ENERGY SECURITY BOARD

POST 2025 FUTURE MARKET PROGRAM

TECHNICAL WORKING GROUP
AHEAD MARKETS - UCS

14 MAY 2020

POST 2025 FUTURE MARKET PROGRAM (P2025)

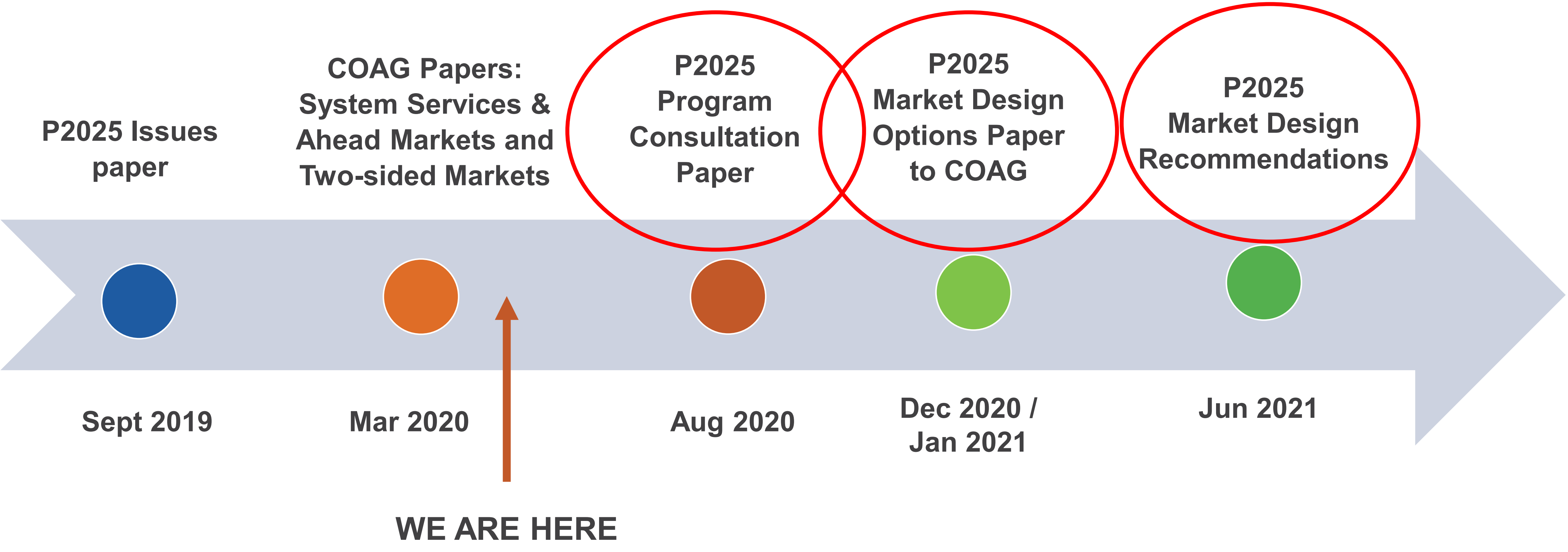
The COAG Energy Council tasked the ESB with developing advice on a

long-term, fit-for-purpose market framework

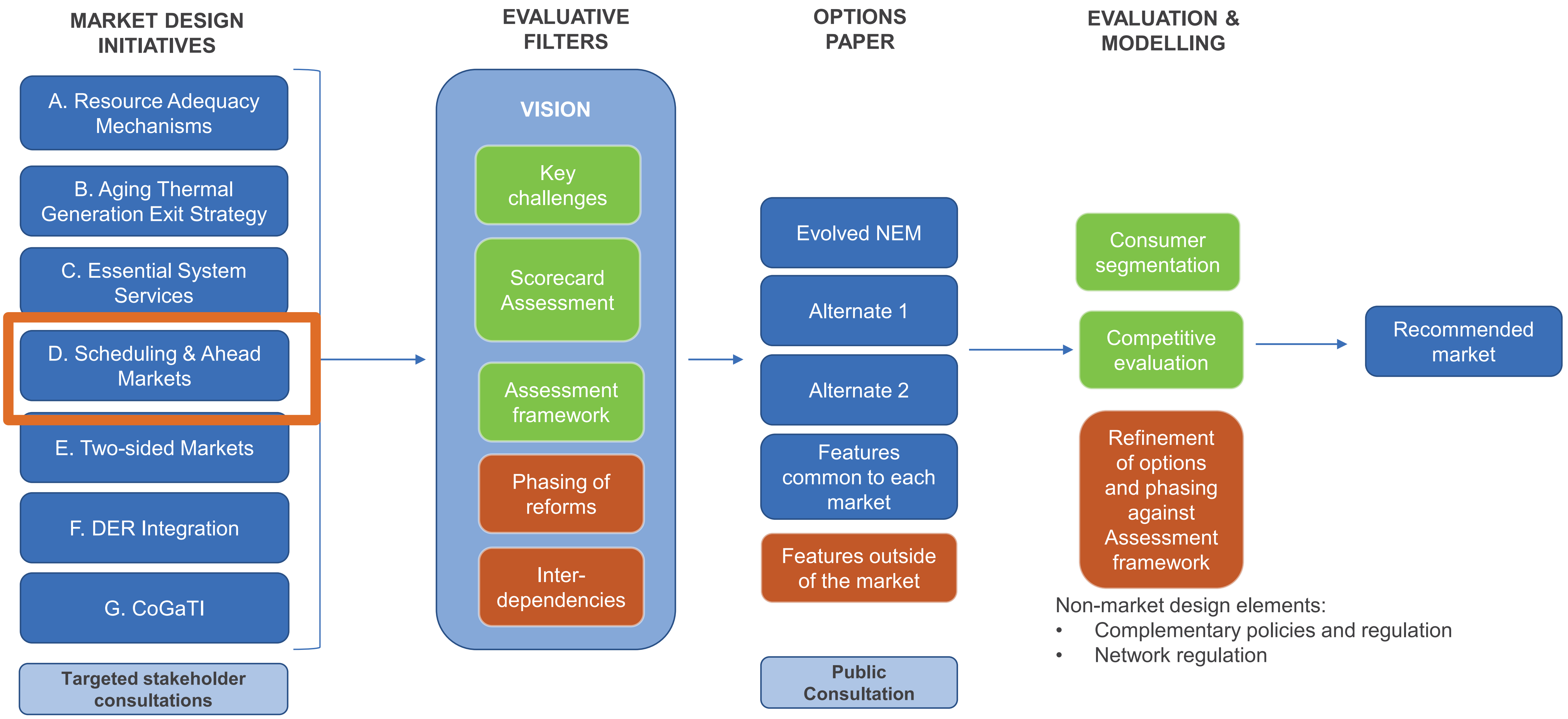
to support reliability that could apply from the mid-2020's.

The ESB needs to recommend any changes to the existing market design or recommend an alternative market design to enable the provision of the full range of services to customers necessary to deliver a secure, reliable and lower emissions electricity system at least-cost.

P2025 PROGRAM – KEY DELIVERABLES



P2025 PROGRAM ARCHITECTURE



WEBINAR PURPOSE & LOGISTICS

AGENDA

1. Stakeholder engagement approach for scheduling and ahead market stream

2. Overview of where the UCS fits in the ahead market design

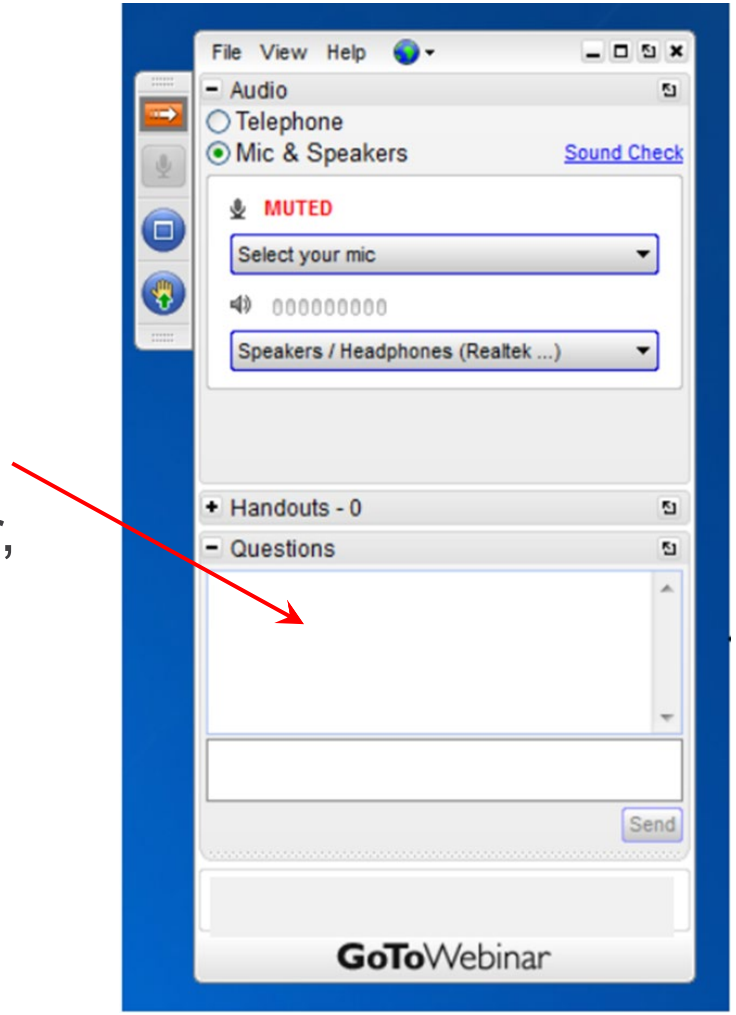
3. Introduction to the UCS

4. A primer on the unit commitment problem

5. Detailed design considerations for the UCS

WEBINAR-WORKSHOP LOGISTICS

- All participants are currently in listen-only mode
- We will pause at the end of each page where you see the ? symbol to answer questions. Please:
  - Type your questions here as we proceed through the content (double-check before sending); and/or,
  - Use the *Raised Hand* to signal that you would like to speak when we open the audio.



