



# Connections Reform Roadmap

Connections Reform Initiative

December, 2021

## **AEMO and the CEC**

The Connections Reform Initiative (CRI) is jointly sponsored by the Australian Energy Market Operator (AEMO) and the Clean Energy Council (CEC).

All involved express their deep gratitude for the leadership and commitment they have shown across all phases of the initiative.

## **Who wrote this report?**

The Connections Reform Roadmap represents the work of over one hundred people.

There is no single author; no-one person or entity was in control.

The language will be at times unfamiliar - and in a sense deliberately so. This Roadmap has not been created by “normal” industry processes.

# Introduction

## Section 1

## Forward (1/2)



**Daniel Westerman**  
Chief Executive Officer  
& Managing Director  
AEMO

We are witnessing the biggest transformation of energy supply and demand in the history of the National Electricity Market as Australia's power systems decarbonise and decentralise at pace.

We have an opportunity to guide the path not only for Australia but, in fact, the world, about how to integrate high levels of renewables into future energy systems.

In this, it's critical to get the connections process right for the sake of project developers, investors, local communities and energy consumers.

But we know the connections process has been a major bottleneck. Our existing processes and frameworks weren't designed for the volume or pace of new inverter-based resources, or for the level of competition in connections.

This Connections Reform Initiative is impressive: it is industry collaboration and reform co-design, at scale, to improve the connections process.

I want to thank the Clean Energy Council and everyone who has contributed to the development of the draft Connections Reform Roadmap.

I want Australia to be the best place in the world to connect new generators, and I think that's the aspiration we should all have.



**Kane Thornton**  
Chief Executive  
Clean Energy Council

As the pace of change in the Australian energy system has accelerated, grid connection emerged as the single greatest challenge for renewable energy projects.

The Connection Reform Initiative stands out as a new model for innovation and collaboration in solving such a complex problem.

I want to thank the hundreds of people from across the energy sector for their effort and contribution, particularly the CEC's members and AEMO, our co-sponsor for this Initiative.

A reformed connection process is now within our grasp, providing greater efficiency and certainty. It's the certainty that will be crucial if we are to accelerate the deployment of our world class renewable energy and Australia's efforts to decarbonise our electricity sector and achieve net zero emissions long before 2050.

## Forward (2/2)



**Alex Wonhas**  
Executive General  
Manager System  
Design  
AEMO

Australia is currently experiencing the world's fastest energy transition. In almost all scenarios, AEMO sees the future rate of change accelerating even further. We therefore need a clear, efficient and effective grid connection process to bring as many of the 132 GW of committed and proposed projects as possible in the NEM to fruition. This enables low-cost, clean energy to flow through the grid to consumers. It also maintains a sufficiently attractive investment environment to drive the \$100+ billion investments needed for our future. Consumers will benefit from a fit-for-purpose process because without efficient investment, prices would be higher, and reliability would be lower, than under the optimal development pathway for Australia.

I'm encouraged by the collaborative design approach that has become a hallmark of the Connections Reform Initiative. I hope this process sets the benchmark for future NEM reforms.

The Connections Reform Roadmap is a significant, world-class piece of work to maximise the benefits of the energy transition for all Australians.



**Neil Gibbs**  
Independent Facilitator

The leadership shown by AEMO and the CEC in adopting a deeply collaborative and co-design based approach to industry reform is, I believe, unique in the NEM. A belief in people, working together, to address truly complex problems.

This initiative was conceived to address challenges with the connection process - challenges driven by the unprecedented growth in connections demand, the increasing complexity as the network has become more fully committed, and the changing mix of synchronous and asynchronous generation.

The Leadership Group has played a critical role in setting the direction and providing the support needed for the CRI. I cannot thank the Working Group enough for their voluntary effort, contributions, care, their enduring curiosity and their preparedness to listen to alternative views and work together to find ways to address complex topics. They have provided the ideas and energy which have allowed this initiative to come as far as it has.

It has been an honour and a privilege to support everyone in this journey. My sincere thanks for allowing me to be part of it.

And yes. The hard work starts now!

We acknowledge the invaluable contributions of these businesses in allowing their people to volunteer to contribute to the Connections Reform Initiative (CRI)



We thank each of the people who make up the CRI Community for their care, thought, energy and passion as they have engaged collaboratively with others to address complex issues, and find alternatives

Shabir Ahmadyar  
Rajesh Arora  
Jane Aubrey  
Joel Aulbury  
Ragu Balanathan  
Stewart Bell  
Luis Brasa Perez-Coleman  
Tony Chappel  
Ian Christmas  
John Cole  
Anna Collyer  
Simon Corbell  
Peter Cowling  
Kav De Silva  
Matthew Dickie  
Andrew Dillon  
Geoff Dutailis  
Darrin Edwards  
Werther Esposito  
Jordan Ferrari  
Alistair Fletcher  
Keith Frearson  
Dennis Freedman  
Sam Fyfield  
Jonathon Geddes  
Joel Gilmore  
Javier Gomez  
Adam Gorton  
Sachin Goyal  
Christina Green  
Sorrell Grogan  
John Haddow  
Matt Hadley

Jacobs  
AECOM  
CEC  
AEMC  
Vestas  
Powerlink  
Acciona Energy  
AEMO  
Edify Energy  
Edify Energy  
AEMC  
CEIG  
Vestas  
Acciona Energy  
RWE  
ENA  
PowAR  
Essential Energy  
ENEL Green Power  
CEC  
Essential Energy  
Jacobs  
Octopus Energy  
Goldwind  
AEMO  
Iberdrola  
X Elio  
AEMO  
Powerlink  
Energy Queensland  
AusNet  
ElectraNet  
CEC

Bradley Harrison  
Martin Hemphill  
Victor Ho  
John Howland  
James Huang  
Jess Hunt  
George Ivkovic  
Tim Johnson  
Aydin Kizilirmak  
Hugo Klingenberg  
Siham Knowles  
Oleg Kochukov  
Ravi Kumar  
Andrew Lim  
Bruno Martins  
Antara Mascarenhas  
Steve Masters  
Martina McCowan  
Abbie McQueen  
Alastair Meldrum  
Craig Memery  
Mike Middleton  
Nicholas Miller  
Chetna Mishra  
Chris Mock  
Tony Morton  
Steven Nethery  
Hieu Nguyen  
Kevin Paice  
Tom Parkinson  
Scott Partlin  
Russell Pendlebury  
Andrew Phipps

ElectraNet  
RES Group  
SA Power Networks  
TransGrid  
MUFG  
ESB  
TasNetworks  
Octopus Energy  
Enel Green Power  
ElectraNet  
AEMO  
AECOM  
AECOM  
SA Power Networks  
Goldwind  
AEMO  
ElectraNet  
AEMC  
AECOM  
CitiPower / Powercor  
PIAC  
CWP Renewables  
Hickory Ledge  
AEMO  
AEMO  
Vysus Group  
Windlab  
CitiPower / Powercor  
Powerlink  
CEC  
Neoen  
AEMC  
Essential Energy

Margarida Pimentel  
David Pointing  
Praneel Pradhan  
Gratian Punciwedikkarage  
Mahbub Rabbani  
Satya Rajamuni  
Peter Rasmus  
Venetia Roberts  
Scott Ryan  
Jennifer Sai  
Erick Sanchez  
Ronny Schnapp  
Jeremy Schultz  
Duan Serfontein  
Mark Shilliday  
Shane Slattery  
Clare Stark  
Anita Talberg  
Kane Thornton  
John Titchen  
Michael Tran  
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Erika Twining  
Natalie Uthaug  
Con Van Kemenade  
Bobby Vidakovic  
Rachel Watson  
Alicia Webb  
Mark Wilson  
Alex Wonhas  
Merryn York  
Rick Zhang  
Christiaan Zuur

AEMO  
Australian Power Institute  
Risen Energy  
AEMO  
X Elio  
GPG Australia  
Jacobs  
Impact Investment Group  
Endeavour Energy  
AEMO  
Enel Green Power  
Neoen  
Finlaysons  
RES Group  
ESCO Pacific  
TransGrid  
AEMC  
CEC  
CEC  
Goldwind  
Maoneng  
Tesla  
AusNet  
AEMO  
Enel Green Power  
CEFC  
Pacific Hydro  
AEMO  
AER  
AEMO  
AEMC  
Tilt Renewables  
CEC

## This Connections Reform Roadmap (CRR) is a living document with non-binding recommendations



This Roadmap is a ‘living document’. It will naturally evolve to reflect further detail and evolved thinking about the recommended Reform Areas it contains, as well as include the addition of further reforms that are developed using the CRI’s collaborative, co-design ways of working.

Like all living things, some may see imperfections and gaps. We encourage the reader to accept that the Roadmap paints a picture of the future, seen through a set of targeted and ambitious reforms.

The reforms span many areas, and will have differing impacts; some transformational, and others more incremental. The reforms could be treated as separate activities, but in aggregate they are best seen as a “fabric” or whole.

### Non-binding recommendations

It is critical to note that the Reform Areas are non-binding on any person or any organisation involved in the CRI. The thoughts presented in this document have been developed through an extensive process of collaboration by many people who work with or are involved in the connections process, including developers and their technical advisors, OEMs, TNSPs, DNSPs, AEMO and the CEC. The thoughts presented here are not those of any particular individual or organisation, do not purport to represent the views of individuals or organisations and do not commit any organisation to action.

The reforms are well supported, but not unanimously so; and critically, the more transformational reforms require much more detailed work before we can be confident that they are entirely suitable.

### Next steps

We welcome your questions or comments, but are not calling for formal “submissions” on the Roadmap as such:

AEMO: [stakeholderrelations@aemo.com.au](mailto:stakeholderrelations@aemo.com.au)

And / or

CEC: [cri@cleanenergycouncil.org.au](mailto:cri@cleanenergycouncil.org.au)



# Executive Summary

## Section 2

## The CRI was created to help overcome challenges in connecting new generators to the grid during the fastest clean energy system transition in the world

Australia is undergoing the fastest transition of any energy system in the world<sup>1</sup>

In 2020, almost 2 GW of new renewable energy capacity was installed with 32 projects connected, contributing to 27.7% of Australia’s electricity generation coming from renewable sources. The growth in installed variable renewable energy will only accelerate, with a further 76 large-scale wind and solar projects under construction at the end of 2020<sup>2</sup>. The draft ISP released on 10<sup>th</sup> December confirms that the rate of new renewable energy capacity will materially increase in the years ahead.

The magnitude and pace of the transition means it is critical to get connections right.

The speed of transition is creating significant challenges in connecting new projects to the grid, leading to the formation of the CRI

The CRI was formally initiated in Q2 2021, although it had been preceded by various joint activities in response to concerns with connections progress, crystallised in a sense by challenges in the West Murray Zone.

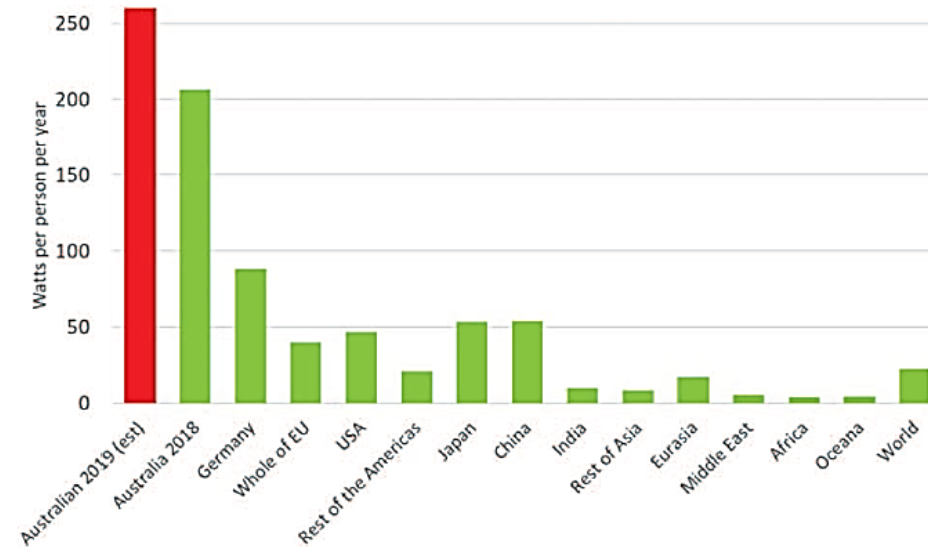
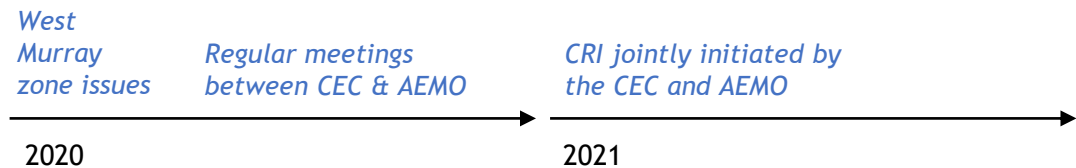


Figure: Annual per capita renewables deployment rate <sup>1</sup>



<sup>1</sup> Blakers *et al.* Pathway To 100% Renewable Electricity, IEEE Journal Of Photovoltaics, Vol. 9, No. 6, November 2019 (via A. Wonhas presentation to Australian Energy Week, 25/5/2021). Accessed online 29/9/2021: <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8836526>

<sup>2</sup> Clean Energy Council, Clean Energy Australia Report 2021 (p. 7). Accessed online 29/9/2021: <https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-australia/clean-energy-australia-report-2021.pdf>

<sup>3</sup> Energy NSW, Accessed online 29/9/2021: <https://www.energy.nsw.gov.au/renewables/renewable-energy-zones>

The vision for the connections process is one that is consistent, predictable, efficient and collaborative - and “*the best place in the world to connect new generators*” (Daniel Westerman)

A strong connections process is critical to unlocking the 100% instantaneous renewable energy future.

Australia is rapidly approaching 100% instantaneous renewable energy penetration. Indeed, AEMO is preparing the grid for this outcome to arrive as soon as 2025<sup>1</sup>.

The speed at which this future is arriving is both exciting and daunting.

While small-scale generation and storage is contributing significantly to this future (with >3 GW of small-scale solar and 238 MWh of household batteries added in 2020), the 100% instantaneous renewable energy future is dependent on successfully installing large-scale generation and storage assets to the grid.

#### The CRI vision for the connections process:

1

A connections process which is **consistent, predictable** and which delivers repeatable outcomes.

2

To improve **efficiency**, including by reducing (eliminating) re-work, improving the quality coming into the process and addressing information asymmetry.

3

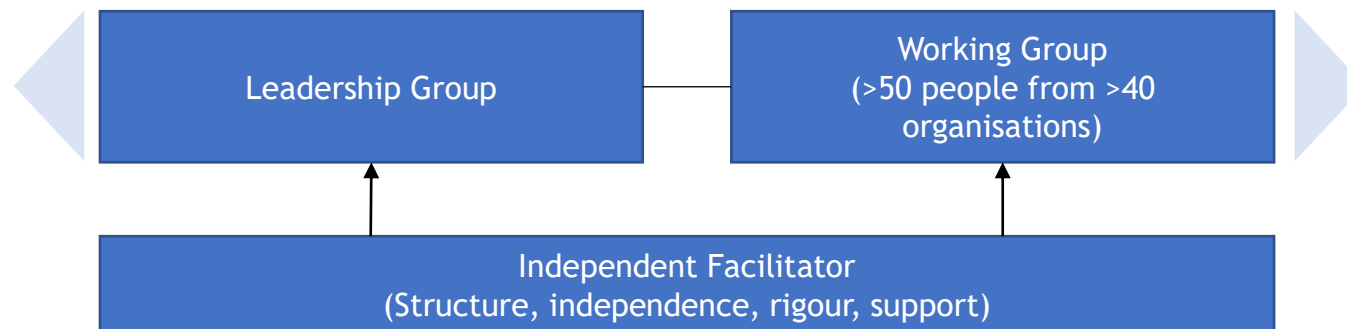
A **collaborative** working model between industry, AEMO and the NSPs.

<sup>1</sup> AEMO Corporate Plan FY2022, Accessed online 29/9/2021: [https://aemo.com.au/-/media/files/about\\_aemo/corporate-plan/2021/fy22-aemo-corporate-plan.pdf?la=en&hash=031377CA8B769A28E705235EFE428633](https://aemo.com.au/-/media/files/about_aemo/corporate-plan/2021/fy22-aemo-corporate-plan.pdf?la=en&hash=031377CA8B769A28E705235EFE428633)

<sup>2</sup> Clean Energy Council, Clean Energy Australia Report 2021 (p. 7-8). Accessed online 29/9/2021: <https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-australia/clean-energy-australia-report-2021.pdf>

## The CRI was initiated as a collaborative co-design

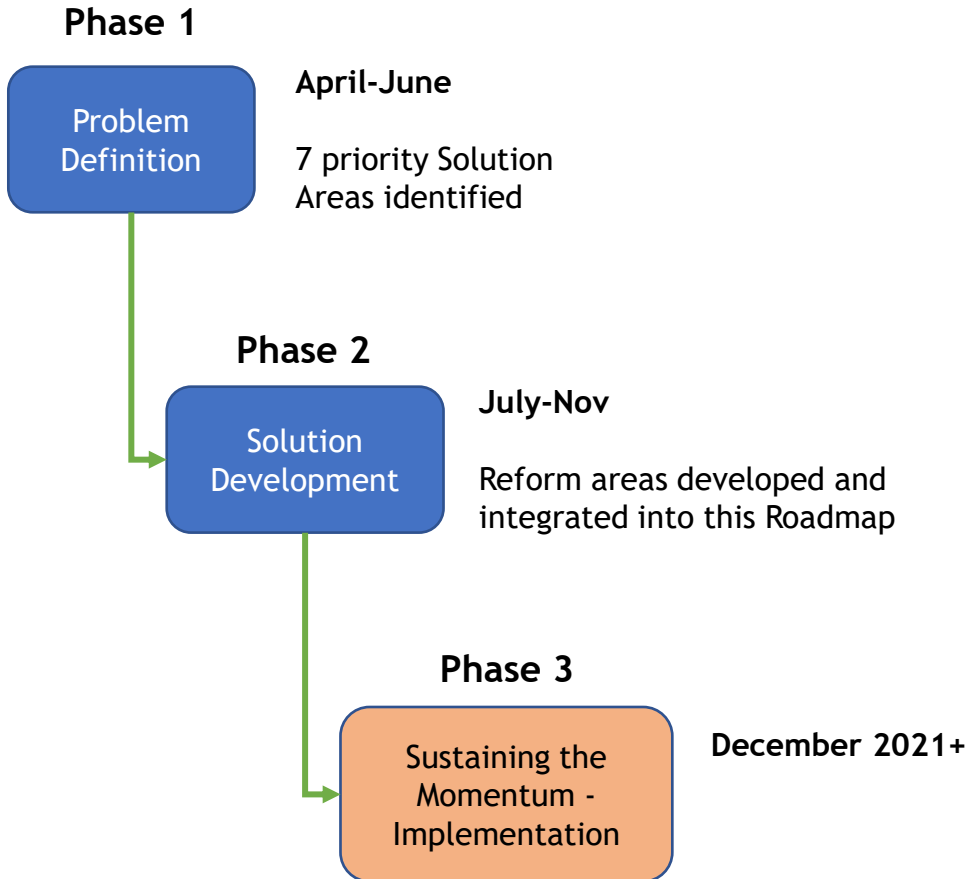
- AEMC
- AEMO
- CEC
- Edify Energy
- ENA
- ElectraNet
- ENEL Green Power
- Goldwind
- Pacific Hydro
- Powering Australian Renewables (PowAR)
- Tesla
- Vestas



- Co-design philosophy
- Collaborative interaction
- Address systemic issues; quick wins where we can
- Nothing off the table

- Acciona Energy
- AECOM
- AEMO
- AER
- AusNet
- Australian Power Institute
- CEC
- CEFC
- CitiPower / Powercor
- CWP Renewables
- Edify Energy
- ElectraNet
- Enel Green Power
- Energy Queensland
- ESB
- ESCO Pacific
- Essential Energy
- Finlaysons
- Global Power Generation Australia
- Goldwind
- Impact Investment Group
- Jacobs
- Maoneng
- Neoen
- Octopus Energy
- Powerlink
- RES Group
- Risen Energy
- SA Power Networks
- Tilt Renewables
- TransGrid
- Vestas
- Vysus Group
- Windlab
- X Elio

# The CRI has advanced through three phases



## Phases 1 and 2

Clusters of part-time volunteers working in parallel undertook:

- Root cause analysis
- Solution ideation
- Solution theme grouping
- Exploration of implementation considerations

The Connections Reform Roadmap is the first and principle output from Phases 1 and 2 of the CRI. It captures the work of all involved, and provides direction as we pivot into the implementation phase.

# The CRI - new ways of working to overcome familiar challenges

The CRI applied an approach to problem solving which is largely unfamiliar in the Australian energy landscape.

Some of the collaboration design features included:

- Suspending the belief that any one person or organisation ‘knows the answers’
- A profound belief in people, with a focus on our conversations, how we talked with each other, and building new relationships
- Down-playing the role of documentation - often slow, lacking in nuance, and too heavily influenced by the person holding the pen
- Volunteers working in Clusters - a breadth of views and opinions across stakeholders (AEMO, developers, NSPs, OEMs, consultants, and others)
- The sheer scale and diversity of the consultation builds its own momentum for action and a material sense of ownership
- Creating a safe place for ideas to be shared
- Aiming for unanimous support, but not expecting it
- Planning to use the existing industry change management processes for all reforms e.g. any CRI participant can propose a rule change (either individually or as part of a group) to the AEMC, and the existing rule change assessment procedures still apply. It is not the place of the CRI to sensor any individual’s actions

People will rightly focus on the reforms from the CRI (see next pages).

But sitting alongside these reforms is the hope that deep collaboration can become an endemic characteristic of our industry, even when the going gets tough. The CRI has gone a little way down that path, but there is quite some way to go.

Traditional energy industry ways of working (simplified)	The CRI ways of working
Formalities (of papers, structured consultations) define the process; relatively irregular engagement. One organisation as lead	Focus on human engagement - conversations of equals. Cadence of weekly Cluster workshops. No one organisation in control
Solutions often developed by one stakeholder (the ‘expert’) and then put to industry as a draft for comment. 1-2 iterations of the thinking	Solutions are co-designed by a range of stakeholders. Numerous iterations of the thinking; many small steps.
Stakeholder feedback is captured via formal engagement processes (webinars, etc.); early focus on documentation.	Focus on seeing issues from a new perspective. Stakeholder feedback is captured in real time via the co-design process. Workshop outputs.
Stakeholder feedback can feel ‘combative’.	<i>“To be brave, you must feel safe.”</i> Feeling safe underpins the pursuit of transformational change.
Established rule and other change management assessment processes apply.	Established rule and other change management assessment processes apply.

## The outputs of the Connections Reform Initiative

The Working Group identified well in excess of 100 ideas to improve the Connections experience for all.

By exploring these, grouping them, refining them, and ultimately prioritising, the Working Group recommended 11 reforms for either further detailed exploration, or in some cases direct implementation.

The Leadership Group has endorsed all 11 reforms for implementation, subject to:

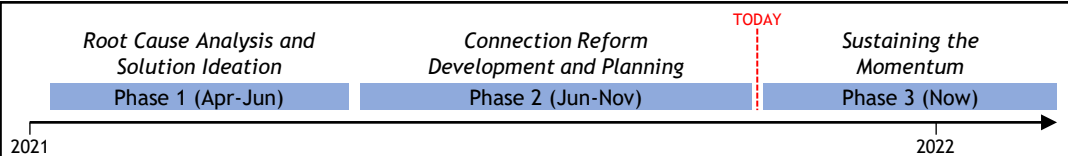
- Finalisation of a Funding Mechanism - noting unanimous support for a compulsory fee on developers (fixed \$/MW basis, over 3 years), and
- Detailed Planning and Scheduling to ensure the program is 'do-able' alongside BAU and other demands (i.e. resource constrained).

Some reforms are already underway - Network Access, Collaboration, BESS behind existing connection points, and Guideline change management process.

# The Reforms of the Roadmap (1/2)

## Purpose of the Connections Reform Initiative (CRI)

A consistent and predictable connections process that delivers repeatable outcomes, reduces re-work, drives efficiency, improves information quality and addresses information asymmetry. Jointly initiated by the CEC and AEMO to create a collaborative working model between industry, AEMO and NSPs.



