ENERGY SECURITY BOARD

TRANSMISSION ACCESS REFORM
TECHNICAL WORKING GROUP

30 March 2023

AGENDA

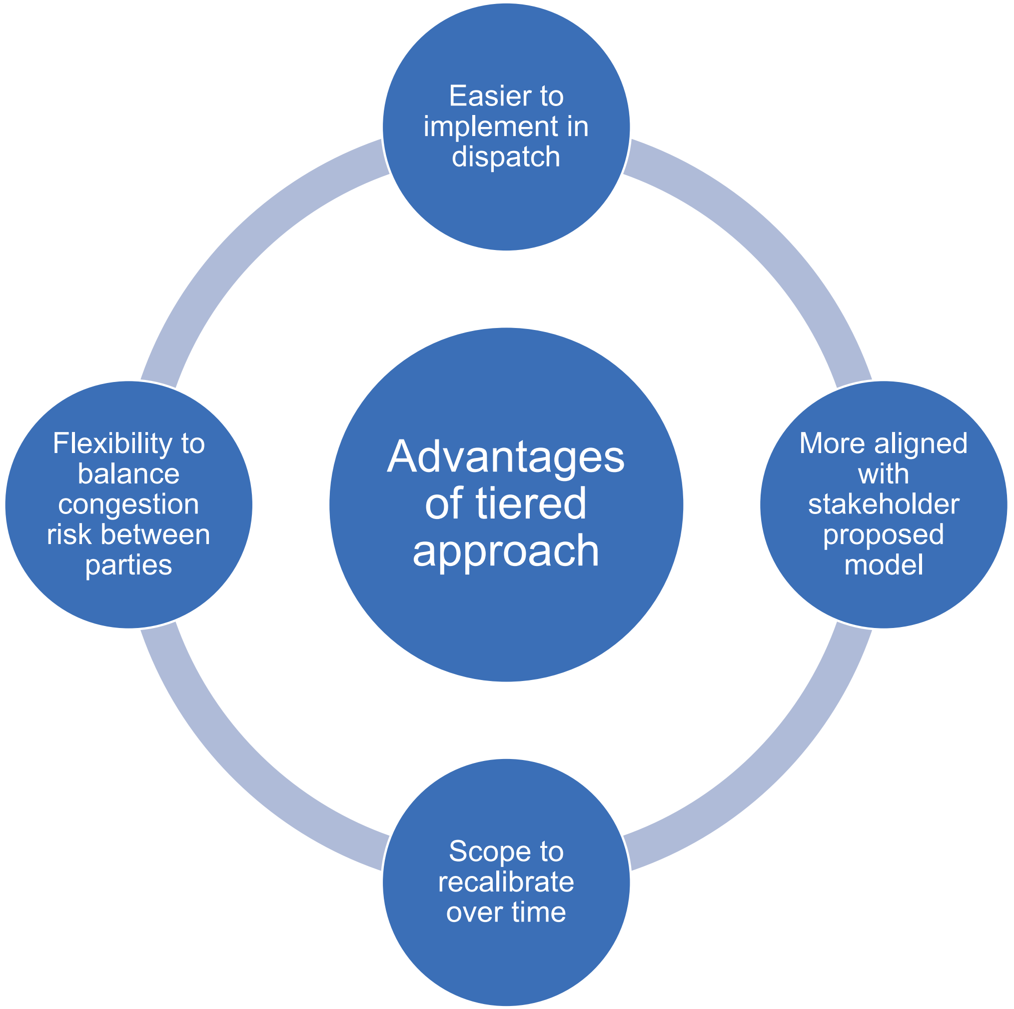
Time	Topic
2:00	Welcome, objectives and agenda
2:05	Priority access discussion
3:05	NEMDE prototype for the CRM design
3:55	Next steps
4:00	Thanks and close

PRIORITY ACCESS

ALTERNATIVE PRIORITY ACCESS ALLOCATION METHODS

An initial discussion on priority access will focus on the balance between incumbents and new entrants. There are trade-offs between the TAR objectives including managing access risk and enabling effective wholesale competition.

