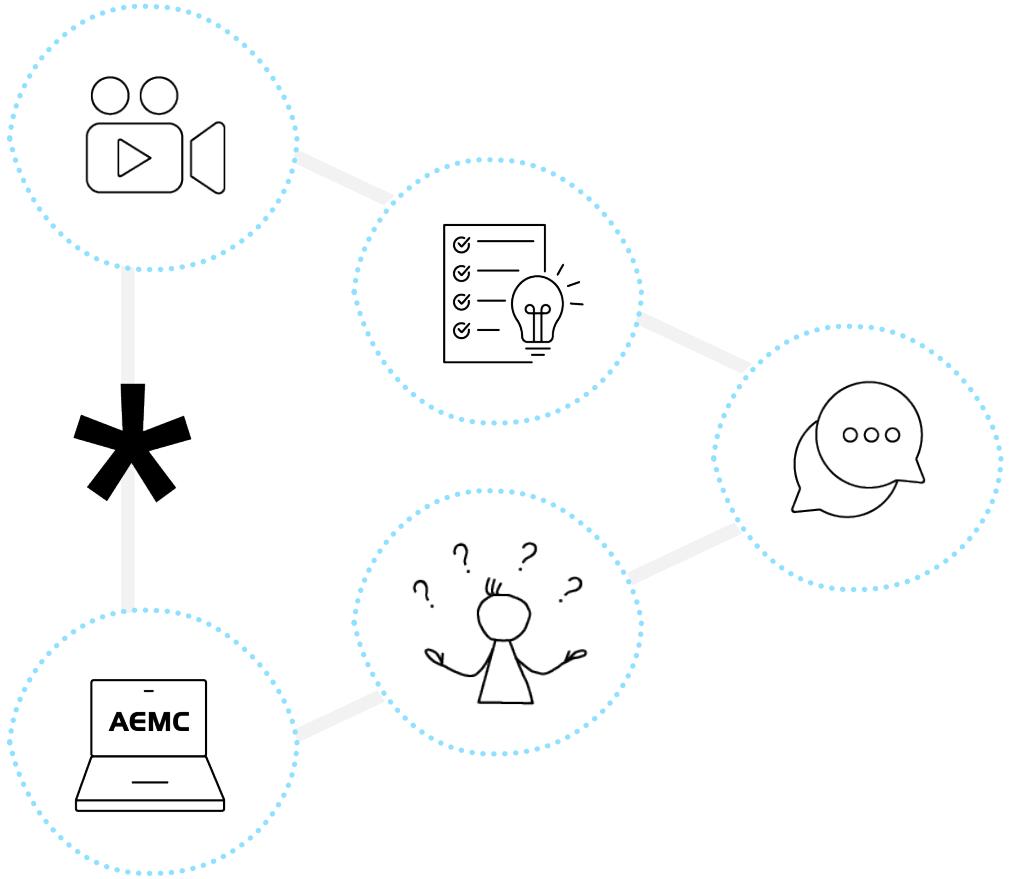

COMPETITION PROTOCOL

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COMPETITION PROTOCOL

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  - Attendees at this forum must not enter into any discussion, activity or conduct that may infringe, on their part or on the part of other attendees, any applicable competition laws. For example, attendees must not discuss, communicate or exchange any commercially sensitive information, including information relating to prices, marketing and advertising strategy, costs and revenues, terms and conditions with third parties, terms of supply or access.
  - Participating in this forum is subject to you having read and understood the protocol including the Key Principles.
- We will keep accurate minutes of the forum, including details of attendees.
- If something comes up during the forum that could risk contravening any competition laws, attendees should:
  - Object immediately and ask for the discussion to be stopped.
  - Ensure the minutes record that the discussion was objected to and stopped.
  - Raise concerns about anything that occurred in the forum with their respective legal counsel immediately afterwards.
- All attendees understand that any competitively sensitive matters must be subject to legal review before any commitment/agreement can be given.
- Any decision about whether, and on what terms, to engage with customers and suppliers is an independent and unilateral decision of each attendee.

Objectives of this TWG meeting

The main objectives of this meeting are to:

- **Provide more detailed information** on co-optimisation and dynamic grouping
- **Understand your views** on the important factors and materiality of any issues for each option.

We are aiming for this to help provide you with additional information that may inform your views and feedback on the options, including through submissions to the consultation paper.

This will also help us develop a stronger understanding of any issues you consider to be important, that would inform our understanding on the potential of the options.

There will also be time to have questions and discuss on transmission access reform more generally.

We will finish with a survey, similar to the one conducted at the April TWG, to help us gauge your views and whether they may have changed from April.

Co-optimisation

Co-optimisation could resolve issues with two-stage dispatch

Two-stage dispatch produces two RRP choices

Two separate dispatches, each similar to current dispatch meaning low implementation cost and complexity.

Access dispatch includes priority access, physical dispatch allows for CRM variations.

Two dispatches leads to two RRP choices for settlement, neither of which is ideal.

We prefer the access RRP to ensure the CRM remains **voluntary**.

Access RRP

Issues include:

- Could be increased by priority access, as demonstrated by AEMO's prototyping
- Additional settlement complexity for unconstrained CRM participants, as CRM deviations would be paid at the physical RRP which could differ from the access RRP

Physical RRP

Issues include:

- Potential pricing inconsistency for non-CRM participants, impacting the voluntary nature of the CRM
- Perverse bidding incentives in access dispatch for CRM participants due to lack of exposure to access RRP

Co-optimisation could resolve RRP issues

Co-optimising access and physical dispatches produces only one RRP that corresponds to the marginal cost of physical generation.

This RRP could address the two-stage dispatch RRP issues by:

- Ensuring pricing consistency for non-CRM participants as their settlement price is from the same dispatch that determines their dispatch outcomes
- Potentially avoiding RRP increases as price is not determined in the prioritised access dispatch
- Ensuring all participants are exposed to the RRP
- Avoiding settlement complexity for unconstrained CRM participants

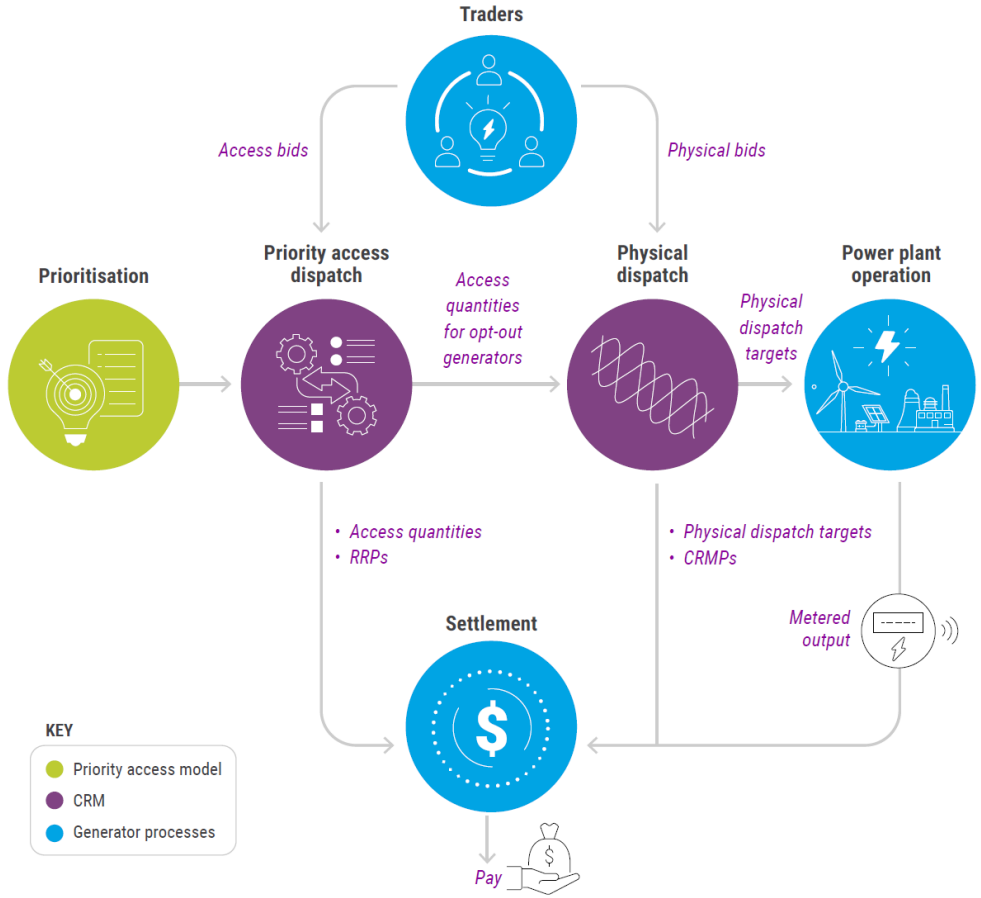
Co-optimisation could also have additional benefits compared to two-stage, see slide 32 for more information.

Two-stage dispatch produces two RRPs

Under the two-stage dispatch option, each dispatch must be physically feasible and balance supply with demand.

Each dispatch would contain a regional energy balance (REB) constraint to ensure supply meets demand.

The marginal cost of this constraint in each dispatch sets the RRP of that dispatch – this is why two-stage has two possible RRPs. The separate dispatches can also add complexity to settlement for CRM participants, as CRM prices would be set separately in a dispatch to the dispatch that sets the RRP (if the access RRP is used).