IMPORTANT NOTES

- These slides are solely for workshop purposes only. The content provides general information to support informed stakeholder engagement and foster a diversity of thinking and feedback.

- The presentation does not represent the official position of the Energy Security Board or any related body.

- The webinar is being recorded and a link to the recording will be provided after the webinar.

STAKEHOLDER ENGAGEMENT

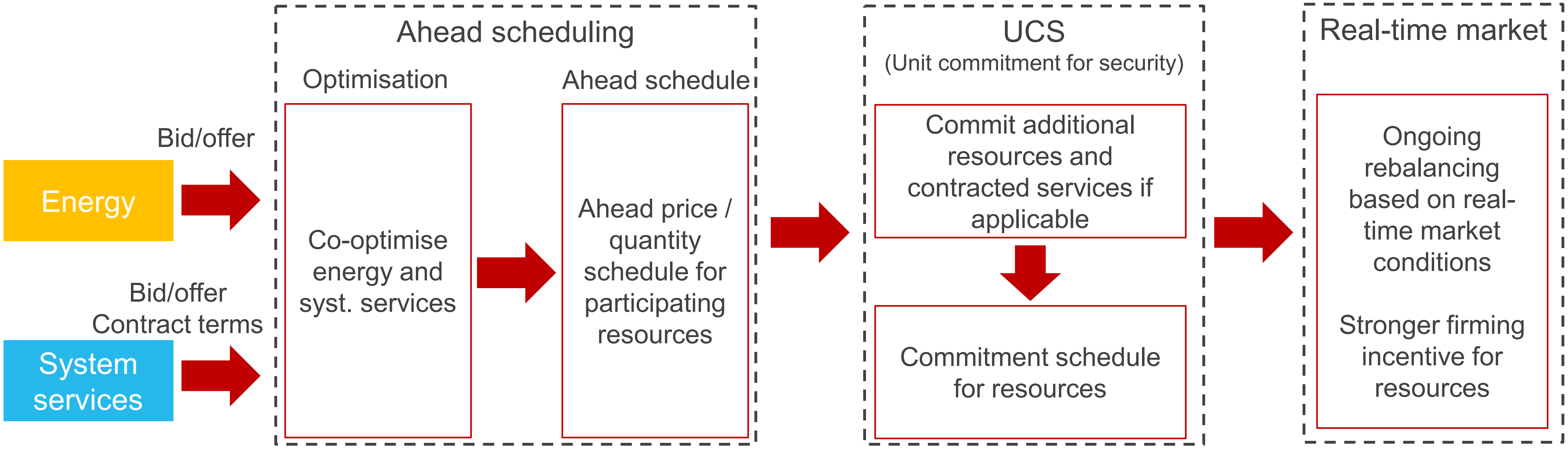
UPCOMING STAKEHOLDER ENGAGEMENT

- Upcoming focus group meetings for the Ahead market workstream:
  - 14 May – Unit Commitment for Security (UCS).
  - 15 June – Ahead market design elements.
  - 16 July – Discuss design, examples, feedback and issues.
- We will hold a follow up 'open mic' feedback session after each focus group meeting to allow further questions and comments from the focus group. The first feedback session is proposed for Wednesday 20 May.
- Each meeting pack will include a summary and response to questions and comments provided at the most recent focus group meeting.
- We encourage focus group members to get in contact with the team with feedback and questions.
- Assessment of the options will be carried out following the development of the high level design.

OVERVIEW

Recap of content covered in last Scheduling and Ahead Markets TWG

OVERVIEW OF AHEAD PROCESS



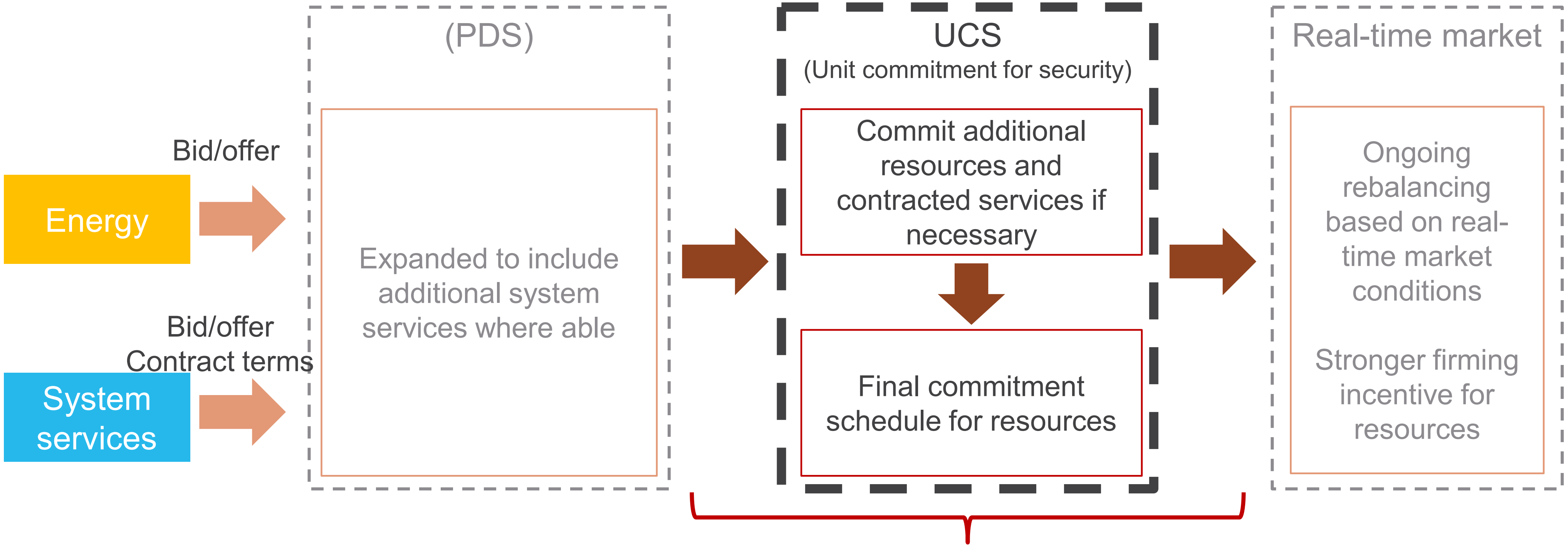
AHEAD MARKET ELEMENTS IN THE SPECTRUM

Minimum change from current NEM → Enhance firming through ST contracts → Co-optimised energy + system services ahead schedule → Most firm commitment

	1. Unit Commitment for Security (UCS - only)	2. UCS plus voluntary forward market	3. System security ahead market	4. Compulsory ahead market design
Ahead scheduling	N/A	Opportunity to trade short term contracts for energy and system services ahead of real-time.	Co-optimised ahead scheduling of energy and system services. Potential scheduling of contracted system services	Mandatory participation for all energy and system service resources.
UCS	Commit additional units to fill system gaps based on PDS and system forecasts Potential scheduling of contracted system services	Similar to option 1, with PDS expected to be updated to reflect VFM outcome	Similar to option 1, with PDS expected to be updated to reflect ahead scheduling outcome	
RT balancing	Stays as per now - mandatory gross pool scheduling. PCP affects payment and operation of relevant resources	Similar to option 1, with VFM schedule included in settlement	Similar to option 1, with ahead market schedule included in settlement	

FOCUS OF TODAY'S DEEP DIVE

- Today the focus is on the UCS, which is in all options
- We will work through it primarily in the context of option 1 (UCS-only option)
- Assumption that the existing pre-dispatch scheduling process (PDS) is retained (expanded to include additional system services), but there are no other ahead scheduling process (unless otherwise noted)



Today's focus is the UCS and its linkage to up- and downstream process

INTRODUCTION TO UCS

What is the UCS?

How does the UCS differ from current processes?