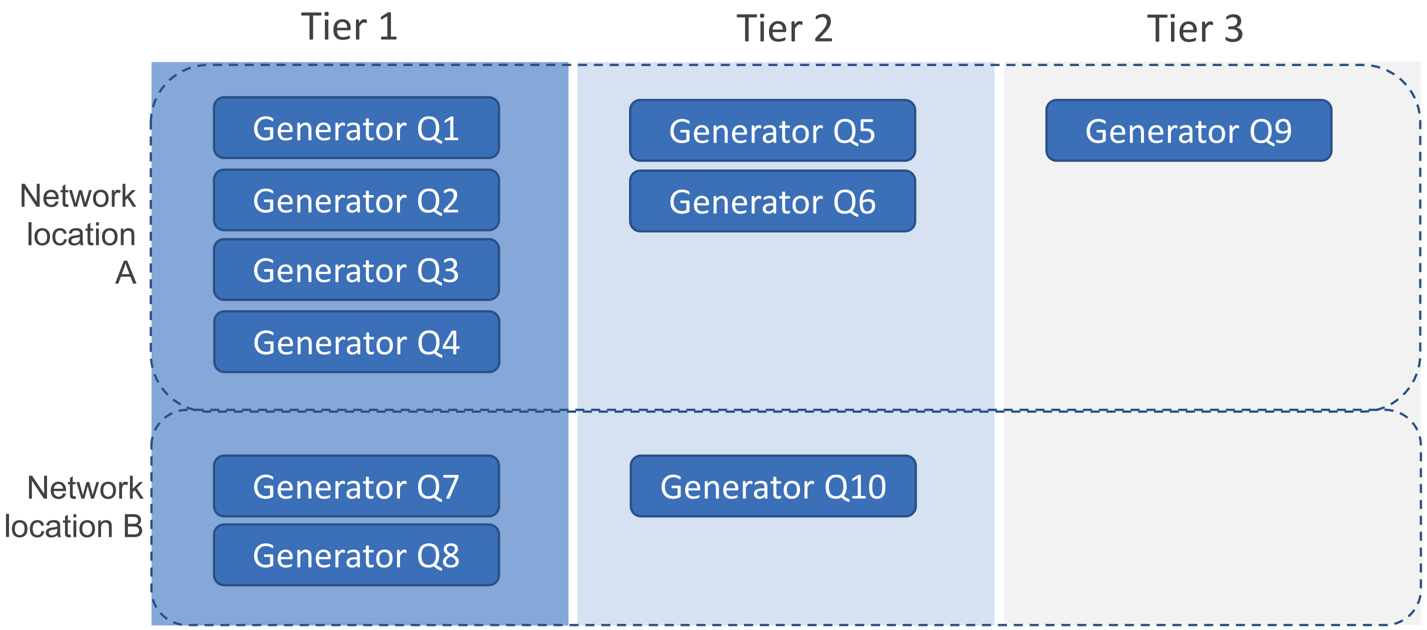
- Priority access only applies in the energy market when two or more generators have bid at the market floor price (to avoid curtailment).
- The primary benefits of the priority access model are to improve:
  - the locational decisions of generation investments
  - the ability of investors to manage congestion risk.
- The Directions Paper proposed a number of options for allocating priority access. They are re-presented as:
  - Queue numbers
    - unique
    - grouped e.g. by time window
  - Centrally determined tiers (referred to as “tiered approach” in this doc)
    - grouped e.g. by level of curtailment (may or may not use queue numbers)
- This first TWG discussion performs a deep dive on the last approach (tiered).
- Note that the number of unique queue numbers or groups may be limited by the technical feasibility to implement into AEMO’s systems. The TWG discussion focuses for now on policy questions rather than technical feasibility assessments (in progress with AEMO).



INTRODUCTION TO A TIERED APPROACH

This approach groups generators based on centrally determined criteria e.g. an expected level of curtailment. Each group is assigned a tier number. Where two generators are competing for access, the lower tier is dispatched in preference.