Only one RRP is produced by co-optimisation

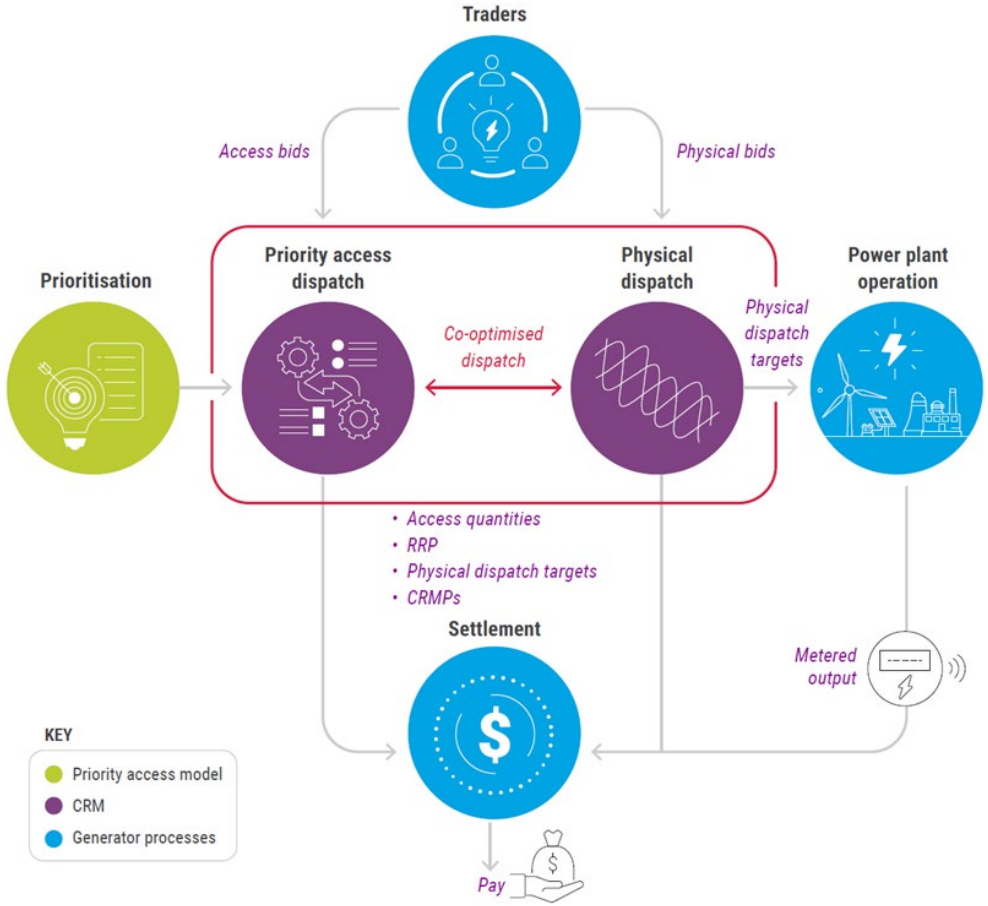
Under co-optimisation, only the physical dispatch needs to be physically feasible.

An REB constraint is only needed in the physical dispatch. In other words, access dispatch does not have a REB constraint.

If there is low-no CRM participation, access dispatch will automatically be made physically feasible by the constraints of the physical dispatch (in co-optimisation, both dispatches influences each other).

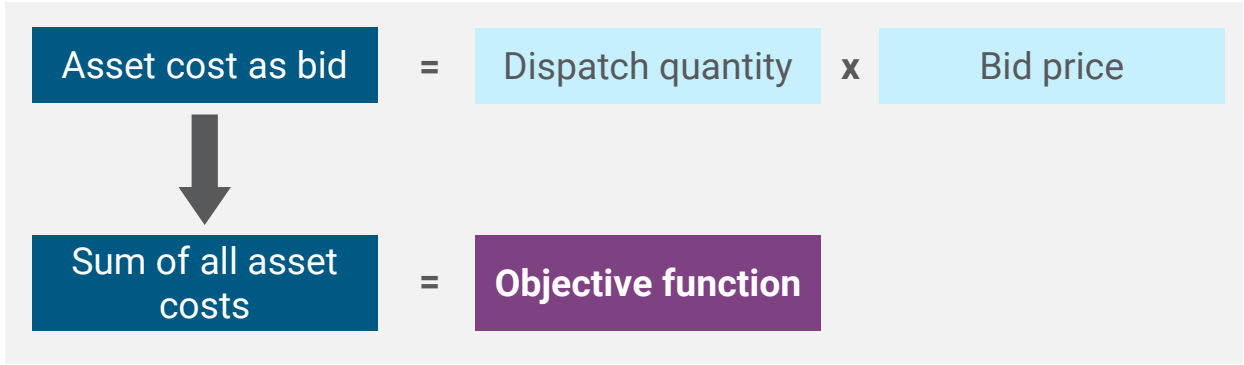
Consequentially:

- Only one RRP is produced in co-optimisation and can be determined by access or physical bids. This is why pricing is consistent for non-CRM participants, whose access dispatch is ultimately physical.
- Since the RRP is determined by physical generation, it would not necessarily be increased by priority access. The RRP could still be increased if there is insufficient CRM participation, as with the two-stage dispatch.
- Supply does not have to meet demand in the access dispatch.



Dispatch co-optimisation

Two-stage – each dispatch is similar to current dispatch



Two-stage dispatch runs two separate dispatches sequentially with separate objective functions:

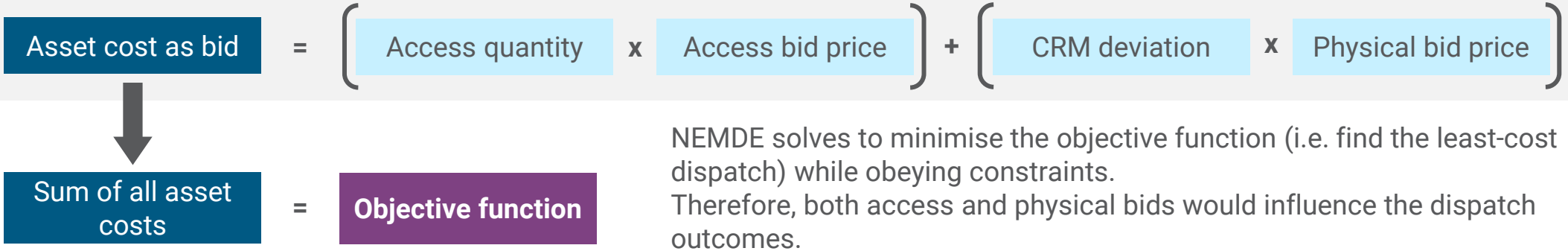
1. Access dispatch
2. Physical dispatch

The separation and order of dispatch means that access dispatch can influence physical dispatch, but not vice versa.

Co-optimisation – least-cost solution across both dispatches

Each asset cost is determined by their bids into access and physical dispatches

Note: physical dispatch = access dispatch + CRM deviation



NEMDE solves to minimise the objective function (i.e. find the least-cost dispatch) while obeying constraints.
Therefore, both access and physical bids would influence the dispatch outcomes.
This is somewhat analogous to how energy and FCAS are co-optimised.

AEMO's concerns with co-optimisation

AEMO has developed an Excel spreadsheet to test co-optimisation:

Issue	AEMO view
It changes the RRP	1. The new RRP can be set by CRM bids which could be perceived to undermine the voluntary nature of the CRM 2. A new RRP could impact the wholesale contract market and trigger reopeners on existing contracts such as LTESAs.
There could be a funding shortfall	The lack of a regional energy balance constraint in the access dispatch means there could be more receivers of RRP than payers, creating a settlements shortfall
Bid combinations can undermine priority access	See next slide
It is unproven and has not been rigorously tested	It is a new market design that, unlike two-stage dispatch, has not been rigorously tested nor proven to fix the impact of priority access on RRP
It will be more costly to implement	The complexity around bidding and dispatch means it will likely be more costly to implement than the two-stage dispatch

Bid combinations in co-optimisation

CRM $/MWh	CRM Delta MW	0	1	2	3	4	5	6	7	8	9	10
80	10	800										
80	9	720	-280									
80	8	640	-360	-1,360								
80	7	560	-440	-1,440	-2,440							
80	6	480	-520	-1,520	-2,520	-3,520						
80	5	400	-600	-1,600	-2,600	-3,600	-4,600					
80	4	320	-680	-1,680	-2,680	-3,680	-4,680	-5,680				
80	3	240	-760	-1,760	-2,760	-3,760	-4,760	-5,760	-5,681			
80	2	160	-840	-1,840	-2,840	-3,840	-4,840	-5,840	-5,761	-5,682		
80	1	80	-920	-1,920	-2,920	-3,920	-4,920	-5,920	-5,841	-5,762	-5,683	
80	0	0	-1,000	-2,000	-3,000	-4,000	-5,000	-6,000	-5,921	-5,842	-5,763	-5,684
78	-1		-1,078	-2,078	-3,078	-4,078	-5,078	-6,078	-5,999	-5,920	-5,841	-5,762
78	-2			-2,156	-3,156	-4,156	-5,156	-6,156	-6,077	-5,998	-5,919	-5,840
78	-3				-3,234	-4,234	-5,234	-6,234	-6,155	-6,076	-5,997	-5,918
78	-4					-4,312	-5,312	-6,312	-6,233	-6,154	-6,075	-5,996
78	-5						-5,390	-6,390	-6,311	-6,232	-6,153	-6,074
78	-6							-6,468	-6,389	-6,310	-6,231	-6,152
78	-7								-6,467	-6,388	-6,309	-6,230
78	-8									-6,466	-6,387	-6,308
78	-9										-6,465	-6,386
78	-10											-6,464
		Access Qty MW										
		Access Bid Price $/MWh	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	79	79	79	79
		EN Cumulative	0	-1,000	-2,000	-3,000	-4,000	-5,000	-6,000	-5,921	-5,842	-5,763	-5,684

Access and CRM delta bids create a complex range of objective function outcomes.

E.g. a 2 MW access bid at -$1000 and -1 MW CRM bid at $78 impacts objective function by -$2078.

This will beat any priority access bid from an opt-out generator.

AEMC's views on co-optimisation

The AEMC is aware of AEMO's concerns and shares views on some issues while having separate views on others.