An example of the UCS process

UNIT COMMITMENT FOR SECURITY (UCS) IS A PROCESS THAT OCCURS IN ADVANCE OF THE CLEARING OF THE REAL-TIME MARKET

(Ahead scheduling /) PDS → UCS (Unit commitment for security) → RT balancing

Potential benefits

- Brings system security and reliability directions processes into a single integrated process
- Optimisation-based, cost minimisation approach to schedule contracts for system services and commit additional resources when required
- Moves away from the current *ad hoc* intervention process

UCS TAKES A SET OF INPUTS AND YIELDS DECISIONS THAT CAN BE TAKEN BY MARKET OPERATOR

Inputs	UCS	Result
1. Forecast of system conditions 2. PDS and/or ahead market solution (if applicable) 3. Plant economic costs* & technical information 4. Terms and conditions of system service contracts	1. Assesses whether all system requirements are met 2. Determines whether contracts for services should be activated 3. Produces indicative commitment schedule for additional resources if gaps in system requirements are identified	1. Activation of contracts for services (including RERT where applicable) 2. Commitment instructions issued by system operator where necessary to: I. Commit out-of-market resources II. Confirm commitment of already-committed resources

- *Economic costs used to commit additional resources are based on the actual costs of operating the plant, not bid-based costs used in the current real-time dispatch.*
- *These economic costs could potentially be subject to a regulatory verification process.*
- *The distinction between this approach and existing arrangements is important – the UCS is a tool to determine additional commitment to deliver system services (eg, system strength, reserves), and is a separate process to RT- dispatch.*

IT IS HELPFUL TO UNDERSTAND THE CURRENT DIRECTIONS PROCESS

Identify potential gap

- There is no single tool that allows operators to assess all system requirements at once given, for example, some rely on binary or inter-temporal variables and dispatch and pre-dispatch uses a sequential linear optimiser.

Manually collect information

- Contact participant operators (including generators, networks, users) to understand options available to address gap
- Assess options so as to minimise cost and market impact.

Inform market

- AEMO issues a notice to the market indicating potential and rationale for intervention, as well as the likely time of that intervention.
- Market does not have information as to what the intervention will be or its impact.

Direct

- Least-cost direction (as per hierarchy in rules) made at the last possible time to allow for a market response.
- Operators continue to monitor to ensure unit has responded to direction and gap is managed.
- Decision is made as to whether to price the direction or not (apply intervention pricing).

Intervention pricing

- Intervention pricing is applied where the direction was for a traded service to restore the price to the value but for the intervention.

Compensate

- The directed participant is compensated based on the 90th percentile of prices over the last 12 months.
- Affected participants are compensated based on their change of market dispatch and spot price.

THE UCS SEEKS TO ESTABLISH A FORMAL, EFFICIENT, TRANSPARENT PROCESS

Optimisation-based approach to meet system needs	• An optimisation which can handle binary variables (eg, whether a unit is online) and attendant costs and constraints • Can handle sophisticated trade-offs and constraints to find optimal **additional** commitment that satisfies all requirements of the power system whenever a gap arises in the commitment.
Respect market process and self-commitment	• Takes commitment outcome from market process (ahead scheduling and pre-dispatch) as a starting point • Only brings on **additional** out-of-market resources to address gaps in the absence of a market response.
Transparent least-cost approach	• Provides a mechanism to schedule contracts for system services to fill gaps and potentially assess market benefit. • Transparent → results from the UCS can be published, providing greater visibility for participants. • Consistent → optimisation produces consistent, efficient results rather than current ad hoc, opaque process.

THERE ARE IMPORTANT DIFFERENCES BETWEEN CURRENT PROCESS AND THE UCS

Current Directions Process

Manual identification of gap
- PDS and various tools manually identify and assess potential issues to the operator

Manual collection of information and assessment
- Contact participants to understand options available to address gap
- Assessed on least-cost and least impact on market

Inform market
Market not aware of what the specific intervention will be or possible impacts

Direction at latest time to intervene
- LTTI based on when the least-cost option would need to be directed

UCS

Automatic continual assessment
- UCS process running at regular intervals to automate and enhance tools to identify and assess power system requirements

Standardised information used as input
- Integrated least-cost assessment, which incorporates all possible **additional** commitments and attendant contracted services

Transparent to market
- UCS results published regularly showing potential gaps and the actions which would be used to address those gaps.

Physical Commitment Plans and contract activation
- Issued to **pivotal** units to fill forecast gaps or prevent likely gaps.
- Issued at the time as advised by UCS

Both processes

Intervention “what-if” pricing mechanisms are similar under both processes

Current Directions Process: Compensation via 90th percentile price

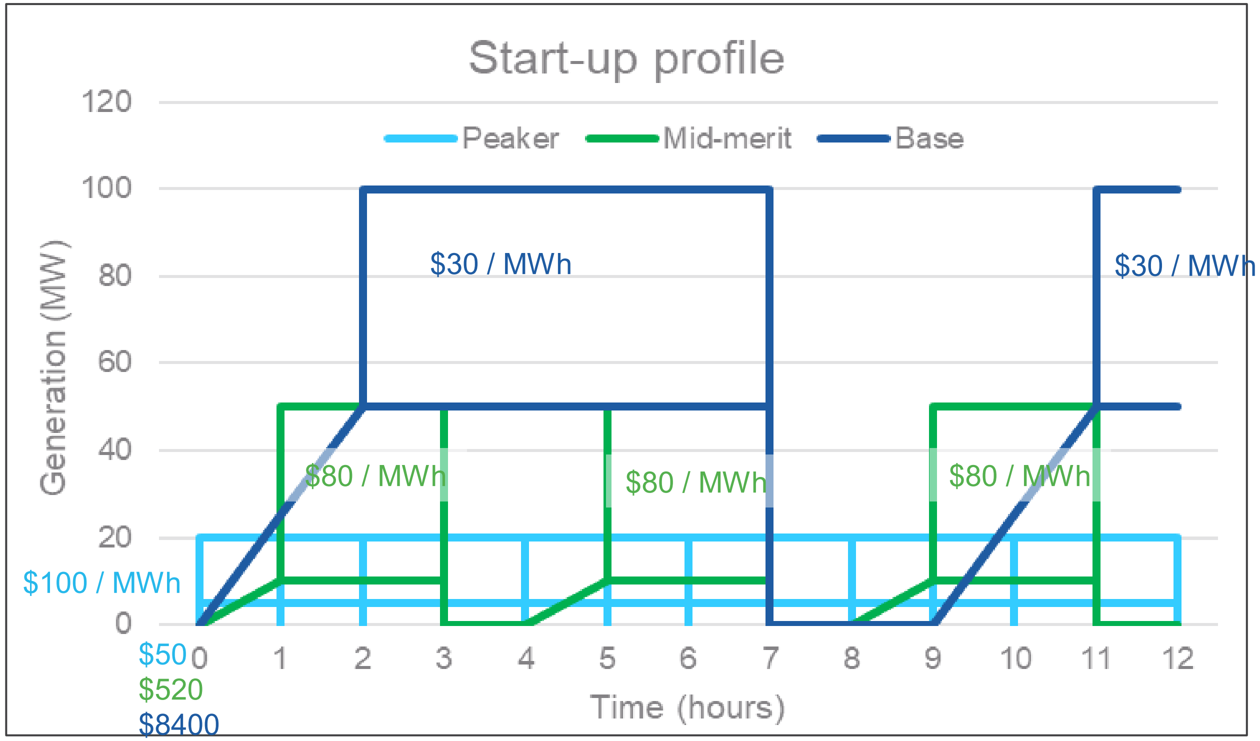
UCS: Compensation based on the unit’s costs as were used to make the PCP decision

**The current process would be retained for exceptional circumstances*

RESERVE EXAMPLE

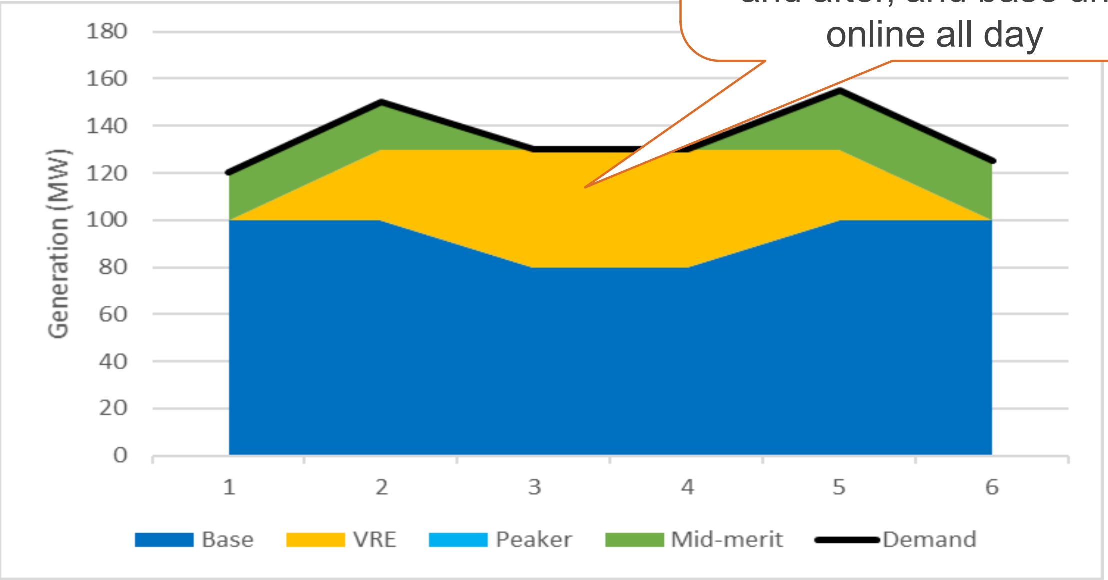
This example:

- Highlights where the UCS may recommend to prevent a unit decommitting to maintain responsive reserve levels (eg. FCAS) during the day.
- Is illustrative only to explain how a UCS would commit units if the PDS is indicating they are not already online and there is a security gap to fill.
- Is not to discuss why or why not the units are online.
- Uses reserve to facilitate TWG understanding as a familiar concept; it is not to say that the UCS will be regularly used to address a reserve gap.
- Can be extended to how units may be committed to provide various capability and in different arrangements.