Figure 1. Illustration of a tiered approach with individual queue numbers



Generators are allocated to a tier depending on how much capacity is available at their chosen network location at the time they connect.
A queue number could be used to determine this grouping. In this case, a high queue number does not necessarily mean a high risk of curtailment. It depends on the location. A key piece of information for investors is mapping the queue number to a tier.

- Rules could set out principles for allocating generators to tiers, supplemented by more flexible guidelines.
- Tiers could be made available on a first-come first-served basis.

Initial questions for consideration:

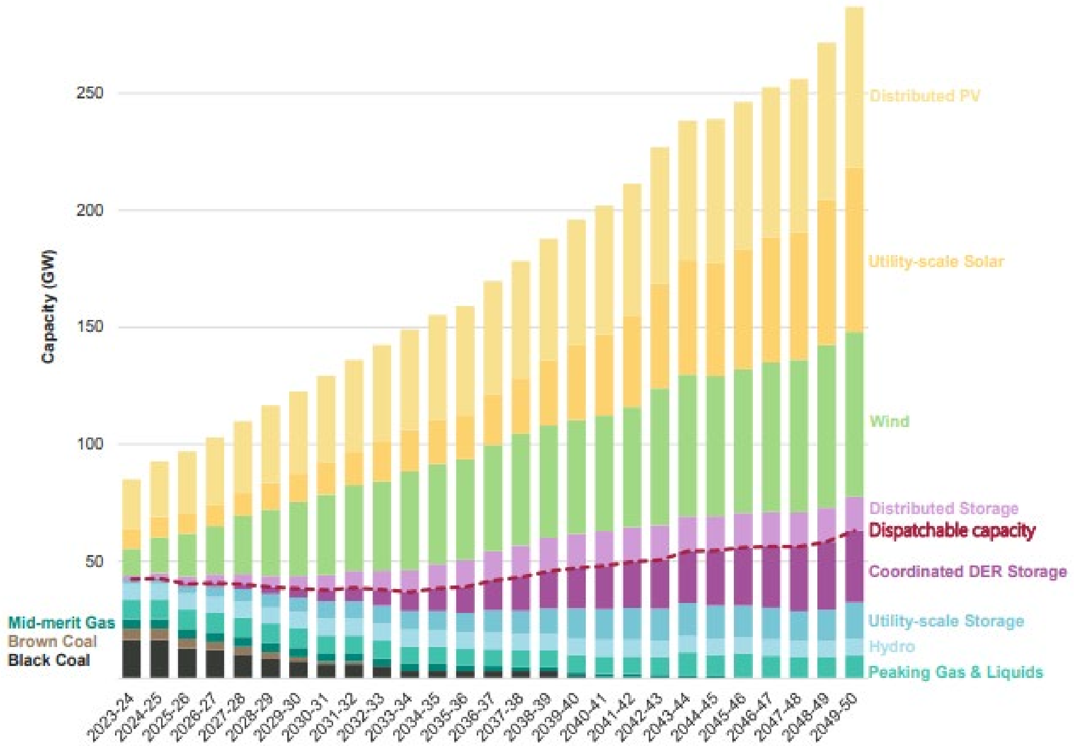
- Should generators have the opportunity to change tiers, and if so, how?

  E.g. tiers could be subject to periodic reviews where generators may move up a priority number if another generator in the vicinity retires. A generator's individual queue number would help to rank their eligibility for this promotion.

- Scope to go to auction in the case of multiple simultaneous connections?