## Proposed Reforms

1. Access	1.1 Network Access	Lower select Minimum Access Standards to allow NSPs to better reflect network performance and system needs at connection location. A more flexible approach for AEMO, NSPs, proponents & OEMs to agree performance standards whilst minimising process uncertainty and system risks.	6. Investment Certainty	6.0 Investment Certainty for R1	To introduce a suite of complementary reforms that create a more stable investment environment with reduced risk of changes or delays between project commitment and revenue. Includes an ongoing ability (i.e. after R1) for NSPs and AEMO to modify plant to meet system planning objectives.
	1.2 OEM Whitelisting	Establish a multi-level AEMO-managed whitelisting process and public register for OEM products for PV inverters, wind turbine generators, synchronous generators and condensers, BESS, and power plant controllers. Likely to require a new NEM 'Participant' category for OEMs.		6.1 Switching System Security Onus of Proof	Require NSP/AEMO to prove energisation will cause or worsen a system security risk in order to request modification of models/plants or delay energisation.
	1.3 Forums and Initiatives to Drive Collaboration	Develop a more collaborative approach to managing connection applications involving all stakeholders. Key recommendations to codify this approach: create collaboration opportunities, showcase examples, support behavioural change.		6.2 "Materiality" Definitions	Define what constitutes a material change (preferably in a guideline) to ensure formal changes are only required for material issues. Propose a new process to be inserted in the registration rules (replacing 2.1.1 (e) (3)) incorporating materiality thresholds.
2. Info & Modelling	2.1 Use of PSCAD	To provide clearer guidance on when to assess plant performance using EMT vs. RMS tools (i.e. PSCAD vs PSSE) to avoid unnecessary work and accelerate connections process.		6.3 Review Mechanism	Offer a facilitated discussion of an issue interpretation or a materiality decision by an expert connections engineer, who is independent to the specific connection process.
	2.2 Model Quality	Improve quality of information provided during connection process by developing a Connection Application Template, establishing a due diligence framework to provide early feedback during the connection process and undertaking formal lessons learned sessions after each application phase.		6.4 AEMO/NSP Compliance and Enforcement Post-Revenue	Allow AEMO/NSP (under the NER) to make R1 GPS capability determination subject to terms and conditions (with civil penalties) that have to be met during commissioning, i.e. issue a 'conditional' registration.
	2.3 OEM Provision of Black-box Models	Require or incentivise provision to AEMO of: 1. Open PSCAD model (equivalent to PSS/E source code) with Confidential User Guide; 2. Black-boxed model (equivalent to PSS/E object code) with Releasable User Guide; Study results benchmarking models 1 + 2 in DMAT scenarios.		6.5 Collective retuning Post Revenue	Extend/amend NER S5.2.2 to generalise the changes that can be requested, such that operational Generators can be requested by NSPs / AEMO to re-tune their plant to support system security of hosting objectives. Consider the appropriate cost recovery mechanism and/or forms of payment.
	2.4 Information Asymmetry	Provide better network and generator information to project proponents at key connection stages, e.g. include DNSP projects in KCI updates at enquiry Phase, and improve info provided by NSPs at pre-application stage to enable improved proponent base cases.		6.6 Introducing BESS Behind Existing Generation	Explore the opportunity to 'cordon off' existing plant from reopening a GPS when adding a battery to an existing generation system.
3. Batching	3.1 Batching	Undertake integrated NEM-wide technical assessment studies in batches of all ready applications on a set frequency basis to determine the successful proponents to receive a 5.3.4A/B letter.	6.7 Defined Process to Introduce Changes to AEMO Guidelines	Make it easier for stakeholders to understand when changes or updates are made to AEMO Guidelines and how to contribute feedback.	

Note: Regarding reform numbering, reforms 4, 5 and 7 (identified during CRI Phase 1) are currently being considered for subsequent phases of work and are therefore not included in this roadmap.



## The Reforms of the Roadmap (2/2)

### Next steps: Phase 3 ('Sustaining the Momentum')

#### Key Characteristics

- All reforms will progress to Phase 3 in the first instance. A detailed initial planning phase will be undertaken for each, with reforms to then be scheduled based on resourcing constraints.
- Reforms will be progressed by substantially dedicated teams, supported by members of the Working and Leadership Groups, ensuring continuity.
- Responsibility for the delivery of each reform is assigned to an individual entity (the 'Reform Sponsor / Lead') which will undertake the detailed initial planning phase required to understand resource requirements and to ensure governance for funding (see next point).
- Implementation of the CRI Reforms will involve some 'hard costs' (e.g. consulting support, facilitation and project management support) to be funded by a simple, transparent and fair Funding Mechanism.
- The use of existing change management mechanisms (e.g. rule changes) for the implementation of all reforms. Regarding rule changes:
  - Continued close engagement with the AEMC.
  - Responsibility to lead rule changes to be shared by various entities (NSPs, CEC, AEMO and potentially OEMs), ideally with the support of a diversity CRI participants.
  - A combination of conventional rule change process requests and the judicious application of the fast-track rule change process led by AEMO.

#### Looking to the Future

- Further reforms will likely be developed during phase 3 of the CRI - Sustaining the Momentum. These reforms were either deferred from the solution development phase due to resource constraints, have been identified during that phase of work, or whose priority has been highlighted by further developmental thinking during phase 2. The same model of collaborative, co-design will be deployed involving entities from across the industry to develop those potential proposed reforms.
- To this point in the Connections Reform Initiative, little explicit attention has been applied to the development of a vision or ambition for the connections process in the NEM. Some effort will be placed on this in the next phase, as we transition from problem resolution to opportunity and optimisation.

#### Governance Model

- Continuation of the collaborative and co-design model utilised to explore emergent reform priorities, engage a wide diversity of perspectives and build support for the implementation detail.
- Responsibility for implementing individual reforms transitions to substantially committed small delivery teams - called 'Reform Delivery Teams' - where needed.
- Majority of reforms would be lead directly by either AEMO or the CEC.
- The two most transformative and impactful reforms ('Batching' and 'Investment Certainty for R1') will be supported by a Delivery Lead, under the guidance of either AEMO or the CEC as Sponsor. These Delivery Leads will drive the project work and bring a level of independence to these large and complex reforms.
- Each Reform Delivery Team will have the support of a Reference Group, drawn from the CRI Working and Leadership Groups, to ensure continuity from the design phase (efficient, ensure broad ownership, re-enforces value of ongoing collaboration).
- Introduction of a 'Roadmap Implementation Oversight Group' to oversee the progress of each of the reforms. This group will introduce fit-for-purpose program and project management discipline to oversight reform delivery, performance against budgets and milestones, ongoing integration, etc. and will report to the Leadership Group.
- Fit-for-purpose performance reporting and communications envisaged as:
  - Brief monthly progress reports against plans and milestones to the Roadmap Implementation Oversight Group.
  - Bi-monthly 'public' reporting of achievements (outputs, milestones, outcomes) across the full CRI community.
  - Tracking of overall impact by utilising the Connections Performance Scorecard (i.e. evidence of delivered, enhanced outcomes).
  - Quarterly sessions with the CRI community - achievements, new challenges, things to do better, further opportunity to collaborate, etc.
- Clear and documented Terms of Reference for all groups identified in the proposed governance model.

# The approved reforms deliver outcomes and benefits across a number of dimensions



Reform Areas	OUTCOMES	BENEFITS			
		Speed <i>Faster connection process speed</i>	Efficiency <i>Lower cost of connection</i>	Grid outcomes <i>Improved hosting capacity, system strength</i>	Timing certainty <i>Firmer connection process timeframes</i>
1.1 Network Access	Enable a more flexible approach to min. standards to better reflect network capability at connection location; process improvements	✓		✓	
1.2 OEM Whitelisting	Some DMAT requirements assessed once only; reduce uncertainty for developers when selecting OEMs (esp. new technology)	✓	✓	✓	
1.3 Forums and Initiatives to Drive Collaboration	Reinforcing the value of collaboration across the connection process; better foundations when things are tricky	✓	✓	✓	✓
2.1 PSCAD vs PSSE (RMS vs EMT) Guidelines	A clear understanding when to use PSCAD and PSSE; avoid overuse of PSCAD	✓	✓		
2.2 Model Quality	Improved quality and consistency of connection information provided by proponents and Due Diligence reports to proponents	✓	✓		✓
2.3 OEM Provision of Black-box Models	Enable proponents to better perform dynamic studies that include detailed plant interactions	✓	✓		
2.4 Information Asymmetry	More informed distribution network connection site selection; more consistent base cases	✓	✓		
3.1 Batching	Improve 534 timing certainty; avoid repeat full technical assessments when new plant commits; reduced AEMO/NSP resource demand; coordination of proponents' system strength mitigation	✓	✓	✓	✓
6.1-6.5 Investment Certainty for R1	A more stable investment environment with reduced risk of changes or delays between project commitment and R1; ongoing AEMO/NSP ability to keep plant aligned with network needs	✓	✓	✓	✓
6.6 Introducing BESS behind existing generation	Opportunity to 'cordon off' existing plant from reopening a GPS when retrofitting BESS	✓	✓	✓	
6.7 Process to Introduce Changes to AEMO Guidelines	A structured, transparent process for introducing change to guidelines		✓		

# Phase 3 - ‘Sustaining the Momentum’

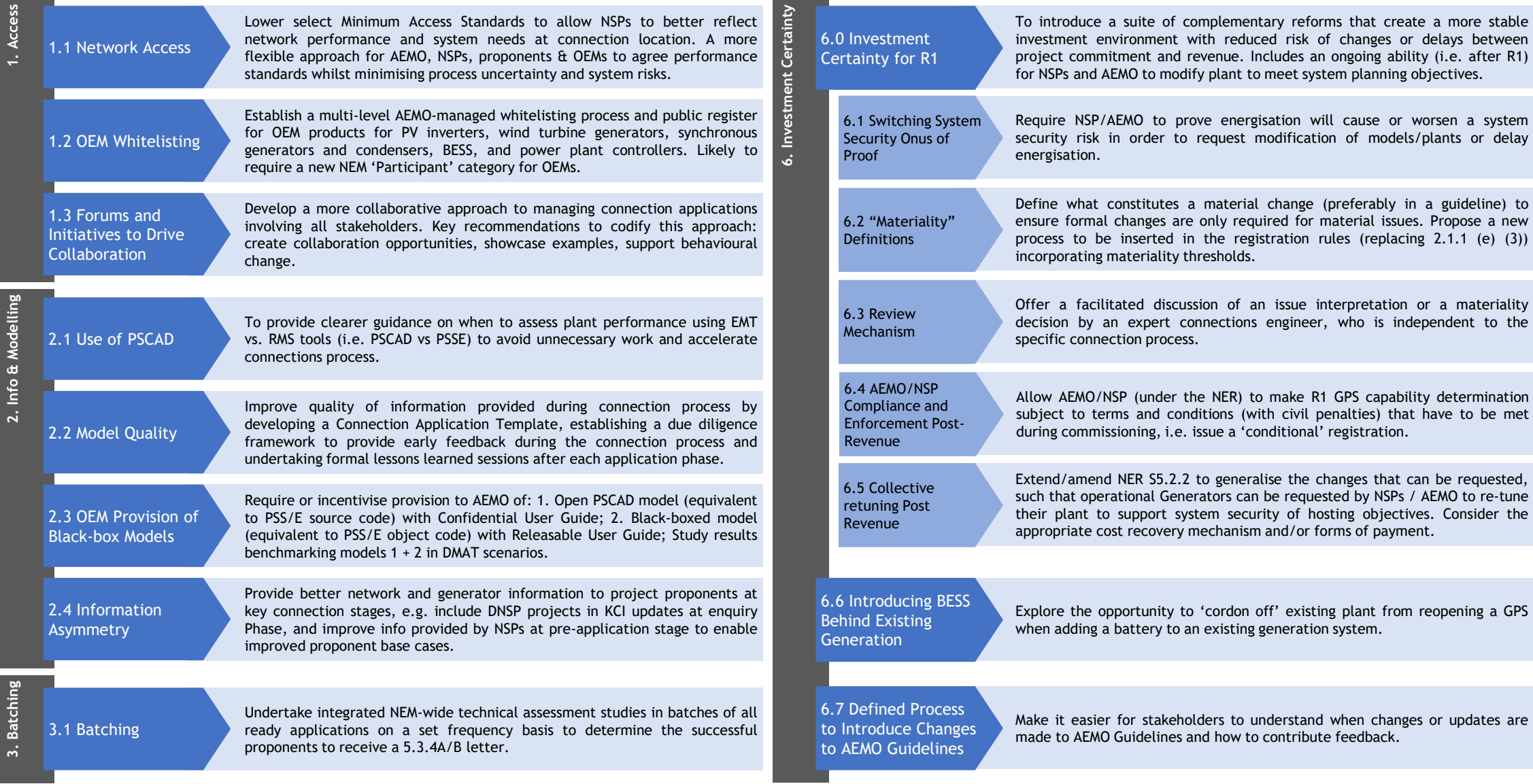
## Section 3

## Phase 3 - 'Sustaining the Momentum'

This Roadmap comprises a number of elements:

- The endorsed reforms;
- Program Establishment, including detailed planning and scheduling;
- The overall timing for reforms;
- An augmented CRI governance model;
- A set of principles to guide approaches to Rule Changes;
- Funding Mechanism; and
- Potential future reforms.

# The 11 endorsed Reforms which constitute the work of the Roadmap



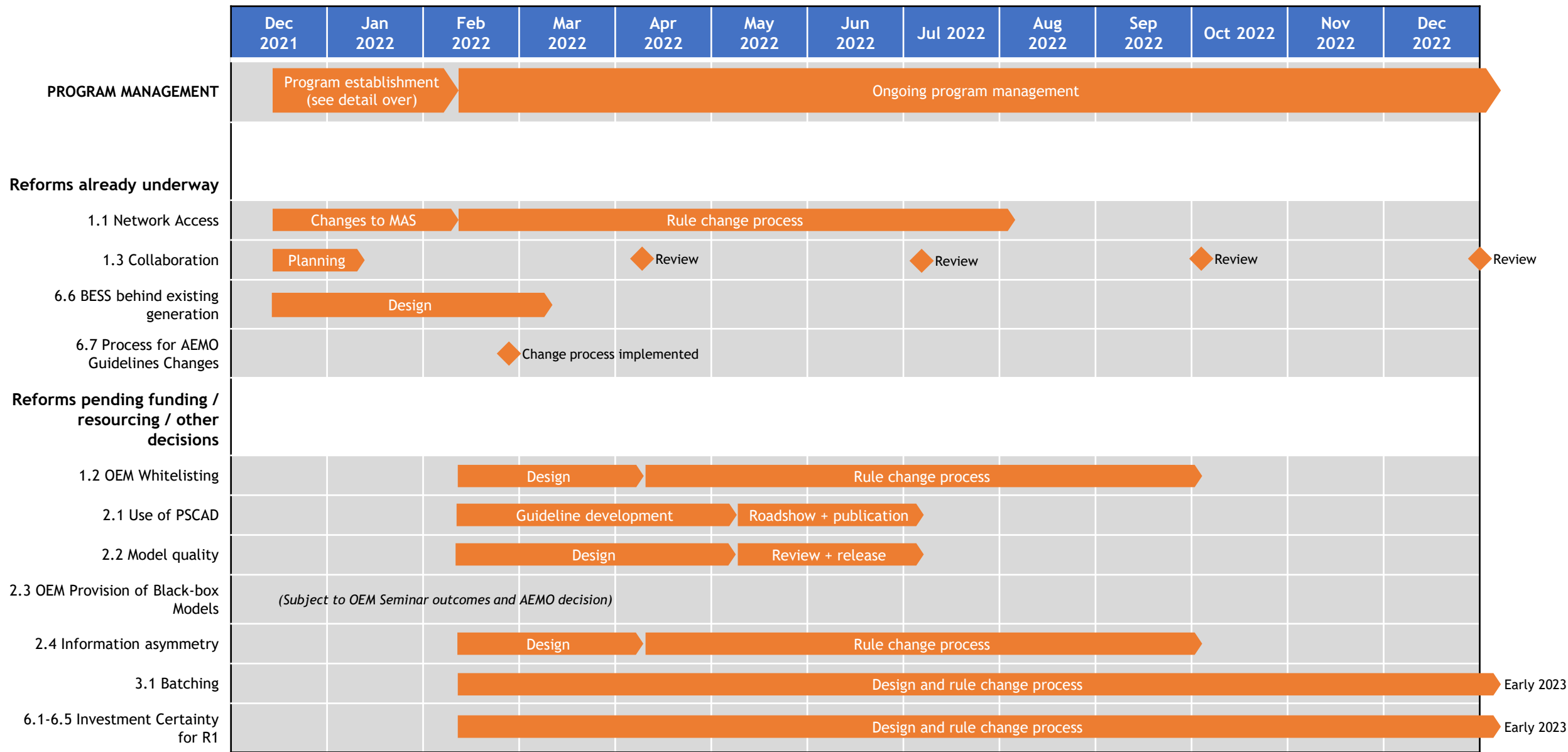
## The Program Establishment stage supports the pivot from Phase 2 ‘Solution Development’ to Phase 3 ‘Sustaining the Momentum’

### The key activities to be completed in this stage of activity will include:

- Developing the detailed scope statements for all reforms, notably including those requiring budget support from the Funding Mechanism (see later). The scope statements will be sufficiently detailed to enable an assessment of resources and costs for management by an Oversight Group.
- Engaging the people to undertake each of the reforms not currently already underway, including:
  - Selecting consultant support where required, and
  - Appointing the Delivery Lead roles to Reform 3.1 (Batching) and Reform 6.1-6.5 (Investment Certainty for R1).
- The development of an overall CRI program schedule, reflecting financial, people/capability, and any other identified constraints. Importantly, this will need to also be cognisant of BAU connection activity, and other related reforms outside the scope of the CRI.
- Forming the Reference Group membership for each of the reform areas, to ensure continuity with the earlier CRI design phase and as a support mechanism for the leads for each reform.
- Establishing the details of a Funding Mechanism. The Leadership Group has a strong preference for a mechanism which is applied to connection charges, compulsorily levied on a per MW basis. Further details of the Phase 3 Funding Mechanism are now being worked through.
- Establishing fit-for-purpose Program Management and associated governance arrangements to be deployed by a Roadmap Implementation Oversight Group.
- Bedding-down the accountabilities and responsibilities of the various roles shown in the governance structure; fine-tuning as appropriate.
- Planning the consideration of any further reforms by the Working Group - what are the priorities? Do we have the capacity to take more on?
- Developing the schedule of communication both internally within the CRI community and externally for industry and other stakeholders.
- Discussing approaches to the rule changes being developed by some reforms - internally to start with, and then later with the AEMC to optimise pathways.

### Phase 3 Schedule (High-level)

Timing for each reform is subject to detailed planning, scheduling and an assessment of resource constraints



## Phase 3 of the CRI will employ a different approach, with the work to deliver the reforms transitioning to largely dedicated teams

### The next Phase of the CRI work will have a number of characteristics:

- Responsibility to deliver each reform will be assigned to an individual entity (the 'Reform Sponsor / Lead'), who will undertake the detailed initial planning phase required to understand resource requirements and costs.
- Reforms will be progressed by substantially dedicated teams, supported by personnel from the Phase 2 clusters to ensure continuity during implementation.
- Implementation of selected CRI Reforms will involve some 'hard costs' (e.g. consulting support, facilitation and project management support) to be funded by a simple, transparent and fair charge on parties applying for connection (see later).
- The use of existing change management mechanisms (e.g. rule changes) for the implementation of all reforms. Regarding rule changes:
  - Continued close engagement with the AEMC on priorities.
  - Responsibility to lead rule changes to be shared by various entities (NSPs, CEC, AEMO and potentially OEMs) but with potentially a number of entities choosing to support these rule changes.
  - A combination of conventional rule change process requests and the judicious application of the fast-track rule change process led by AEMO.

### The Phase 3 core principles:

- The ongoing sponsorship of AEMO and CEC as lead agents in this reform.
- The continued support of the Leadership Group in guiding the establishment of priorities, challenging the work program in the search of value, and suggesting the prioritisation of activities.
- Ongoing central coordination of the reform initiative, to ensure integration across timelines and logical dependencies, and also to drive progress.
- Leveraging AEMO's existing work on a Connections Dashboard, to create a clear statement of performance metrics both for the connections process as well as for the Connections Reform Initiative.
- A continued emphasis on communication, including a program which regularly reports achievement of the reforms (quarterly?), and sustains a focus on the necessary transformational outcomes which underpin the endeavour.
- The augmentation of a substantially collaborative endeavour (CRI Phases 1 & 2), with the addition of strengthened project management discipline and transparency around the achievement by all parties in the delivery of reform outcomes.



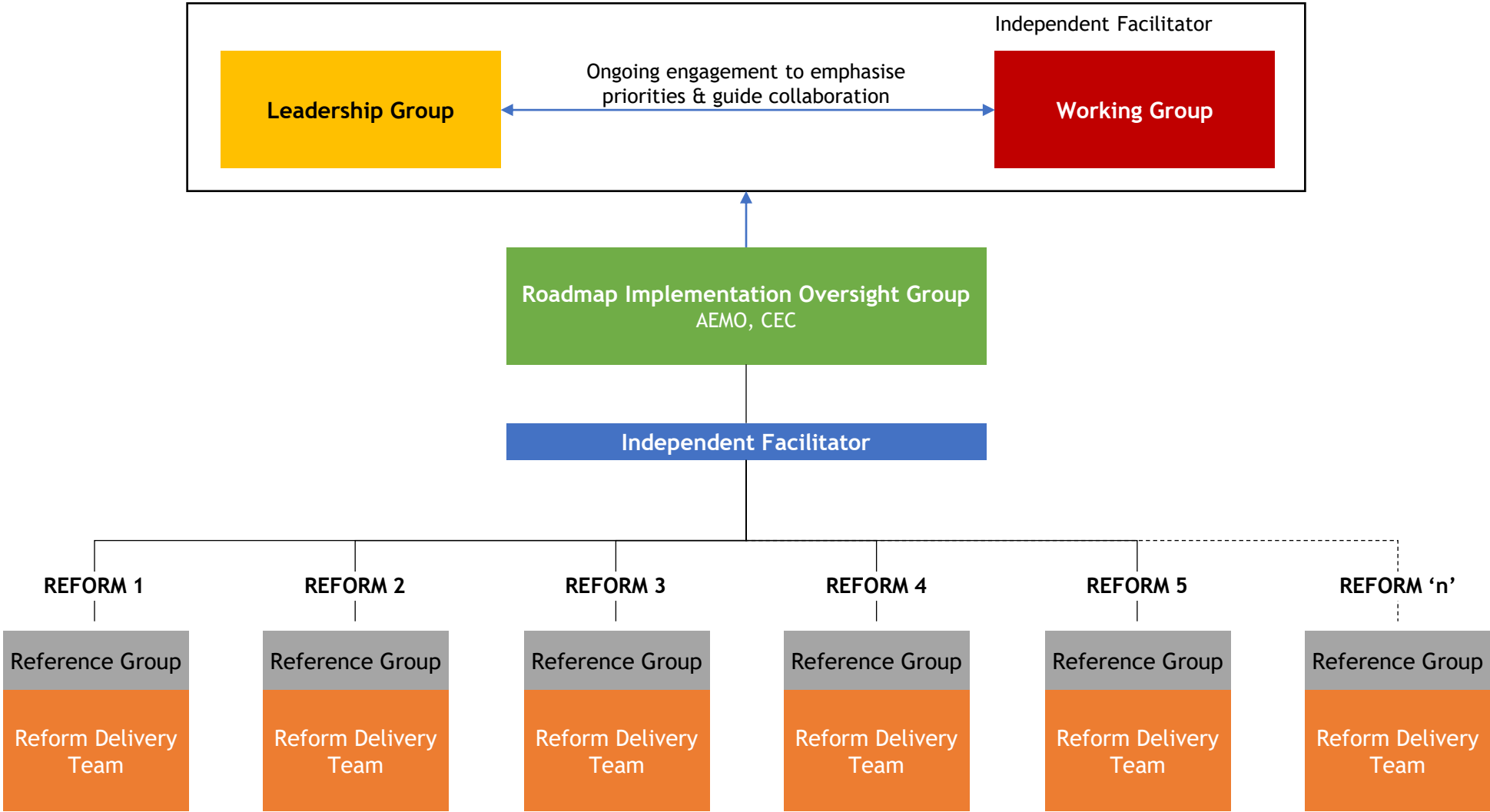
## The Phase 3 program of activities will require a governance model which reflects a number of characteristics, as the nature of the CRI evolves (1/3)

### CRI Phase 3 governance characteristics:

- Continuation of the collaborative and co-design model utilised to explore emergent reform priorities, engage a wide diversity of perspectives, and build support for the implementation detail.
- Responsibility for implementing individual reforms transitions to substantially committed small delivery teams - called 'Reform Delivery Teams' - where needed.
- Unsurprisingly, the majority of reforms would be lead directly by AEMO or the CEC.
- The two largest and most transformative reforms ('Batching' and 'Investment Certainty for R1') would be supported by a Delivery Lead, under the guidance of either AEMO or the CEC as Sponsor. These Delivery Leads will drive the project work and bring a level of independence to these large and complex reforms.
- Each Reform Delivery Team will have the support of a Reference Group, drawn from the CRI Working and Leadership Groups, to ensure continuity from the design phase (efficient, ensure broad ownership, re-enforces the value of ongoing collaboration).
- The introduction of a 'Roadmap Implementation Oversight Group' to oversee the progress of each of the reforms. This group will introduce fit-for-purpose program and project management discipline to oversight reform delivery, performance against budgets and milestones, ongoing integration, etc. and will report progress to the Leadership Group.
- Fit-for-purpose performance reporting and communications envisaged as:
  - Brief monthly progress reports against plans and milestones to the Roadmap Implementation Oversight Group.
  - Bi-monthly sharing of achievements (outputs, milestones, outcomes) across the full CRI community.
  - Tracking of overall impact by utilising the Connections Performance Scorecard (i.e. evidence of delivered, enhanced outcomes).
  - Quarterly sessions with the CRI community - achievements, new challenges, things to do better, further opportunity to collaborate, etc.
- Clear and documented Terms of Reference for all groups identified in the proposed governance model.