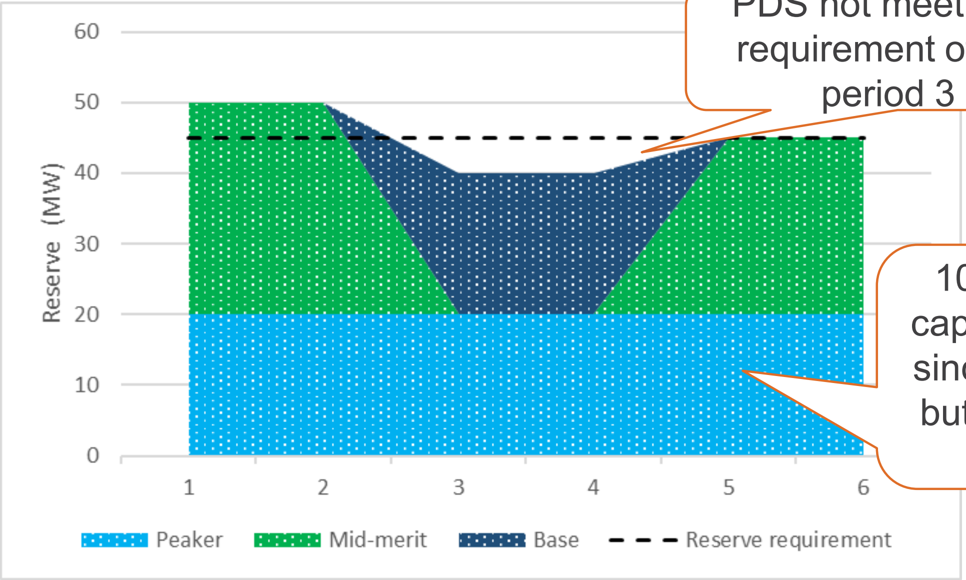
UNIT	MIN GEN	MAX GEN	START TIME	MIN ON TIME	MIN OFF TIME	START COST	RUN COST	Responsive Reserve
	MW	MW	Hours	Hours	Hours	$ / start	$ / MWh	Status to provide
VRE	0	100	0	0	0	$0	$0	N/A
Peaker	5	20	0	1	0	$50	$100	Offline
Mid-merit	10	50	1	2	1	$520	$80	Online
Base	50	100	2	5	2	$8400	$30	Online

PRE-DISPATCH SCHEDULE



PDS indicating VRE in middle of day, with mid-merit unit online before and after, and base unit online all day

RESPONSIVE RESERVE



PDS not meeting reserve requirement of 45 MW in period 3 and 4

100% of peaker capacity is reserve since unit is offline but has negligible start-time

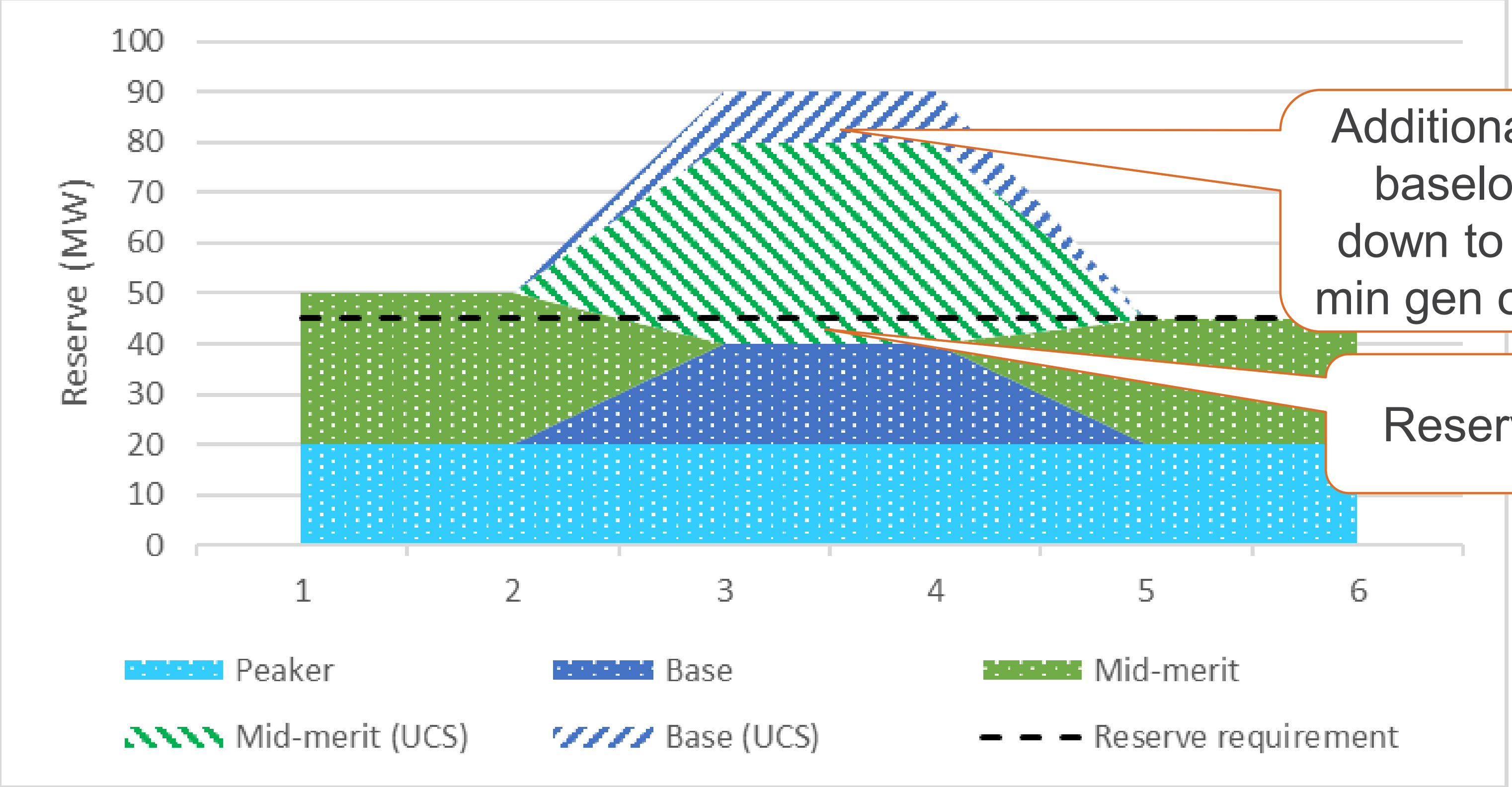
Period		1	2	3	4	5	6
Demand forecast (MW)		120	150	130	130	155	125
VRE (solar) (MW)		0	30	50	50	30	0
Net demand (MW)		120	120	80	80	125	125
Initial Status		**Energy Schedules**					
Peaker	OFF	0	0	0	0	0	0
Mid-merit	ON	20	20	0	0	25	25
Base	ON	100	100	80	80	100	100
Reserve available (MW)		50	50	40	40	45	45

UCS RECOMMENDATION

Period	1	2	3	4	5	6
Peaker	OFF	OFF	OFF	OFF	OFF	OFF
Mid-merit	ON	ON	ON	ON	ON	ON
Base	ON	ON	ON	ON	ON	ON

Peaker remains offline because it won't provide any additional reserve by turning ON

UCS recommends retaining mid-merit commitment during middle of day



Additional reserve from baseload as turned down to accommodate min gen of mid-merit unit

Reserve requirement met

UCS results published to the market

PHYSICAL COMMITMENT PLAN

- As real-time nears, the UCS continues to highlight a gap in reserve over periods 3 and 4, and continues to recommend that the mid-merit unit fills the gap.
- A PCP is issued to the mid-merit unit as per the UCS recommendations.

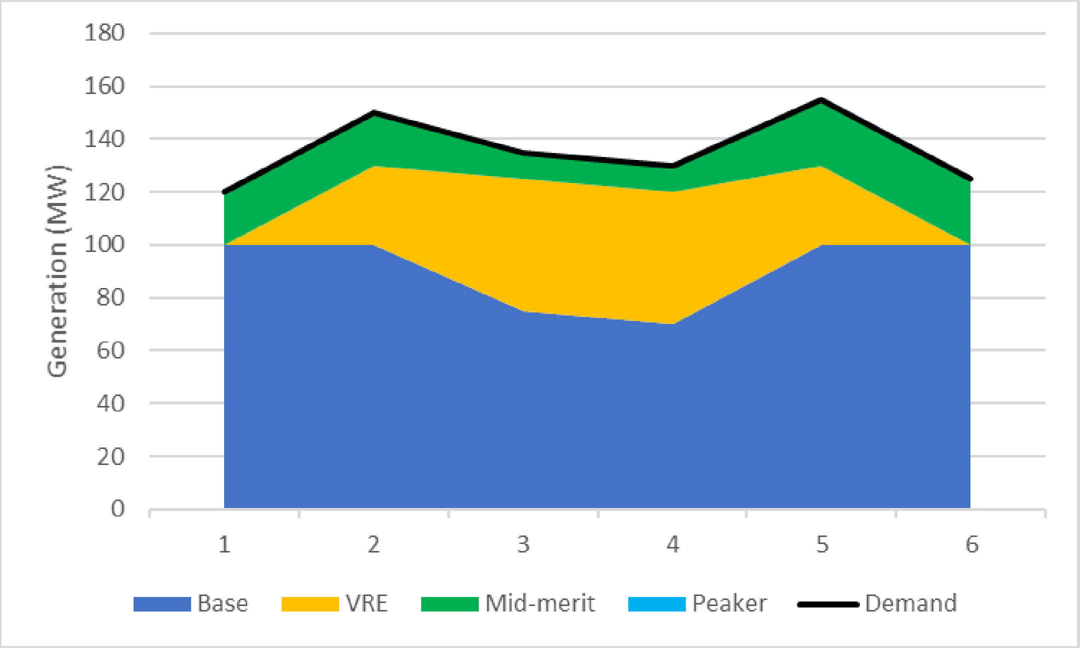
  Do not decommit at end of period 2.