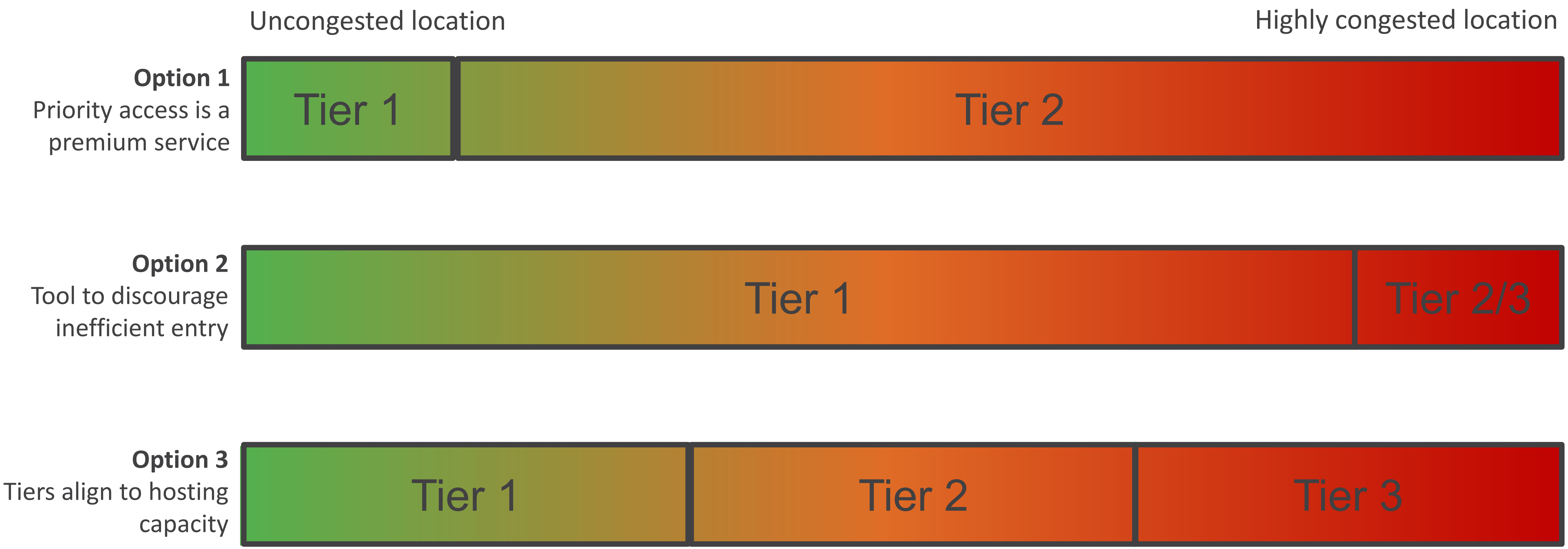
NATURE OF THE CHALLENGE

Figure 2. Forecast NEM capacity to 2050, *Step Change* scenario



- Key challenge is to strike a balance between the interests of existing and future investors.
- We want to provide investors with the certainty required to support investment, however this has an impact on future investment opportunities.
- Given forecast 9-fold increase in the renewable generation fleet, incumbents and new entrants are the same people.
- Which design choices best support efficient investment throughout the energy transition?

Figure 3. Three preliminary options for allocating access rights (for consideration)



Note: Approach will need to accommodate government preferences with respect to REZ schemes, technical limitations.

POLICY LEVERS

There are a range of policy levers that we can use to calibrate the balance between incumbents and new entrants.

Duration of rights

- How long should primary access rights last?
  - Life of asset
  - Proportion of asset life
  - Fixed duration
- Should longer life assets receive longer duration access?

Recalibration of tiers

- Should exposure to congestion for primary access holders increase over time in line with efficient level of congestion?

How is access made available?

- What happens when primary access positions become available? E.g. due to new transmission, retirements or expiry of access rights.
- Can generators change priority levels, and if so, how?

Grandfathering arrangements

- Incumbents are more/less protected from being curtailed as a result of new entry.
- More/fewer opportunities for new entrants as they are more likely to be curtailed.

AVAILABILITY OF ACCESS RIGHTS

Option 1 of 3

Uncongested location | Highly congested location

Option 1
Priority access is a premium service

Tier 1 | Tier 2

Pros

Cons

Suggestions for other policy levers to accompany this approach

Duration of rights?

Recalibration of tiers?

How do generators change access levels?

Grandfathering arrangements

AVAILABILITY OF ACCESS RIGHTS

Option 2 of 3

Uncongested location — Highly congested location

Option 2
Tool to discourage inefficient entry

Tier 1 | Tier 2/3

Pros

Cons

Suggestions for other policy levers to accompany this approach

Duration of rights?

Recalibration of tiers?

How do generators change access levels?

