A structured approach towards 100% renewables

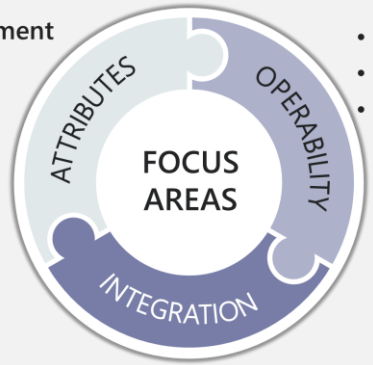
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

The Engineering Framework

Current knowledge and work

(March 2021)

- Frequency Management
- System Restoration
- System Strength
- Voltage Control
- Resource Adequacy



- System Analysis
- Control Room and Support
- Resilience

- Distributed Energy Resources
- Performance Standards

Potential gaps and actions

(December 2021)

Operational Conditions Summary (July 2021)

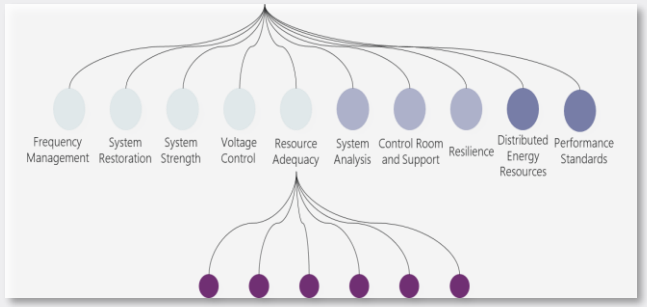
1	Fewer synchronous generators online
2	Ubiquitous rooftop solar
3	Extensive grid-scale VRE
4	Structural demand shifts
5	Responsive demand
6	Widespread energy storage

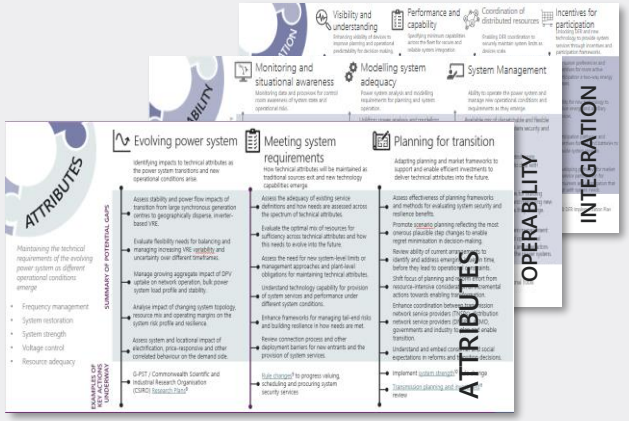
Elements of the Initial Roadmap

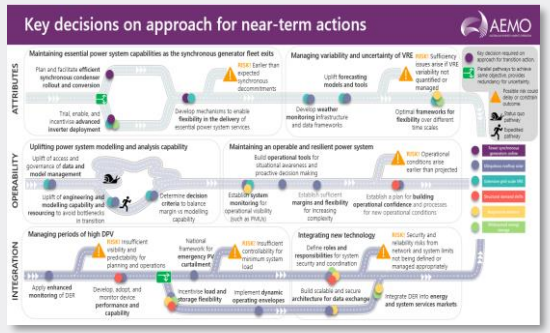
300+ individual potential gaps

Summaries of potential gaps

Key decisions on approach







Key decisions – attributes

ATTRIBUTES

Maintaining the technical requirements of the evolving power system as different operational conditions emerge

Maintaining essential power system capabilities as the synchronous generator fleet exits

Plan and facilitate efficient synchronous condenser rollout and conversion

Trial, enable, and incentivise advanced inverter deployment

Develop mechanisms to enable flexibility in the delivery **of essential power system services**