  Run for periods 3 and 4 at minimum generation.

- Since the mid-merit unit was already online as per the PDS outcome for commercial reasons, the unit does not need to be compensated for its start-up costs.
- The unit is only guaranteed to be compensated for its cost of running at minimum generation (10 MW) at its running cost of $80 / MWh for period 3 and 4.

REAL-TIME MARKET

- Demand in the RTM varies from when the UCS was run to be 5 MW greater in period 3.
- VRE remains as was predicted in UCS run.
- Base unit output changes compared to what was indicated in PDS as it is dispatched to:
  - Accommodate min gen of UCS unit in period 3 and 4
  - Take up additional demand (in RTM compared to PDS) in period 3



Period		1	2	3	4	5	6
Demand forecast (MW)		120	150	135 (+5)	130	155	125
VRE (solar) (MW)		0	30	50	50	30	0
Net demand (MW)		120	120	85 (+5)	80	125	125
Initial Status		Energy Schedules					
Peaker	OFF	0	0	0	0	0	0
Mid-merit	ON	20	20	10 (+10)	10 (+10)	25	25
Base	ON	100	100	75 (-5)	70 (-10)	100	100

SETTLEMENT

Unit	Comment
Peaker	Not impacted by UCS commitment
Mid-merit	Needs to be compensated for UCS commitment. Guaranteed revenue for running costs at time of PCP
Base	Generates less due to UCS commitment – is an affected participant under intervention pricing application.

PRIMER ON UNIT COMMITMENT

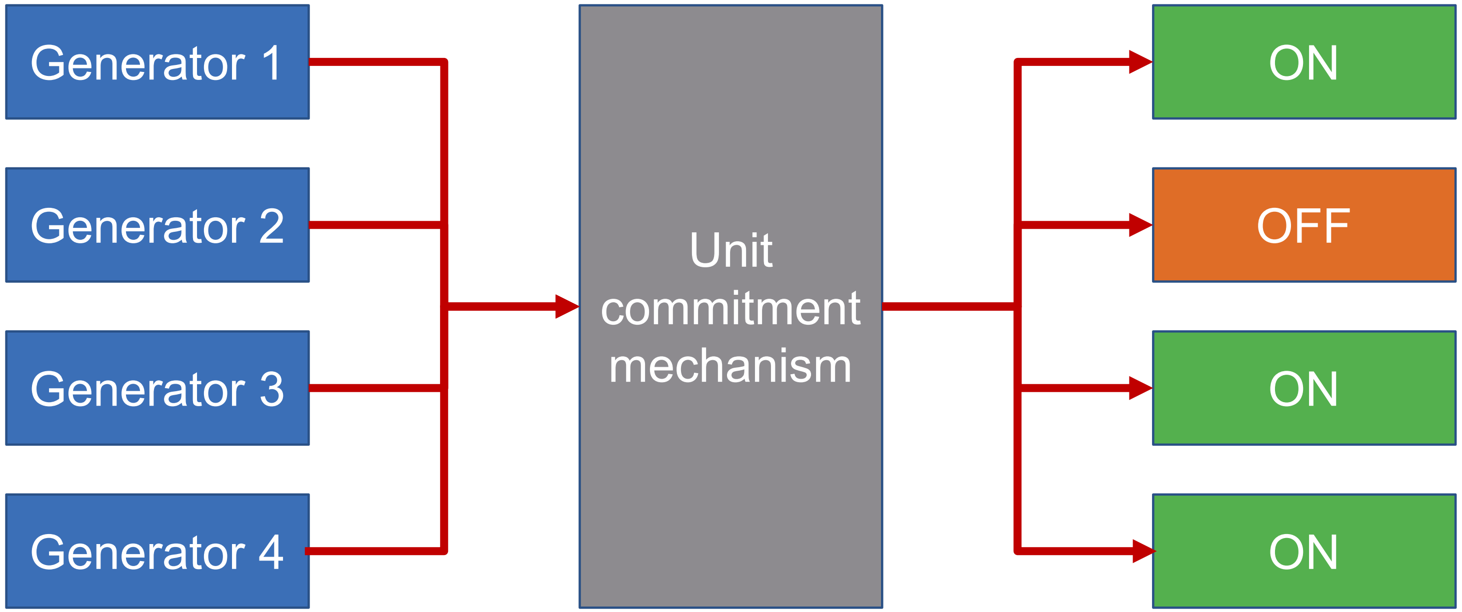
Unit commitment overview

Optimisation window

THE UNIT COMMITMENT PROBLEM

Unit commitment is a problem that determines which resources should be turned on in order to meet total system security and reliability requirements at lowest cost.

- Generator submits costs and other relevant technical parameter regarding their plant
- A process that finds the optimal commitment pattern (which generator to turn on or off) based on the operating costs of the unit.
- Generator that are on are then available for dispatch



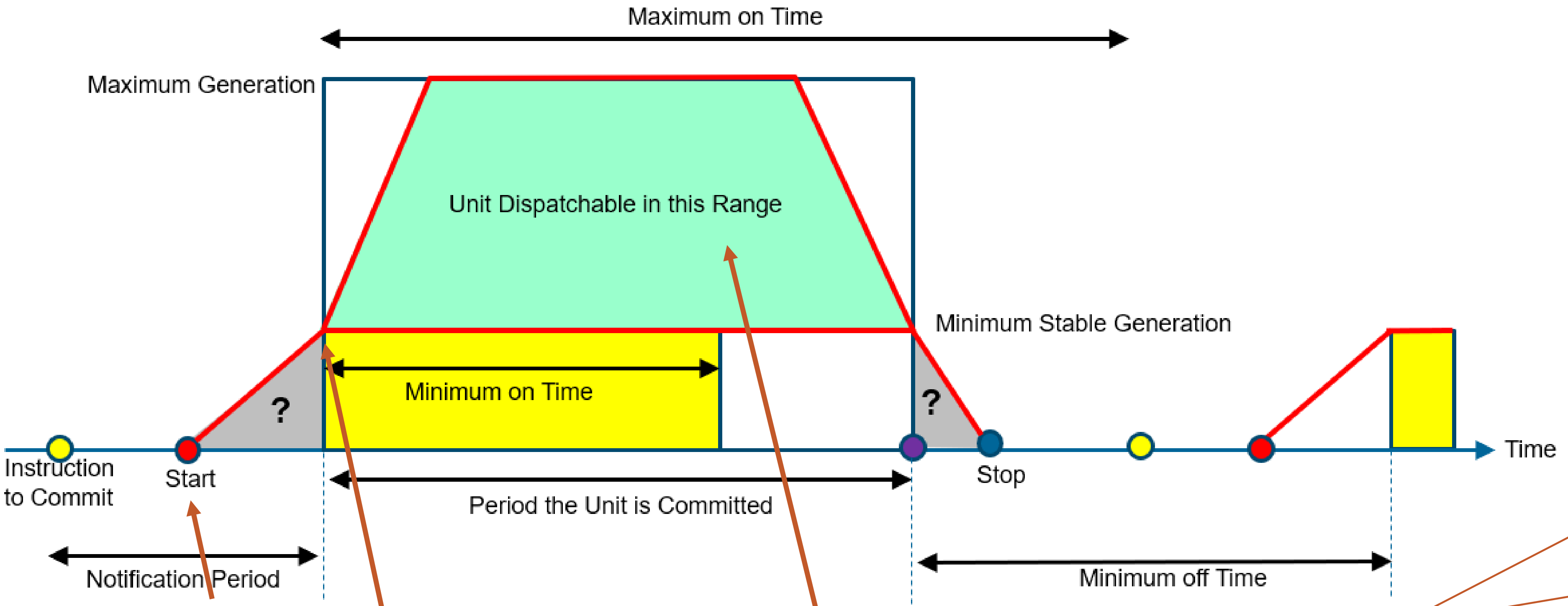
MODELLING THE UNIT COMMITMENT PROBLEM

The seemingly simple problem of turning on a generator (i.e., unit commitment problem) is complicated by constraints such as:

1. How fast the unit can react to instruction
2. What is its minimum stable generation, and how quickly can it reach that level and at what rate
3. How long does it take to reach maximum output and at what rate
4. Minimum duration for the unit to remain on
5. Minimum wait time to restart the unit if it is turned off
6. Etc…

Typically handled through a well-developed technique called mixed integer programming.

These constraints may also change per unit depending on the status / mode of the unit. e.g. Is the unit hot, warm, or cold? Does it have different operating modes and/or fuels?