Grandfathering arrangements

Option 3 of 3

Uncongested location — Highly congested location

Option 3
Tiers align to hosting capacity

Tier 1	Tier 2	Tier 3

Pros

Cons

Suggestions for other policy levers to accompany this approach

Duration of rights?

Recalibration of tiers?

How do generators change access levels?

Grandfathering arrangements

CRM NEMDE PROTOTYPE RESULTS

OBJECTIVES AND APPROACH

Objectives of the NEMDE prototype

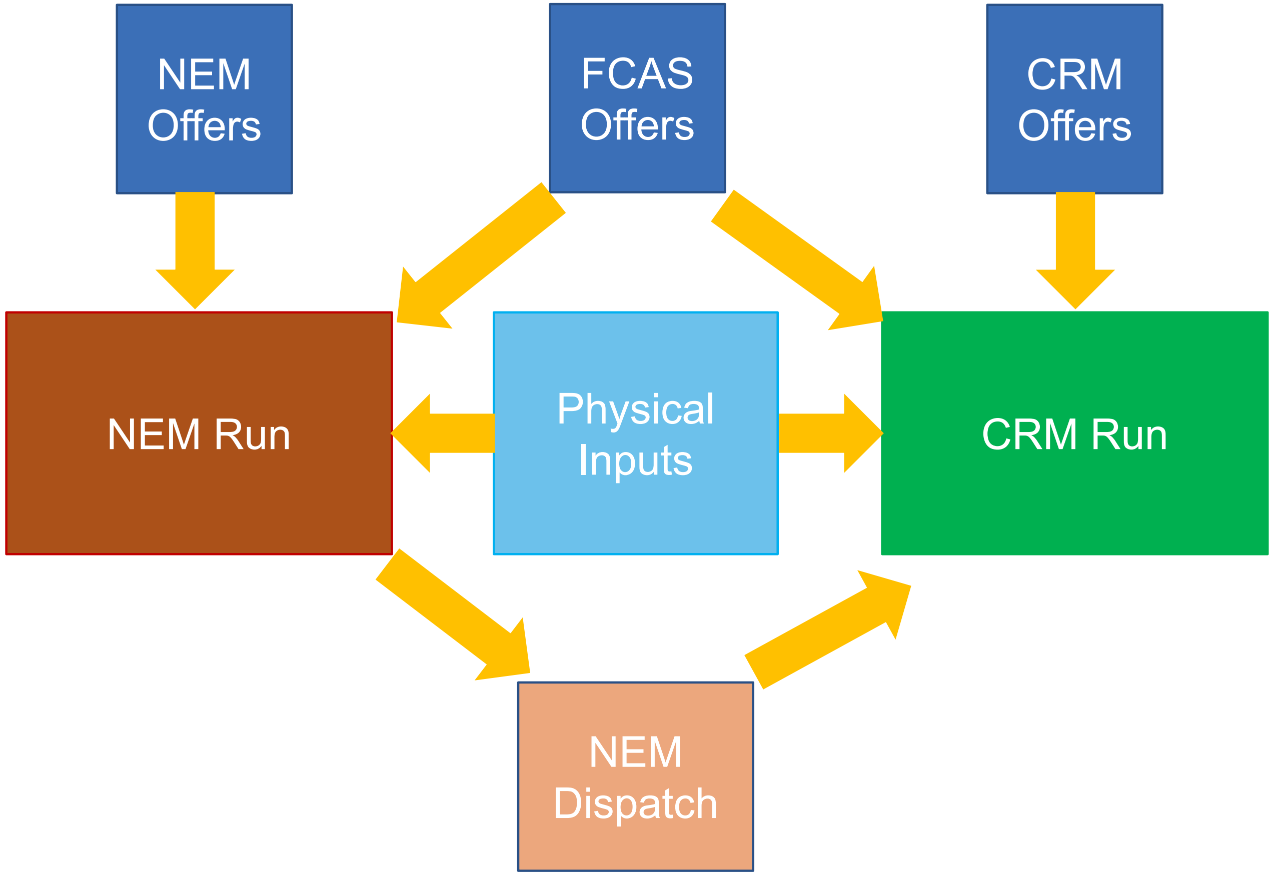
- To test the validity of the CRM design – does it work on a NEM scale ?
- To inform design decisions for the CRM e.g. how to deal with opt-out, IRSR formulation etc.
- To determine the impact on NEMDE for costing purposes.