*A diagram illustrating the Phase 3 Governance model is shown on the following page.*

The Phase 3 program of activities will require a governance model which reflects a number of characteristics, as the nature of the CRI evolves (2/3)



## The Phase 3 program of activities will require a governance model which reflects a number of characteristics, as the nature of the CRI evolves (3/3)

<p><b>Roadmap Implementation Oversight Group</b> AEMO, CEC</p>	<ul style="list-style-type: none"> <li>Plays a central facilitation and steering role in Phase 3 to ensure successful delivery of reforms. The Oversight Group is proposed to be comprised of AEMO and CEC representatives, with its key activities being to ensure continued alignment of reforms to the overall CRI program objectives, to provide budget oversight &amp; support, to provide performance and reporting oversight, to provide advice when required, as well as identify and help mitigate risks for the reform delivery teams as they arise.</li> </ul>	<p><b>Reform Delivery Team</b></p>	<ul style="list-style-type: none"> <li>Led by the Reform Lead (i.e. AEMO, CEC or an Independent Party). Takes the reform design that has been developed, evolves it to a final design and ultimately delivers the reform. The team comprises substantially committed resources. Key activities of the Reform Delivery Team will depend on the particular reform and are likely to include extensive engagement with stakeholders, development of detailed reform design work, development of documentation needed to submit rule changes, develop new Guidelines, amend processes, etc.</li> </ul>
<p><b>Leadership Group</b></p>	<ul style="list-style-type: none"> <li>The LG continues its current role in Phase 3 by providing executive-level guidance on reform priorities for the CRI, and feedback on individual proposed reforms. The LG continues to provide an opportunity for industry to give voice to matters of interest, and plays a role in leading by example with collaborative contributions. It maintains a degree of oversight of the reform delivery program and provides advice to the Roadmap Implementation Oversight Group as required. Option to contribute as Reference Group members.</li> </ul>	<p><b>Delivery Lead</b></p>	<ul style="list-style-type: none"> <li>Under the guidance of either AEMO or the CEC as Reform Sponsor, the Delivery Lead applies for 'Batching' and 'Investment Certainty for R1' reforms, and will drive the project work and bring a level of independence to these large and complex reforms.</li> </ul>
<p><b>Working Group</b></p>	<ul style="list-style-type: none"> <li>The WG continues the Phase 2 contribution by tackling any further identified issues and reform options, albeit at a lower intensity level than in Phase 2. Some Working Group members will also act as members of the various reform area "Reference Groups".</li> </ul>	<p><b>Reference Group</b></p>	<ul style="list-style-type: none"> <li>Select members from the Leadership and Working Groups, including those closest to the design of the reforms during Phase 2 to act as advisors to the teams now delivering those reforms. Role is to suggest the scope and provide design continuity (efficient / avoid re-work), brief the Reform Delivery Team members on key design considerations, address the problem statement, ensure a diversity of perspectives, continue to demonstrate and deliver the value of collaboration, challenge the Delivery Team when needed, etc. The Reference Group will also act as a 'sounding board' for Reform Delivery Team members as design evolves.</li> </ul>
<p><b>Reform Sponsor / Lead</b></p>	<ul style="list-style-type: none"> <li>The Reform Sponsor Lead is the organisation responsible for leading and delivering each individual reform. Has prime responsibility for resourcing, setting timeframes and organisation of the Reform Delivery Team.</li> </ul>	<p><b>Independent Facilitator</b></p>	<ul style="list-style-type: none"> <li>The Independent Facilitator brings structure and rigour to the CRI, guides discussions to points of conclusion and to help with reform development, supports the Roadmap Implementation Oversight Group with Program Mgt tasks, ensures collaboration and integration across the Delivery Team, supports communication, completes performance reporting, facilitates LG &amp; WG, etc. Leads on a limited number of the more complex &amp; contested reforms.</li> </ul>

The Reform Sponsor / Leads are the central drivers for driving the delivery of each reform with responsibility for resourcing, timeframes and organisation of the Reform Delivery Team



Reform Areas	Reform Sponsor / Lead			
			NSPs	Other
1.1 Network Access			✓	
1.2 OEM Whitelisting	✓			
1.3 Forums and Initiatives to Drive Collaboration		✓		CRI
2.1 PSCAD vs PSSE (RMS vs EMT) Guidelines				Power System Modelling Reference Group (PSMRG)
2.2 Model Quality	✓			
2.3 OEM Provision of Black-box Models				CRI
2.4 Information Asymmetry		✓	✓	
3.1 Batching	✓			+ Delivery Lead
6.1-6.5 Investment Certainty for R1		✓		+ Delivery Lead
6.6 Introducing BESS behind existing generation		✓		
6.7 Defined Process to Introduce Changes to AEMO Guidelines	✓			

## Possible approaches to Rule Changes: For reforms likely to require rule changes, strategies have been developed that consider the fast-track rule change process, the option to submit rule change packages and resource limitations

Several proposed reforms involve submitting rule change requests. The CRI has identified some key considerations and proposed strategies for each (right).

### *Conventional versus ‘fast-track’ rule change process:*

- Rule change needs to be proposed by AEMO (more likely) or AER.
- The requirement for public consultation still applies (via webinars, written submissions, etc.)
- Conventional rule change process is ~ 4 months longer (depending on various factors)

### *Packages versus individually submitted rule changes:*

- AEMC can choose to bundle proposals together but cannot divide a bundle of changes into constituent parts.
- Bundles are likely more complex and possibly more challenging to secure approval.

### *Resourcing limitations:*

- The absolute effort involved in developing rule change documentation and sharing responsibilities among CRI participants.
- Resource demands being placed on the AEMC.

Reform	Suggested rule change strategy
Reform 1.1 (Changes to minimum access standards)	NSPs lead a conventional rule change requests for amended minimum access standards, with AEMO and OEM support.
Reform 1.2 (OEM white listing Suggestion)	AEMO lead this conventional rule change process, with OEM support, if the reform proceeds.
Reform 2.3 (OEM provision of black-box models)	To be re-visited following MHI and OEM seminar.
Reform 2.4 (Information asymmetry)	NSPs lead a conventional rule change process, with AEMO support. Linked to Reforms
Reform 3.1 (Batching)	AEMO to lead a fast-track rule change leveraging work already completed.
Reform 6.1-6.5 (Investment Certainty for R1)	The industry (CEC with the support of a group of businesses) lead a conventional rule change process.

## Funding Mechanism (1/2): Unanimously supported proposal - a charge on parties applying for connection

### What is needed to move forward?

The implementation phase will require a greater level of substantially dedicated resourcing - with associated costs - to ensure it is executed effectively and as quickly as practically possible, alongside continuing in-kind voluntary support by participating CRI members.

Costs for the next phase primarily relate to:

- Facilitation and project management support,
- Consulting support including detailed technical design, Rule change drafting, legal and regulatory, etc., and
- Reform-specific execution costs, substantially by AEMO and CEC.

### Principles of the proposed model

- **Simplicity:** Minimise governance and administrative burden.
- **Transparency:** High levels of openness about the funds raised and the expenditure dispersed, including regular reporting.
- **Fairness:** Alignment between the allocation of costs to achieve the necessary reforms and those parties expected to benefit.
- **Governed by industry:** Strong leadership & oversight from industry.



### The proposed funding model:

A charge on parties applying for connection on a fixed per MW basis.

## Funding Mechanism (2/2): While further detail is yet to be developed, several key aspects have been agreed in-principle with the CRI's Leadership Group

### Collaboration remains key

The in-kind contribution of a wide range of market entities has been critical to the integrity of the reform design, and to acceptance of the reforms.

- The process moving forward should continue to emphasise this part-time, in-kind contribution from a diversity of organisations in the support of each and every proposed reform.

### Governance - Oversight

An appropriate governance body that is agile, transparent and well-represented across different stakeholders should oversee the allocation of all funds, and their effective application in delivering reforms.

- A governing group would oversee the raising of funds (on a cost recovery basis), its disbursement and reporting.

### Governance - Funding application and project delivery

Reform areas seeking funding support for implementation costs will be required to develop and deliver a project scope statement, budget, etc.

- The governing group will review this documentation and satisfy itself about the costs, deliverables and value.

### Cost recovery period

Expenditure is likely to be incurred ahead of when full cost recovery is secured; further, cost recovery will occur over a longer period, to better ensure fairness and recovery from the longer term beneficiaries of the work. This reflects the expected enduring benefits of the reform program. This is likely to create a cash flow challenge.

- A third party loan facility might be considered if this is a material issue.

### Size of charge per MW

The size of the charge per MW is closely linked to the period of cost recovery and is to be determined. A fixed connection charge per MW is preferable as this can be factored directly into development economics with certainty.

- Proposed that a fixed charge be determined once the full project costs are known and that the levy continues until the reform costs are recovered.

### Point of charge

Either a single charge applied at the start of the connection process, or two charges (possibly one on commencement and one on Registration).

- This detail is to be determined.

### Compulsory or Opt-Out

The unanimous preference is for a compulsory charge, but there are legal issues about this under the NER. Opt-out would be the fall-back option. Failing this, an Opt-in model may be considered.

- Compulsory, fixed charge per MW preferred by all.

### Surplus funds?

All efforts will be taken to ensure that funds raised match reform costs as closely as possible. However, it is possible that the level of funds raised from the charge will not perfectly align with the costs incurred.

- The governing body will review any surplus funds and make a decision how best to re-assign it at the end of the reform process, noting the option to assign it to support collaboration and education related activities relating to connections.

## Looking to the future: Potential future reforms



In parallel to delivering the 11 reforms noted in the Roadmap, further reforms may be explored during phase 3 of the CRI. These reforms were either deferred from the solution development phase due to resource constraints, have been identified during that phase of work, or whose priority has been highlighted by further developmental thinking during phase 2.

The same model of collaboration and co-design will be deployed involving entities from across the industry in the development of those potential proposed reforms. The role of the Working Group will remain central to this.

Given the extent of activity planned under the Roadmap, the extent of any such work is expected to be limited.



# APPENDIX

Summaries of the Recommended Reform Areas

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# Reform Area 1.1

## Network Access

## Reform Area 1.1: Network Access (1/4)

Where it impacts the connection process



### Problem Statement

Under current NER negotiating framework, new generators are required to meet the automatic access standard or propose a negotiated access standard as close as practicable to the automatic access standard. However in many instances a performance level below the automatic standard would lead to better overall system outcome including system stability and coordination with future generators.

Minimum access standards for some clauses (e.g. S5.2.5.5) can present a barrier for new connections and may lead to adverse network impacts.

Current minimum access standards can require more aggressive behaviour from the Generator than is practically possible, particularly whilst also ensuring a stable response to network fault conditions.

In some cases, this can cause performance standards to compete with each other. To be compliant against one performance standard, you may need to create a response that will increase the likelihood of the plant being non-compliant with another performance standard. This requires OEMs to repeatedly tune their models to achieve a tight balance, which may not always be practically achievable.

In other cases, this can require behaviour from the Generator that is either not required by the network or detrimental to the network at a particular location or under certain system conditions.

There is an information asymmetry that:

- Makes it hard for proponents to critically assess the connection locations they are considering, properly tune their generators and propose appropriate performance standards
- Can create inconsistencies between the NSPs and AEMO assessments, requiring rework

Inconsistent negotiation and assessment approach across regions.

Inappropriate assessment approach of some of the GPS clauses.

Need to consider how these GPS requirements should be assessed when reviewing REZs or project portfolios.

### Proposed solutions and recommendations

**OBJECTIVE 1 - Minimum access standards.** Allow performance standards to be negotiated consistent with:

- Specific network performance
- Needs at a particular connection location

### PROPOSED SOLUTION:

To lower selected Minimum Access Standards to be applied across the NEM.

This is designed to limit the potential adverse network impacts of the current minimum access standards, and create some more room for negotiation between the minimum and AAS. In creating that negotiating range, along with a supportive negotiating framework (guideline), the standards for connection can be set appropriately for the local network circumstance and allow NSPs to better reflect network performance and system needs at connection location.

### Key actions:

- Revisit and modify the following minimum access standards as highest priority:
  - S5.2.5.5 (l) Multiple fault ride through.
  - S5.2.5.5 (n) (1) (i) Reactive current injection / absorption during disturbances.
  - S5.2.5.5 (o) (2 & 3) Reactive current rise and settling time.
- Identify any additional minimum access standards that require modification as a lower priority, possibly S5.2.5.10
- Consider whether there is a need to revisit and modify any automatic access standards
- Set up technical sub-group of NSPs and OEMs to review original intent of these access standards and propose changes as appropriate.
  - Understand if Rule change proposal for S5.2.5.5 submitted by OEMs can be leveraged
- Use of defined criteria to set common reference for NSPs whilst allowing flexibility across networks.
- Develop a draft Rule change that can be tested with key stakeholders and the broader CRI group

(cont. over)

# Reform Area 1.1: Network Access (2/4)

**Proposed solutions and recommendations (cont.)**

*OBJECTIVE 2 - Approach  
Allow flexibility / practicality whilst minimising risk for process uncertainty.*

**PROPOSED SOLUTION**

- Recalibrate understanding across AEMO, NSPs, Proponents & OEMs
  - NSPs to provide clearer guidance on network needs
  - Review approaches across NSPs, with a focus on highest impact GPS, with the intent to achieve consistency across NSPs and AEMO where possible
  - Relook at the S5.2.5.4 (CUO) assessment approach and propose modifications as required.
  - Update and consolidate GPS guidelines to provide greater clarity on assessment approach for S5.2.5.1, S5.2.5.2, S5.2.5.4, S5.2.5.5, S5.2.5.7, S5.2.5.10, S5.2.5.8/12, S5.2.5.13 and CUO.
  - Periodic (quarterly?), central updates from AEMO on any learnings and agreed approaches with OEMs across projects and regions
- Develop a consistent process across NSPs and AEMO where practicable
  - Restructure process to enable key issues to be identified early i.e. staging of model tuning, GPS and FIA to focus on showstopper issues
  - Key GPS to be assessed early include S5.2.5.1, S5.2.5.4 and S5.2.5.5
  - Check how TNSPs may be able to leverage DNSP enquiry process.
- Provision of better information for proponents,
  - Access to PSCAD Wide area model while still protecting confidential data
  - Early guidance on assessment scopes, including generation and network projects to consider, and key system conditions and contingencies to assess
  - Provision of model checklist, including minimum DMAT requirements
  - Consider provision of PSSE and PSCAD base cases
  - Review proposed and alternative connection options, noting considerations
- Establish and maintain strong communication channels with OEM
  - Robust model version control, with consistent model information provided to NSP and AEMO (critical signals and block diagrams)
  - Share lessons learnt across projects and regions.

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
✓	✓	✓		

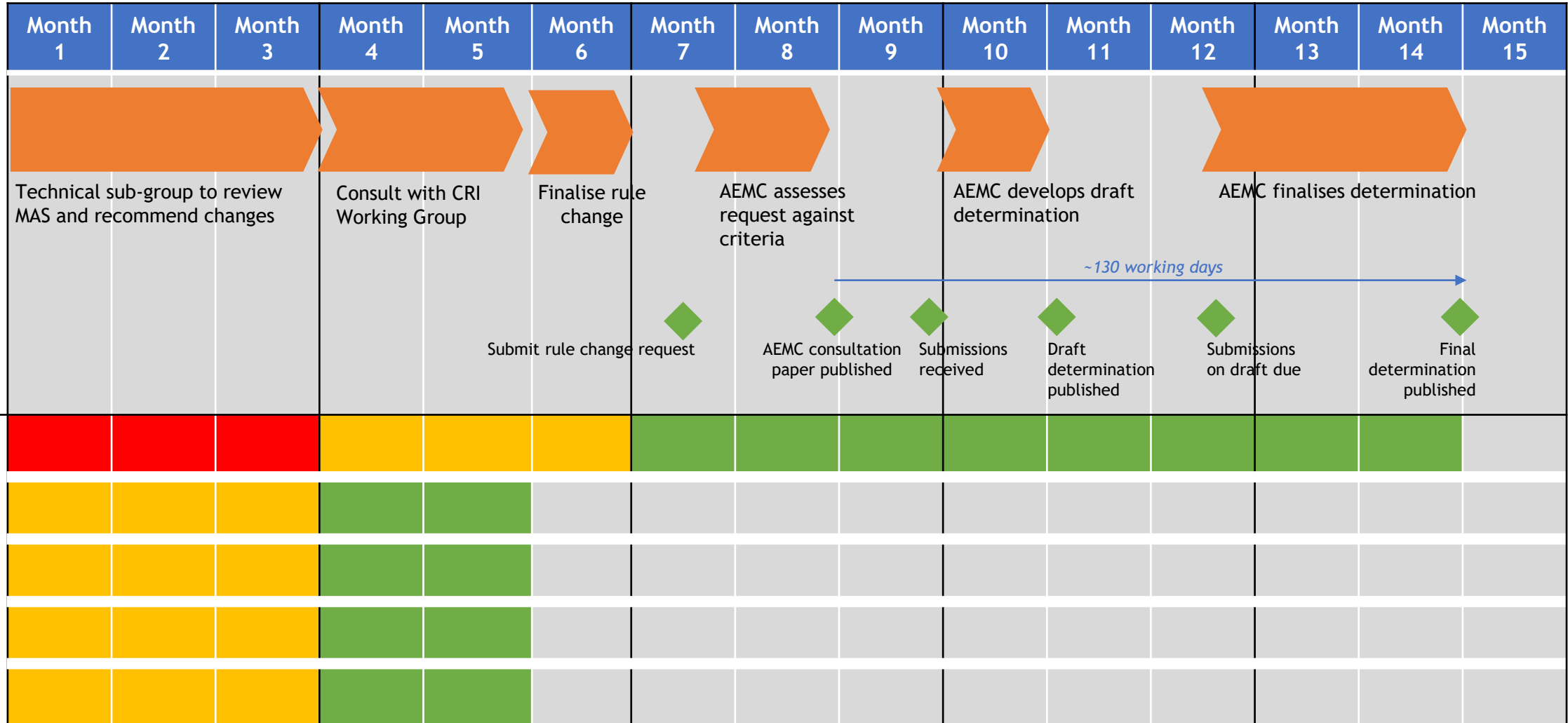
- The most complex elements to get right**
- Develop appropriate revised minimum access standards
  - Agree consistent approach whilst acknowledging that different networks may require different outcomes
  - Agree appropriate assessment methods for some of the GPS clauses (e.g. S5.2.5.4)
  - Ensure that we do not undermine investment certainty, assessment transparency and predictability, by allowing for negotiation/flexibility

- Key questions that remain to be worked through**
- Appropriate MAS for identified priority clauses - to be determined by technical working group.
  - Who will take the lead on updating assessment guidelines (note crossover with other clusters), and consulting on these changes
  - How can wide area PSCAD model be shared with proponents without compromising confidentiality obligations?
  - What will the agreed changes to the connections process look like, and what information will be required by NSPs and Proponents to facilitate this?

- Linkages and dependencies**
- Other CRI initiatives
- Cluster #2 including information asymmetry and Guideline changes to S5.2.5.4
  - Cluster #1 OEM whitelisting
  - Cluster #6 Process to introduce changes to AEMO guidelines
  - Cluster #3 interpretation of Rules clauses and relationship to Australian Standards; identifying showstopper issues upfront
  - Need to align with NER 5.2.6A process and include any AEMO work already undertaken
- Key stakeholders
- AEMO, NSPs, OEMs and Developers

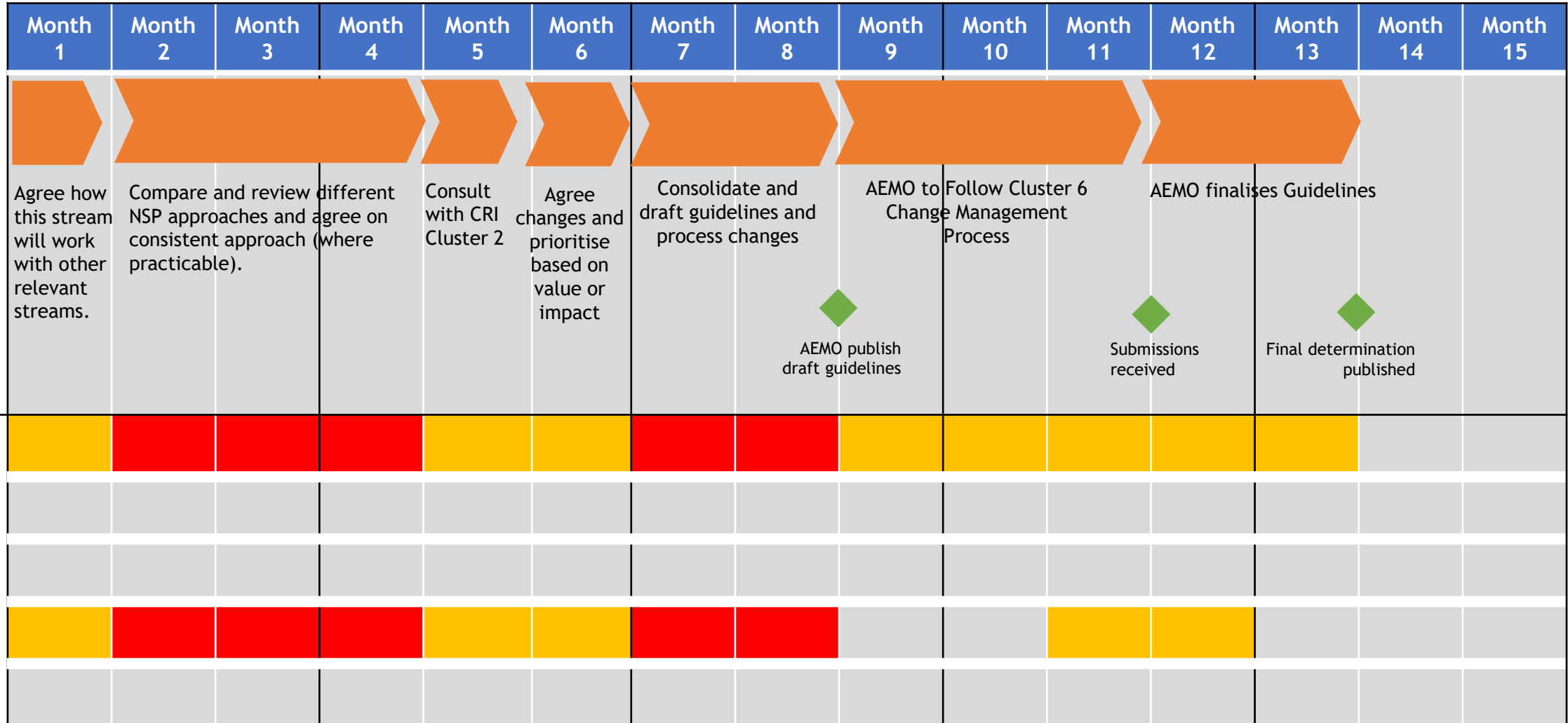
## Reform Area 1.1: Network Access (3/4)

### Reform Area Plan - Minimum Access Standards (Objective 1)



## Reform Area 1.1: Network Access (4/4)

### Reform Area Plan - Assessment guidelines (Objective 2)



# Reform Area 1.2

## OEM Whitelisting



## Reform Area 1.2: OEM Whitelisting (1/3)

Where it impacts the connection process



### Problem Statement

- Requirement to assess the full DMAT scope across each connection application leads to time consuming and inefficient connections process;
- Model acceptance outcomes vary depending on assessor;
- Inadequate confidentiality provisions for OEM;
- Uncertainty for developers when choosing OEM especially new entrants.

### Proposed solutions and recommendations

- Develop a whitelisting process and maintain a public register for OEM products including:
  - PV inverters;
  - Wind turbine generators;
  - Synchronous generators / condensers;
  - BESS;
  - Power plant controllers.
- Multi-level whitelisting process e.g.
  - Level 1: Minimum DMAT requirements
  - Level 2: Power System Model Guidelines minimum requirements, e.g. functional block diagrams
  - Level 3: Testing and validation
- AEMO to manage / maintain OEM whitelist register.
- New NEM Participant category for OEMs.
- Mandated timeframes for whitelisting process.

## Reform Area 1.2: OEM Whitelisting (2/3)

### The most complex elements to get right

- Management of confidentiality provisions between AEMO and OEM.
- Product variants and firmware updates.
- Timelines for the whitelisting process.
- Ability to introduce a NEM Participant category for an OEM.
- Obtaining consensus on whitelisting criteria across the NEM.
- AEMO to streamline and automate the model assessment.
- Ensure the initiative lowers barriers to entry for new OEMs and encourage proponents to consider new products, new technologies, new market entrants, etc.