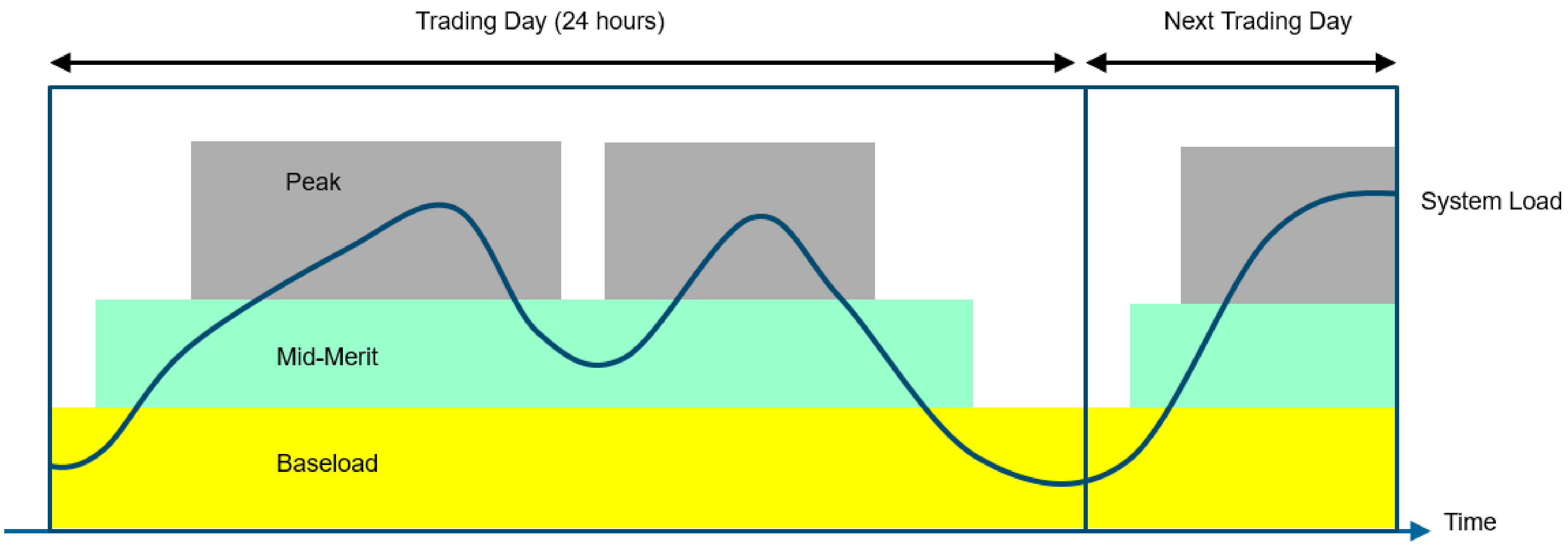


Costs incurred: start up + min gen costs + variable

The cost of committing a unit = Start up ($/start) + Cost to run at min gen for min on time ($ / MWh) + Variable costs beyond this ($ / MWh)

OPTIMISATION OVER TIME

- Illustration below uses an energy example, but the same reasoning applies to co-optimisation with other system services.
- Solving unit commitment problem needs to look ahead in order to make a meaningful choice between:
  - Inflexible resources with higher start cost but with lower ongoing cost *vs*
  - Flexible resources with lower start cost but more expensive running cost
- Knowing system conditions ahead also important when scheduling energy limited resources (e.g., battery and pumped hydro)
- Often optimisation window extends beyond the period of interest to mitigate sub-optimal solutions issues at the end of period



DETAILED UCS EXPLANATION

Process of the UCS

Inputs, optimisation, output, resulting actions

Timing of commitment instructions

Settlement implications

THE PROCESS OF UCS

A generic flow chart of the end-to-end UCS process. More on the timing of daily- and hourly or intraday-UCS next…

Input

1. AEMO forecast of system conditions and constraints
2. PDS and/or ahead market solution (if applicable)
3. Plant economic costs & technical information
4. Information on contracted system services

→

Optimisation

1. Least cost commitment outcome to meet demand and system services over forecast period
2. Commitment based on PDS or ahead scheduling taken as fixed
3. Activate system service contracts to fill system gaps and potentially provide market benefit

→

Output

1. ***Indicative*** commitment schedule including:
   I. Additional commitment by UCS
   II. Contracts activated by UCS
2. Pivotal units identified (see later)
3. Other technical solution related information
4. Potential system gap and contract activation communicated to market

→

Commitment instruction and contract activation

1. Out-of-market commitment instruction made on last minute to intervention basis
2. Contract activated and communicated to market in accordance with terms and conditions, as per indicated in UCS solution

DUCS AND HUCS

Combination of Daily and Hourly UCS (DUCS and HUCS) to allow for

- Early identification of problem to assist operational planning and alert the market
- Continued monitoring of system conditions and communicate updated information to the market
- Committing additional resources at the appropriate time if market response is not available (more on this later)

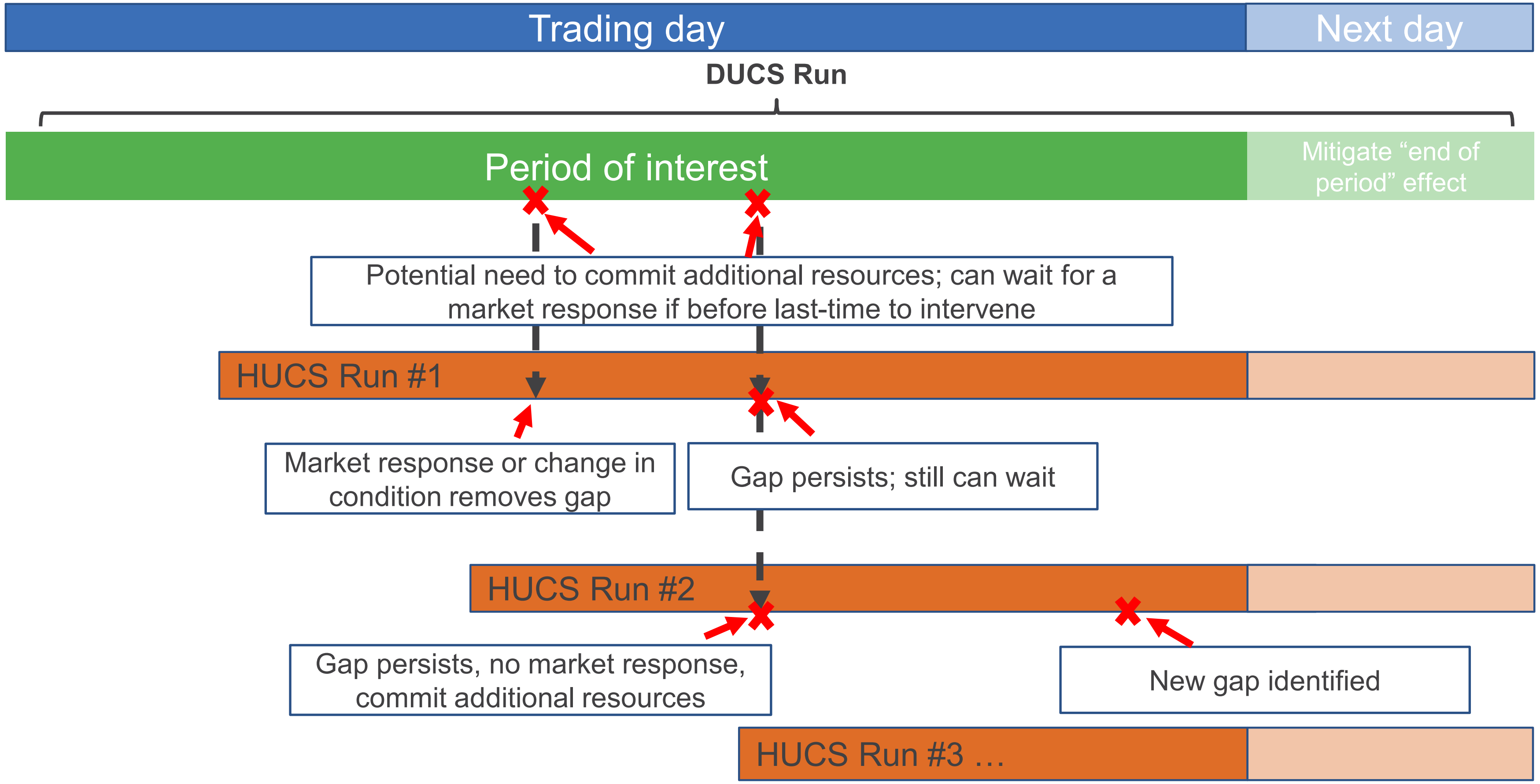
**Note below is for illustration only. DUCS does not have to be run for a day, but instead once every 4/6/12 hours depending on design.*

DUCS run

- Run over the whole day/x-hour-block
- Provide indicative outlook for SO and can be communicated to markets
- Can “wait for market response” when gap initially identified

HUCS run

- Runs every hour/2 hours (for example)
- Run for the remainder of the day with updated information
- Outcome communicated to market
- Commit resources when approaching real-time with no forthcoming market response



USING THE UCS TO DISPATCH (OR ACTIVATE) SERVICE CONTRACTS

What are "service contracts"?