Approach

- NEMDE is a scalable solver so we initially developed the CRM version by replicating a simple 4 node Excel model.
- Eventually we progressed to a 7 node 2 interconnector 1 FCAS service model before running it on a full historical NEM dispatch interval.
- Around 8 historical DIs were chosen based on input from the TWG and many of these are quite extreme cases involving multiple binding constraints and negative residue management.

PROTOTYPE FORMULATION

Figure 4. Illustration of prototype formulation



- Prototype comprises 2 identical dispatch runs with the same constraints and physical inputs (initial MW etc).
- Locational prices are determined using the existing NEM methodology.
- Participants submit 2 sets of energy offers and a single set of FCAS offers.
- NEM run occurs first and dispatch outcomes feed into the CRM as a constraint.

  Opt-out participants receive the NEM dispatch outcome.

  Participants can bid to limit the energy dispatch difference between the 2 runs.

APPROACH TO "OPT-OUT" AND CRM PRICES

- The CRM is a voluntary market. If a party chooses not to participate in the CRM, they do not have to submit energy bids. They are referred to as "opt-out" as a shorthand in this presentation.
- However, the CRM dispatch is a full physical dispatch run so requires energy bids from all DUIDs.
- In the CRM run opt-out DUIDs are dispatched at the same level as in the NEM run subject to a small tolerance (0.001 MW) to deal with degeneracy issues.
- The prototype uses the NEM energy bids for each opt-out DUID.
- The effect of this is to effectively "import" the locational prices from the NEM run into the CRM for opt-out DUIDs.
- Given there is no dispatch variation associated with these DUIDs the CRM prices do not have a financial impact.

CASE STUDY 1 – TRADING BEHIND A SIMPLE RADIAL CONSTRAINT

	NEM	CRM
LKBONNY2	41.9 MW	55.2 MW
LKBONNY3	10.3 MW	10 MW
LBBL1 BATTERY	0 MW	-13 MW
	<=	<=
	52.2 MW	52.2 MW
Location price	-$1000/MWh	$5/MWh

Case study	1
Description	Trading behind a simple radial constraint
Dispatch interval	10th May 2021

- LKBONNY2 and 3 bid at -$1000/MWh behind a 52.2 MW radial constraint and are dispatched under tie-breaking. SA RRP is $57.12/MWh.
- CRM bids assumed an SRMC close to $0/MWh:

  LKBONNY2 42 MW at -$5/MWh, 91 MW at +$5/MWh

  LKBONNY3 10 MW at -$7/MWh, 14 MW at +$7/MWh

  LBBL1 10 MW at $20/MWh, 15 MW at $10/MWh

- CRM Price is $5/MWh:

  LKBONNY2 receives +13.3 MW at $5/MWh

  LKBONNY3 pays back +0.3 MW at $5/MWh

  LBBL1 pays 13 MW at $5/MWh

CASE STUDY 1 – TRADING BEHIND A SIMPLE RADIAL CONSTRAINT

Why isn't LLBL1 dispatched to charge at 25 MW?

- LKBONNY2 is marginal at $5/MWh and LBBL1 is prepared to charge unless prices rise above $10/MWh.
- The reason is to do with FCAS bids.
- LBBL1 is already being dispatched to provide 25 MW of Lower Regulation.
- 12 MW is bid at $0/MWh and 13 MW bid at $3.70/MWh.
- Each MW of energy it is dispatched for reduces the Lower Regulation it can provide and increases the requirement from the next lowest cost provider (in this case it is GSTONE at $7.73/MWh).
- NEMDE trades off energy and FCAS bids until it is no longer worthwhile at which point:
- Each extra 1 MW of LBBL1/LKBONNY2 dispatch reduces the objective function by 1 * ($5/MWh - $10/MWh) = -$5/MWh.
- Each extra 1 MW of load increases the FCAS cost by $7.73/MWh - $0/MWh = +$7.73/MWh
- To fully charge the battery it would need to raise its second bid band from $10/MWh to $12.74/MWh.