### Linkages and dependencies

Linkages with other CRI initiatives:

- Cluster #2 including model quality, OEM provision of black-box models, information asymmetry

### The type(s) of change being recommended

Rule change	Guidelines	Approach	Governance	Information
✓ *		✓	✓	

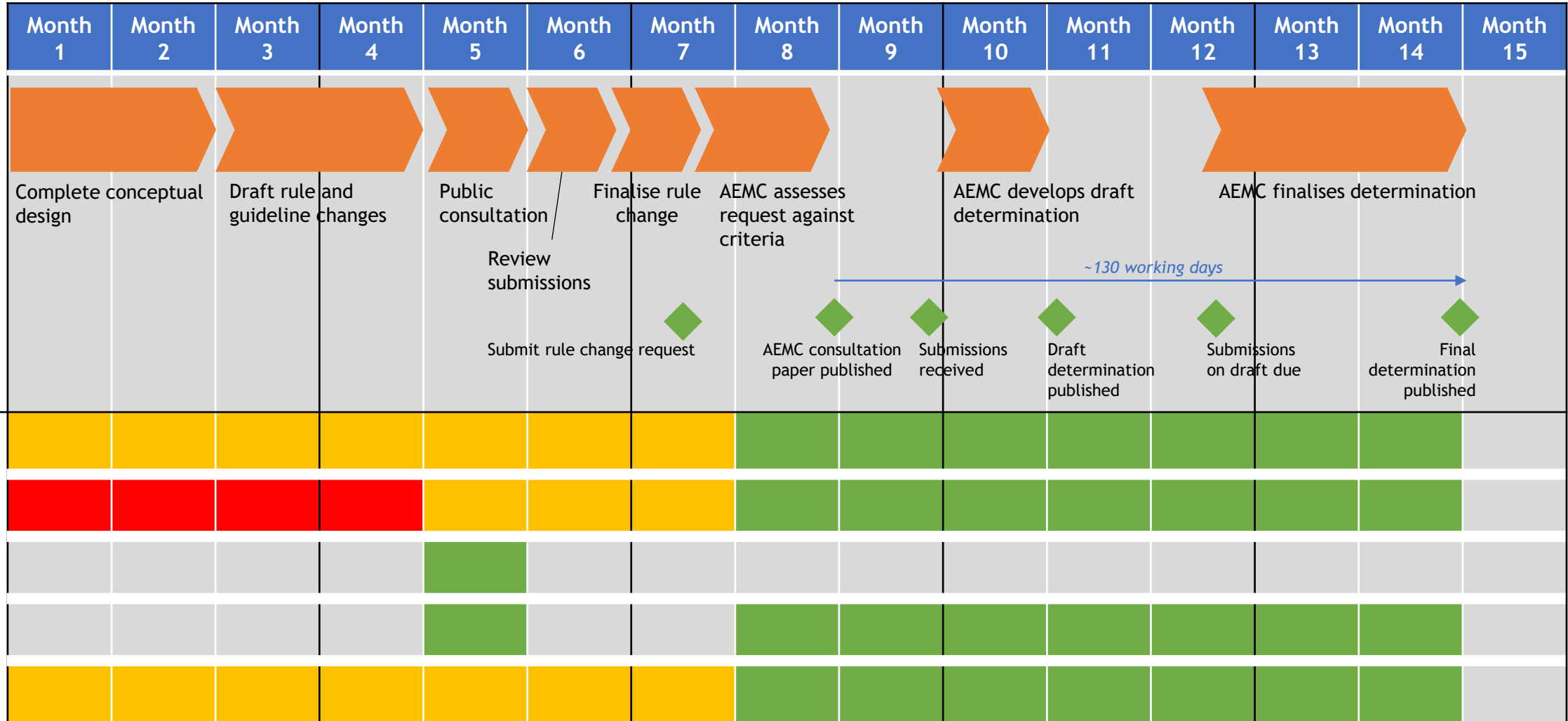
\* New Participant category for OEMs (similar to “Intending” participant category)

### Key questions that remain to be worked through

- How can lessons learnt be shared across projects / jurisdictions without compromising confidentiality?
- Developers may make decisions based on the whitelisting but this does not guarantee suitability for a specific project / location - how could this be communicated across the industry?
- Currently OEMs are not registered participants so it is unclear how confidential information will be treated. Does this require a new registration category for OEMs with limited set of NER obligations? Possible to explore use of a standardised NDA instead of a new participant category, however would require a contract to be signed with each OEM and may result in inconsistencies if not defined in the Rules.
- Can required rule change to facilitate OEM Whitelisting be expedited?

## Reform Area 1.2: OEM Whitelisting (3/3)

### Reform Area Plan



# Reform Area 1.3

Forums and Initiatives to Drive Collaboration

## Reform Area 1.3: Forums and Initiatives to Drive Collaboration (1/3)

Where it impacts the connection process



### Problem Statement

We are in the midst of an energy transformation from rotating generation to an inverter based fleet.

The retirement of synchronous generation is happening more quickly than anticipated, and the inherent services these rotating machines provided will need to come from new renewable generation plants.

Our ability to evolve the regulatory framework to meet these new totally different generators is being outpaced by the network transformation.

The current connection framework is proving to be slow, cumbersome, and arguably not fit for purpose.

In addition to potential rule changes, guidelines etc, we believe more can be achieved within the existing framework by working more collaboratively together.

### Proposed solutions and recommendations

This Collaboration Initiative will seek to:

- Develop a more collaborative approach to managing connection applications
- Involve all stakeholders including AEMO, Generators, Developers, Consultants, OEMs, and Network Operators.
- Drive collaboration on innovative approaches to managing challenges

The core recommendations are:

#### Create Collaboration opportunities:

- CEC Collaboration Award
- Young Profession Forum
- Build Collaboration into CRI activities
- Quarterly CRI Forum

#### Showcase examples:

- ASP Forum
- Murray 5
- Industry Events

#### Support behavioural change:

- Collaboration Champions
- Collaboration moments
- Prioritise and Support internally

## Reform Area 1.3: Forums and Initiatives to Drive Collaboration (2/3)

### The most complex elements to get right

- Collaboration is a behaviour and not an activity
- It is difficult to Codify
- There is a danger of being seen to be providing parenthood advice
- We require something which is in short supply: time

### Linkages and dependencies

This initiative underpins the success of everyone of the CRI initiatives. It is a cornerstone behaviour. More importantly it changes the culture in the industry. Every stakeholder will feel the benefit.

### The type(s) of change being recommended

Rule change	Guidelines	Approach	Governance	Information
				✓

### Key questions that remain to be worked through













- How do we build momentum and maintain it? We need to follow through by launching activities that drive and reinforce the collaborative culture we want to see more broadly in day-to-day interactions.
- How do we measure success?
- What level of Executive support do we need in our organisations?
- How we do manage the challenge of time and resources?
- We must overcome historical mistrust and suspicion

## Reform Area 1.3: Forums and Initiatives to Drive Collaboration (3/3)

### Reform Area Plan

**KEY:**

-  [Step]
-  [Milestone]
-  High resource intensity
-  Medium resource intensity
-  Low resource intensity

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15
															
															
Resource intensity:															
AEMO															
CEC															
Developers / consultants															
NSPs															
OEMs															

# Reform Area 2.1

## Use of PSCAD



## Reform Area 2.1: Use of PSCAD (1/4)

Where it impacts the connection process



### Problem Statement

#### The situation:

- The provision an use of PSCAD models for all new (and existing IBR) plant has been mandated
- PSCAD studies take several orders of magnitude more time to complete than PSSE studies, due to the inherent extra computational burden
- Wide-area PSCAD models cannot be shared to (non-AEMO or non-NSP) participants who need to know how their plant interacts with the system
- Participants report instances where PSCAD is used to evaluate GPS clauses where RMS models would suffice (e.g. frequency response)
- Participants report instances where PSCAD and PSSE model comparison overlays have been required for scenarios where PSSE models are unreliable

#### The result:

- Appreciable delays to the connection process
- Re-work due to insufficient information being available to correctly tune proposed plant models early in the process
- Potential overuse of PSCAD to evaluate some aspects of plant performance

**The use of PSCAD to evaluate new generators performance has resulted in appreciable delays to the connections process, at a time where an acceleration to the connections process is needed.**

This has led the CRI to examine a fundamental question of “Is the requirement to use PSCAD valid?”

### Proposed solutions and recommendations

An EMT-based modelling tool (such as PSCAD) is required to correctly assess the performance of new connections to the NEM

- Due to nature of inverter based generation (not magnetically coupled, custom algorithms, non-linear behaviour)
- Examples of real-world instability in NEM replicable only in EMT-based software (RMS tools fail to predict or replicate)
- Growing recognition world-wide in areas with high renewable penetration that EMT modelling yields most correct results

Changing the offline EMT modelling tool (e.g. use something other than PSCAD) would be an unwelcome and highly costly exercise for the industry, with no guarantee that the same issues (i.e. inability to share) would not arise again

**PSCAD modelling must continue to be used to assess new generation connections, with some changes / recommendations outlined below.**

#### Recommendations:

There must be clear guidance on when it is appropriate to assess plant performance using EMT and RMS tools (i.e. PSCAD vs PSSE) to avoid unnecessary work and speed up the connections process.

- It is suggested that the Power System Modelling Reference Group (PSMRG), in conjunction with several broader industry technical representatives, would be best placed to create this guidance.

A wide-area EMT model must be shared with connecting parties early the connection process (at application stage) to reduce delays and rework (and hence, cost to customers), and to result in a better designed and robust system

- “Sharing” could mean direct provision of secured EMT models to applicants, or the use of a shared modelling platform

## Reform Area 2.1: Use of PSCAD (2/4)

### The most complex elements to get right

#### Provision of satisfactory evidence for the need of EMT modelling

- There must be a balance between efforts applied to collate compelling evidence for the case to use EMT modelling in inverter-dominated grids, and the recognition that some people may simply never agree regardless of the evidence provided.
- Australia is at the forefront of several aspects of inverter-based energy uptake, and international evidence may not yet be plentiful.
- Independence for the organisation performing this task is vital to maintain output integrity, as that majority of organisations active in this space in Australia are likely to have a biased view, one way or another.

#### PSCAD vs. PSSE Guide development

- Guides can be useful to provide an authority on common issues, but they cannot foresee all possible scenarios likely to occur in a highly complex and evolving power system. Engineering judgement must still be able to apply, lest system security issues worsen for certain projects.
- Guides need to evolve as new information comes to light, and new information is rapidly flowing in as our system evolves. Once updated, it is crucial that key personnel across the industry are across the changes.
- The scope of the guide does not (as yet) have well-defined boundaries.

#### Model Sharing

- If black-boxing EMT models and sharing them more broadly in the industry is determined to be viable, it must be done in extremely close collaboration with, and to the satisfaction of, OEMs active in Australia. The model sharing issue cannot be resolved unless all OEMs agree to the same approach.
- Please see area 2.3

### The type(s) of change being recommended

Rule change	Guidelines	Approach	Governance	Information
✓	✓			✓

### Linkages and dependencies

#### Other CRI initiatives:

- 2.5 Improved Guidelines for S5.2.5.4 and S5.2.5.5
- 2.3 Provision of Black Box EMT Models (critical linkage)
- 3.1 Batching - Guides need to match tightly with the batching process and may be suitable to be encapsulated within the work there.

#### Other non-CRI initiatives:

- AEMO's Centralised EMT Simulation Platform / Connections tool (critical linkage)

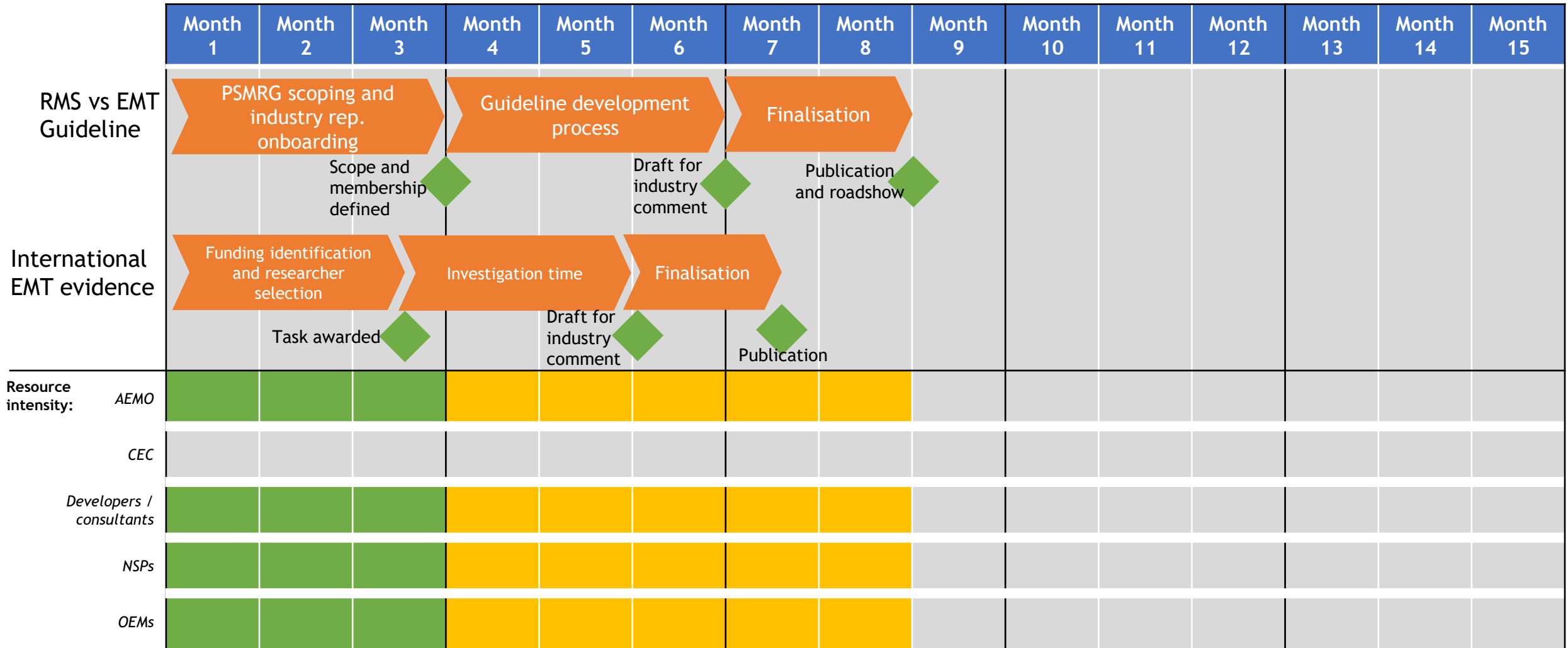
## Reform Area 2.1: Use of PSCAD (3/4)

### Key questions that remain to be worked through - PSCAD vs. PSSE guidelines

- How strongly should it be applied? Does it need to be recognised in the NER? Should it form part of an existing guideline, such as the Power System Model Guidelines? Or is it more a case of being “training advice” or simple rules of thumb? (i.e. should they be capital “G” Guidelines? Or lower case “g” guides?)
- Who should undertake the development of any PSCAD vs PSSE guides / Guidelines?
- When should PSSE be used? When should PSCAD? What overlap is required?
- When is benchmarking between EMT and RMS models expected to fail?
- Who should contribute to its development, and how soon can it be produced?
- Will the creation of such a guideline de-emphasise the accuracy of some components of models?
- Are existing RMS models (i.e. what’s in OPDMS) up to the task to support accurate power system studies? (e.g. If a frequency study is completed using PSSE, are the existing PSSE models going to be able to provide correct results?)
- How to account for risk of EMT modelling creating presumption in favour of over-precision and inferring detail that is not present at planning stage? Do we need a way to flag to project parties where EMT model detail relies on estimates vs firm values, and/or where performance outcomes are especially sensitive to these details?
- How to deal with legacy (especially old thermal) plant and <5MW DER that do not have models?
- Any guidance relating to when to use PSCAD over PSSE should not be so prescriptive to attempt to capture every possible scenario within it. It needs to be flexible.

## Reform Area 2.1: Use of PSCAD (4/4)

### Reform Area Plan



# Reform Area 2.2

## Model Quality

## Reform Area 2.2: Model Quality (1/4)

Where it impacts the connection process



### Problem Statement

The quality of each connection application has impact far beyond just that of the submitting proponent. It locks in resources from “assessing & approving” parties which are obligated to assess the application. Having poor quality and inconsistency among submissions slows down the connection process, reduces confidence in new generators and results in a bad experience.

It should be noted that, quality applies to all parties involved starting with the information & guidelines provided by the NSPs & AEMO, the connection application by proponents to the feedback from the due diligence and negotiation process.

There are limited available resources within the Australian market for developing and assessing Connection Applications. With the volume of applications being seen, and what is expected in coming years, these resources need to be used efficiently across the industry to ensure good projects, with high prospects of being connected, are not delayed by poorer or unrealistic projects, or else projects which are not sufficiently prepared that they can be quickly and efficiently assessed.

The industry is no longer going to accept “quick and dirty” applications. Painful experience has shown that every minute that is attempted to be saved in preparing an application turns out to be hours of rework later on, seriously increasing risk of power system security, financial close, and delay penalties. By ensuring a more consistent and higher standard of Connection Application work package, approving authorities can spend more time review and approving Connection Applications, rather than endless “back & forth” slowing inching poor connection applications to an acceptable state.

### Problem Statement (cont.)

When synthesized the problem is defined by the following items:

- Quality refers to a range of items including but not limited to: Documentation, DMAT requirements, consistency, practice vs simulations and ease of integration into OPDMS models.
- Lack of quality adds time and cost to a project's development before it can reach financial close and creates a resourcing challenge for NSPs and AEMO.
- The lack of quality is causing delays in the connection application process, increase the resources required and compromises the security of the system.
- This also applies to information and models provided by NSPs & AEMO e.g. OPDMS snapshots and harmonic information.

Aspiration for this work to achieve the following:

- Quicker connection applications with a better experience.
- Modelling inputs used for studies and due diligence are the same, avoid delays associated with information asymmetry.
- Connection application for different projects look and feel the same.
- Planned and committed network upgrades can be accounted for in the studies.
- OEM models are tested, verified and don't materially differ between R0 & R1.

## Reform Area 2.2: Model Quality (2/4)

### Proposed solutions and recommendations

#### Connection Application Template

- Framework to align with AEMO's and NSP's application checklist
  - Relate to Generators and Load (hybrid plant)
- A folder structure for the connection application package
- Consistency in Connection Study Report (CSR) Structure
  - Report chapters - table of content to align with NER Schedules
  - Assessment methodology of NER clauses
  - SMIB representation
  - Base case definitions
  - Channels measured and reported for each clause
  - Results for clauses should be in appendix and aligned with NER schedules e.g. S5.2.5.1\_Results
- Review and update of Power System Design and Settings Datasheet
- Template developed may serve as the foundation for an online submission portal (later).

#### Lessons Learnt Framework

Lessons Learned should ideally be carried out after each phase of the connection application process but at a minimum soon after 5.3.4A/B is granted .

Objective: Review the key learning with the aspiration of having an efficient and timely connection process.

Stakeholders should include:

- AEMO
- NSP
- OEM
- Due Diligence consultant
- Proponent and their consultant is relevant

### The type(s) of change being recommended

Rule change	Guidelines	Approach	Governance	Information
	✓	✓		

### Proposed solutions and recommendations (cont.)

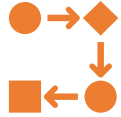
#### Due diligence framework

This applies to any generator performance feedback given to the proponent, during the connection application.

The following should be provided to the proponent during the due diligence

- Assessment procedure to replicate assessment
  - Initial conditions
- Case files and a summary of cases with detailed description of the criteria used for each case
  - Total load in state
  - Total generation
  - Total synchronous generation connection
  - Total asynchronous generation
  - Contingencies
  - Interconnector flows
- Results as monitored output channels
  - A minimum - P, V and Q at the PoC
    - Id & Iq
    - Fpoc
    - L & HVRT flags
    - Reference voltage angle
  - Responses from stability remediation plant (e.g. Statcom)

The most complex elements to get right



Balancing of 'guidance' and templates and the need for flexibility  
Don't want to create roadblocks



Interaction with Batching



Getting it right before implementation



Ensuring focus is on the 'real problem' rather than perfection

### Linkages and dependencies

- 2.1 Is the need for PSCAD valid
- 2.4 Information Asymmetry
- 1.2 OEM Whitelisting
- 3.1 Batching

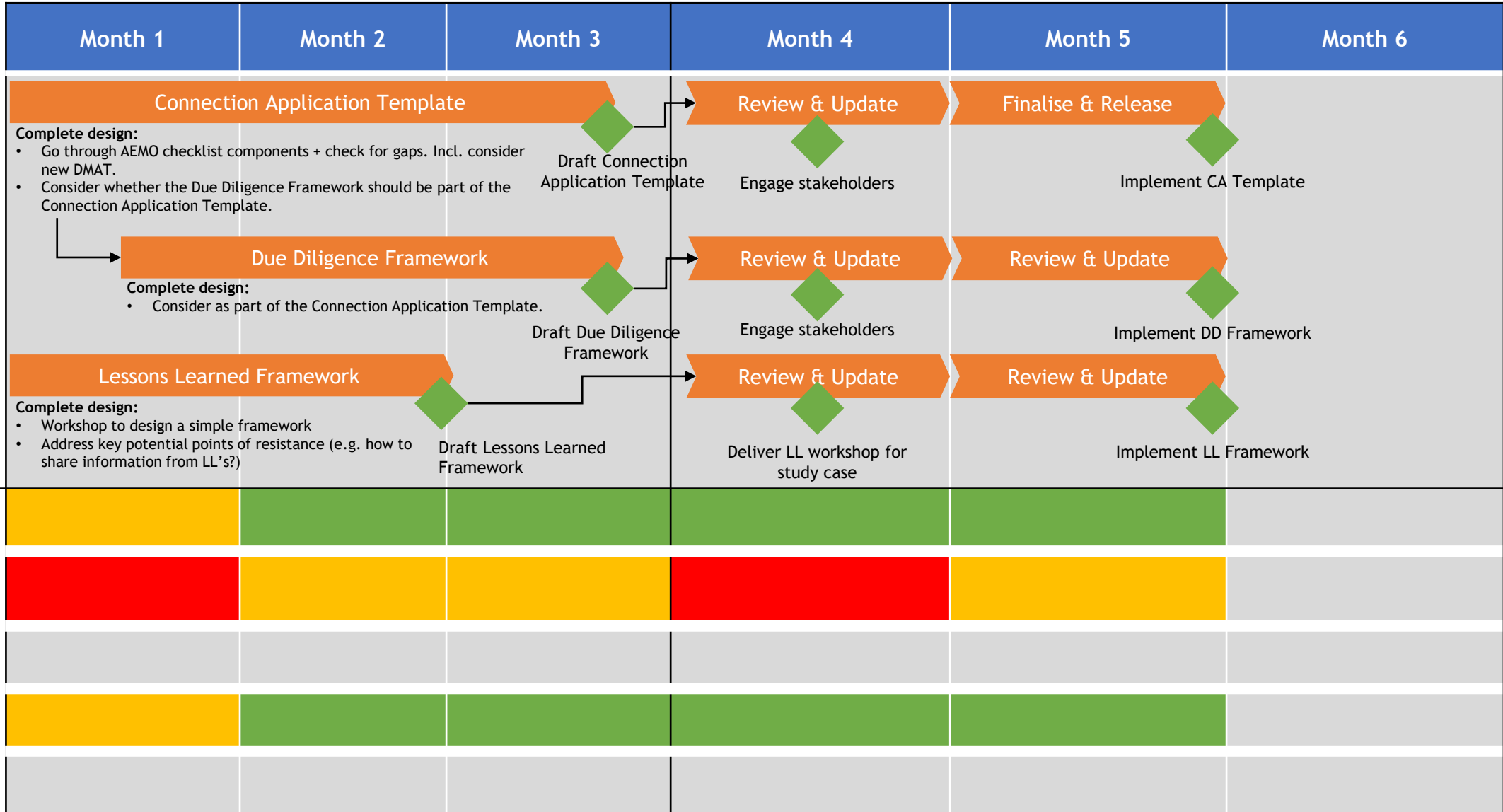
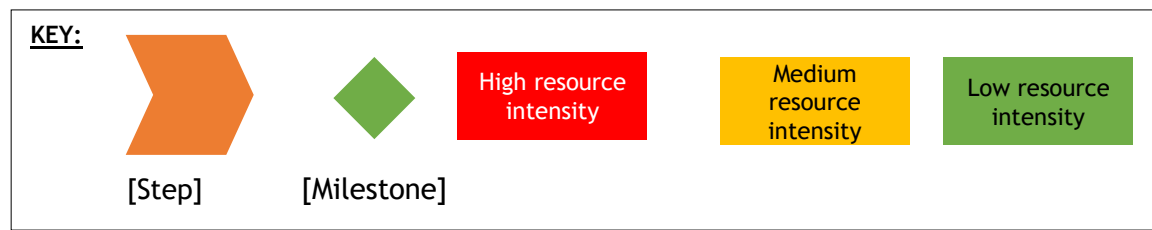
### Key questions that remain to be worked through

- Scripting, what can be developed and shared?
- DMAT - this should build on the value the DMAT is bringing.
- How would this be shared with the industry?
- Interaction with OEM whitelisting?
- Should we consider the use of pseudo code or Unified modelling language to demonstrate process taken in Python script instead of sharing scripts?



# Reform Area 2.2: Model Quality (4/4)

## Reform Area Plan



# Reform Area 2.3

## Provision of Black Box EMT Models

## Reform Area 2.3: Provision of Black Box EMT Models (1/3)

Where it impacts the connection process



### Problem Statement

NEM participants rely on a dynamic model of the interconnected power system in order to perform the studies and investigations required to meet their obligations under the Rules. This is essential not only at the time of establishing a connection, to ensure equipment is suitably designed and configured to avoid adverse interactions with other plants on the power system, but also to meet ongoing compliance obligations under NER Chapter 4.