RISK! **Earlier than expected synchronous decommitments**

Managing variability and uncertainty of VRE

Uplift forecasting models and tools

Develop weather monitoring infrastructure and data frameworks

Optimal frameworks for flexibility **over different time scales**

RISK! **Insufficient flexibility to balance VRE variability**

Operational Conditions

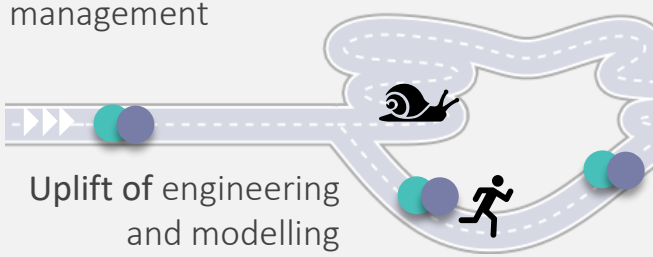
Key decisions – operability

OPERABILITY

System analysis, operational tools and practices to support and enable increasingly complex power system operation

Uplifting power system modelling and analysis capability

Uplift of access and governance of data and model management



Uplift of engineering and modelling capability and resourcing to avoid bottlenecks in transition

Determine decision criteria to balance margin vs modelling capability

Maintaining an operable and resilient power system

Build operational tools for situational awareness and proactive decision making

Establish system monitoring for operational visibility (such as PMUs)

Establish sufficient margins and flexibility for increasing complexity

RISK! Operational conditions arise earlier than projected

Establish a plan for building operational confidence and processes for new operational conditions

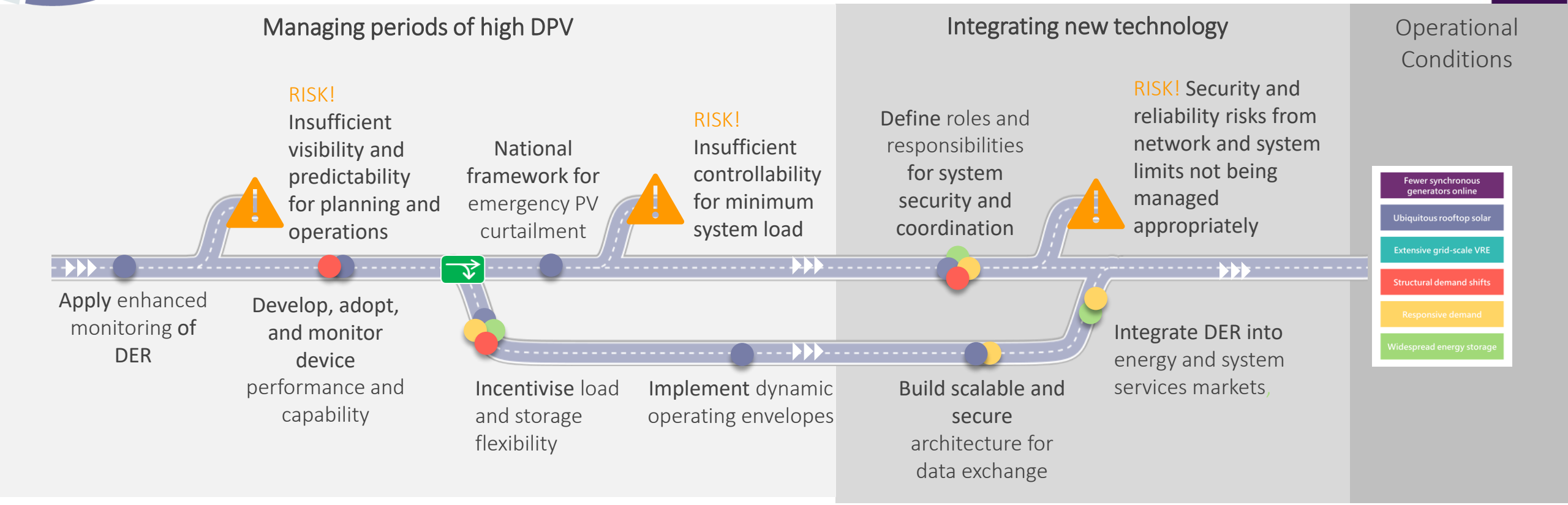
Operational Conditions

- Fewer synchronous generators online
- Ubiquitous rooftop solar
- Extensive grid-scale VRE
- Structural demand shifts
- Responsive demand
- Widespread energy storage