Topic	AEMC view
Physical RRP	We consider that co-optimised RRP would represent the efficient physical RRP. While it could be set by CRM bids, we consider that CRM is still voluntary as participants would be able to not participate in the CRM and only face the RRP (similar to how FCAS is voluntary).
Funding shortfall	We do not consider that there would be any increase to funding shortfalls under co-optimisation, however we acknowledge that further investigations would be needed to determine the potential of large negative inter-regional settlement residues. We consider that any intra-regional settlement residues would be positive due to the CRM, and would be allocated back to consumers (as per the two-stage).
Bidding combinations	We agree that priority access would need to be modified to address this concern. We could consider a solution that could adjust BPFs to resolve this issue and are considering potential implications.
Testing to date	We agree that co-optimisation has not been fully tested and there are aspects of it that have not been definitively proven. However, we expect co-optimisation to be able to achieve the desired outcomes, particularly resolving the RRP issues in two-stage. If there was support, this would be the next stage to undertake i.e. detailed testing.
Implementation costs	We agree that implementing co-optimisation would be more technically complex and costly, but that it would produce higher benefits. Therefore, an updated cost estimate and consideration of benefits would be required if co-optimisation is pursued further.

Is a co-optimised CRM voluntary?

- Like the two-stage model, the co-optimised model ensures that generators can choose to opt-out. For a generator that does not opt-in to the CRM:
  - the physical and access quantity will be equal, such that they are only settled at the RRP
  - they will only be settled at one FCAS price (we have heard that this is not a concern for the two-stage model).
- The RRP may change compared to the status quo due to the co-optimisation. We consider co-optimisation may:
  - provide a more efficient RRP that reflects the cost of meeting demand, being less affected by today's disorderly bidding
  - be similar to a new FCAS market where the energy price is influenced by the FCAS price but a participant is not required to participate in FCAS
  - keep the CRM voluntary, as we consider that participants who do not wish to participate in the CRM would be able to manage their position and would continue to be exposed only to the RRP.
- We are interested in stakeholder views on this point
- We note that the two-stage model will also result in a change to the RRP due to priority access, despite the two dispatches being (largely) separate. Opt-in generators may have different bidding incentives in the access dispatch compared to the status quo, which could change the RRP and dispatch outcomes.

Further work required on co-optimisation

The AEMC is considering whether to continue investigations on co-optimisation.

Our recommendations to Ministers in September will need to be well-informed, however finer details (such as rules drafting) would not be required for either CRM implementation option.

Continuing work on co-optimisation

If stakeholders support further development of co-optimisation, the AEMC would need to conduct further investigations into co-optimisation prior to providing recommendations to Ministers in September.

This further work would include:

1. Addressing AEMO's concerns
2. Obtaining an estimate of implementation costs from AEMO
3. Developing a prototype to further test co-optimisation
4. Further consideration of more detailed design options.

Focusing work on two-stage

If there is insufficient support for co-optimisation and/or if the AEMC considers that two-stage is preferrable:

- Further investigations on co-optimisation will be halted
- Work will focus on development and refinement of two-stage dispatch implementation option.

Dynamic grouping

There are four grouping options for priority access

Option 1. Grouping by time-window

- This is our preferred option and have presented this option to stakeholders in 2023. There would likely be 10 priority levels.
- Participants would be grouped into priority levels in annual batches, based on when they connect or when their REZ reached some point in the planning process.
- Each group would move up a priority level each year, before pooling in the highest priority level for the duration of priority access.

Option 2. Grouping by time-window with REZ preferences

- This is identical to option 1, however REZs (and REZ generators) are immediately placed in the highest priority level.

Option 3. Two centrally determined tiers

This option is a departure from the market-based queue model agreed by Ministers in 2023. Jurisdictions or a central body would either prioritise or deprioritise generators into two tiers.

- Prioritised generators would likely be:
  - Incumbents and committed plant
  - Generators in REZs
  - Other generators that may be desirable to prioritised.
- All other generators would be deprioritised.

Option 4. Dynamic grouping

- Dynamic grouping is a new grouping method that could provide harder priority access (compared to other options) and provide a strictly chronological prioritisation approach.
- A sequential dispatch algorithm would be run before dispatch to progressively prioritise or deprioritise generators based on when they connected and whether their dispatch would need to be constrained to avoid constraint violations.
- Using only two BPFs allows priority access to be ‘harder’.

Legend Preferred option | Option requiring further investigation

The potential benefits of dynamic grouping

Limitations on hardness of priority access

The options to group by time-window (with or without REZ preference) use 10 BPFs.

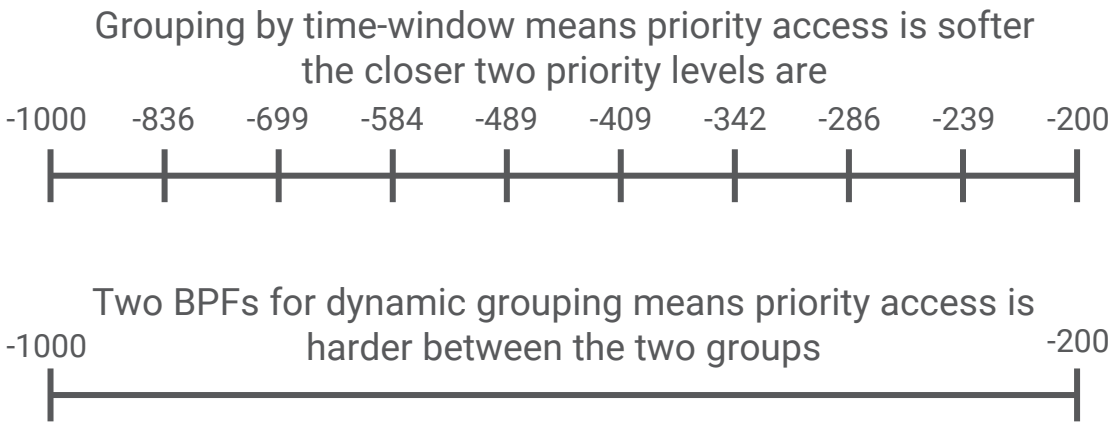
The more BPFs are used, the softer priority access will be between adjacent levels of priority access. This is because the BPFs are closer together and the bid price advantage of the higher priority generator is weaker.

Dynamic grouping presents an option to provide harder chronological priority access by using only two groups (and BPFs). Dynamic grouping would prioritise generators in order of when they connect, so that new entrants are less able to cannibalise older generators.

Dynamic grouping can exclude or include select constraints

Dynamic grouping is also an option to exclude wide-reaching constraints from priority access (discussed more on slide 20).

This cannot be done in other priority access grouping options, as they are implemented directly in dispatch which must include the constraints to be physically feasible.

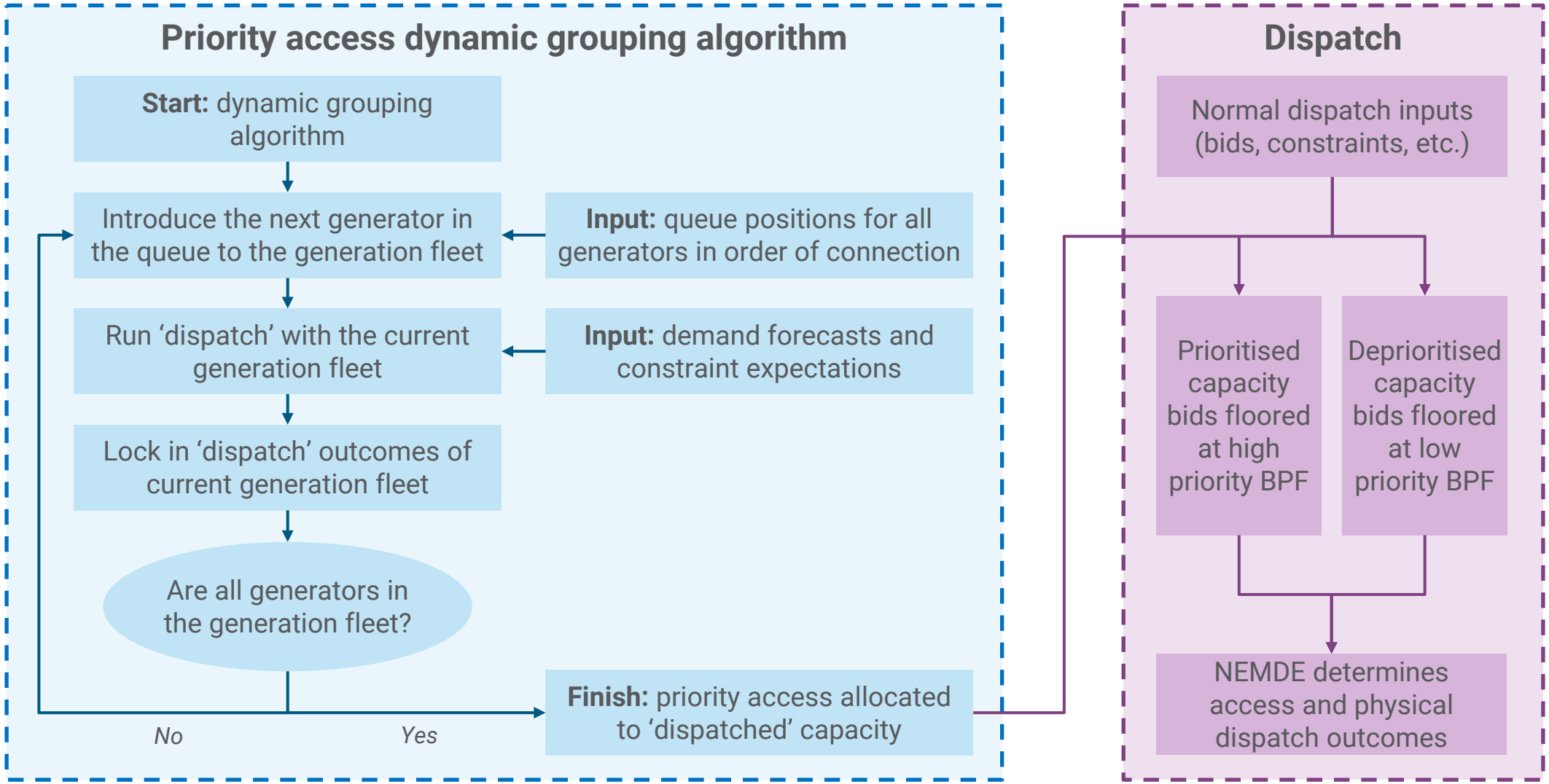


BPF numbers are indicative.