Prior to 2018, compliance requirements could be adequately assessed using PSS/E software and dynamic models for PSS/E. Existing and intending participants can request from AEMO the PSS/E dynamic model information sufficient to undertake required studies. In order to protect the sensitive intellectual property of plant owners and technology suppliers, the information provided is limited to that necessary for study purposes (as per the definition of Releasable User Guide in the Rules), and model codes, in particular, are supplied only in compiled or encrypted form.

Under current arrangements, for reasons elaborated under Reform Area 2.1, EMT dynamic modelling in PSCAD must be undertaken in parallel with PSS/E to have adequate assurance of appropriate system performance wherever doubts arise due to weak grid effects or interactions between complex supervisory controls. However, wide-area EMT studies to demonstrate or investigate system performance cannot currently be undertaken by NEM participants. This leads to delays and additional costs in the grid connection process and information asymmetries which ultimately undermine the objectives of the NEM for customers.

Ideally, an approach is sought where NEM participants can perform dynamic studies in satisfaction of their compliance obligations while protecting the commercially sensitive intellectual property of equipment owners and technology suppliers, as has long been possible using the current approach based on PSS/E software.

AEMO is now working toward the provision of an online EMT simulation platform that may allow NEM participants to undertake modelling of their own plant in a full wide-area simulation environment that conceals sensitive information on EMT models of other plants behind a firewall. This approach may address many of the needs above but leaves gaps where detailed plant interactions need to be studied, in line with recent NEM experience.

### Proposed solutions and recommendations

It is proposed either to amend the NER information provision requirements (S5.2.4) to require, or to amend relevant industry guidelines to incentivise, dual PSCAD model provision to AEMO from generators:

1. Open PSCAD model (equivalent to PSS/E source code) with Confidential User Guide;
2. Black-boxed model (equivalent to PSS/E object code) with Releasable User Guide; and
3. Study results benchmarking the black boxed model against the open model in typical DMAT scenarios.

The open PSCAD model may not include full source code for all components but would provide sufficient source-level description to meet current AEMO Model Guidelines. It would be used by AEMO to develop and assure the quality of internal simulation tools and (like PSS/E source code at present) would not be releasable to other NEM participants (including NSPs). Only the black-boxed model would be able to be released by AEMO to other NEM participants. As with the provisions for compiled PSS/E models today, the NER would prescribe the purposes for which the black-boxed PSCAD model could be supplied and the confidentiality obligations on recipients.

Generators, in regard to their own plant, would continue to rely on their own commercial arrangements with OEMs at the initial planning stage of their developments and in subsequent supply and O&M contracts, to be able to model the plant in standalone EMT studies (in SMIB configuration) and in conjunction with AEMO's wide area simulation tool, to meet their compliance obligations. Separate bilateral arrangements may similarly be entered into between OEMs and NSPs or other project stakeholders to cover provision of models as at present. Provided the OEM separately gives benchmarking evidence to AEMO as above, the black-boxed model can be provided for studies (in lieu of the open model as at present) with an assurance of model quality and the studies accepted as suitable evidence of performance by AEMO.

The permitted purposes for release of black boxed PSCAD models by AEMO to NEM participants are expected to be more tightly circumscribed than for compiled PSS/E models due to the greater IP sensitivity of these models (particularly if the AEMO simulation tool is successful in broad applications), but may include the performance of 'near area' studies in consultation with relevant NSPs and plant owners.

The use of incentives for provision of black-boxed EMT models may be considered initially, with NER mandate for provision as a backstop if this together with the AEMO simulation platform fails to resolve fundamental issues. Incentives may link to a whitelisting process for OEMs (area 1.2).

## Reform Area 2.3: Provision of Black Box EMT Models (2/3)

### The most complex elements to get right

Accommodating the expressed needs of OEMs to protect their sensitive intellectual property is vital to success of this initiative. Accordingly it will be vital to technically assure a black-boxing approach within PSCAD that is robust to reverse-engineering of sensitive control architectures and techniques.

This assurance will require close work with the PSCAD vendor and with individual OEMs to identify and mitigate issues. See slide 6.

The AEMO simulation tool is the other major element intersecting with this proposal, whose success is critical to the final form in which the proposal is likely to take effect.

### Linkages and dependencies

Other CRI initiatives:

- 1.2 OEM whitelisting - it is proposed black-boxed EMT model provision is a whitelisting criterion
- 2.1 Necessity for EMT modelling - supports the need for EMT model provision on similar basis to existing RMS models
- 2.2 Model quality - assurance of quality and consistency across all parties utilising EMT modelling, including where black-boxed model only is used
- 2.4 Information asymmetry - model availability limits information that involved parties can glean in good faith from wide area studies
- 3.1 Batching of generator assessments

Other non-CRI initiatives:

- AEMO real-time simulation platform being progressed independently of CRI
- Broad industry shift to PSCAD version 5 - offers more technical capability for model encryption

### The type(s) of change being recommended

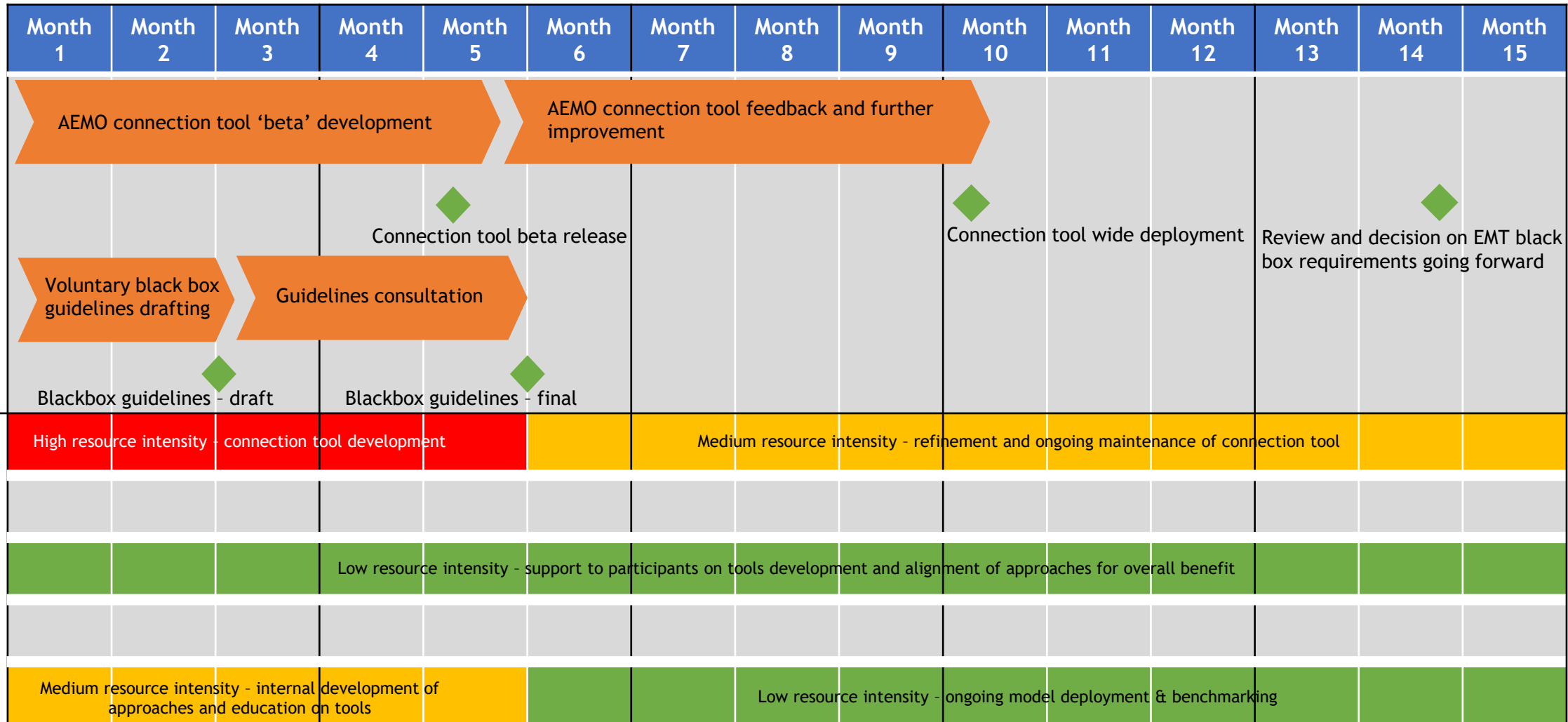
Rule change	Guidelines	Approach	Governance	Information
✓		✓		

### Key questions that remain to be worked through

- The IP question is critical (see LHS).
- Work will also be needed on the extent to which the AEMO simulation tool will be practically useful for conduct of wide area EMT studies by NEM participants for all required purposes.
- Need to ensure agreement on definition of 'open' and 'blackbox' models.
- We are not stressing the need for full source code in open EMT models, but there have been questions raised about the robustness to new compiler versions as with PSS/E. Might this mean we need to consider more firm source code requirement and how will this affect OEM buy-in?
- Provision of external library files in a "future-proof" executable (i.e. DLLs over library files that need to be recompiled). In particular, the need for 64-bit DLLs.

## Reform Area 2.3: Provision of Black Box EMT Models (3/3)

### Reform Area Plan



# Reform Area 2.4

## Information Asymmetry

## Reform Area 2.4: Information Asymmetry (1/4)

Where it impacts the connection process



### Problem Statement

Asymmetry in information held by networks and AEMO vs. developers at:

#### Enquiry Phase

- Interest of connection in a location
- KCI available - distribution projects are not included

#### Application/R1 Phase

- Base case models- built from AEMO snap shots but don't contain all the required information
  - Assumptions are made by developers
  - Leads to iteration and rework as there is discrepancy in assumptions leading to different results

### Proposed solutions and recommendations

#### Enquiry Phase recommendations: KCI Updates

- Rule change - either amend 3.7(g) to include DNSP projects, or a new clause 3.7(h)
- Cost to implement rule- minimal; rule change could be based on ERC0257 (<https://www.aemc.gov.au/rule-changes/transparency-new-projects>) with minor tweaks
- Cost to action- minimal administrative work from DNSPs.
- Suggested party to submit rule change: CEC as the primary benefit will be for their members. If not, NSPs, as this will impact the networks.
- Generation connecting under Chapter 5A already publicly captured: <https://pv-map.apvi.org.au/postcode>

#### Application/R1 Phase recommendations: Base Cases

Improved base cases process change - two options:

- Improved information from NSPs in the pre-application stage to enable developers to create better base cases
  - Currently lack of consistency and quality between NSPs
- NSP develop base cases and supply to developers

### Reform Area 2.4: Information Asymmetry (2/4)

**The most complex elements to get right**

- If NSPs develop, how to manage the models efficiently? Versioning? Consistency between provision to various proponents?
- If NSP developed, periodic development or bespoke for each project?
  - Would suggest bespoke for each project (could do a basic assessment to see if information was unchanged from most recent project to improve efficiency)
  - If quarterly (for example), how to ensure important updates included? Sensitivity studies?
  - Provided with the DRE or a specific request pre-Application? There could be significant time lag between DRE and when the proponent is ready to undertake Connection Application
- Consistency - how to ensure consistency of quality amongst NSPs supplied models and/or information?
- If improved information from NSPs is used by developers, how formal does the information requirements need to be? Updates to the Power System Modelling Guidelines? Or is a simple updated framework sufficient?

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
✓	✓	✓		✓

**Linkages and dependencies**

Other CRI initiatives:

- 2.2 Modelling Quality

Other non-CRI initiatives:

- AEMO Connection Reform - web-based wide area network

**Key questions that remain to be worked through**

- NSP developed or better information provision by NSPs?
- Pros and cons need to be fully explored for each option.
- Case study to examine better cost/time outcome.
- Who to lead changes for Distribution KCI (including rule change requests)?

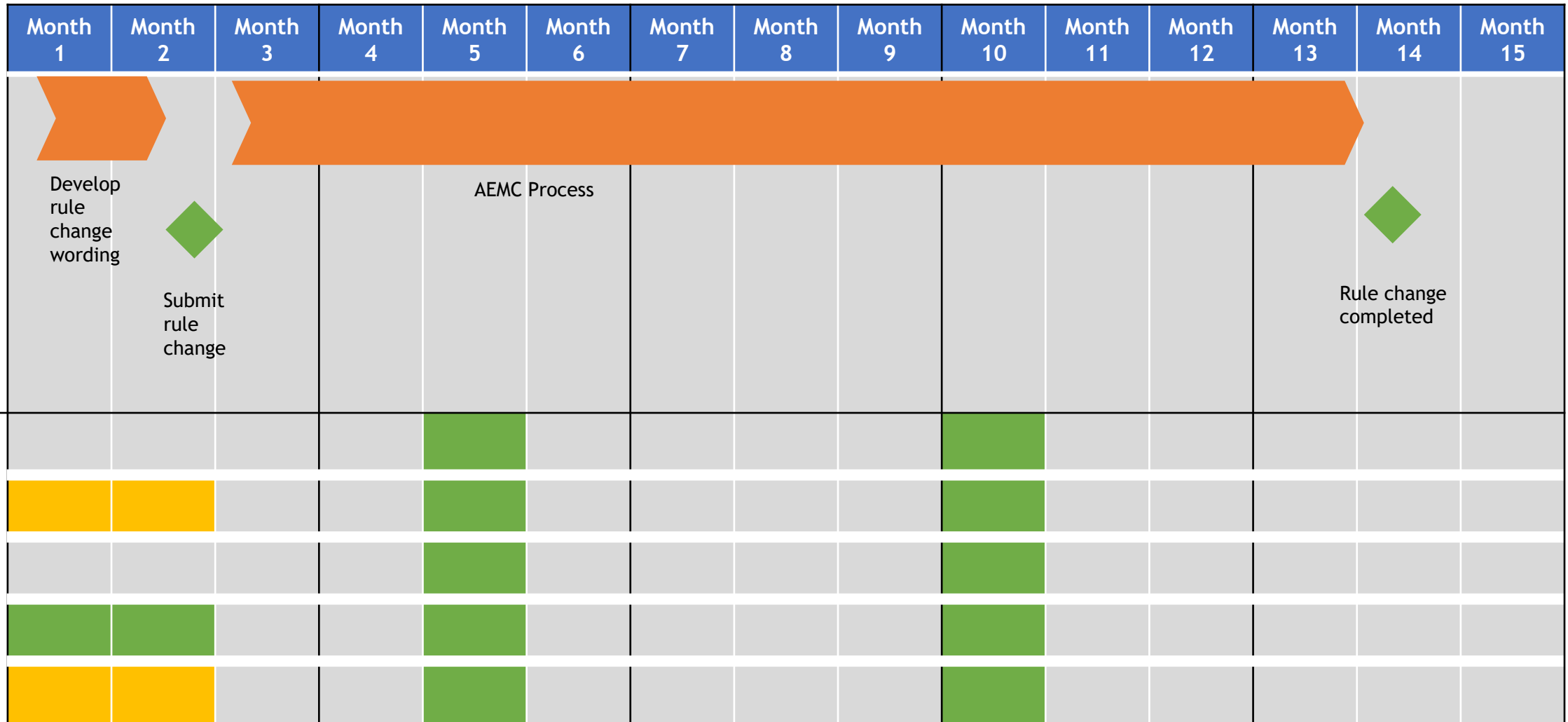


## Reform Area 2.4: Information Asymmetry (3/4)

### Reform Area Plan - KCI Updates

**KEY:**

-  [Step]
-  [Milestone]
-  High resource intensity
-  Medium resource intensity
-  Low resource intensity



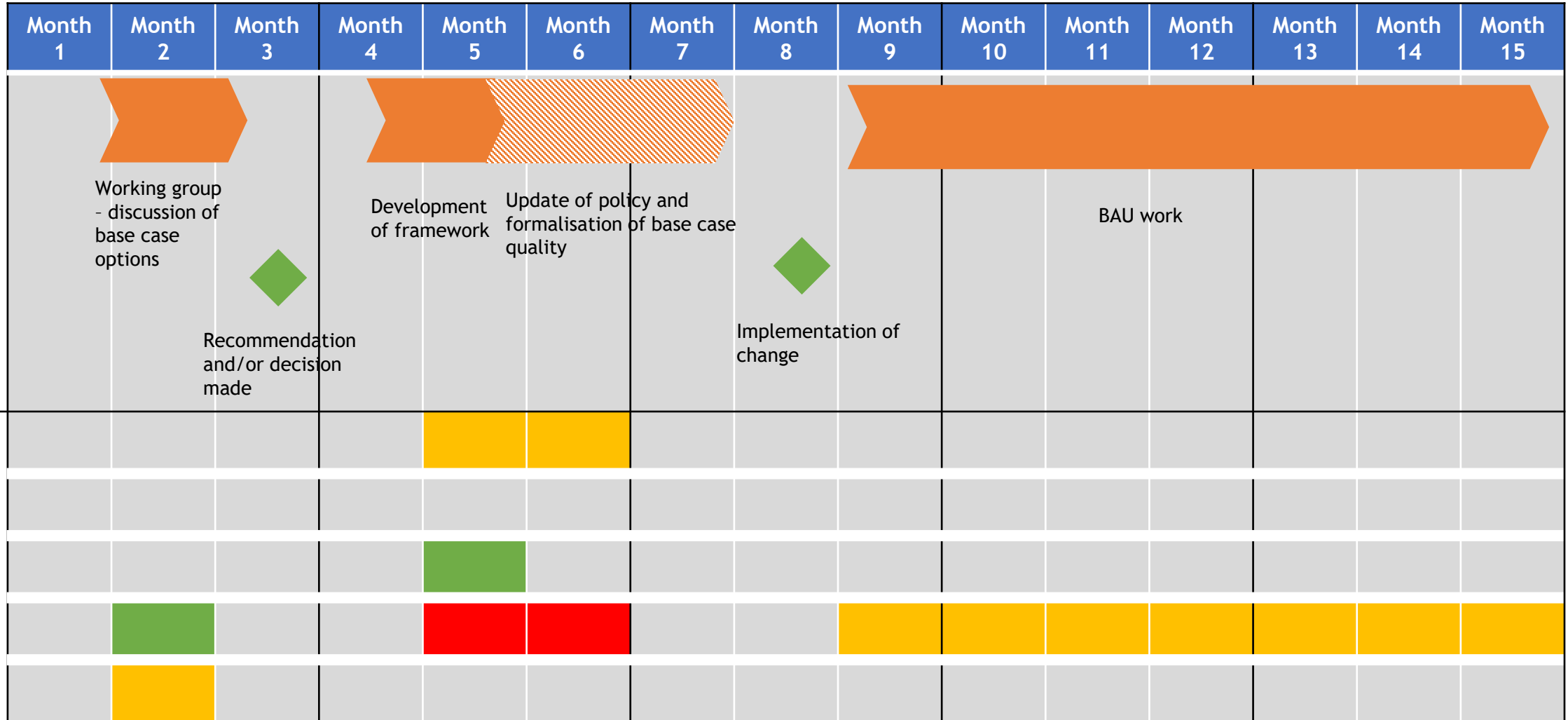
## Reform Area 2.4: Information Asymmetry (4/4)

### Reform Area Plan - Base Cases

**KEY:**

[Step] [Milestone]

High resource intensity  
Medium resource intensity  
Low resource intensity



# Reform Area 3.1

## Batching

## Reform Area 3.1: Batching (1/6)

Where it impacts the connection process



### Problem Statement

- In many parts of the NEM there are areas of the grid with significant constraints, low system strength and/or large numbers of projects in the connection process that are on similar timelines across multiple NSPs that are often in close electrical proximity.
- This has led to a lack of predictability in the timeframe required to complete technical assessments, particularly when the technical assessments can no longer be relied upon at a region level assessment in isolation of the consideration of other connection applications across multiple NSPs and regions. Additionally, in many cases a full impact assessment is required to complete performance standards assessments.
- The current approach of evaluating projects individually is posing a risk to timelines for obtaining their 5.3.4A/5.3.4B approval where the assessment is subject to other projects becoming committed during the assessment phase.
- Current approach is a threat to timeline for Final Investment Decision, since finance cannot be secured typically until at least a 5.3.4A/B is obtained.
- Proponents are experiencing extensive re-work at Registration stage, particularly in weak parts of the network where changes to the network, including network configuration, load and generation operational patterns, existing generator settings, commitment of other projects and retirements may impact the Connection Applicant's ability to meet the proposed performance standards. The outcome of this assessment could include a need to retune / coordinate control system settings of plant, modify or add ancillary plant, or other measures to meet the agreed performance standards. Should other advanced projects proceed, there may be an impact on the project.

### Proposed solutions and recommendations

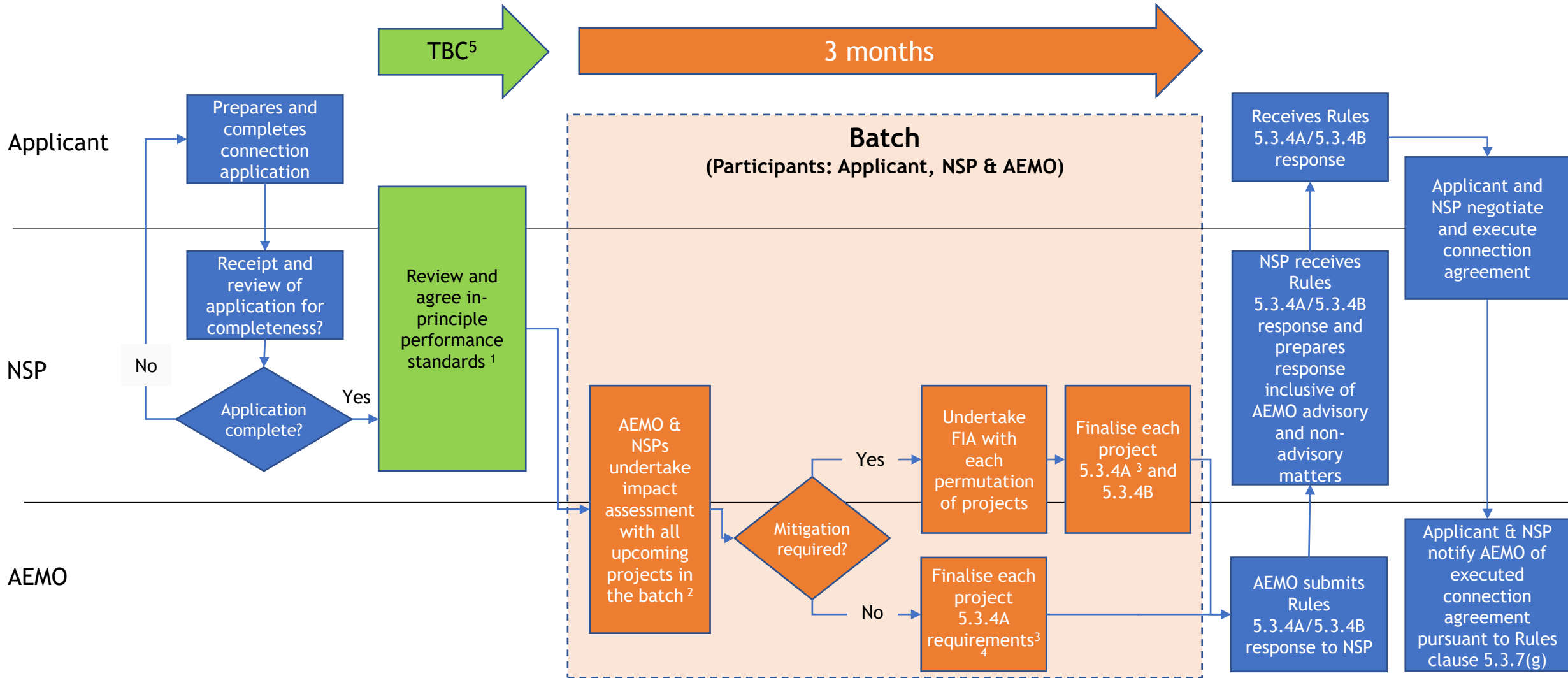
To create a coordinated connection application assessment process that batches projects with similar timeframes to undertake integrated NEM-wide technical studies.

- Batches are run 4 times a year and connection applications are accepted by specified timelines (e.g. 30-Jan, 30-Apr, 30-Jul, 30-Oct) so NSPs & AEMO can focus efforts on all proposed generators on the network, concurrently.
- Applicants can enter a batch based upon the quality and completeness of the application package - GPS access standards robust and considered 'agreed in-principle'; slow projects cannot hold up others if they can't proceed, and can be kicked out of the batch.
- At the end of the batch assessment period, response to GPS acceptability and system strength remediation scheme proposal (5.3.4A/B) is given, based upon the impact assessment completed with all upcoming projects in the batch, and the unique factors of the network at that area.
- The new connection application process steps, obligations across participants and time limits would be built into the NER requirements.

### Benefits:

- Provides better certainty to developers, off-takers, investors and lenders on the timing of the 5.3.4A/B letter.
- Avoid the need to repeat full technical assessments for all applicants each time a new generator is committed
- Reduces the demand on AEMO and NSP engineering resources
- Allows for coordination of system strength mitigation schemes between proponents seeking connections within similar timeframes. This may be useful in the immediate period prior to the introduction of the new system strength framework by the AEMC.
- A batching solution at the prior 5.3.4A/B stage may alleviate some of the extensive re-work at Registration.