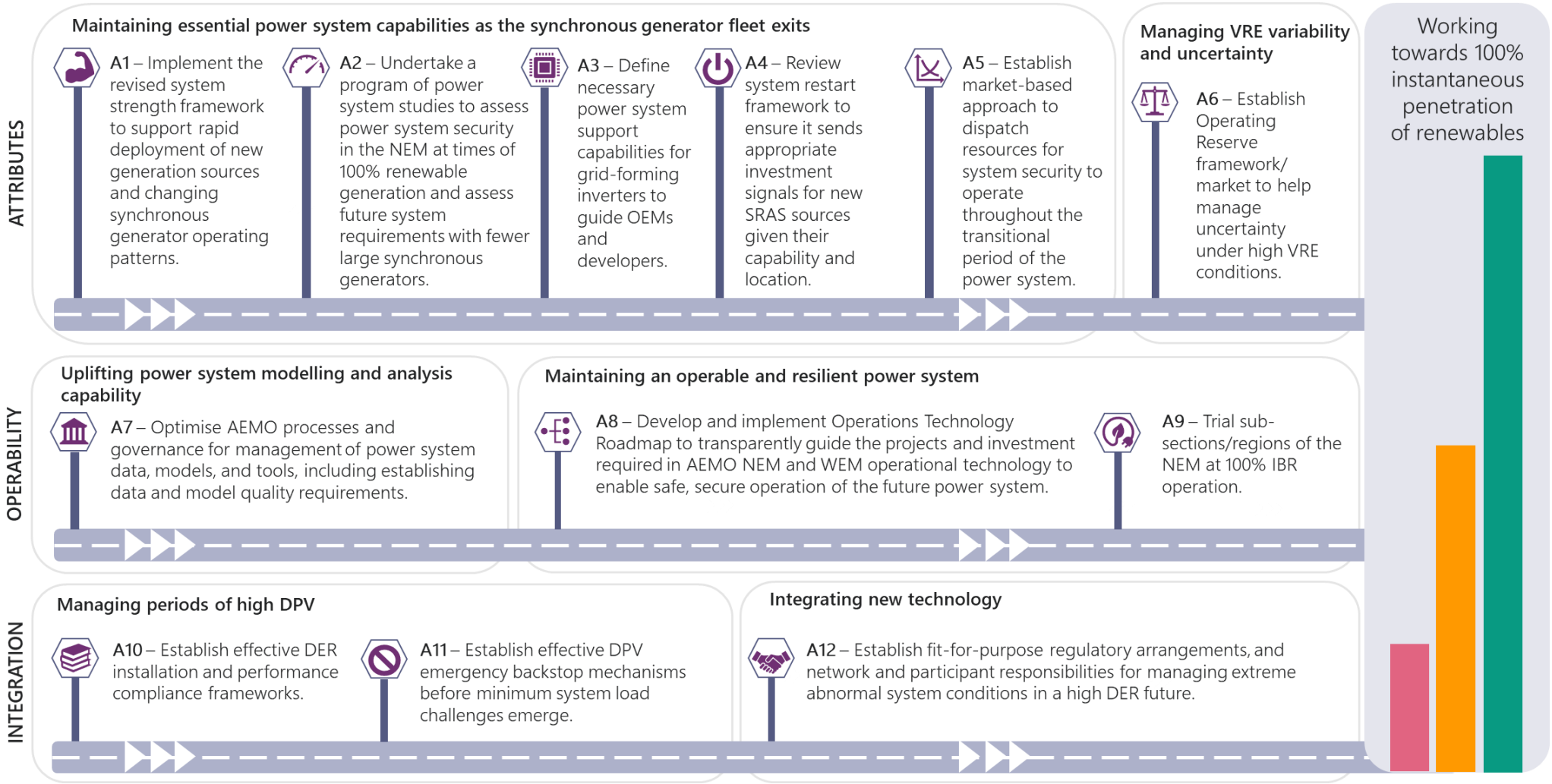
Key decisions – integration

INTEGRATION

Optimally deploying and incentivising new and existing technologies, both grid-scale and distributed, within the power system and market



Priorities to support 100% instantaneous penetrations of renewables



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