	Two-stage	Co-optimisation
Smaller BPF difference	Softer priority access, more RRP increases	Softer priority access, least RRP increases
Larger BPF difference	Harder priority access, most RRP increases	Harder priority access, less RRP increases

If dynamic grouping is decided to be a preferable priority access option, further work would be required to design it in more detail and to test its implementation and effects.

Dynamic grouping algorithm would run before dispatch



This is only indicative of how dynamic grouping might work.
Specific details and process would need to be determined, for example using a faster but equivalent algorithm.

Dynamic grouping – an indicative example

In a simple example, consider three generators (G1, G2, G3) behind a radial 175 MW constraint, and a fourth unconstrained generator (G4). All generators have 100 MW capacity and were built in order (from oldest to newest) of G1, G2, G3, and G4.

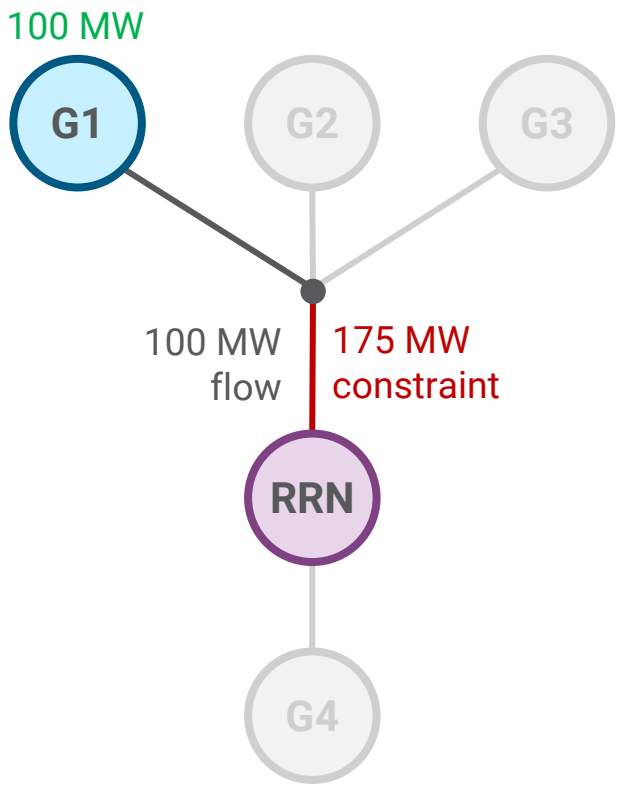
The dynamic grouping algorithm is run before dispatch to *allocate priority access* in a strictly chronological order.

Each consecutive dispatch '*locks*' the dispatch of generators from the previous run adds the next generator in the queue.

This way, the generators first in the queue get allocated priority access ahead of generators behind them, subject to transmission constraints.

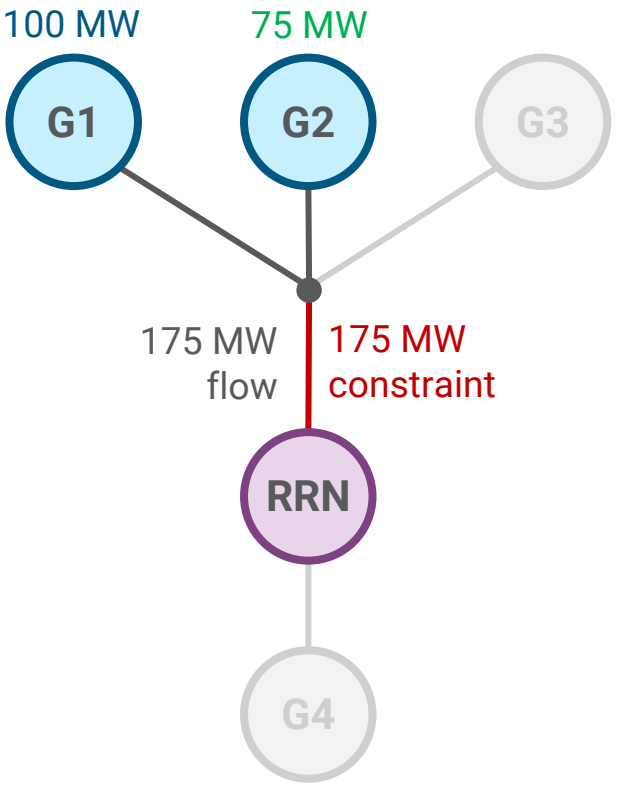
Dynamic grouping – run 1

In the first run, only G1 is allowed to be dispatched. It can be fully dispatched to 100 MW without violating the constraint.



Dynamic grouping – run 2

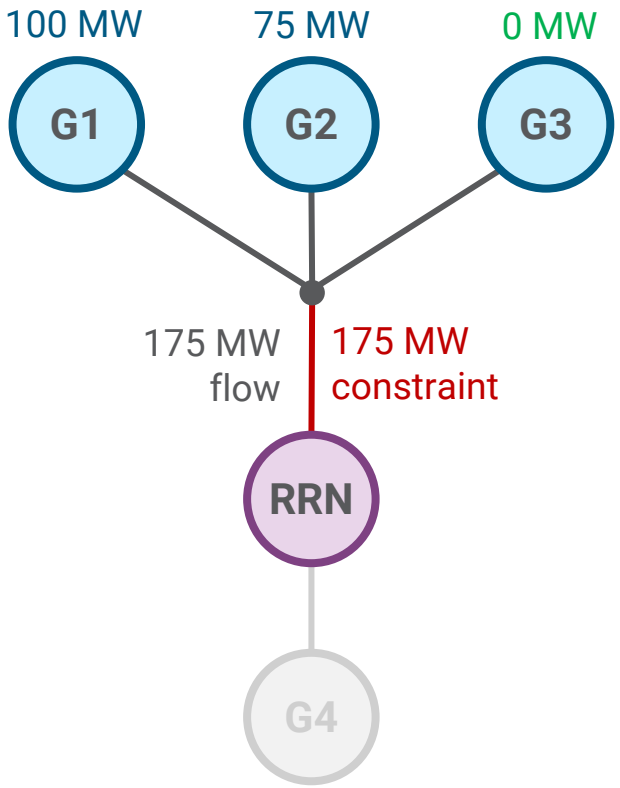
With G1's 100 MW dispatch 'locked', G2 can only be dispatched to 75 MW before the constraint binds.



Dynamic grouping – an indicative example

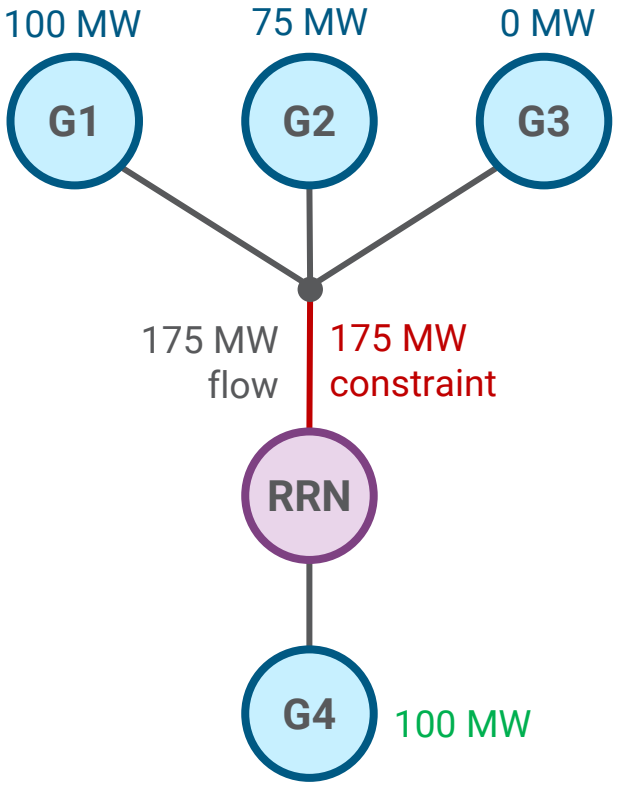
Dynamic grouping – run 3

In the third run, previous dispatches of G1 and G2 are 'locked' and the constraint is binding. Hence, G3 cannot be dispatched at all without violating the constraint.



Dynamic grouping – run 4

In the fourth run, G4 can be fully dispatched since it does not contribute to the constraint.



The final 'dispatch' from this dynamic grouping algorithm corresponds to the *allocation* of priority access for the actual dispatch.

Prioritised capacity could be offered at the lowest bid price floor (e.g. -$1000/MWh), while deprioritised capacity could only be offered at some higher bid price floor (e.g. -$200/MWh). Due to the algorithm, capacity is prioritised in chronological order of entry and accounts for constraints.

The table below shows the prioritised and deprioritised capacity from the dynamic grouping algorithm.

	G1	G2	G3	G4
Prioritised MW	100	75	0	100
Deprioritised MW	0	25	100	0

Dynamic grouping could address wide-reaching constraints

1 Generators currently 'share the pain' for wide-reaching constraints

Wide-reaching constraints are constraints that can be spontaneously introduced to manage the power system (e.g. a spontaneous system strength constraint) and affect a large number of participants with equal constraint coefficients.

When such constraints arise and bind, affected generators constrained by the constraint bid at MFP (to maximise individual dispatch).

They are dispatched pro-rata based on availability (due to equal coefficients).

This means that they 'share the pain' of the wide-reaching constraint.

2 Low priority generators faces risks from wide-reaching constraints

Introducing priority access would limit how low generators can bid to their BPF, altering the dispatch outcomes.

Low priority generators would have higher bids and be dispatched less than high priority generators when wide-reaching constraints bind (subject to other binding constraints).

Therefore, low priority generators would face increased risks to such constraints.

However, we also recognise that it may be these circumstances that priority access might be most important to prioritised generators.

3 Dynamic grouping could 'share the pain' as if a constraint did not exist

Priority access is directly integrated with dispatch grouping by time-window options. Constraints cannot be removed since dispatch must be physically feasible.