# Reform Area 3.1: Batching (2/6)



<sup>1</sup> Based on standards that could be automatically met by reasonable quality generating plant - linkages with cluster 1 - Access, and cluster 2 - Information & modelling

<sup>2</sup> AEMO and NSPs complete joint studies with agreed allocation of model assessments across NSP & AEMO with stable base cases

<sup>3</sup> NSP, AEMO & Applicant agree negotiated access standards

<sup>4</sup> Projects could be considered to exit the batch earlier

<sup>5</sup> Need to determine adequate time required for NSP to complete due diligence on the application

## Reform Area 3.1: Batching (3/6)

Proposed solution	Recommendations
<p><b>Batch features</b> - NEM wide batch, target quarterly</p>	<ul style="list-style-type: none"> <li>• Up to 10 projects per batch (subject to trials) with no minimum number required</li> <li>• Target to run batches 4 times a year and connection applications accepted by specified timelines (e.g. 30-Jan, 30-Apr, 30-Jul, 30-Oct) so NSPs &amp; AEMO can focus efforts on all proposed generators on the network, concurrently. To be assessed after first batch completes.</li> </ul>
<p><b>Entry into batch</b> - NSP responsible for ensuring that submissions are of sufficient quality. Develop checklist/guideline for NSPs to ensure consistent approach for entering a project into the batch</p>	<p>Pre-requisites for entering batch:</p> <ul style="list-style-type: none"> <li>• Model quality from the applicants - DMAT application checklist and Power System Modelling guidelines</li> <li>• Validation of document quality of the relevant documents in the application checklist (and ensure that all items are present), benchmarking etc.</li> <li>• The scope of these studies, including performance clauses checked, could be defined in a guideline, building on existing guidelines</li> <li>• Have in-principle agreement on performance standards so that the NSP is comfortable - can GPS performance standards be consistently identified &amp; agreed across NSPs (potentially per technology type)?</li> </ul>
<p><b>Batch assessment</b> - AEMO and NSPs to complete joint concurrent studies with agreed allocation of model assessments across NSP &amp; AEMO (<i>Not a sequential process where NSP undertakes assessment followed by an AEMO WAM assessment per current process, and it is not a duplication of all studies</i>)  <i>To foster better collaboration, consider physical co-location of engineers during a batch process, even for limited periods (NSP/AEMO/OEM/Consultant)</i></p>	<ul style="list-style-type: none"> <li>• Technical studies to be conducted jointly to assess impacts of all generators in the batch across regions and across multiple NSPs simultaneously</li> <li>• AEMO and each NSP with connections in the batch, to agree base cases to be utilised to complete PSCAD and PSSE studies i.e. when to use NEM-wide Four State Model (FSM) to assess impacts across regions and when to utilise limited region studies utilising NSP developed models particularly with more detailed jurisdictional network asset data to assess the local impacts of the generator(s) at the point of connection</li> <li>• Base case models (AEMO FSM and NSP region WAM) to include all previously committed projects (from prior batch)</li> <li>• Batch assessment to include scenario with all generators in batch at full output capacity and under agreed contingency scenarios and with different combinations of generators in service</li> <li>• Model assessments to be completed across PSSE and PSCAD and where there are material discrepancies in assessment results, they will need to be investigated further particularly to investigate the root cause of any observed performance issues</li> <li>• Resolution of any performance issues may require further work to fine tune GPS plant models</li> <li>• Implement a screening process whereby projects which do not require mitigation can be identified and separated from those which require further assessment via a full suite of impact studies</li> </ul>

## Reform Area 3.1: Batching (4/6)

Proposed solution	Recommendations
<p><b>Collaboration</b> - across AEMO, NSPs, and developers in the batch</p>	<ul style="list-style-type: none"> <li>• Sharing of project information by developers across batch participants is necessary to enable joint impact assessments</li> <li>• Willingness to share model information (PSSE and PSCAD) between NSPs and AEMO to align on assessments and review results will be critical to facilitate efficient process - an openness and professional respect amongst power system engineers and modellers to work collaboratively on reviews is critical</li> <li>• Willingness of developers and OEMs to work collaboratively with AEMO and NSP to resolve any performance issues including any plant tuning will be important to enable projects to progress efficiently through the batch</li> </ul>
<p><b>Outcome of batch</b> - approval to connect (5.3.4A/B) is given, based upon impact assessment completed with all upcoming projects in the batch, and the unique factors of the network at that area</p>	<ul style="list-style-type: none"> <li>• Limit 5.3.4 A/B validation to 3 or 6 months to achieve committed status (5.3.7(g)) to ensure batching framework is consistent and uncommitted projects are not carried through for multiple batches after they come out of their batch impacting the integrity of model assessments in future batches</li> <li>• Consider a pathway for projects which have completed their assessment and are deemed electrically independent of other projects in the batch to exit the batch earlier</li> <li>• Where individual project issues are identified within the batch that cannot be reasonably resolved within the batch period and are found to impact on other projects within the batch, they cannot hold up the other projects in the batch and can be pushed out of the batch</li> <li>• Projects pushed out of the batch can re-enter a future batch, however known project issues would be expected to be resolved prior to entry into a future batch</li> </ul>
<p><b>Rule changes</b> - create a batch administrator to manage batching process and procedural fairness</p>	<ul style="list-style-type: none"> <li>• Rule change proposal to be considered to reflect:             <ul style="list-style-type: none"> <li>• new role for batch administrator</li> <li>• obligations for applicants and NSP for activities pre-entry to batch</li> <li>• obligations for technical studies across NSP and AEMO within the batch</li> <li>• time-bound obligations to undertake batch assessments</li> </ul> </li> </ul>

## Reform Area 3.1: Batching (5/6)

**The most complex elements to get right**

- Model quality! Model quality will be very important to avoid proponents submitting “incomplete” applications for the sake of getting into the batch
- Implementing a new process that can generally be agreed is fair and equitable and better than the current process
- Modelling capability uplift across NSPs and AEMO
- Collaboration across AEMO, NSPs, and developers in the batch
- Defining and agreeing upon obligations of each party in the batch NSP, AEMO and developers; Sharing of confidential info within the batch
- Dependency of projects and issues for resolution commitment on dates for delivery of key equipment (e.g. sync condensers)
- General alignment of projects timelines across different developers such that it is possible to form and implement a batching process
- Sharing of confidential info within the batch amongst proponents that may be in competition with each other.
- Reliance on set timeline; a) 3 months to get through batch; b) time to get from 5.3.4a/b to 5.3.7g with potential limit
- Interaction between cutting edge tech and established tech

**Linkages and dependencies**

*Other CRI initiatives*

- 2.2 Model Quality: To help define a model quality stage gate that projects must pass prior to being included as part of a batched FIA assessment.
- 2.4 Information Asymmetry: To improve the transparency of network modelling information for proponents and also improve the visibility of nearby applicants to foster better collaboration between generators by using the batch as a conduit.

*Other non-CRI initiatives*

- AEMC System Strength Investigation.
- Dedicated Network Assets rule change.
- State led development of renewable energy zones.

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
✓	✓	✓		

**Key questions that remain to be worked through**

- How does this work interact with current system strength rule change under consideration ?
- How will grid constraints be dealt with?
- Fairness on timeline for issue resolution / Can the batch administrator push proponents out of the batch ?
- How many projects/MW in given locations to accept in a batch? How to manage batch over subscription ?
- Who would be running the impact assessment? AEMO or NSPs?
- Is a specified timeframe required post submission of a complete application to agree the GPS in principle before entering a batch ? What amount of time is sufficient to agree on an “in-principle” GPS? Especially when so many know the start date of the next batch and will be competing with one another to get into the next batch, flooding the NSP with applications? How can this be managed? NB: AEMO would not be involved pre-batch entry to agree negotiated access standards
- At the FIA stage, if you identify and isolate a “poor quality” project in the batch do you a) spend time on that project to resolve their issues or b) eject from the batch and proceed with the remaining projects after a specified time ?
- Under what particular circumstances/criteria can a project exit the batch early?
- How do upcoming batch projects that are preparing their modelling etc. take into account the projects currently being assessed in the batch(es) ahead? How much time do they need to factor into their preparation those projects that are about to receive their 534 notices (noting the need for a high quality of modelling to enter a batch)?
- What happens when participants in the batch collectively exceed the capacity of the network? Or if there is an oversubscription of applicants to a batch?

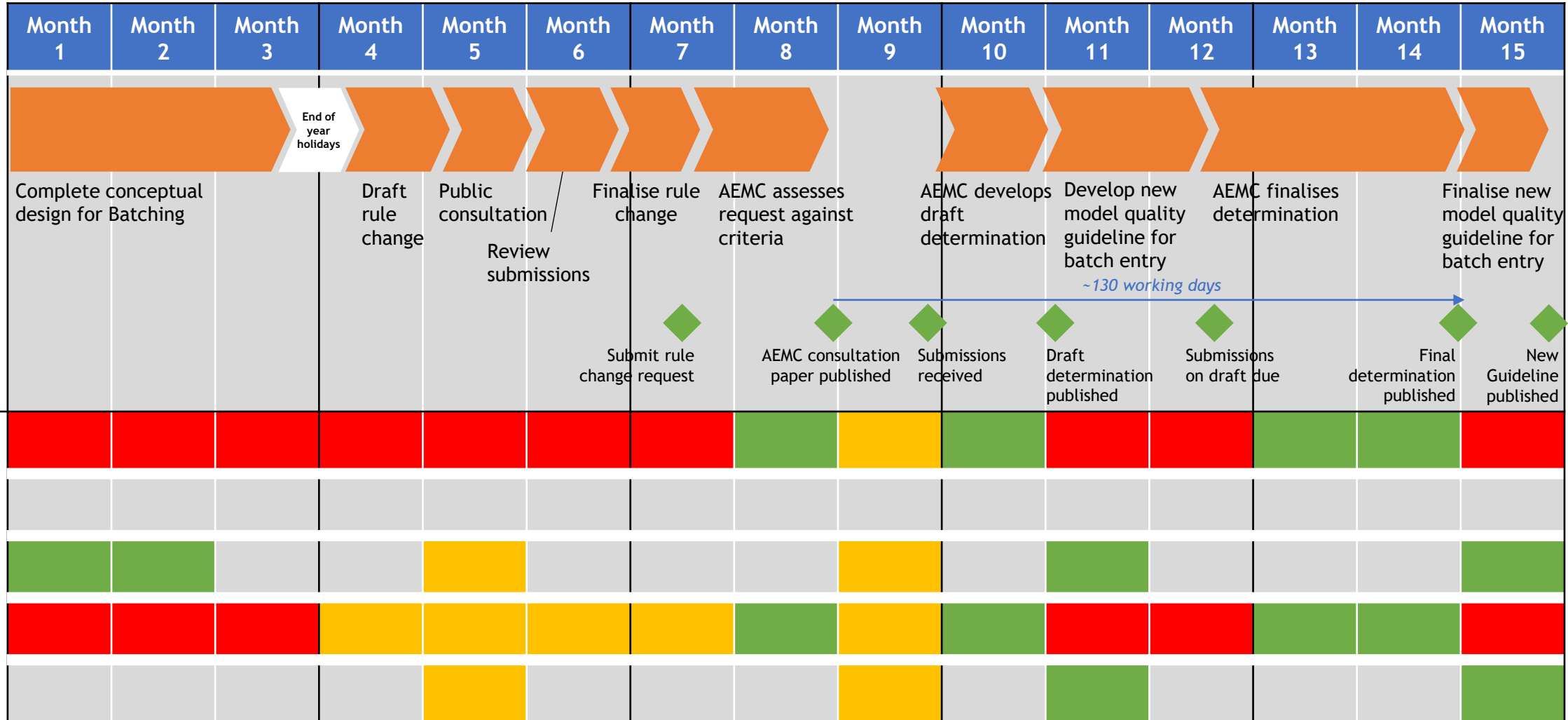


# Reform Area 3.1: Batching (6/6)

## Reform Area Plan

**KEY:**

- [Step] (Orange arrow)
- [Milestone] (Green diamond)
- High resource intensity (Red box)
- Medium resource intensity (Yellow box)
- Low resource intensity (Green box)



# Cluster 6 Overview

Providing Investment Certainty for R1

## Cluster 6 Overview: Providing Investment Certainty for R1 (1/6)

Where it impacts the connection process



### Value Proposition

Construction of new non-exempt generating systems requires substantial investment and contracting. Proponents must commit to contracts worth hundreds of millions of dollars such as:

- power purchase agreements,
- debt financing agreements and
- construction contracts including EPC and other design/construct.

Each of the contracts have substantial financial implications. They require a predictable pathway post-connection agreement, to get to full generation and therefore operating revenue.

### Problem Statement

The R1 assessment framework that underpins the current Generator registration pathway is not fit for purpose.

The framework lacks clear and express NER obligations in relation to:

- the provision and assessment of R1 information and
- R1 GPS capability requirements.

The process is over reliant on engineering judgement, lacks any formal review mechanisms, is prone to re-work and iteration which all leads to unpredictable timeframes.

Undertakings made by a proponent to AEMO, to rectify issues after registration is achieved aren't enforceable under the NER. This framework is inflexible, lends itself to informal lopsided negotiation that is punitive on Generators for technical issues, escalations and "all or nothing" outcomes at the registration stage for proponents.

Generation projects are technically assessed at both the Offer to Connect stage (R0) and the Registration stage (R1). The re-assessment at R1 can often lead to design changes (due to reasons above) and as this occurs during construction while the project contracts are on foot. This results in delays, variations and significant project risks.

The NER framework and obligations for a Connection Applicant to submit an R1 package and for AEMO to determine R1 GPS capability is not fit for purpose. The obligation to provide the R1 information to AEMO and the NSP under Chapter 5 does not functionally align with the obligations for AEMO to assess the information and determine R1 GPS capability under Chapter 2 for Generator registration.

The NER is absent of R1 GPS capability requirements, or a NER prescribed guideline that sets out these requirements. Therefore R1 GPS capability assessment process is reliant on AEMO guides and engineering judgement. AEMO's R1 GPS capability determination is not reviewable, and AEMO has no NER obligations to provide reasons why it is not satisfied a generating system will be capable of meeting or exceeding its performance standards, unless AEMO determines a person is ineligible for registration as a Generator at the end of the registration process. Although AEMO does do this informally as practice.

AEMO is unable to approve an application to be registered as a Generator subject to terms or conditions, this applies to R1 GPS capability determinations too. This makes the R1 GPS capability determination process inflexible when issues arise at the R1 assessment phase. Any undertakings made by a proponent to AEMO, to rectify an issue after registration is achieved, that was identified during the R1 assessment process, are unenforceable under the NER.

This framework lends itself to an "all or nothing" outcome at the R1 assessment stage. A Generator registration application is not considered complete, until all the information requested under clause S5.2.4(b) is received by AEMO. AEMO has no obligation to determine an incomplete Registration application. The experience is that leaving this 'for later' or 'conditional' leads to long-standing non-compliances, etc. as the 'stick' is gone. *(Cont. over)*

### Problem Statement (cont.)

#### Registration (2.9.2)

- In the NEM a person cannot connect a generating system to the network unless that person is registered by AEMO as a Generator.
- To be eligible for registration as a Generator, AEMO must be satisfied the generating system will be capable of meeting or exceeding its GPS under 2.2.1(e)(3) (GPS capability) based on the information provided to AEMO under clause S5.2.4(b).
- AEMO's GPS capability assessment for registration under 2.2.1(e)(3), is supported by the provision of registered planning data conforming to Power System Model Guidelines and Data Sheet requirements, under clause S5.2.4(b). When a person provides this information to AEMO under clause S5.2.4(b), AEMO has no clear and express obligations under Chapter 5 to assess this information and determine if it is incomplete or contains information upon which AEMO requires clarification. Unlike AEMO's express obligation to assess a Generator registration application submitted under clause 2.9.1.
- AEMO formally determines a generating system's GPS capability as part of determining a person's application to be registered as a Generator under clause 2.9.2. The determination is made by AEMO's participant registration committee (PRC). AEMO's registration approval must be unconditional. Unlike AEMO's ability to impose term and conditions to specified generating unit classification and aggregation approvals and Generator exemptions under NER chapters 2 and 3.
- Neither the NER Dispute Resolution (8.2) or Independent Engineer (5.4) rules apply to a decision made by AEMO that a person is not qualified to be registered as a Generator under clause 2.9.2(c), including R1 GPS capability.

#### Control and protection settings for equipment (5.8.3)

- Under rule 5.8.3, AEMO may be required to determine proposed generating system parameters settings, if there is disagreement between the NSP and the proponent. This determination will likely impact R1 GPS capability assessments undertaken by proponents, NSPs and AEMO.

#### Commissioning program (5.8.4)

- Before commencing commissioning, AEMO along with an NSP must approve the generating system's commissioning program.

## Cluster 6 Overview: Providing Investment Certainty for R1 (3/6)

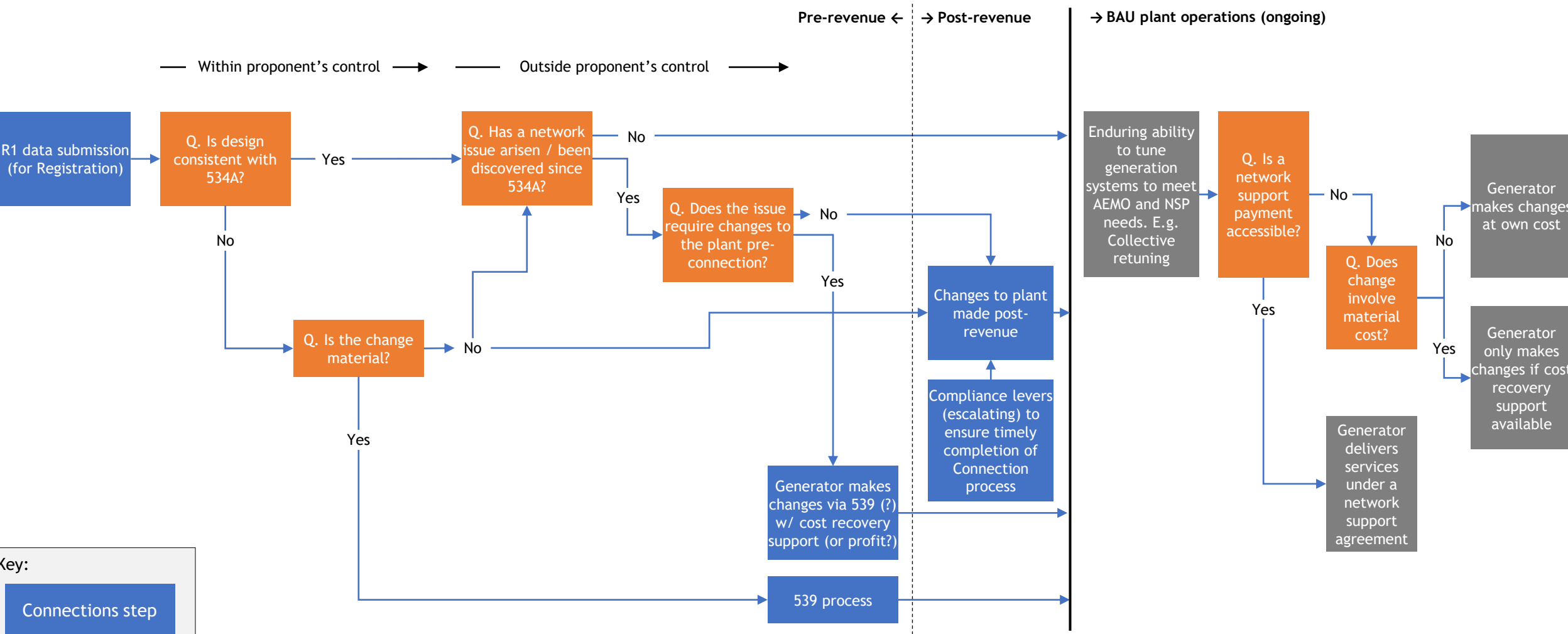
### Proposed solutions and recommendations

It is proposed that the Generator registration and R1 assessment processes be changed, including the associated Rules, to:

- Use the R0 models (finalised at Commitment) of the generating system for operational modelling until a final R2 model is made;
- Allow Generator registration and generating system energisation without requiring remodelling at the R1 stage provided:
  - AEMO and the NSP have assessed whether the R1 design is materially consistent with the R0 preliminary design;
  - where an issue emerges between Commitment and Registration, energisation of the generating system will not cause a material system security issue proven by AEMO and/or the NSP.
- Establish new Chapter 5 Post-connection agreement processes, with NER defined time obligations, for AEMO:
  - and the NSP to assess a Connection Applicant's R1 package,
  - to determine a generating system will be capable of meeting or exceeding its performance standards (R1 GPS capability) in accordance with the reformed R1 assessment framework and "onus of proof" obligation.
- Amend the Generator registration requirements, such that to be eligible for registration as a Generator a person must have already satisfied AEMO of the generating system's R1 GPS capability under the new Chapter 5 Post-connection agreement process.
- Allow AEMO to make a R1 GPS capability determination, subject to terms and conditions, that are limited until the completion of R2 testing (R2 GPS capability). The purpose of this T&Cs mechanism, is to enable:
  - a person satisfy AEMO R1 GPS capability when non-material issues arise during the R1 assessment and
  - AEMO register a Generator, whilst also managing power system security risks in a more flexible manner.
- Recommend the R1 GPS capability T&C NER provisions are classified as civil penalty provisions.
- The new Chapter 5 Post-connection agreement processes can be subject to a internal AEMO review mechanism and may be subject to the Independent Engineer and Dispute Resolution rules.
- Allow NSPs and AEMO to modify a generating system's models, control systems, and GPS to meet system needs - after the plant has reached full output.