Current Framework

1. NSCAS contracts between AEMO/NSP and generators.
2. Where TNSPs have contracted for services to fulfil minimum system strength or inertia requirements.
3. RERT

Potential Future Designs

1. The Essential System Service workstream is investigating procurement methods for system services.
2. System strength review may also highlight a change to the way services are procured.
3. Service could be supplied by resources owned/contracted to NSP

Possible structure

Availability payment + Activation payment

How can the UCS activate a service contract?

- The UCS identifies the least-cost commitment schedule of resources to meet the security and reliability needs of the power system.
- Contract terms for providing services can be an input to the UCS processing (like a cost-based bid).
- UCS objective can be to commit a unit to meet a power system need based on the contract terms, indicating when to activate the service contracts.
- When a contract is activated, compensation would be based on contract terms.

Why would the UCS activate a service contract?

In the absence of ahead scheduling the UCS is the only way of activating contracts in a co-optimised way. The counterfactual would be activation based on *ad hoc* assessment, but still done before real-time.

1. To fill a security or reliability need

Where the UCS has identified a gap and there is an existing contract to fill the gap, the UCS can activate the contract.
Activation of NSCAS contracts is currently done on a manual, ad-hoc basis.

2. To provide market benefit

There may be cases where activation of a service contract to alleviate a local security constraint would release additional low-cost generation.

- *What are the alternatives to activating service contracts through the UCS?*

INPUTS

System forecast	• Demand and VRE generation • System service requirements • Network constraints
PDS and ahead scheduling solution	• Self-commitment and availability for energy and system services in PDS taken as input in UCS run • Commitment based on ahead scheduling solution (if applicable) could be reflected in subsequent PDS commitment
Plant economic and technical data	• Plant economics to commit additional resources including start up, no load and incremental variable cost provided as "standing data" but could also be updated on regular (e.g., daily) basis • These costs are true economic costs that could be verified, not bid-based cost used in actual dispatch • Unit technical information such as notification time, min on/off time, min-gen, ramp rate, energy storage limit, etc.
Contracted system services	• Contracted resources for providing system services could be included as notional generators • E.g., contract costs replace plant economics and other contractual terms could be reflected in unit technical information

- *Are there any additional inputs required to assess the security and reliability of the system and to determine least cost commitment outcome?*

OPTIMISATION

A CONSTRAINED MINIMISATION APPROACH

Minimise total cost of committing and running units over time, subject to the following sets of constraints

1. Energy demand = supply
2. System services demand and constraints met
3. Network constraints satisfied
4. Generator output within technical limits
5. Generator on/off decisions feasible

**Note self-commitment through PDS would be treated as fixed in the UCS run, with potential adjustments to ensure feasibility.*

TREATMENT OF CONTRACTS FOR SYSTEM SERVICES IN UCS

- Contracts for system services would be treated as if they are “notional generators” with plant cost and tech limitation reflecting contract terms.
- UCS can activate contracts to fill system gaps or to potentially to provide overall market benefit
- For the latter, UCS would explicitly consider the following trade-off :
  - Activating additional contract for more system services beyond min. requirement (e.g., more system strength)
  - Allowing lower total system cost (e.g., more VRE output)

- *What are your thoughts on dispatching service contracts if there is a market benefit to do so, but the contract is not needed to maintain security and reliability? Is there a better way to schedule these contracts to provide such benefit other than the UCS?*

SOME CONCEPTS AND TERMINOLOGY REGARDING UCS RECOMMENDATIONS

ACTIONS AEMO COULD TAKE BASED ON THE UCS

DEFINITION OF "OUT-OF-MARKET COMMITMENT"

PCP APPLICATION TO PIVOTAL UNITS

Activate a contract

Service	Purpose	Action	Definition of "out-of-market commitment"	PCP application to pivotal units
For contracted system services	To fill system gap or potentially provide market benefit	Contract activation	NOT "out-of-market" commitment, as contracts are "in-market" services	Resource operates as per contract requirement

Issue a physical commitment plan (PCP)

Service	Purpose	Pivotal units	Definition of "out-of-market commitment"	PCP applied
For services traded in spot (ahead and/or RT) markets or For services not traded in spot market but from an uncontracted resource	To fill a system gap	Commit additional resources Extend commitment of self-committed resources	These are "**out-of-market commitments**"	• Synchronisation time and duration • Level of output (if applicable)
	To prevent a system gap due to a single unit decommitting	Request relevant resources to seek AEMO approval before decommitment	NOT "out-of-market" commitment *unless* request to decommit not approved	Need to seek permission before decommitment

UCS OUTPUT AND COMMITMENT INSTRUCTIONS

UCS output

UCS output is not automatically a commitment by the system operator. It is an **indicative commitment schedule** that informs both the operator and the market of potential system gaps and out-of-market commitment that might be required if the gap persists

What happens in between…

Commitment instruction

AEMO issues a **commitment instruction** when it:

- Applies PCPs to participants
- Activates a contract for system services

Contract activation

Additional commitment identified to fill system gaps

Other pivotal units

Communication to market

- Forecast gap and potential additional commitment
- Pivotal units
- Contract activation information
- Other technical solution info (run time, MIP gap, constraint violation, etc)

Activate as per indicated in UCS → Contract activated

If there is no market response → Out-of-market commitment made, additional unit brought online

AEMO monitor market conditions → Seek approval from AEMO to decommit

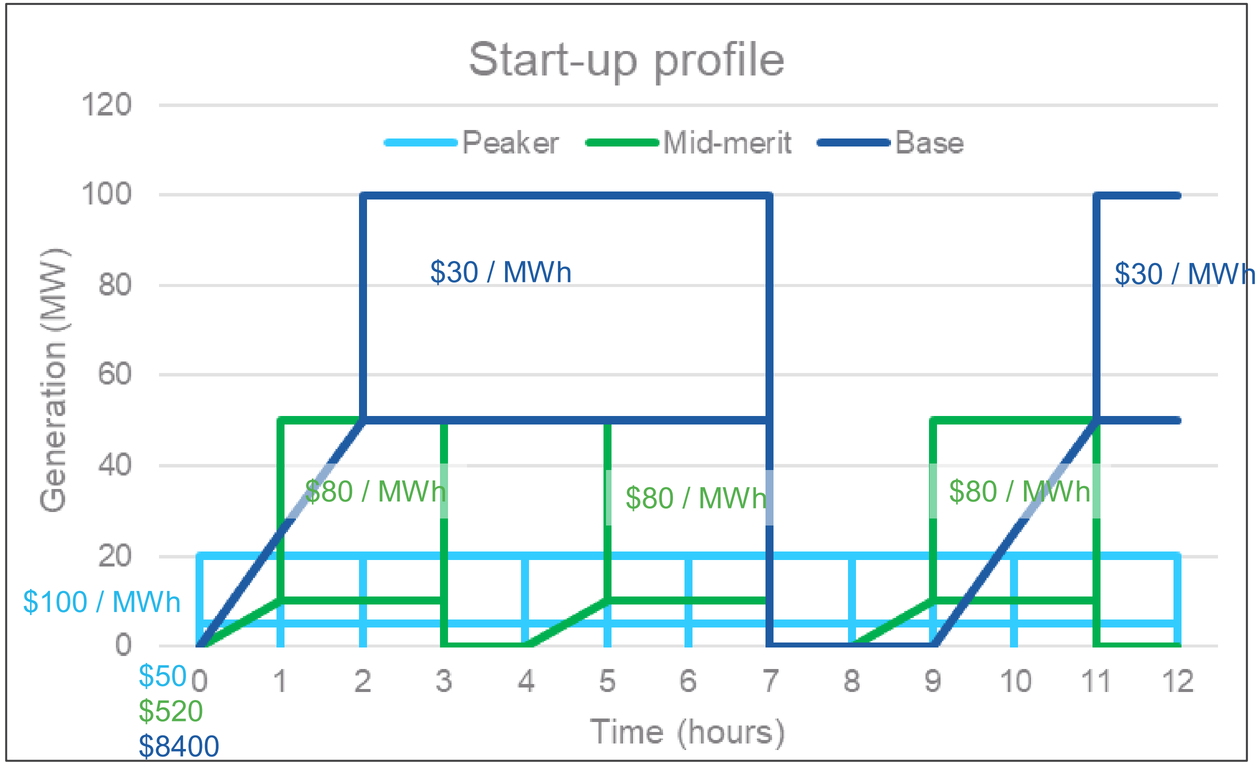
PCP applied

CONTRACT ACTIVATION EXAMPLE

This example:

- Illustrates how the UCS could recommend the activation of a contract to fill a system security gap.
- Has some assumptions in the way security constraints are handled between pre-dispatch, dispatch and the UCS, and how pricing is managed in the event of activation of a contract.

- The same set of units are available in this example, and now the peaker unit has a contract to provide system strength in a particular location of the network.
- AEMO can call on the contract for the peaker to run at minimum generation, and the unit is paid as per the contract terms.