The dynamic grouping algorithm is run before dispatch and does not need to be physically feasible. This means certain constraints could be left out if desired.

If a wide-reaching constraint arose, it could be excluded from dynamic grouping. Priority access and dispatch would be determined as if it did not exist, 'sharing the pain' similar to current arrangements.

Note that a deprioritised generator not dispatched prior to the wide-reaching constraint, would still not get dispatched.

Open discussion

Over to you – open discussion

What would you like to discuss or ask?

Survey

Survey

At the April TWG, we did a survey to get your initial feedback on the consultation paper.

We are conducting another survey to gauge your current feedback and see how TWG members' views may or may not have changed since April.

We also understand that any feedback you provide today is still preliminary feedback, submissions to the consultation paper are due 6 June.

Please join Mentimeter survey as directed.

We will go through each question and provide time for you to enter an answer.

We may ask you to elaborate on your answer and hope this will lead to discussions on other matters that interest TWG members.

Next steps

Submissions to the consultation paper are due by 6 June 2024

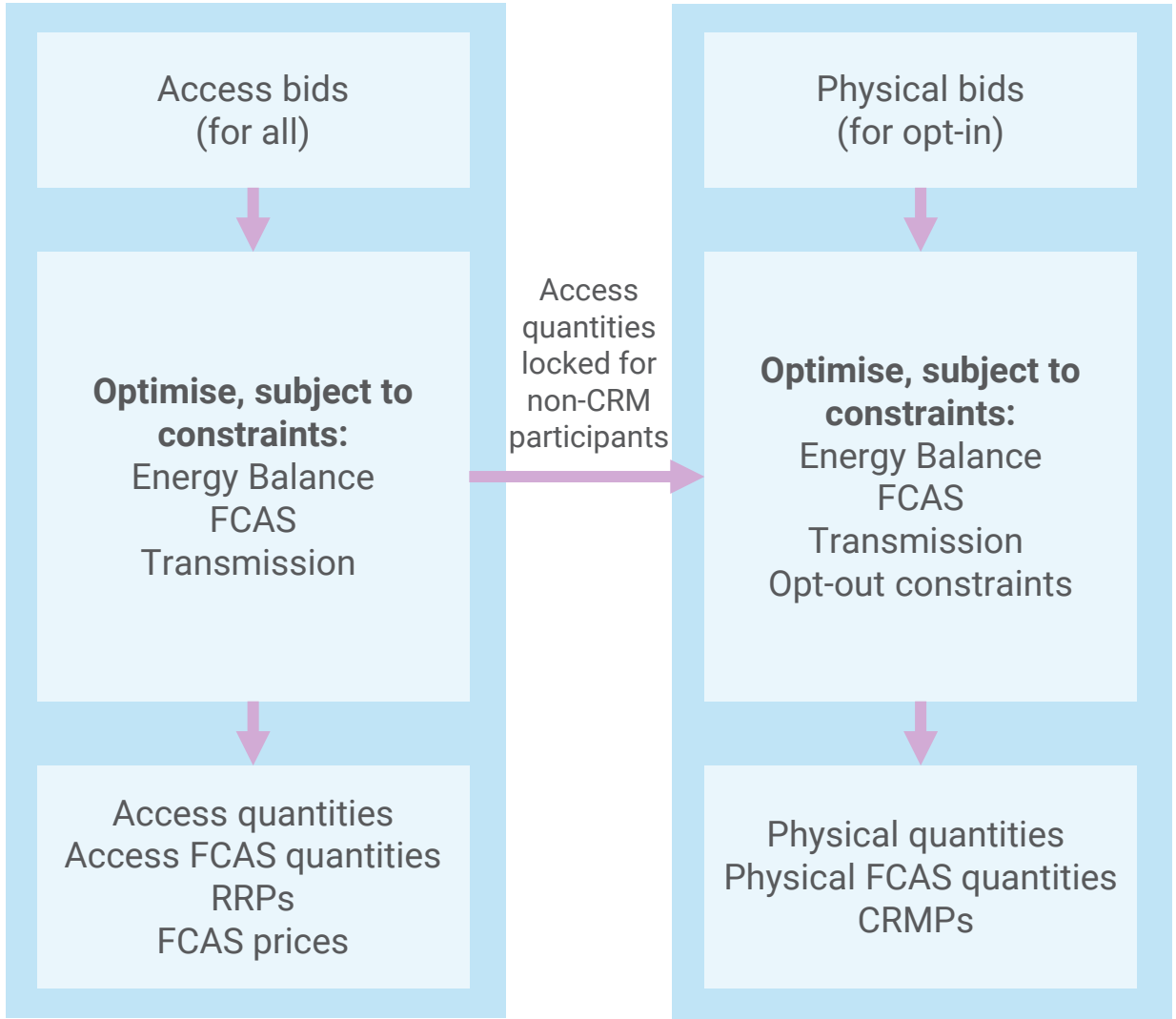
	Q4 2023		Q1 2024			Q2 2024			Q3 2024			Q4 2024		
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ministerial	3 Nov ESCOG 24 Nov ECMC			XX Feb ECSOG	1 Mar ECMC				5 July ECSOG 19 July ECMC				22 Nov ESOG	6 Dec EMSG
AEMC Deliverables														
Hybrid model		**AEMC submits plan / budget to SO**		**SO approve plan / budget**		Publication of paper on draft design on CRM & priority access	**Stakeholder consultation**	Review submissions			Final Recommendations due to Ministers	Recommendations considered at December EMSG meeting		
CRM (Workstream 1)					Policy development – outstanding issues	Rules mapping	Consultation period	Review submissions Rules mapping	Refinement of policy positions	Refinement of policy positions				
Priority access (Workstream 2)					Policy development – policy issues	Test case results set out in publication	Consultation period Advice from modelling advisory firms	Review submissions	Refinement of policy positions	Refinement of policy positions				
Interlinkages between CRM and PA (Workstream 3)					Comms material developed	Consideration of links between CRM and PA model designs		-		Assessment of the model against objectives				
Stakeholders														
Jurisdictions				ECSOG discussion	Jurisdictional workshops		Jurisdictional workshops		Jurisdictional workshops					
Industry					Technical working group	Technical working group	Formal consultation period	Technical working group	Technical working group					

We are here

Reminder: submissions due 6 June

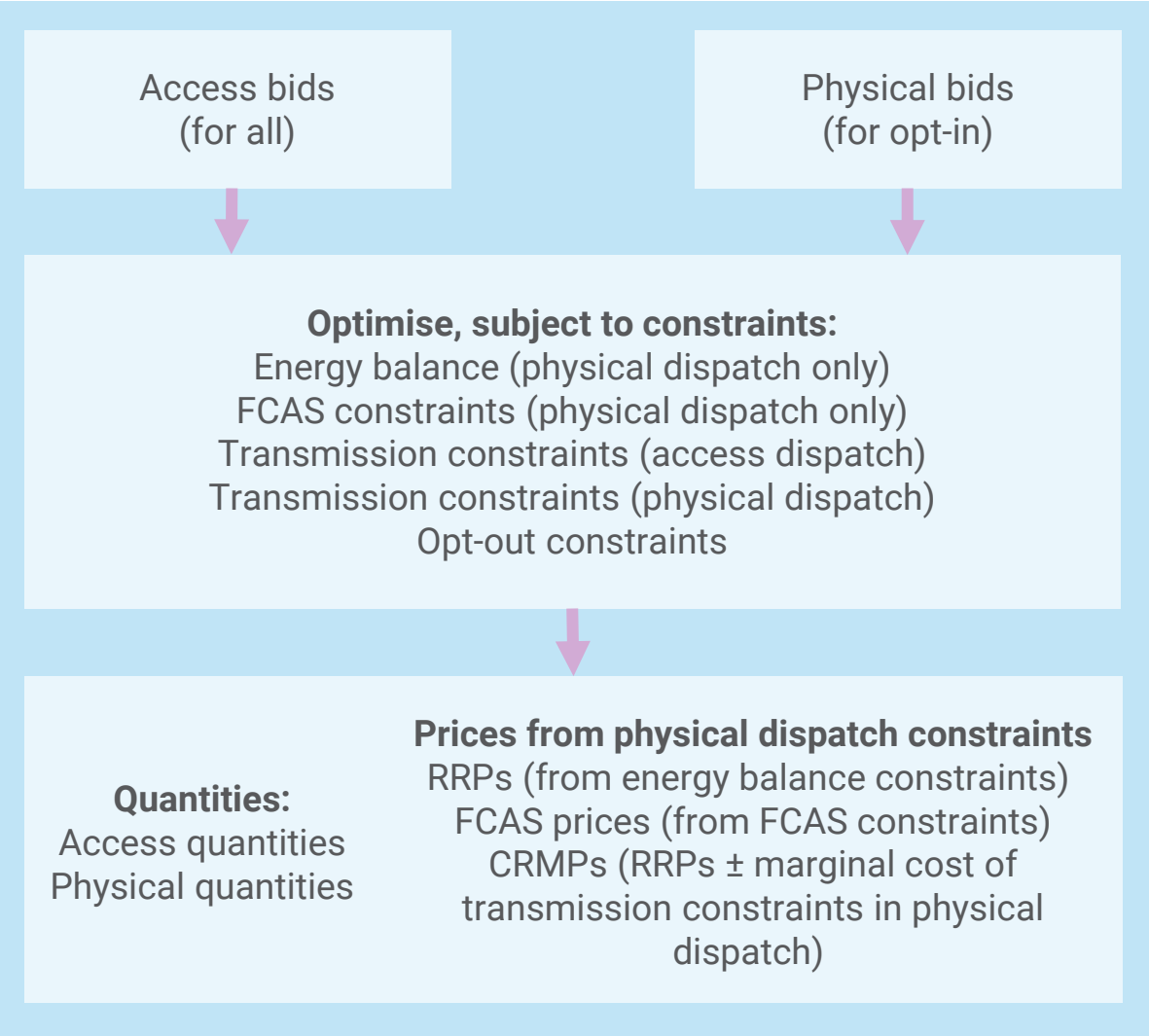
Appendix: comparing the co-optimised and sequential dispatches

Two-stage dispatch mechanics



- Two NEMDE runs, with different inputs (e.g. bids) and new constraints in the physical dispatch to lock opt-out generator physical dispatch to their access dispatch.
- The access dispatch must be physically feasible in case no generators opt-in to the CRM. It must include all the energy balance constraints and FCAS constraints.
- There are two sets of prices for energy and FCAS - being the marginal cost of alleviating the energy balance and FCAS constraints in each dispatch. RRP for settlement taken from the access dispatch, while CRM prices are taken from the physical dispatch.
- There are also two sets of quantities coming out of each dispatch, this is by design to have separate access and physical dispatch quantities. However, an unwanted side-effect is two quantities for FCAS as well.
- On a constrained transmission loop, a change in dispatch under the CRM by one generator is not met by an equal and opposite change by another generator. A third unconstrained generator is needed in the CRM to ensure that the energy balance constraint is met.