CASE STUDY 2 – TRADING BEHIND A LOOP CONSTRAINT

Constraint	N^^N_NIL_2				Dispatch MW				Locational price $/MWh	
Type	DUID	Coeff	Region	Sign	NEM	CRM	Var	LHS Chg	NEM	CRM
I/C	V-S-MNSP1	-0.3572		1	155.5	155.5	0.0	0.0	0.0	0.0
ENOF	ARWF1	0.0931	VIC1	1	41.7	41.7	0.0	0.0	-74.4	19.2
ENOF	BANN1	0.3084	VIC1	1	75.7	75.7	0.0	0.0	-294.8	15.1
ENOF	BROKENH1	0.4573	NSW1	1	44.1	44.1	0.0	0.0	-444.4	15.1
ENOF	BULGANA1	0.1109	VIC1	1	37.8	37.8	0.0	0.0	-92.6	18.8
ENOF	COHUNSF1	0.1749	VIC1	1	0.0	0.0	0.0	0.0	-158.1	17.6
ENOF	COLEASF1	0.9571	NSW1	1	128.2	128.2	0.0	0.0	-956.1	5.8
ENOF	CROWLWF1	0.0991	VIC1	1	22.6	22.6	0.0	0.0	-80.5	19.1
ENOF	CRWASF1	0.3248	NSW1	1	4.8	4.8	0.0	0.0	-308.8	17.6
ENOF	DARLSF1	1.0000	NSW1	1	105.6	108.0	2.4	2.4	-1,000.0	5.0
ENOF	FINLYSF1	0.3248	NSW1	1	125.3	125.3	0.0	0.0	-308.8	17.6
ENOF	GANNBG1	0.1749	VIC1	1	0.0	0.0	0.0	0.0	-158.1	17.6
LDOF	GANNBL1	-0.1749	VIC1	-1	-2.0	-15.5	-13.5	-2.4	-158.1	17.6
ENOF	GANNSF1	0.1749	VIC1	1	42.7	42.7	0.0	0.0	-158.1	17.6
ENOF	KARSF1	0.3572	VIC1	1	25.0	25.0	0.0	0.0	-344.8	14.2
ENOF	KIAMSF1	0.2716	VIC1	1	125.6	125.6	0.0	0.0	-257.1	15.8
ENOF	KIATAWF1	0.1540	VIC1	1	0.0	0.0	0.0	0.0	-136.7	18.0
ENOF	LIMOSF11	0.6865	NSW1	1	109.8	109.8	0.0	0.0	-679.1	10.9
ENOF	LIMOSF21	0.6865	NSW1	1	0.0	0.0	0.0	0.0	-679.1	10.9
ENOF	MUWAWF1	0.1860	VIC1	1	106.8	106.8	0.0	0.0	-169.5	17.4
ENOF	STWF1	0.4573	NSW1	1	17.9	17.9	0.0	0.0	-444.4	15.1
ENOF	SUNRSF1	0.6865	NSW1	1	87.3	87.3	0.0	0.0	-679.1	10.9
ENOF	URANQ11	0.0997	NSW1	1	0.0	0.0	0.0	0.0	-78.3	21.8
ENOF	URANQ12	0.0997	NSW1	1	0.0	0.0	0.0	0.0	-78.3	21.8
ENOF	URANQ13	0.0997	NSW1	1	0.0	0.0	0.0	0.0	-78.3	21.8
ENOF	URANQ14	0.0997	NSW1	1	0.0	0.0	0.0	0.0	-78.3	21.8
ENOF	WEMENSF1	0.3084	VIC1	1	77.6	77.6	0.0	0.0	-294.8	15.1
Outside of Constraint				1						
ENOF	MURRAY		VIC1	1	117.6	128.4	10.9	0.0	20.9	20.9

Case study	2
Description	Trading behind a loop constraint
Dispatch interval	9 April 2021 (Edify)

- This voltage stability loop constraint has a wide range of coefficients and includes an interconnector.
- DARLSF1 is marginal at -$1000/MWh and would like to be dispatched more but has a high coefficient.
- GANNBL1 is assumed to increase its max availability from 2 MW in NEM run to 25 MW in CRM but only gets dispatched to 15.5 MW because of FCAS.
- GANNBL1's low coefficient of 0.1749 means that only 2.4 MW of additional dispatch is possible at DARLSF1.
- The imbalance on energy must be provided outside of the constraint and so MURRAY dispatch is increased.