# Cluster 6 Overview: Providing Investment Certainty for R1 (4/6)

## Cluster 6 proposed solution (high-level view)



**Key:**

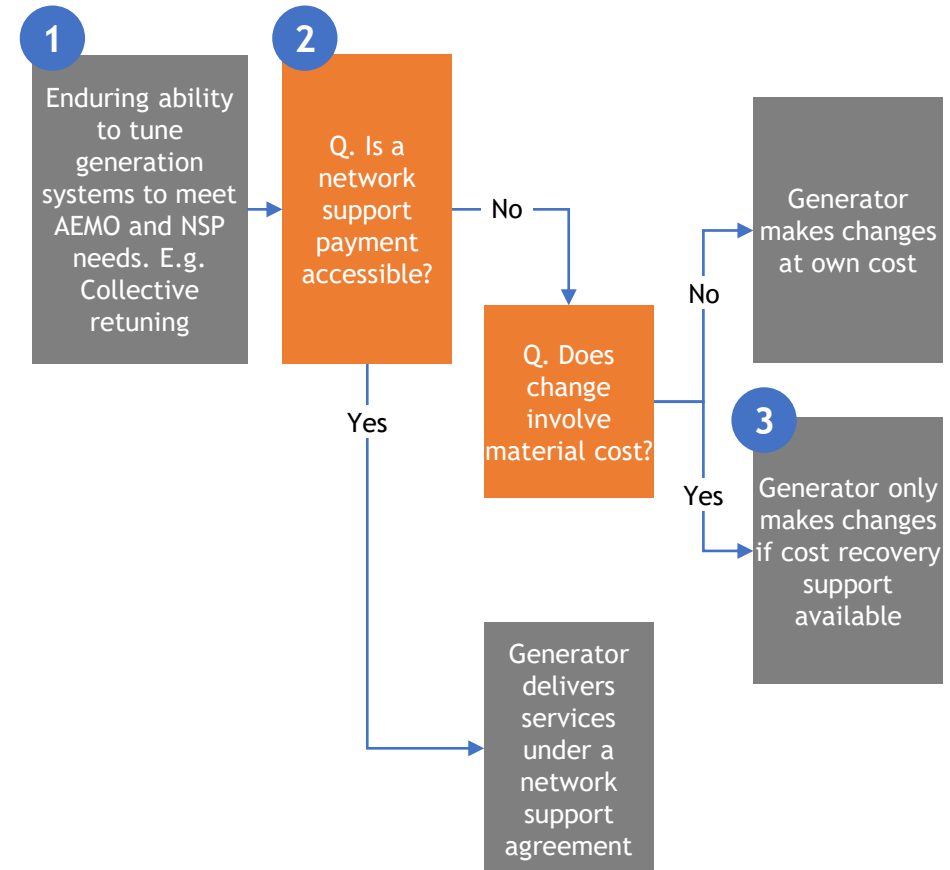
- Connections step
- Plant ops step
- Decision point

## Cluster 6 Overview: Providing Investment Certainty for R1 (5/6)

Key outstanding questions: BAU plant operations (ongoing) steps

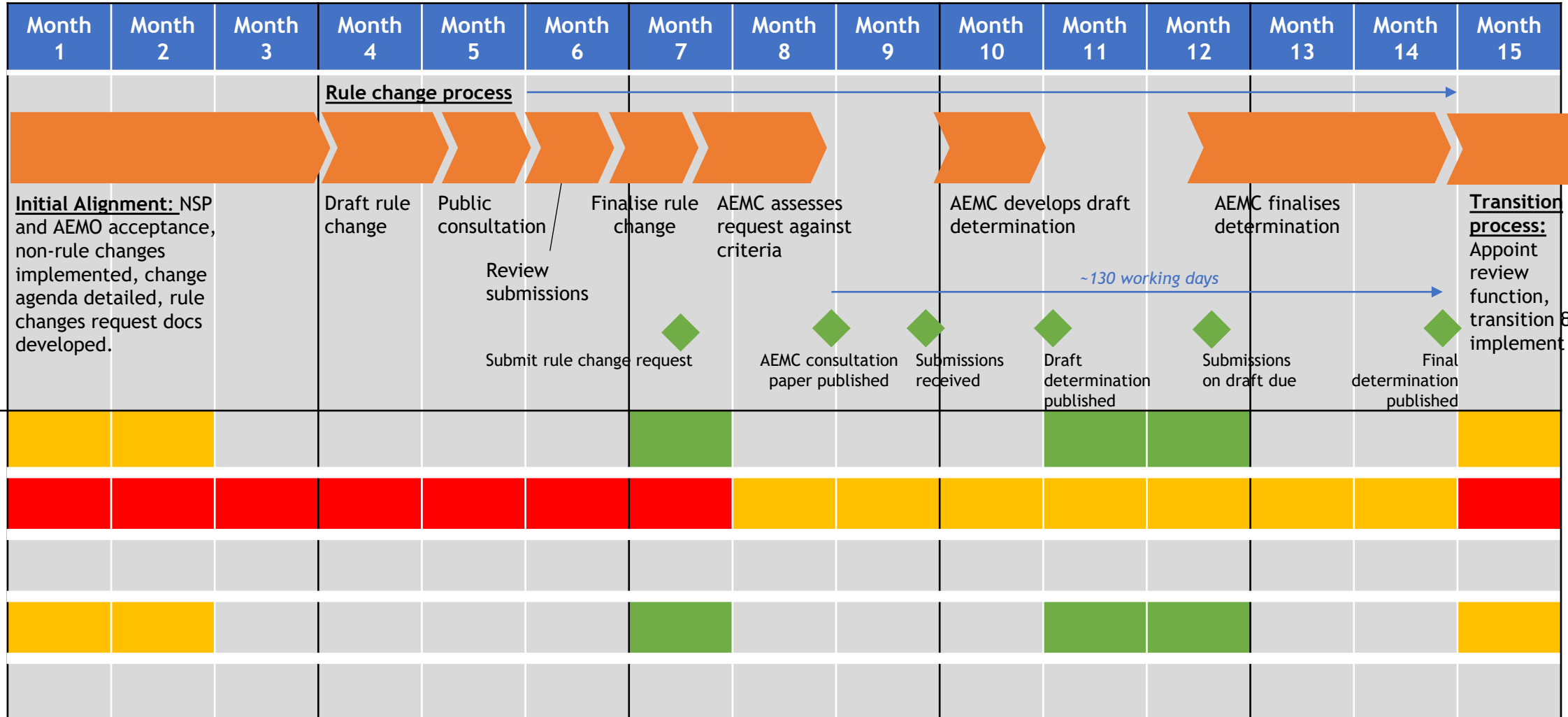
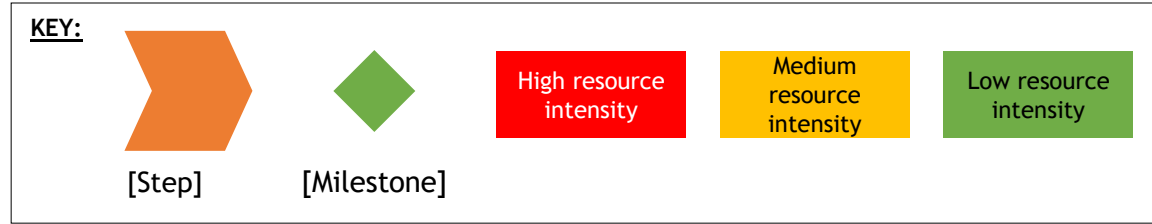
- 1 Should this happen only at regular intervals (e.g. every 6/12 months, etc.)? Or should it be available to NSP/AEMO whenever the need arises?
- 2 What would lead the answer to this question be “no”?
- 3 Where does the money come from for this? (Is it a RIT-T / RIT-D?)

### → BAU plant operations (ongoing)



# Cluster 6 Overview: Providing Investment Certainty for R1 (6/6)

## Reform Area Plan



Note: Timing assumes the industry (CEC with the support of a group of businesses) lead a conventional rule change process. Timing does not include the rule change implementation period.



# Reform Area 6.1

Switching the Onus of Proof for System Security

# Reform Area 6.1: Switching the Onus of Proof for System Security (1/2)

Where it impacts the connection process



**Problem Statement**

Currently, in order to achieve Registration, Generators have to prove that a plant can meet its GPS and won't cause any system security issues. This has to be signed-off by AEMO and the NSP's connection teams (following "technical DD") before a project can be put to AEMO's Registration Committee.

Part of the technical DD process includes re-testing a project's performance in wide-area-network (WAN) modelling, which can result in external network issues or unexplained phenomena being identified. There have been several instances of this holding up the registration of Generators. In this instance, the Generator must prove that their plant is not causing the phenomena and by extension, must therefore solve the phenomena whether they caused it or not. This can be almost impossible to achieve when generators don't have access to the WAN models to interrogate potential causes of issues.

The same can occur during commissioning on the real network, and there have been examples of pre-existing and externally caused network oscillations delaying projects from proceeding through commissioning while those projects are asked to demonstrate that they are not the root-cause.

Also, Registration is not actually rejected currently. It is delayed due to the Generator's submission lacking information. That information is the proof above and other minor modelling issues.

**Proposed solutions and recommendations**

For context, it is assumed that Generators will continue to be thoroughly modelled at the Offer to Connect / 5.3.4 stage, and at this stage there would remain no obligation to issue a 5.3.4 or offer to connect until all parties were fully satisfied that the plant was compliant with its GPS and the NER.

Once a project has been issued a 5.3.4 letter, and subsequent Offer to Connect from the NSP ("Commitment"), the onus for proof of compliance will be reversed. Upon submission of R1 data, full "technical DD" would not be repeated, and would instead be replaced with "consistency checks", which if passed would result in Registration of the generator.

An NSP or AEMO must be able to prove that energization of the Generator will cause or materially worsen a material system security risk in order to:

- Modify a Generators' models, commissioning program, control systems, or GPS;
- Require remodeling of the Generator's connection;
- Delay energization of the Generator; or
- Delay progression of commissioning;

between *Commitment* and full revenue (ie release from the final hold point).

That decision will be

- Accountable (TBD)
- Transparent (The NSP and AEMO would provide a written report with findings - positive or negative - of their technical DD)
- Timed ([20?] Business Days) and
- Subject to independent review (upon request by any of the involved parties).

If an NSP or AEMO is unable to prove a Generator shouldn't be held-up, then the plant will progress to energization, or to the subsequent hold point, as the case may be.

# Reform Area 6.1: Switching the Onus of Proof for System Security (2/2)

**The most complex elements to get right**

The National Electricity Rules is a complex web of potential hurdles for Generator’s to progress their projects.

It will be vital to ensure that addressing this proof issue doesn’t just lead to another rule being used to hold up Generator energization.

As such, any rule change should both provide specific wording changes, but also provide high-level guidance to NSPs and AEMO to energise, or progress the plant through hold points, as a priority.

A suitable approach to materiality is key to making this work.

- It wouldn’t be practical for the onus of proof to be placed on the energies NSP & AEMO in the event that a generator makes substantial changes to its plant;
- However in practice there are always some small changes made between concept design (offer to connect) and detailed design/as-built (registration).

Therefore you need to have a concept of “material changes to plant configuration”. As long as material changes were not made then consistency checks would suffice in lieu of repeating DD. One potential solution to this is to identify the key elements of a plant that may change between concept and detailed design, and to define practical “envelopes” for each within which designers and constructors can work. For example transformer impedance is x +/- 10%; cable impedances are x +/- 5%; etc.

Reasonable consideration should be taken to define which parameters necessarily require a redesign of the Generator upon change.

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
✓				

**Linkages and dependencies**

Linkages with other CRI initiatives:

- Batching (Reform Area 3.1)

**Key questions that remain to be worked through**

- Exactly which clauses of Rules and internal NSP/AEMO processes are holding up project energization.
- For AEMO and NSPs to take on the onus of proof, and an onus to respond within a fixed timeframe, it would be essential that they have a complete set of information before they commence Consistency Checks. A very clear set of information requirements to be the “trigger” for them to start would be needed to ensure there was certainty around this point. Without it, the point at which AEMO and NSP Consistency Checks commence could become uncertain and at times contentious (i.e. “insufficient information is available to commence consistency checks” could just become another hold-up point).
- Would any further work be required at 5.3.4 stage to protect system security (some of the feedback suggested this would be the case). What would that work be?

# Reform Area 6.2

“Materiality definitions”

## Reform Area 6.2: “Materiality” Definitions (1/5)

Where it impacts the connection process



### Problem Statement

The delays to projects reaching commercial operations have occurred in the vast majority of cases during the registration phase of the project, where AEMO performs its final due diligence or assessment of the the generator’s Generator Performance Standards (GPS). Under Clauses 2.2.1(e) (3) of the registration rules AEMO “must be satisfied” that generators can meet or exceed their performance standards. Generators must provide AEMO with their most updated technical information (so called R1 data) for it to perform this assessment (in accordance with S5.2.4(b) of the rules).

At the heart of the issue is that there is little guidance in the rules, on what happens if AEMO is not satisfied of these matters. AEMO appears to have unlimited discretion to reopen access standards, demand technical changes to generation equipment, require implementation of system strength remedial measures and request detailed power system modelling, if it considers the connection applicant (CA) may be unable to meet its GPS. AEMO could arrive at this view if there has been any change in plant design or power system conditions since the completion of the 5.3.4A process.

There is no prescribed process for how AEMO should undertake a GPS assessment under 2.2.1 (e) (3), nor are there any time bound obligations associated with how long such an assessment should take.

Further, there is no materiality threshold for triggering the assessment in the first place. AEMO has complete discretion to decide how and for how long it chooses to undertake such an assessment. This creates an enormous degree of unpredictability and uncertainty for a CA in the connection process.

As part of a broader suite of reforms proposed in Reform Area 6.0, which include in particular a structured and time bound pre-registration GPS assessment process, it is also proposed that a higher bar be set for when such an assessment should take place. This will be addressed through the implementation of a materiality threshold, which is the focus of this section.

## Reform Area 6.2: “Materiality” Definitions (2/5)

### Proposed solutions and recommendations

The connection rules under 5.3.4A provide a framework for negotiating access to the network. At the core of this framework is the requirement for the connection applicant to agree a set of performance standards with the NSP, which must be approved by AEMO. The process is prescriptive, with well defined stages and timelines for information exchange and when GPS are to be accepted or rejected by AEMO and the NSP. There are also important requirements for AEMO and NSPs to provide detailed reasons for why a proposed GPS is rejected and what must then be done for them to be approved.

Similar prescription and definition should apply to AEMO’s assessment of performance standards under 2.2.1(e) (3), however a higher bar should be set to reopen/re-model GPS which have been already agreed under 5.3.4A. That is, a materiality threshold should be introduced that ensures more detailed assessment and reopening of GPS will only occur in exceptional circumstances.

Area 6 reform proposal is for a new process to be developed for AEMO’s due diligence assessment (i.e., R1 package review) prior to registration. The key principles and features of this process are set out below:

#### *Key principles to underpin new arrangements*

- The pre-registration GPS review process should primarily be a consistency check between preliminary data (R0) provided as part of the 5.3.4A process and the more update R1 data provided closer to connection.
- GPS should not be ‘reassessed’ during the R1 assessment except for a narrow and clearly defined set of circumstances, based on a clear materiality threshold.
- Materiality should be defined, preferably in a guideline, to ensure clarity and consistency in its interpretation.
- Changes to plant design or power system conditions post 5.3.4A should only trigger a more detailed assessment where these changes are likely to cause a material impact on system security.
- Where AEMO determines that a change in plant design post 5.3.4A is likely to have a material impact on system security (as appropriately defined) the assessment should revert to the normal 5.3.9 process.
- Non-material changes to plant design or power system conditions that occur post 5.3.4A should never hold up the registration process, these changes should be managed/assessed in the post operations phase of the project (perhaps through R2 validation process).
- Where plant design changes and/or GPS compliance assessment is deferred to post operations phase the rules must provide sufficient discipline for generators to meet their GPS compliance obligations post operations.
- Where a post 5.3.4A AEMO assessment determines that generators are required to make changes to their plant, based on a change in power system conditions, the costs of making these changes including opportunity costs, should be compensated, to the extent the incurred costs are material.

## Reform Area 6.2: “Materiality” Definitions (3/5)

### Proposed solutions and recommendations (cont.)

#### Key features of proposed new arrangements

- A new process is proposed to be inserted into the rules, post offer to connect and prior to registration. AEMO’s assessment typically carried out under 2.2.1 (c) (3) would now fall under this new process.
- The process will check for consistency between preliminary data (R0) and the most up to date R1 data.
- A more detailed R1 assessment of GPS compliance will apply in the following circumstances:
  1. Where there has been a change in plant design since the offer to connect was made and this is likely to result in a material adverse impact\* on power system security through the generator’s failure to comply with its GPS; and/or
  2. Where there has been a change in power system conditions since the offer to connect was made and this is likely to result in a material adverse impact on power system security through the generator’s failure to comply with the GPS.
- The assessment timeframe under pre-registration is time limited (e.g., 40 business days).
- A guideline is to be implemented that provides guidance on what constitute the types changes to plant design and network conditions that are likely to cause a material adverse impact (or conversely, the changes that constitute non-material changes). The guideline would also set out AEMO’s general approach to GPS assessment, and the specific modelling and time frames for the assessment.
- If the AEMO assessment determines that the change in plant design is likely to have a material adverse impact on system security (through the CA not being able to comply with its GPS), the CA would revert to the 5.3.9 process. If no such material adverse impact is determined, the CA would be allowed to proceed direct to registration.
- If the AEMO assessment determines that the change in network conditions is likely to mean that the generator will have a material adverse impact on system security (through the CA not being able to comply with its GPS) then AEMO must give

reasons for this determination and set out the changes the generator must implement to ensure its compliance with the GPS. The applicant would revert to the 5.3.9 process. This decision is reviewable.

- As part of this determination AEMO must also determine whether the technical changes it requires to be made must be implemented prior to registration or whether they may be deferred to the post operational phase, and the conditions attached to such deferment (e.g. time frame for completion post operations). By default non-material changes should be deferred to post operations.
- Any deferment of changes to the post operational phase should be incorporated into the assessment of GPS compliance as part of the R2 process (which has a time limit of 3 months ).
- The connection framework should give AEMO the power to defer technical changes and/or GPS compliance to the post operational phase (R2 assessment process). It is not currently clear whether AEMO or NSPs have the power to defer compliance.
- The rules should provide sufficient discipline for generators to complete their GPS compliance assessment post operations (i.e. as part of the R2 assessment). The rules maybe sufficient in this respect. Participants have ongoing obligations to ensure that their plant meets or exceeds the performance standard applicable to their plant under a range of clauses, including Clause 4.15. The NEL appears to provides the AER with the power to take enforcement action if a person is in breach of GPS, including immediately after registration, with Tier 1 and 2 penalties applying.
- Where AEMO determines that changes to generation equipment are required prior to registration, and these changes are unable to be made within the timeframe of the new assessment process (and thus causing delay to registration of the plant) then a cost recovery mechanism should be applied, which includes the recovery of any opportunity cost (lost generator revenues).
- The concept of a material adverse impact should also be applied to clause 5.3.9. When clause 5.3.9 is triggered, it reopens the GPS negotiation process, which creates significant uncertainty for generators. A higher bar should be set for its use.

\* Proposed definition: “Any event, condition or change which materially and adversely affects or could reasonably be expected to materially and adversely affect, power system security”

## Reform Area 6.2: “Materiality” Definitions (4/5)

### Proposed solutions and recommendations (cont.)

#### *Proposed rule changes*

- A new process to be inserted in the registration rules (replacing 2.2.1 (e) (3)), incorporating:
  - Materiality thresholds
  - Time limited assessment
  - Requirement for AEMO to give reasons for its decisions
  - Ability for changes to generator’s equipment or plant to be deferred to post operation, where system security considerations allow for it.
- A new guideline to be developed through AEMC rule change process, which sets out key considerations and approach of the GPS review process and which defines the situations or changes that are likely to lead to a material adverse impact to system security (or alternatively which changes are considered of a non-material nature).
- Amendments to Clause 5.3.9 to ensure that ‘only’ alterations or modifications to plant which are likely to have a material adverse impact on system security should trigger the 5.3.9 process (as a consequence of the generator not being able to meet its GPS).
- Relevant clauses to be reviewed and amended as necessary to confirm AEMO has the power to defer GPS compliance and confirm generators have sufficient incentive to meet post operations GPS compliance
  - Clause S5.2.2 - Applications of Settings
  - Clause 4.15 - Compliance with performance standards
  - Clause 5.7.3 - Tests to demonstrate compliance with connection requirements for generators
  - Clause 5.8.2 - coordination during commissioning
  - Clause 5.8.4 - commissioning program
  - Clause 5.8.5 - Commissioning Tests
- Where generator suffers a material delay to registration due to pre-registration GPS review process (i.e., a requirement to implement technical changes to plant), that both direct costs and opportunity costs are payable (possible a mechanism such as what is available under Clause 3.12.2).



## Reform Area 6.2: “Materiality” Definitions (5/5)

**The most complex elements to get right**

- Establishing and defining the materiality threshold for intervention, that provides a reasonable balance between system security and the commercial interests of participants (in particular the predictability they require).
- Establishing a reasonable time frame obligation for the pre-registration GPS review process.
- Getting the balance right between addressing GPS issues prior to and post registration. The reform may unintentionally provide an increased incentive and pathway for developers to transfer issues and connection risks to generating system owners down the track, when they are not the same party.

**Linkages and dependencies**

Linkages with other CRI initiatives:

- Strong linkages to Batching (Reform Area 3.1).

Linkages with non-CRI initiatives:

- System strength rule change.

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
✓				

**Key questions that remain to be worked through**

- Can we lean on existing frameworks to define materiality rather than creating another? For example, can we refer to the existing Australian Standards for equipment tolerances to define materiality?
- Can we consider a ‘top down’ approach to defining materiality to achieve the desired outcome without the complexity of defining individual parameters.
- Whether and if so what time frame should be attached to the pre-registration GPS review process.
- What amendments, if any, need to be made to the rules to allow for deferment of technical changes and/or GPS compliance assessments to post operations.
- Whether AEMO has the power under the rules to defer its ‘satisfaction’ of GPS compliance to the post commissioning phase?
- We note there are existing obligations for Generators to comply with their GPS under a range of clauses, including 4.15, 5.3.7, 5.8.2. The NEL appears to provides the AER with the power to take enforcement action if a person is in breach of GPS, including post registration, with Tier 1 and 2 penalties applying. Are these sufficient?
- What amendments need to be made to 5.3.9 to ensure only changes to plant design that are likely to lead to material adverse impact on the network should trigger the 5.3.9 process. The principle is that a much higher bar should be set for triggering of this clause.

# Reform Area 6.3

## Review Mechanism

## Reform Area 6.3: Review Mechanism (1/4)

Where it impacts the connection process



### Problem Statement

#### *The problem*

In an environment that involves high levels of **engineering judgement** and resulting consequence at key decision points in the connections process, there needs to be a workable, readily accessible process available for parties (in particular proponents) to have those decisions reviewed.

This includes at points where decisions around ‘materiality’ are made (as per our proposed new process), given the impact this has on a proponent’s pathway through to Registration. For example, where a change made to plant design post-5.3.4A is determined as being ‘material’ and therefore requiring a 5.3.9. process.

Timeliness is a key consideration in creating a workable and readily accessible review mechanism. The existing review mechanisms (see below) are rarely if ever used in the Connection process.

#### *What currently exists*

The NER currently includes two types of dispute resolution process:

1. The Independent Engineer Process (Chapter 5)
2. The Dispute Resolution Process (Chapter 8)

#### *Why the existing mechanisms don’t solve the problem*

We do not consider the two existing dispute resolution processes are ‘readily accessible’. This is evidenced by the fact that - to our knowledge - neither dispute resolution process has been accessed in the past 5 years.

The reluctance to use these processes is substantially due to the additional time that proponents incur by accessing them, but also as proponents rarely want to be seen as ‘legalistic’ (brand).

These mechanisms would remain available, if other efforts were unsuccessful.

### Proposed solutions and recommendations

#### *What happens today?*

As we understand it, contested positions and difficult decisions are often discussed at length between the developer and their advisors, AEMO and the relevant NSP; this process can take some time.

#### *Proposal for consideration*

We propose a new review mechanism:

### Discussions Facilitated by a Connections Expert

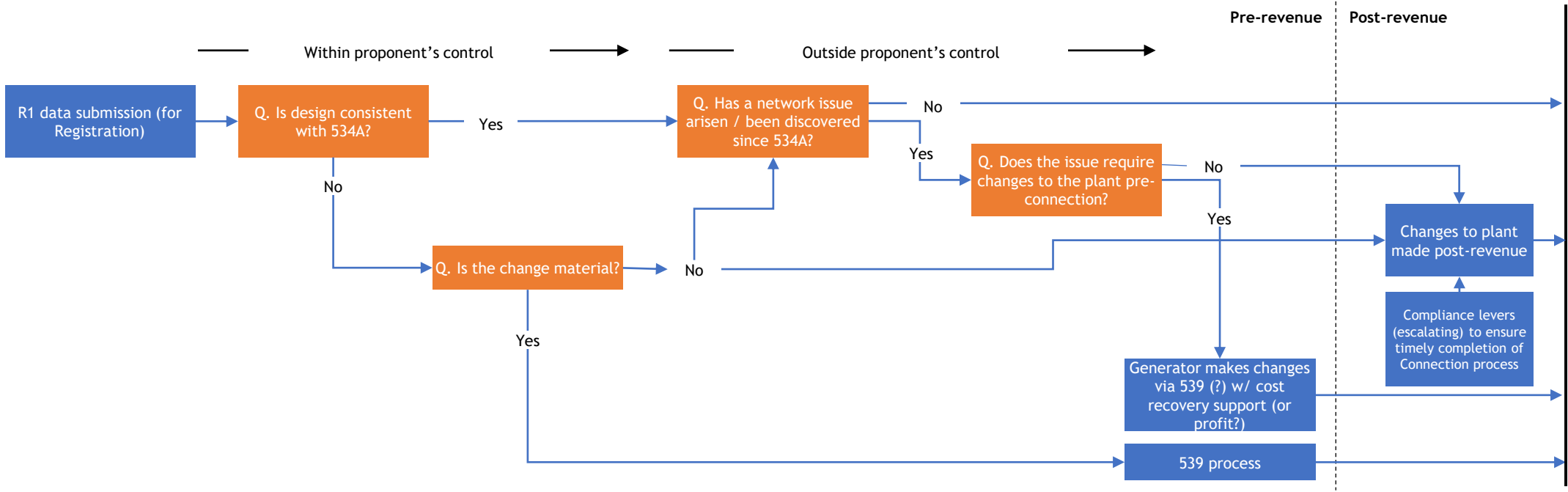
- Can be initiated by the proponent, AEMO or NSP
- An Expert Connections Engineer (Independent Facilitator) must be a person with a strong technical understanding, to help in guiding any discussion.
- Acts as a facilitator to improve the quality of human engagement (collaboration), and guide discussions by asking relevant questions
- Facilitated discussions involve a broader number of people than those who have been involved in that connection matter to date: more people from AEMO, NSP and the developer and their technical advisors. A review to provide opportunity for another set of expert eyes.
- Review the position which has been reached, and provide advice as appropriate.
- Discussions would occur a maximum of 10 working days after a Review is requested. Actions must be agreed, with completion targeted across a maximum of 10 working days.
- To include AEMO stakeholder relationship management.
- The Expert Connections Engineer has no ability to override an AEMO position / decision; but is asked to provide advice which would be visible to all.

*(Cont. over)*

# Reform Area 6.3: Review Mechanism (2/4)

## Proposed solutions and recommendations (cont.)

We propose that the review mechanism is available at distinct decision points in the registration process, in particular those points where questions about ‘materiality’ being posed and the degrees of engineering judgement are highest. These have been highlighted in the high-level flow chart below in orange:



### Reform Area 6.3: Review Mechanism (3/4)

**The most complex elements to get right**

Key points of the new proposed review mechanism:

- The proposed review mechanism is intended to operate on a basis of collaboration and joint problem-solving (i.e. **less formal, less legalistic** than the existing dispute resolution options). The collaborative, co-design and high-communication approach between parties (as exemplified in the Connections Reform Initiative more broadly) is a key principle of the proposed mechanism.
- It is **fast to access**, with the aim to secure a faster resolution. Envisaged that a Facilitated discussion would occur in (say) 2 weeks.
- **No override on AEMO decisions.** This could lead to the new mechanism being accused of being ‘toothless’. The existing NER based mechanisms have decision making powers - no need to duplicate this.