Co-optimised dispatch mechanics

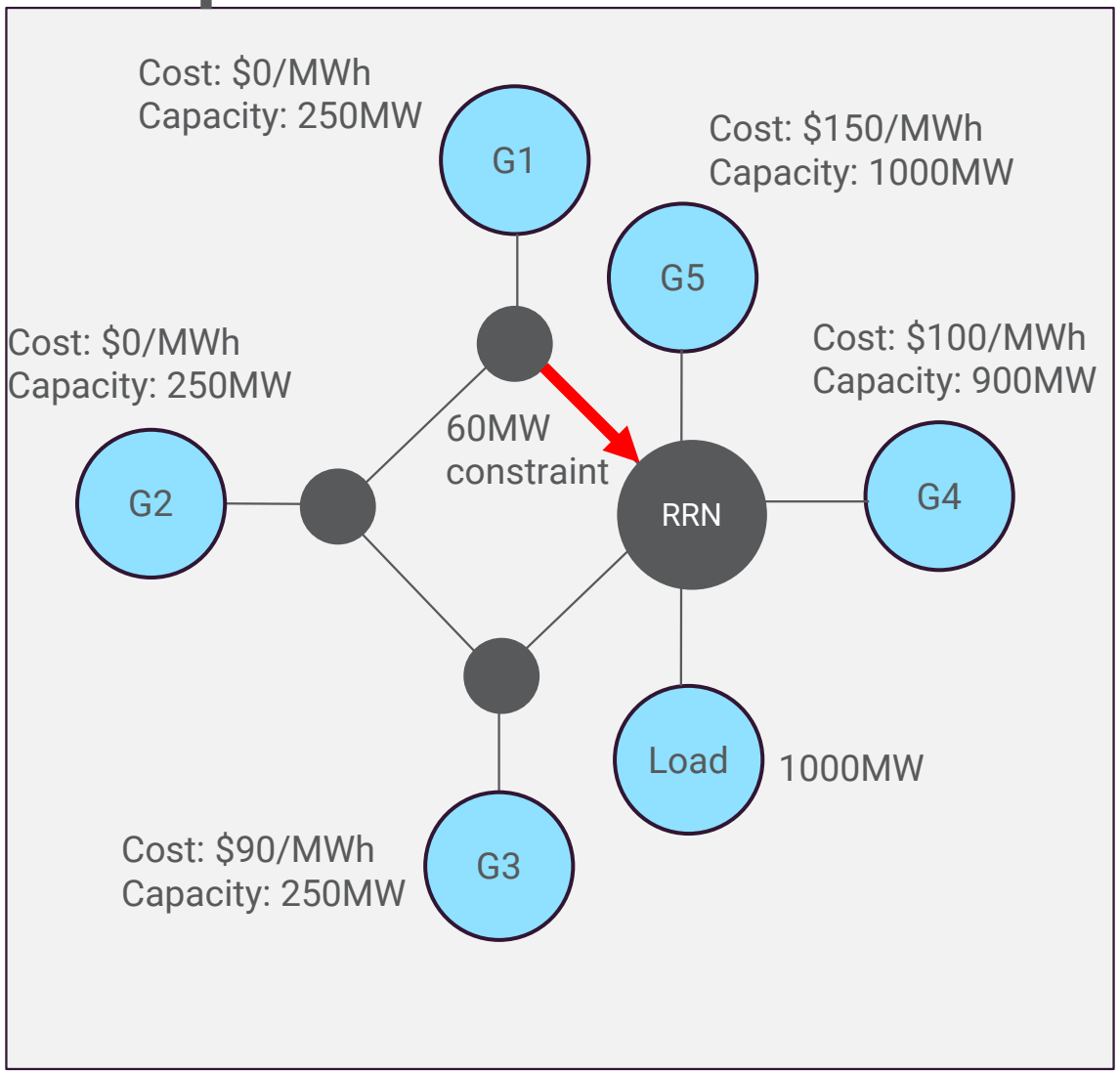


- Single NEMDE run, containing constraints that apply to:
  - Physical quantities only (energy balance and FCAS)
  - Separately to both physical quantities and access quantities (transmission)
  - The difference between the dispatch quantities (for non-CRM generators).
- No energy balance constraints apply to access quantities. Access provided to generators may mean that total access > load or total access < load. This is okay:
  - The constraints applying to physical dispatch quantities ensures (including energy balance) that physical dispatch is feasible
  - CRM trades are settled at difference between RRP and CRMP, which is zero for unconstrained generators. Access quantities of unconstrained generators irrelevant for settlement in the spot market.

Comparison of approaches

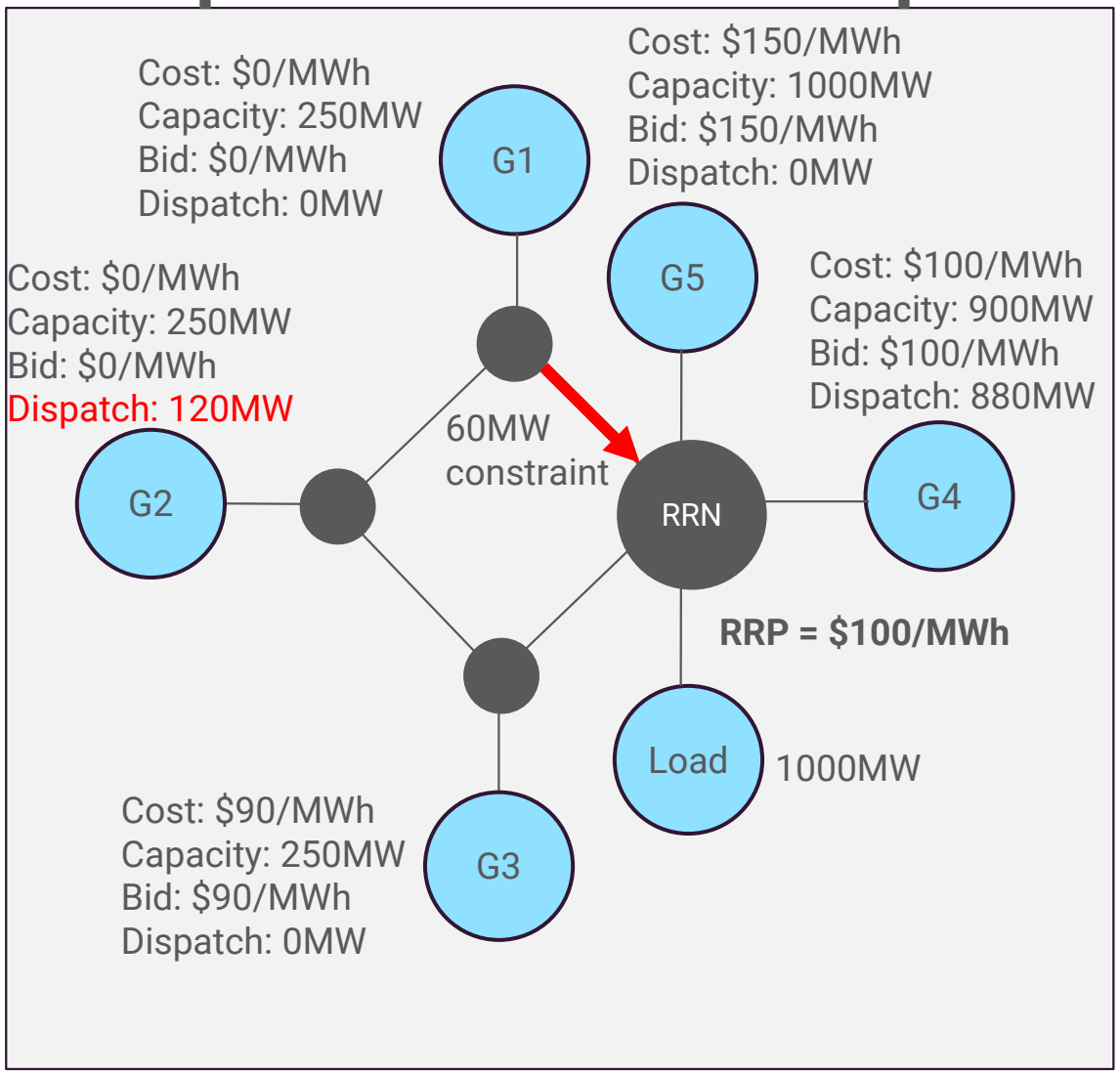
	Two-stage	Co-optimised
Efficient physical dispatch	Yes – assuming no liquidity concerns.	Yes
Prioritised dispatch	Yes	Yes
Level of testing to date	Tested with a NEMDE prototype	Tested with an Excel spreadsheet, has not been tested rigorously
Pricing complexity for unconstrained market participants	Yes – RRP determined in access dispatch can differ from CRMP determined in physical dispatch for unconstrained generators; therefore unconstrained generators can be settled at two prices in the CRM, adding complexity	No – RRP and CRMP determined in same dispatch, so for unconstrained generators they are the same
Complexity for AEMO to implement	Likely to be relatively low	Likely to be more complex and costly to implement
FCAS complexities	Yes – two sets of FCAS prices and quantities	No – single set of FCAS prices and quantities