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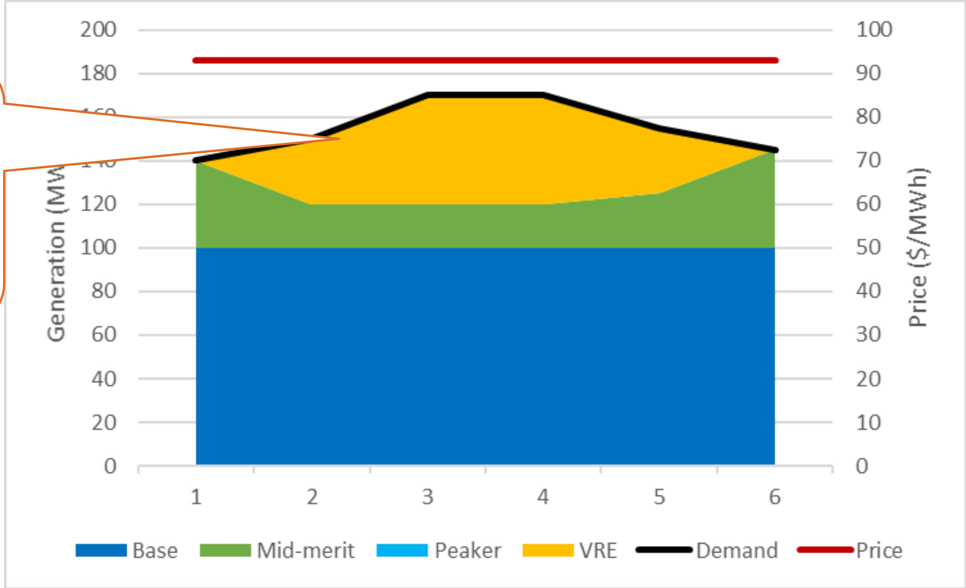
	MW	MW	Hours	Hours	Hours	$ / start	$ / MWh	
VRE	0	100	0	0	0	$0	$0	
Peaker	5	20	0	1	0	$50	$100	Activation payment: $60, Usage payment: $110/MWh
Mid-merit	10	50	1	2	1	$520	$80	
Base	50	100	2	5	2	$8400	$30	

PRE-DISPATCH SCHEDULE

Full VRE output scheduled in pre-dispatch.
Given non-linearities in system strength constraints, PDS is unable to "see" potential local limitations.

PDS (and dispatch) cannot "see" non-linear constraints in this example as the solve time would be too great to have the PDS solve for these.



Mid-merit unit sets price for the day.

Peaker not scheduled

Period			1	2	3	4	5	6
Demand forecast (MW)			140	150	170	170	155	145
VRE (solar) (MW)			0	30	50	50	30	0
Net demand (MW)			140	120	120	120	125	145
Bid Price	**Initial Status**		**Energy Schedules**					
$105	Peaker	OFF	0	0	0	0	0	0
$93	Mid-merit	ON	40	20	20	20	25	45
$32	Base	ON	100	100	100	100	100	100
Sync units online			2	2	2	2	2	2
Pre-dispatch price			$93	$93	$93	$93	$93	$93

UCS RECOMMENDATION

UCS assessment finds:

- Local system strength limits would be breached with current pre-dispatch schedule in the middle of the day.
  - **The UCS can highlight this where perhaps PDS may be unable because of mixed integer programming enabling understanding of non-linear constraints.**
- There is a contract available to alleviate this system security breach.

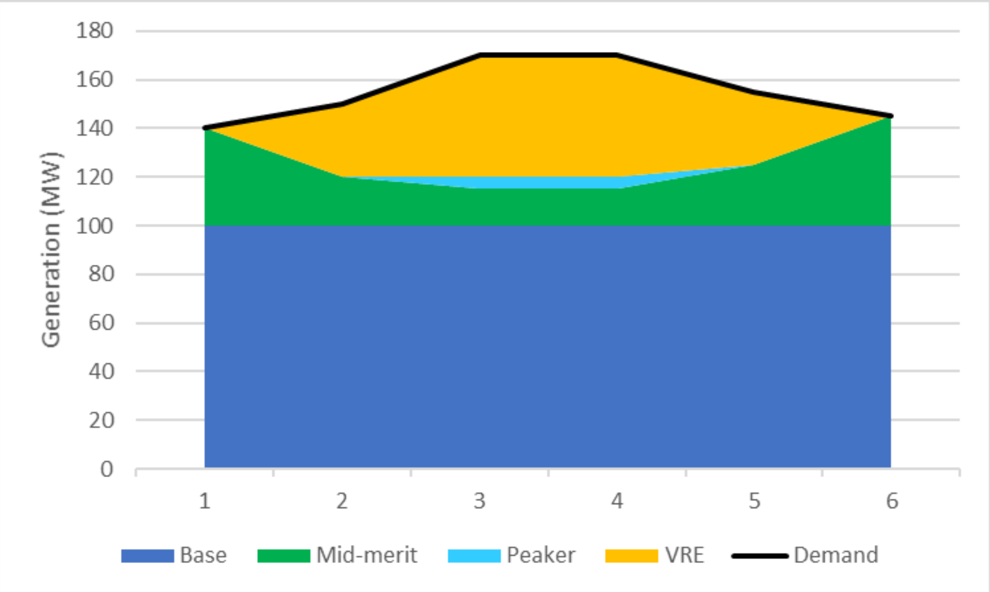
UCS optimisation recommends the activation of the peaker unit contract.

Period	1	2	3	4	5	6
Peaker	OFF	OFF	ON	ON	OFF	OFF
Mid-merit	ON	ON	ON	ON	ON	ON
Base	ON	ON	ON	ON	ON	ON

Contract activated

REAL-TIME MARKET

- Real-time market takes into account that the contract has been activated and schedules the peaker unit.
- Mid-merit unit ends up being dispatched 5 MW less than PDS had indicated to account for peaker min gen.



Peaker can't set market price because it has been activated via a contract.

Period			1	2	3	4	5	6	Total MWh
Demand forecast (MW)			140	150	17[illegible]	170	155	145	
VRE (solar) (MW)			0	30	50	50	30	0	160
Net demand (MW)			140	120	120	120	125	145	
Bid Price	**Initial Status**		**Energy Schedules**						
$105	Peaker	OFF	0	0	5 (+5)	5 (+5)	0	0	10
$93	Mid-merit	ON	40	20	15 (-5)	15 (-5)	25	45	160
$32	Base	ON	100	100	100	100	100	100	600
Sync units online			2	2	2	2	2	2	
Pre-dispatch price			$93	$93	$93	$93	$93	$93	

SETTLEMENT

Unit	Comment
Peaker	Settled as per the terms of activation of its contract.
Mid-merit	Receives real-time market revenue for generation. Generates less compared to original PDS due to contract activation, but intervention pricing is not applied in this case as the contract is a market-based process.
Base	Receives real-time market revenue for generation.

TIMING OF ISSUING COMMITMENT INSTRUCTIONS

The main trade-off:
1. Wait for a market response *vs.*
2. Wait for too long and have only expensive options (or no options at all) to address gap

Services traded on spot markets (ahead or RT)	• Market response and capturing scarcity conditions crucial for resources to exercise commercial options and recover investment cost • Cost of committing more expensive resources secondary especially if "out-of-market" commitment is rare	→ Wait until last minute to issue PCP
Contracted system services	• Contract itself is a market mechanism with pricing and conditions negotiated upfront • Cheapest "market solution" therefore is indicated in the UCS run already • Provide participants with certainty and sufficient notice about pending contract activation	→ Activate contract as indicated in the UCS solution if reasonably sure of its need

- *Do you agree with the principles applied here for when an intervention should occur based on the recommendations of the UCS?*
- *What are the relevant inputs to making this trade-off?*

SETTLEMENT RELATED ISSUES

Basic principles

- Resources committed out-of-market to be compensated based on cost
- “Intervention pricing” applies to “out-of-market commitment” *and* services traded on spot market (ahead and/or RT) just like now, and not to system service contract activation.

- Settlement for UCS commitments based on real-time price and quantity (and ahead schedules where applicable):
  - Resources committed “out-of-market” receive cost-based compensation based on plant economic cost data or other relevant verified cost
  - Resources under system services contract receive remuneration based on contract terms
- Contracted system services are provided and remunerated through a form of market mechanism and price signals in spot energy and other services markets reflect the efficient resource mix. Therefore intervention pricing not needed post system service contract activation.
- Contract activation will be communicated to market as early as possible and reflected in subsequent pre-dispatch so market participants and system operator has time to respond to its impact.

- *Do you agree with the principles of when and how to apply intervention pricing?*

FURTHER DESIGN CONSIDERATIONS

1. Details for inputs
2. Consider the characteristics of different generation technologies and modes of operation.
3. Details for scheduling storage units and DER resources
4. Lead time, optimisation horizon and frequency of UCS runs
5. Representing uncertainty and risks in modelling
6. Trade-off between granularity of modelled time interval and modelling complexity and run time

- *Are there any other important design details we should consider?*

SEEKING YOUR INPUT

Some issues we specifically want feedback on

- Proposed approach to upcoming stakeholder engagement.
- Activation of system service contracts through the UCS, and any potential alternatives.
- Inputs required to assess security and reliability
- The potential to dispatch service contracts if there is a market benefit to do so.
- Principles for the timing of an intervention that is identified in the UCS.
- Principles for when and how to apply intervention pricing.

How you can provide feedback

Please provide initial feedback to info@esb.org.au with email subject heading titled '*TWG UCS briefing'* by **Tuesday 26 May**.

Please get in contact if you have further questions.

- Upcoming focus group meetings:

  20 May – UCS feedback session
  (please download Slido.com)

  15 June – Ahead market design elements

  16 July – Discuss design, examples, feedback and issues