CASE STUDY 2 – TRADING BEHIND A LOOP CONSTRAINT

Lessons learned

- Batteries are important providers of FCAS and this will affect how much charging they can provide in the CRM to allow additional energy dispatch behind constraints.
- Loop constraints in the NEM can comprise a wide range of coefficients and often have interconnector terms.
- It is difficult for a high coefficient generator to displace a low coefficient generator in the CRM.
- For DARLSF1 (coeff 1) to displace ARWF1 (0.0931) bidding at $5/MWh it would need to bid at -$150/MWh.
- However, it doesn't need to displace the lowest coefficient DUID just the next lowest one participating in the CRM.
- Trading behind loop constraints will involve different coefficients and typically will require DUIDs outside the loop to participate in the CRM and provide the energy balance.
- Given that loop constraints often involve interconnector terms trading behind a loop constraint can have NEM wide impacts.
- FCAS impacts can be far reaching. Even DUIDs that are not participating in the CRM may be dispatched differently for FCAS. If we prevent this occurring it will reduce the amount of energy trading in the CRM.

CASE STUDY 3 – MULTIPLE CONSTRAINTS AND NEGATIVE RESIDUE MANAGEMENT

Constraint	NEM	CRM
#TORRB3_D_E	Binding	Binding
$SWAN_E	Binding	Binding
F_I+LREG_0210	Binding	Binding
F_I+NIL_APD_TL_L5	Binding	Binding
F_I+NIL_APD_TL_L6	Binding	Binding
F_I+NIL_APD_TL_L60	Binding	Binding
F_I+NIL_MG_R5	Binding	Binding
F_I+NIL_MG_R6	Binding	Binding
F_MAIN++NIL_MG_R6	Binding	Binding
F_MAIN++NIL_MG_R60	Binding	Binding
F_MAIN+NIL_DYN_RREG	Binding	Binding
F_T+MAXS_LREG	Binding	Binding
F_T+MAXS_RREG	Binding	Binding
F_T+NIL_MG_RECL_R60	Binding	
F_T+STH_NYR_ML_L5	Binding	Binding
F_T+STH_NYR_ML_L6	Binding	Binding
F_T+STH_NYR_ML_L60	Binding	Binding
N::N_UTRV_2	Binding	Binding
NRM_NSW1_VIC1	Binding	
N^N-LS_SVC	Binding	Binding
N_TARALGAWF_ZERO	Binding	Binding
Q_STR_7C0K_HASF	Binding	Binding
T>T_X_NTH_STH_B	Binding	Binding
T_CTHLWF_100	Binding	Binding
T_GRANVH_100	Binding	Binding
T_MRWF_100	Binding	Binding
F_I+NIL_MG_R60		Binding

Case study	3
Description	Multiple constraints and negative residue management
Dispatch interval	2 November 2022

- N::N_UTRV_2 is an outage constraint for transient stability which when combined with negative residue management on NSW->VIC is limiting NSW wind output.
- The NEMDE prototype allows the NRM constraint to be removed in the CRM run so that only the NEM run is clamped.
- This leads to:

  +264 MW NSW wind dispatch

  -203 MW VIC brown coal

  -50 MW TAS hydro

  -267 MW flow south on VNI

  -50 MW flow north on Basslink
- This is no longer a counter-price flow because the NSW wind farms are being paid at -$7/MWh and the flow into VIC realises +$8.94/MWh

NEXT STEPS

NEXT STEPS

Next meeting, 27 April 2023

ESB project team to finalise and circulate agenda and presentation materials.

Consultation paper, due for release in late April 2023

We plan to hold consultation forums during this period for the public and peak bodies.

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