Example: scenario overview



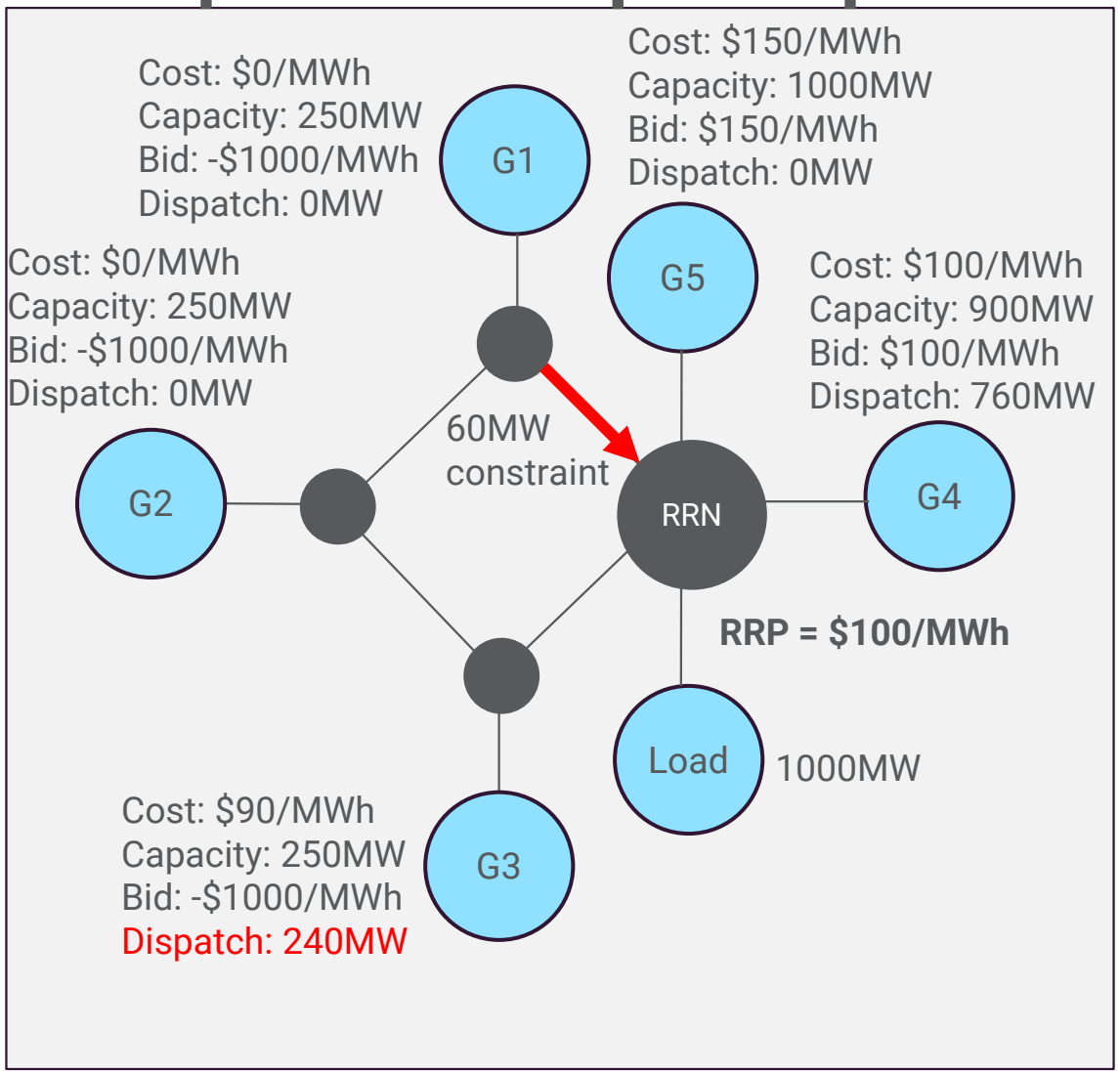
- 3 generators (G1, G2, G3) behind a 60MW constraint with differing participation factors (0.75, 0.5 and 0.25 respectively)
- G1 is an incumbent renewable generator and so is prioritised in the access dispatch
- G2 and G3 connect after the reforms are implemented and so are de-prioritised in the access dispatch.
- G3 has higher costs than G2.
- G4 and G5 are unconstrained high-cost generators. G5 is more expensive than G4. G4's capacity is 900MW
- Load is 1,000MW.

Example: the efficient dispatch



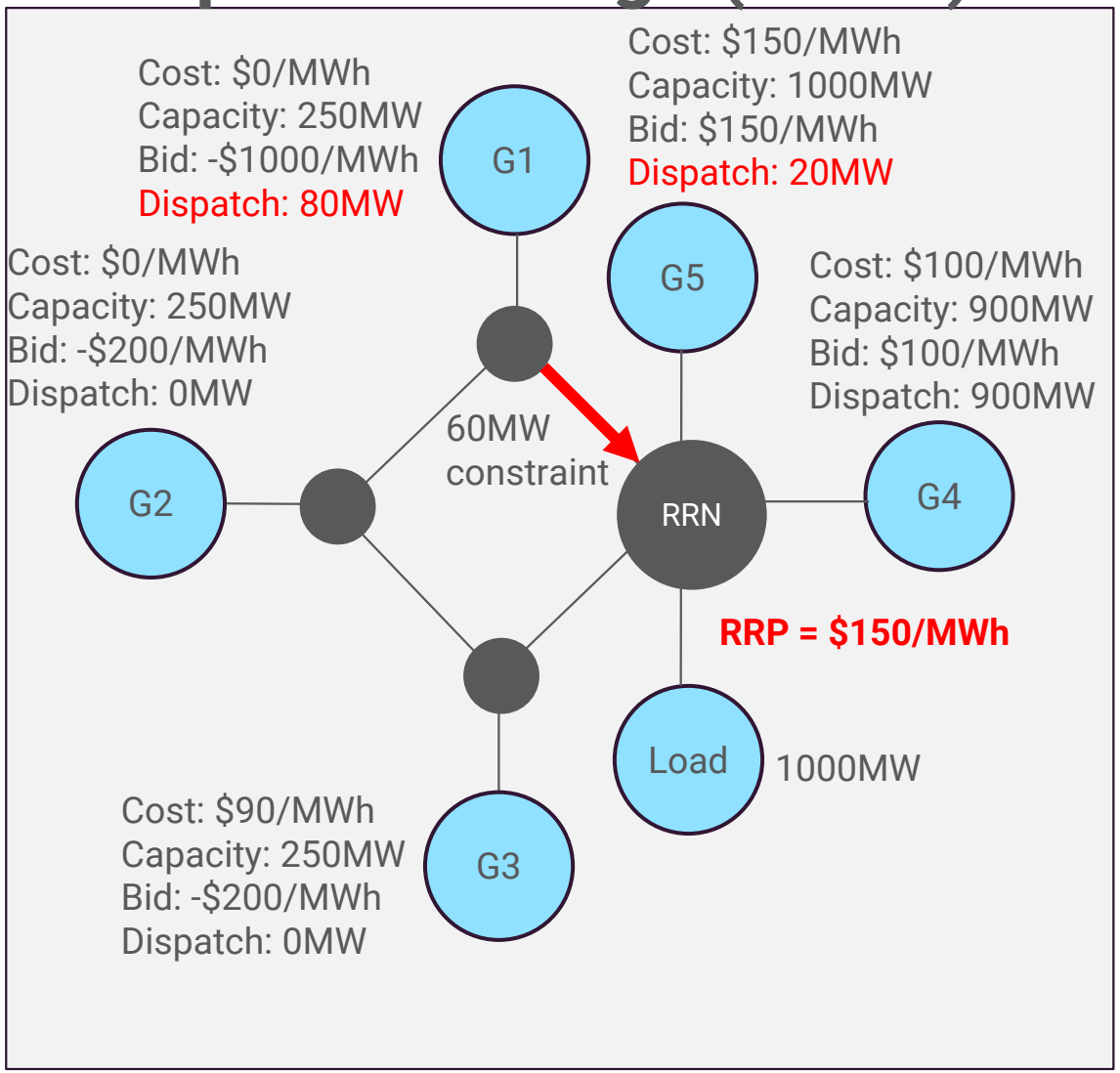
- It would be efficient for G2 to be dispatched to 120MW (exhausting the capacity of the constrained line) because it has:
  - a lower participation factor than G1
  - lower costs than G3 (which outweighs the effect of G3's lower participation factor)
- G4 meets the remaining demand, setting the RRP at $100/MWh