**Linkages and dependencies**

*Linkages and dependencies to other CRI initiatives*

- The key decision points of the new process proposed by Cluster 6, in particular:
  - Switching systems security onus of proof (6.1)
  - “Materiality” definitions (6.2)
- Forums and Initiatives to Drive Collaboration (1.3) could be used as an input into the new Review Mechanism

**The type(s) of change being recommended**

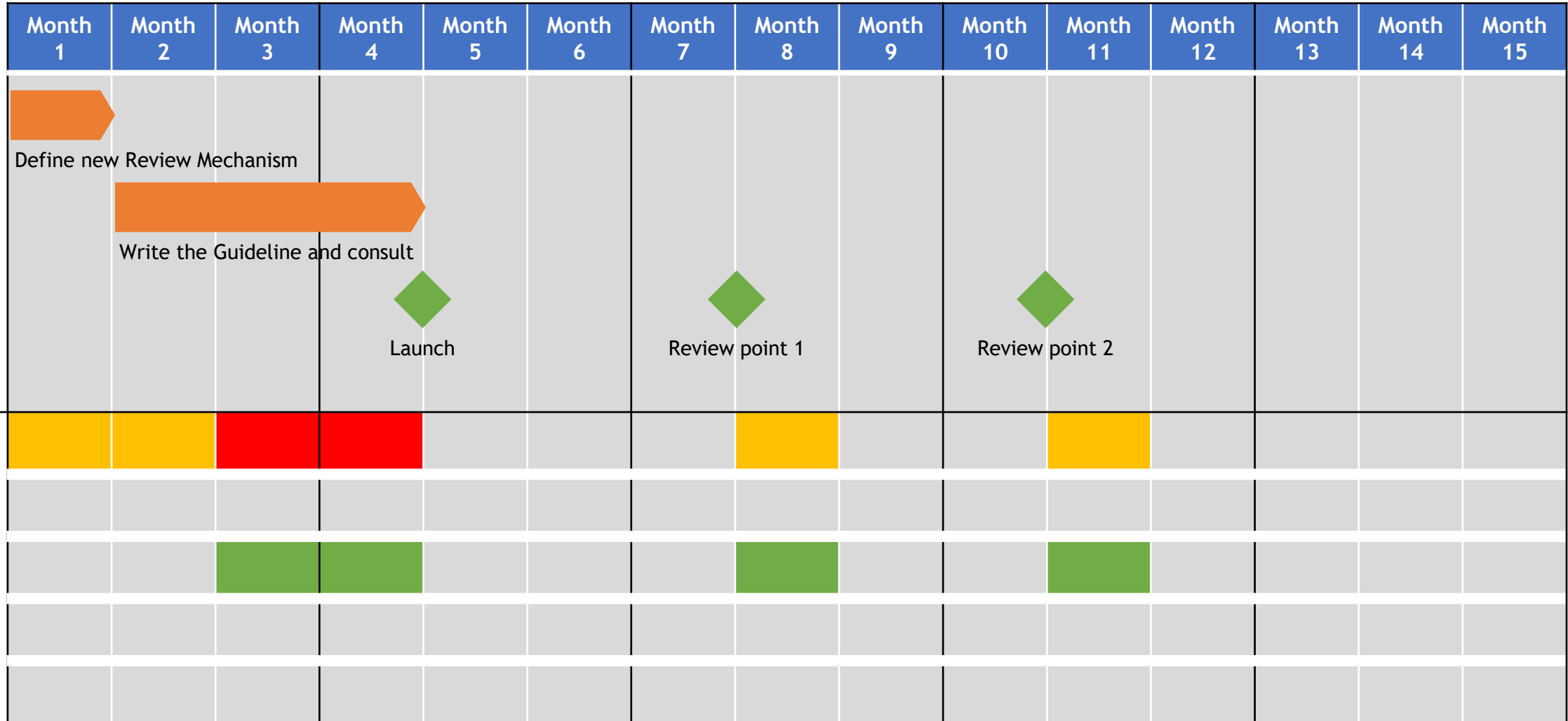
Rule change	Guidelines	Approach	Governance	Information
	✓	✓		

**Key questions that remain to be worked through**

- How do we ensure that the process is not over-used? (Might bog down the connection process.)
- Where should it be codified? (Suggest in a Guideline, not NER)
- At what decision points in the Connection process is it accessible? (Needs to be specific.)
- Would the Expert Connections Engineer be a ‘standing appointment’ (retained)? This would speed access to the process. The expert would also need strong mediation skills.
- How would this be activated? E.g. could it be accessible under an existing agreement to save time.
- How will this add confidence to a time line? E.g. have a deadline for intervention/support.

## Reform Area 6.3: Review Mechanism (4/4)

### Reform Area Plan



## **Reform Area 6.4**

AEMO's escalating compliance and enforcement capabilities  
post-revenue

## Reform Area 6.4: AEMO’s escalating compliance and enforcement capabilities post-revenue (1/2)

Where it impacts the connection process



### Problem Statement

AEMO is unable to approve an application to be registered as a Generator subject to terms or conditions, this applies to R1 GPS capability determinations too. This makes the R1 GPS capability determination process inflexible when issues arise at the R1 assessment phase. Any undertakings made by a proponent to AEMO, to rectify an issue after registration is achieved, that was identified during the R1 assessment process, are unenforceable under the NER. This framework lends itself to an “all or nothing” outcome at the R1 assessment/registration stage.

AEMO formally determines a generating system’s R1 GPS capability as part of determining a person’s application to be registered as a Generator under clause 2.9.2. The determination is made by AEMO’s participant registration committee (PRC). AEMO’s registration approval must be unconditional. Unlike AEMO’s ability to impose term and conditions to specified generating unit classification and aggregation approvals and Generator exemptions under NER chapters 2 and 3.

### Proposed solutions and recommendations

It is proposed that the Generator registration and R1 assessment processes be changed, including the associated Rules.

#### Recommendations:

1. AEMO be allowed under the NER to make a R1 GPS capability determination subject to terms and conditions.
2. the T&Cs are to be limited in application, to the commissioning period (R2 GPS capability).
3. the R1 GPS capability T&C NER provisions are classified as civil penalty provisions.

The **purpose** of this T&Cs mechanism, is to enable AEMO be satisfied of R1 GPS capability when non-material design or plant related issues arise during the R1 assessment, the issue is unresolved, has been determined to not be a proven GPS non-compliance issue and the Connection Applicant satisfies AEMO it can rectify the issue during R2 commissioning.

The **benefit** of the T&Cs mechanism, is it will allow AEMO to be able to register a person as a Generator, whilst managing power system security and quality of supply risks in a more flexible manner and an approach based on risk. The T&Cs mechanism should incentivise the completion of the R2 commissioning process.



## Reform Area 6.4: AEMO’s escalating compliance and enforcement capabilities post-revenue (2/2)

### The most complex elements to get right

- Balancing and limiting AEMO’s T&Cs powers, against introducing a new “AEMO T&Cs” connection risk.
- The AEMC cannot create new civil penalty provisions. However, it may, jointly with the AER, recommend to the ministerial forum of energy ministers that new or existing provisions of the NER be classified as civil penalty provisions.
- An inaccurate model at registration means that the next generator in line can't do their modelling or be assessed either, thereby creating a roadblock for subsequent connections. How can this risk be minimised?

### Linkages and dependencies

Linkages with other CRI initiatives:

- Switching System Security Onus of Proof (Reform Area 6.1)
- “Materiality” Definitions (Reform Area 6.2)

### The type(s) of change being recommended

Rule change	Guidelines	Approach	Governance	Information
✓				

### Key questions that remain to be worked through

- Can existing Rules be better leveraged by AEMO and NSPs, rather than introducing new T&Cs powers during the commissioning phase?
- What are the broader views of NSPs on this reform? (View from one NSP participant within the CRI: Need assurances that issues have a mechanism to be resolved, accurate models will be provided in a timely manner and network power quality can be maintained.)
- Should AEMO be able to place terms and conditions on Generators that extend post commissioning?
- Should AEMO’s ability to enforce terms and conditions just be limited by civil penalty provisions that are enforced by the AER. Alternatively, should AEMO be able to set and enforce T&Cs by commissioning hold points, constraints or disconnection?
- Does AEMO have the heads of power to impose terms and conditions on a Connection Applicant, outside of AEMO’s statutory function to register a persons as a Generator?
- What are the AER’s and AEMC’s views of new NER civil penalty provisions being introduced in relation to R1 GPS capability that are applied during commissioning?

# Reform Area 6.5

Collective Retuning Post Revenue

## Reform Area 6.5: Collective Retuning Post Revenue (1/2)

Where it impacts the connection process



### Problem Statement

Projects have experienced delays in registration and commissioning due to retuning (settings change).

When the NSP undertakes a FIA for a new connection/alteration of a generating system, it will include existing generators and committed projects. The outcome of the assessment may find a need to “retune” existing generators/committed projects.

Similarly, when an NSP looks to meet its new obligations for provision of system strength under the system strength standard, it could include collective retuning of generator responses to reduce the demand for system strength. However, it is not entirely clear whether the existing NER frameworks enable this effectively, or whether more explicit arrangements are required to enable NSPs to utilise this solution to reduce demand for system strength (fault level).

### Proposed solutions and recommendations

#### Current:

NER S5.2.2 allows NSP/AEMO to request settings change (protection and control systems) to comply with the relevant *performance standard* or to maintain or restore an inter-regional or intra-regional *power transfer capability*.

#### Proposed to extend/amend NER S5.2.2 provision to:

- make the changes that can be requested more general - currently only refer to setting changes for protection and control systems;
- include an explicit link to new system strength standard, increasing hosting capacity for new IBR (to manage IBR driven instability), voltage / transient stability, and network capability - all of which would significantly broaden the scope of issues to which the clause could be applied;
- Consider the appropriate cost recovery mechanism and/or forms of payment.

A suggestion here as to what kinds of power system considerations could be included in a collective retuning process is to look at what is currently included in clause 5.2.5 of the NER, which set out the obligations on generators in the connection process, which specify that:

- (d) If in AEMO's reasonable opinion, there is a risk that a *Generator's plant* will:
- (1) adversely affect *network capability, power system security, quality or reliability of supply, inter-regional power transfer capability*;
  - (2) adversely affect the use of a *network* by a *Network User*; or
  - (3) have an *adverse system*

AEMO may request a Generator to provide information of the type described in clause S5.2.4, and following such a request, the *Generator* must provide the information to AEMO and the relevant *Network Service Provider(s)* in accordance with the requirements and circumstances specified in the *Power System Model Guidelines*, the *Power System Design Data Sheet* and the *Power System Setting Data Sheet*.

# Reform Area 6.5: Collective Retuning Post Revenue (2/2)

**The most complex elements to get right**

- Cost recovery
- Forms of payment

The type(s) of change being recommended

Rule change	Guidelines	Approach	Governance	Information
✓				

**Linkages and dependencies:**

- Cluster 3 Batching - to identify the need for collective retuning during the integrated impact assessments.

**Key questions that remain to be worked through**

1) *What is retuning being used to do?*

- to maintain system security?
- to allow an NSP to meet its standards more effectively (such as meeting hosting capacity obligations under the new system strength standard, or the existing power transfer standards that already exist in the NER?)
- to provide more hosting capacity and facilitate more connections?

2) *how often should these retuning processes occur?*

- Can they be done more frequently than 18 months?
- Can it be done when there are a number of new projects seeking to connect in an area, such as during the batching process?

3) *Is it S5.2.2 an effective mechanism? Are NSP/AEMO using S5.2.2 to request changes post revenue?*

4) *Cost recovery - should there be a different cost recovery mechanism?*  
 Currently S5.2.2 - If the Network Service Provider requires a Generator to change a setting within 18 months of a previous request, the Network Service Provider must pay the Generator its reasonable costs of changing the setting and conducting the tests as requested.

5) *What forms of payment are appropriate?*

- if it is being used to enable an NSP to meet its obligations such as utilises collective retuning as a non-network solution, at a lower cost (and therefore earn revenue through capex savings), should the payment be on the basis of commercial negotiation with the affected parties, and come in the form of a network support agreement? Or on the basis of costs only?
- are the costs based on the direct costs of running the modelling / tuning exercises? Or do they capture any opportunity costs associated with foregone energy market revenue if the unit is taken offline to do the retuning?
- if an NSP draws on collective retuning through a NSA to help meet its other standards - such as power transfer obligations under S5.1, does this need to be on a costs basis, or is it a commercial negotiation
- if it helps to facilitate more connections, should the new projects pay?

6) *What are the cost and flow-on impacts on energy consumers (noting though that they are already paying today via RIT-Ts, etc.).*  
 Collective retuning could be another option for AEMO/ NSPs to achieve network outcomes, with the cheapest option being the preferred and ultimately resulting in the lowest cost outcome for consumers.

# Reform Area 6.6

Introducing BESS Behind Existing Generation

# Reform Area 6.6: Introducing BESS Behind Existing Generation (1/2)

Where it impacts the connection process



**Problem Statement**

Many existing wind and solar generators are looking to retrofit BESS behind an existing connection point where there is an existing generating system, or have scope in the original project planning to undertake such a retrofit. Multiple parties benefit from this:

- Benefits accrue to the generator in terms of being able to firm output - potentially reclassify as scheduled, sell firm swap contracts etc.
- However benefits also likely to flow through to the system, through improved hosting capacity, fault current, system strength, VSM / GFI capabilities etc.

There are also likely scale economies associated with using existing connection assets, such as utilising existing substations/cut in works, rather than building new assets for a new CP. These benefits initially accrue to the generator but also contribute to overall customer benefit, through lower wholesale prices.

However, experience of current parties has been that enabling retrofit of a BESS behind an existing connection point has:

- Required reassessment of the existing legacy plant’s GPS. In some instances, this has required building a new PSCAD model as the legacy asset was modelled and connected through PSSE. This is despite the fact that the asset has operated stably for years. Also, it can be expensive and very time consuming to create a whole new PSCAD model for a legacy asset, particularly if the OEM is unwilling/ unable to do so
- This assessment in turn slows down 5.3.4A, commissioning and registration of the new BESS asset
- Potentially, the legacy asset could be required to meet new levels of performance if the NER access standards have changed since it was connected, although this has not been clearly identified as an issue

The time associated with all of these processes can be significant, imposing material delays and costs. It is likely that if the issue can’t be resolved, parties will simply look to connect stand alone batteries through a new CP. This may be a faster process, but will lose the significant scale economies associated with utilising existing connection works. Other issues arise such as difficulty in making most efficient use of power generated behind the connection point, exposure to congestion and loss factors etc.

**Proposed solutions and recommendations**

At this stage, we do not have any detailed proposed solutions, however at a very high level, the solution would aim to somehow ‘cordon off’ the existing legacy plant from having to reopen its GPS, and undertake additional modelling

This would speed up the process of connecting the new asset, and avoid the time / costs of having to build a new PSCAD model from scratch for the legacy asset

A key challenge to overcome here is that the GPS are currently defined at the connection point. This means that as soon as you change the overall characteristics of the generating system behind the connection point (such as by retrofitting a battery), it follows you would need to go through a full 5.3.9 to adjust the overall GPS

So, some potential avenues to explore to avoid this:

- Can we impose an overall restriction on the way that 5.3.9 is interpreted? That is, clarify that 5.3.9 is *only* about the generator demonstrating that it can continue to meet its existing GPS despite a change in equipment, rather than fully ‘opening the GPS up’, and seeing if the asset can get closer to the auto in the most recent version of the access standards? Problem is - even if there is agreement between AEMO and participants that this is the appropriate interpretation of 5.3.9, can this be achieved through use of legacy PSSE models? Or is a new PSCAD model always going to be required for the legacy plant?
- Could the DCA/DNA process be utilised to ‘move’ the CP back into the reticulation of the generating system? IE - so that the CP is now closer to the terminals of the original legacy asset and so wont be affected by the new connecting BESS? Seems unlikely to work, as moving the CP in this way will likely change the way that the plant responds - ie reducing the apparent impedance between terminals and CP will affect reactive current response - which would in itself likely require the GPS to be reassessed
- Could a ‘light touch’ form of 5.3.9 be instituted where the new asset behind the connection point will likely only provide upside, mean that the legacy plant is explicitly not required to update its modelling, or undertake similarly simple/low spec assessment of its ability to continue to meet the legacy GPS?
- If the above aren’t possible, is it possible to institute a faster/simpler process for the connection of a BESS, at a separate connection point?

# Reform Area 6.6: Introducing BESS Behind Existing Generation (2/2)

**The most complex elements to get right**

Its hard to argue against the fact that connection of a battery behind an existing connection point wont change the physical performance of the overall generating system, in terms of the GPS which are assessed at the CP.

So, trying to ‘cordon off’ the BESS from the legacy plant may not be physically possible.

Equally however, it seems unlikely that connection of the BESS will degrade or in any way worsen the overall performance of the system...

...however we need to test this, in terms of the magnitude of the risk associated with control system interactions, or how protection will work in the new hybrid system.

The challenge is therefore to get the balance right between doing the due diligence that is needed to ensure that system security is maintained and that the generating system overall continues to meet its GPS, against making sure you don’t make the whole proposition so uneconomical that it doesn’t go ahead, and not bring on an asset that will likely drive benefit for the whole system.

In terms of the other elements of the cluster 6 work, seems that this is a reasonably discrete piece of work. That is, it applies in reasonably specific cases where a hybrid retrofit occurs. Its also likely to occur well past the revenue commencement stage, which is the main focus of cluster 6.

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
✓	✓			

**Key questions that remain to be worked through**

- How does this any such change interact with the AEMC’s recent Integrating Energy Storage rule change, which actively seeks to remove any reference to assets from the NER? Specifically, how do you make a rule to facilitate hybrid retrofit of a BESS behind an existing CP, when the NER don’t refer to BESS?
- Does any such process here apply to retrofitting other equipment behind an existing CP? What if you have a CP with a 15 year old wind farm and want to switch out an old cap bank / statcom etc. for new ones with greater capability? Is it possible to ‘cordon off’ any elements of the existing legacy asset GPS that relate only to the legacy wind farm in this case, where the new equipment is demonstrably likely to deliver a clear system benefit?
- Does this arrangement apply where you are looking to swap out old turbines for new ones? i.e. - type 3 for type 4?
- Does this arrangement apply where you are looking to connect a new stage of an existing generating system through the same CP?
- Does this arrangement apply where you are adding a new type of generating unit to an existing CP - such as adding a solar PV array behind an existing CP with an operating wind farm?

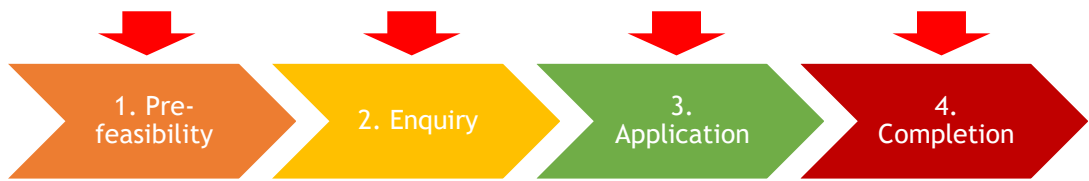
# Reform Area 6.7

Defined Process to Introduce Changes to AEMO Guidelines



# Reform Area 6.7: Defined Process to Introduce Changes to AEMO Guidelines (1/5)

Where it impacts the connection process



**Problem Statement**

The National Electricity Rules (NER) describe the process and requirements for a generator seeking grid connection in Chapter 5, and changing the NER has a well established and understood process.

In addition to the NER, there are a number of guidelines, templates and checklists developed and owned by AEMO which define the process and requirements of connection in detail.

Some of these documents have the potential to significantly impact generators across the whole project scope from technical design to contract design. Therefore, it is important that any material revisions or updates to these documents undergo a well understood engagement process which ensures broad awareness of any changes and takes into account the views of key stakeholders.

At this point there is no defined engagement requirement when updates or changes are made to some of these documents.

In addition, the timing of implementation of changes requires consideration, where they could materially change expectations for projects mid way through the connections and registration process.

**Proposed solutions and recommendations**

There should be a consistent and fit-for-purpose approach to collaborating, engaging and communicating with the energy industry on new documents, or changes/updates to documents currently published on the AEMO Network Connections webpages. These documents include guidelines, templates and checklists.

A suggested approach must take into account:

- The materiality of the document
- The materiality of the change

The goal is to make it easier for stakeholders to understand when changes or updates are happening, and how to get involved and put forward their thoughts on the change or update.

The proposed categorisation of documents is shown over.

### Proposed solutions and recommendations (cont.)

#### Proposed categorisation of documents:

#### Rules consultation procedures

- System Strength Impact Assessment Guidelines
- Power System Design and Setting Datasheets
- Guideline and Template for preparation of a Releasable User Guide
- Power System Model Guidelines

#### Material documents

- AEMO Template Generator Performance Standards
- Guidelines for Assessment of Generator Proposed Performance Standards
- Clarification of S5.2.5 Technical Requirements
- Dynamic Model Acceptance Test (DMAT) Guideline
- Generator Connection Application Checklist
- Generator Connection R1 Submission Checklist
- Generating System Test Plan Template for conventional synchronous generation
- Generating System Test Plan Template for Non-synchronous generation
- Commissioning Requirements for Generating Systems
- R2 Testing Guideline
- Turbine Governor Testing and Model Validation Guideline
- Communication system failure guidelines
- Guidance Note - Network Conditions and Requirements for Generator Commissioning

#### Administrative documents

- NSP Connection process diagram
- Generation Alterations in the NEM except for Victorian process map

## Reform Area 6.7: Defined Process to Introduce Changes to AEMO Guidelines (3/5)

### Proposed solutions and recommendations (cont.)

*Suggested process for a new document or a material change to a material document:*

#### Identify or request the change

- Consider who the key stakeholders are.
- Describe the issue/reason or proposal for a change in a notice to all participants.
- Set out an initial consultation plan.

#### Publish the notice and invite submissions

- The notice on the website should contain info on how to make a submission.
- Put it in AEMO Communications newsletter.
- Hold one or more stakeholder workshops, forums, and/or invite written views on the issues and impacts, as well as urgency where relevant.
- Feedback will determine approach and timeframes - review or confirm consultation plan.

#### Draft document and/or stakeholder workshop

- After considering feedback, AEMO to publish either draft or final document with reasons for decisions.
- For a draft stage, invite written submissions on the draft document.
- The submission period must be at least 10 business days.
- If major new issues or significant differing views, host a further stakeholder workshop with open discussion of key issues.

#### Final document

- The final document must be accompanied by a summary of any material issues raised in submissions and AEMO's response.
- The final document will be notified in AEMO Communications and possibly other newsletters.

*Suggested process for administrative changes or updates:*

#### Notification

- AEMO to prepare updated document and publish it, ideally in advance of changes becoming effective.
- Identify the changes made and the effective date.
- Put a link to the updated document and describe the update in AEMO Communications newsletter.
- Provide an email address for comments or questions.

#### Review

- AEMO considers any feedback received and goes back to notification stage if it concludes the changes should be deferred or reviewed.
- Changes come into effect unless otherwise notified.

Important note: The nature of the notices, documents, papers published will be able to flex. For example, sometimes two or three steps could be combined into one document depending on the material issue being consulted upon and the method of consultation (e.g. workshops v written documents). It is noted that there is a pending rule change proposal to make consultation under the NER8.9 more flexible, so that only one formal (and longer) publication/submissions stage is mandated in the rules and other steps will be determined for each consultation so they are fit for purpose. As this slide is talking about material issues, this is an example of where additional steps could produce better outcomes as per best practice consultation.

## Reform Area 6.7: Defined Process to Introduce Changes to AEMO Guidelines (4/5)

**The most complex elements to get right**

The key issues for consideration will be:

1. *The tension between guideline certainty and the evolving physical system*
  - If it is possible to freeze a set of guidelines and documents for a project upon commencement of the connections process, this will enhance project certainty.
  - Given the rate of change in the system, there is a non-trivial chance that updates and revisions will be made while the project is going through the process. Once registered and commissioned, there may be situations in which the project can or should change its configuration to meet those new requirements.
  - Deciding how and when to achieve this will be a complex element to get right.
2. *Balancing effort and enhanced outcomes*
  - Engaging on too many types of change to too many connections documents would clearly be an enormous investment of resources that may or may not result in better outcomes.
  - It will be complex but important to write the engagement process to ensure that we engage enough but not too much.

**The type(s) of change being recommended**

Rule change	Guidelines	Approach	Governance	Information
	✓			

**Key questions that remain to be worked through**

- How is a review or update triggered?
- Should required reviews and updates be made when issues arise or on a regular and predictable timetable?
- How should documents be correctly categorised as ‘material’ or requiring an established engagement process or ‘administrative’ and not requiring a process?
- Do the proposed process flows strike the right balance between collaboration and transparency and adding an administrative burden to very busy teams?
- Can the set of guidelines that apply to a project be ‘frozen’ while the project goes through the process? And if so how and when can any relevant updates made since the project commenced the process be retrospectively applied?

# Reform Area 6.7: Defined Process to Introduce Changes to AEMO Guidelines (5/5)

## Reform Area Plan

**KEY:**

[Step] [Milestone]

High resource intensity  
Medium resource intensity  
Low resource intensity

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15
	Define the engagement process			Revise to a final process via further workshops or written submissions			Implementation								
		Workshop	First draft			Agree process									
Resource intensity:	AEMO														
	CEC														
	Developers / consultants														
	NSPs														
	OEMs														



# Contact

AEMO: [stakeholderrelations@aemo.com.au](mailto:stakeholderrelations@aemo.com.au)

CEC: [cri@cleanenergycouncil.org.au](mailto:cri@cleanenergycouncil.org.au)

CRI Independent Facilitator

Neil Gibbs

E: [neil@onlinepower.com.au](mailto:neil@onlinepower.com.au)

M: +61 432 755 455 | S: neil-gibbs