Example: status quo dispatch



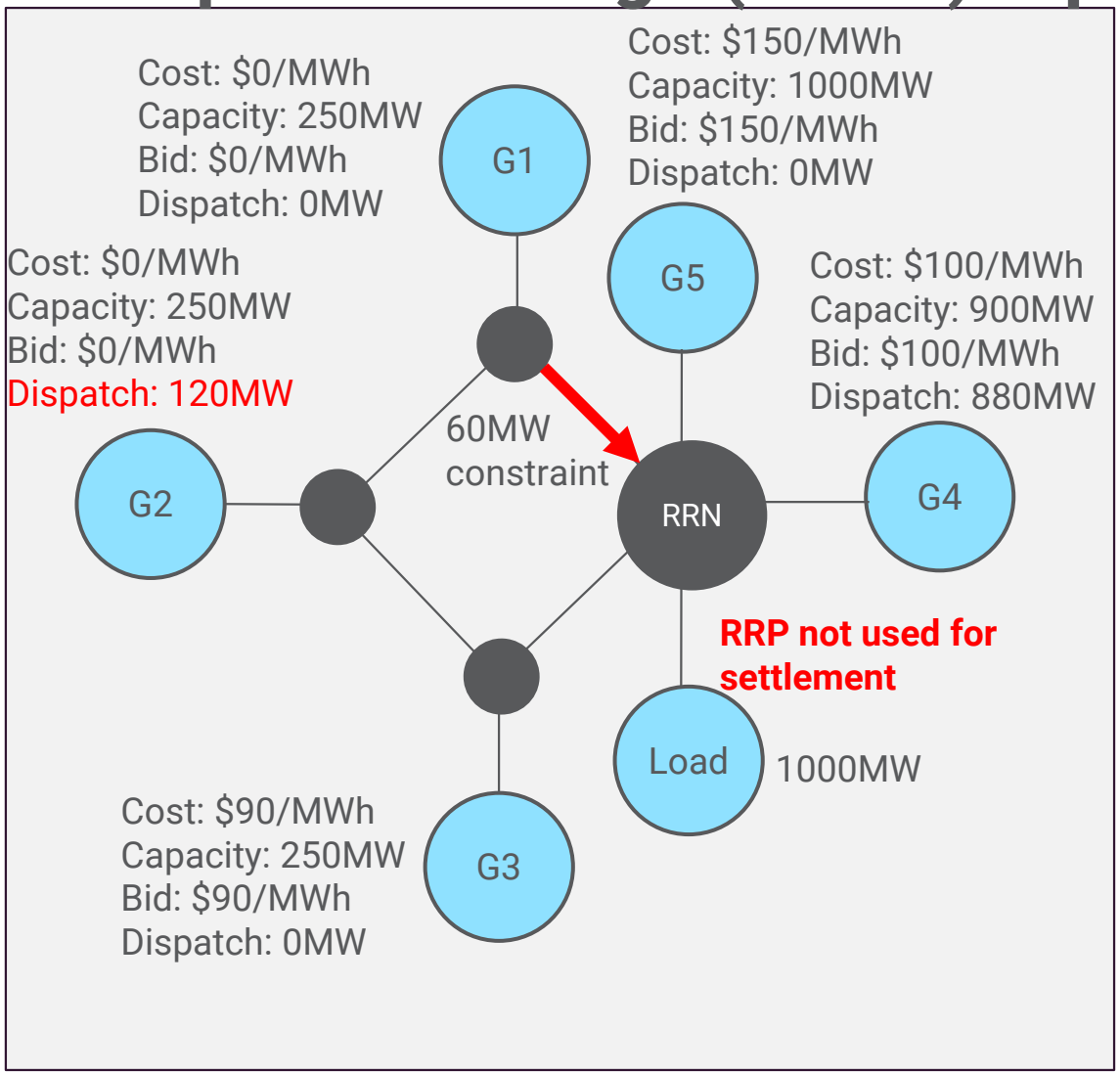
- All the constrained generators (G1, G2, G3) are incentivised to bid to the floor.
- G3 is dispatched instead of G1 or G2 because of its lower constraint coefficient. This results in:
  - Higher overall dispatch cost
  - G1's access has been cannibalised by G3.

Example: two-stage (1 of 3) – access dispatch



- As G1 was an incumbent, its BFP is -$1000/MWh; G2 and G3's is -$200/MWh. This prioritises G1 in access dispatch.
- Because of its high participation factor, G1 can only be dispatch for 80MW.
- This then requires 920MW to be provided by G4 and G5 to meet demand.
  - As G4's capacity is 900MW, G5 is required to meet demand.
  - G5 sets the RRP at $150/MWh, higher than $100/MWh in both the status quo and efficient dispatch.

Example: two-stage (2 of 3) – physical dispatch



- Generators are now all incentivised to bid at cost, resulting in efficient physical dispatch.
- However, the marginal cost of meeting physical demand, set by G4's bid of $100/MWh, is not used to set the RRP for settlement. The access RRP from the previous slide ($150/MWh) is used for settlement.

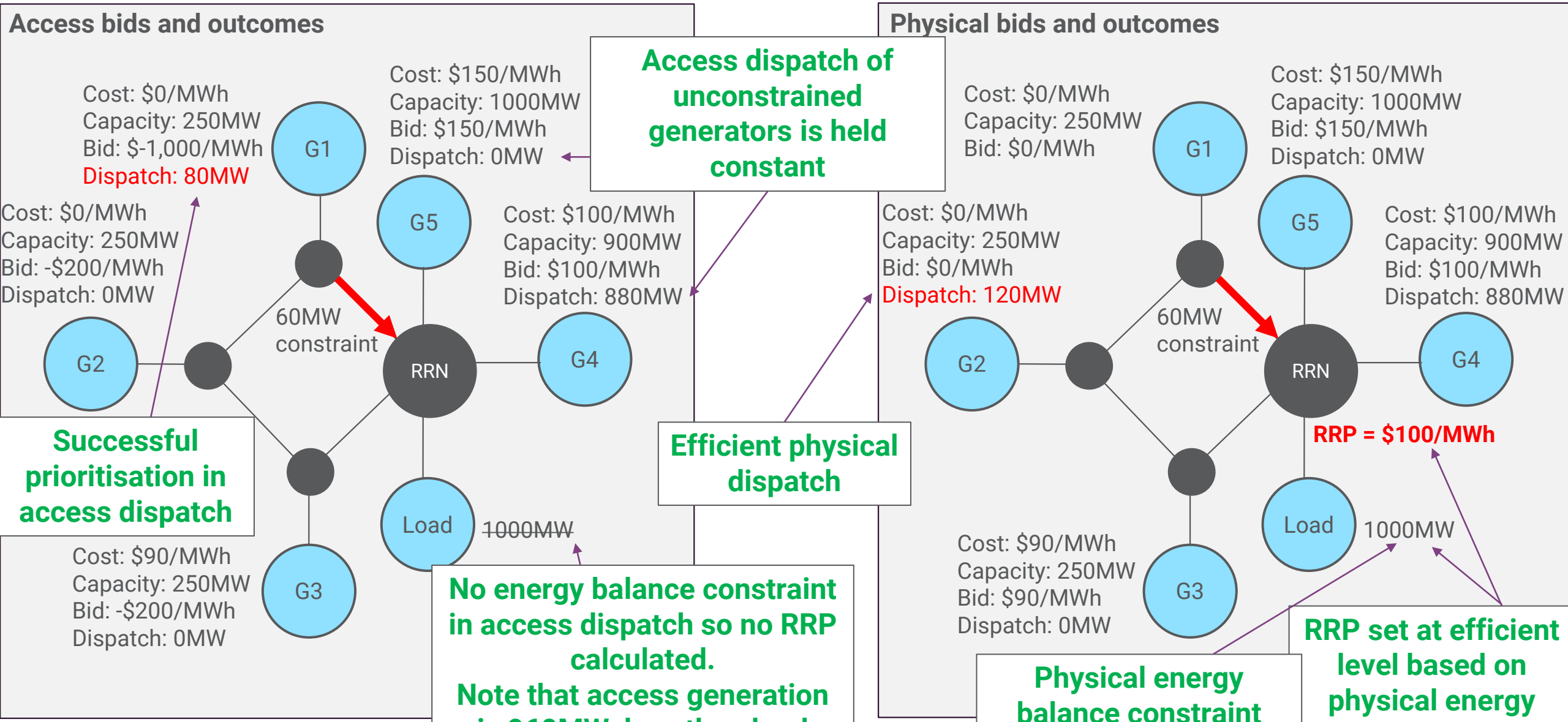
Example: two-stage (3 of 3) – settlement

Gen	Access MW	Physical MW	Access RRP ($/MWh)	Access revenue ($/h)	CRMP ($/MWh)	CRM revenue ($/h)	Output cost ($/h)	Profit
G1	80	0	150	12,000	-50	4,000	0	16,000
G2	0	120	150	0	0	0	0	0
G3	0	0	150	0	50	0	0	0
G4	900	880	150	135,000	100	-2,000	88,000	45,000
G5	20	0	150	3,000	100	-2,000	0	1,000
Total	**1000**	**1000**		**150,000**		**0**	**88,000**	**62,000**

Load pays 1000MW at access RRP $150/MWh, which is $150,000/h.
Generators receive total payment of $150,000/h and profit $62,000/h.

Reminder:
Access revenue = access MW x RRP
CRM revenue = (physical MW – access MW) x CRMP

Example: co-optimisation (1 of 2) – dispatch

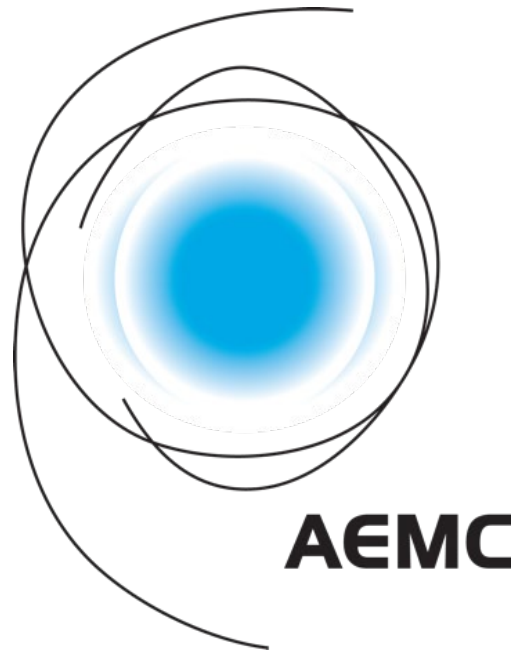


Example: co-optimisation (2 of 2) – settlement

Gen	Access MW	Physical MW	Access RRP ($/MWh)	Access revenue ($/h)	CRMP ($/MWh)	CRM revenue ($/h)	Output cost ($/h)	Profit
G1	80	0	100	8,000	-50	4,000	0	4,000
G2	0	120	100	0	0	0	0	0
G3	0	0	100	0	50	0	0	0
G4	880	880	100	88,000	100	0	88,000	0
G5	0	0	100	0	100	0	0	0
Total	**960**	**1000**		**96,000**		**4,000**	**88,000**	**4,000**

Load pays 1000MW at access RRP $100/MWh, which is $100,000/h.
Generators receive total payment of $100,000/h (access + CRM revenue) and profit $4,000.
Generator profit is less compared to two-stage, however consumers pay less due to the co-optimised RRP.

Reminder:
Access revenue = access MW x RRP
CRM revenue = (physical MW – access MW) x CRMP


AEMC