

South Australian Energy Transformation regulatory investment test (RIT-T)

Public Forum

Forum outline

Item	Lead
Opening and welcome	Shaun Spinks (facilitator)
Chief Executive introduction	Steve Masters
Drivers and identified need	Rainer Korte
Exploring options	Hugo Klingenberg
Assessing market benefits	Brad Harrison
Recap on information shared	Rainer Korte
Discussion at tables	Shaun Spinks
Questions from the floor	Shaun Spinks
Next steps	Rainer Korte
Close	Shaun Spinks

8 December 2016

Chief Executive introduction

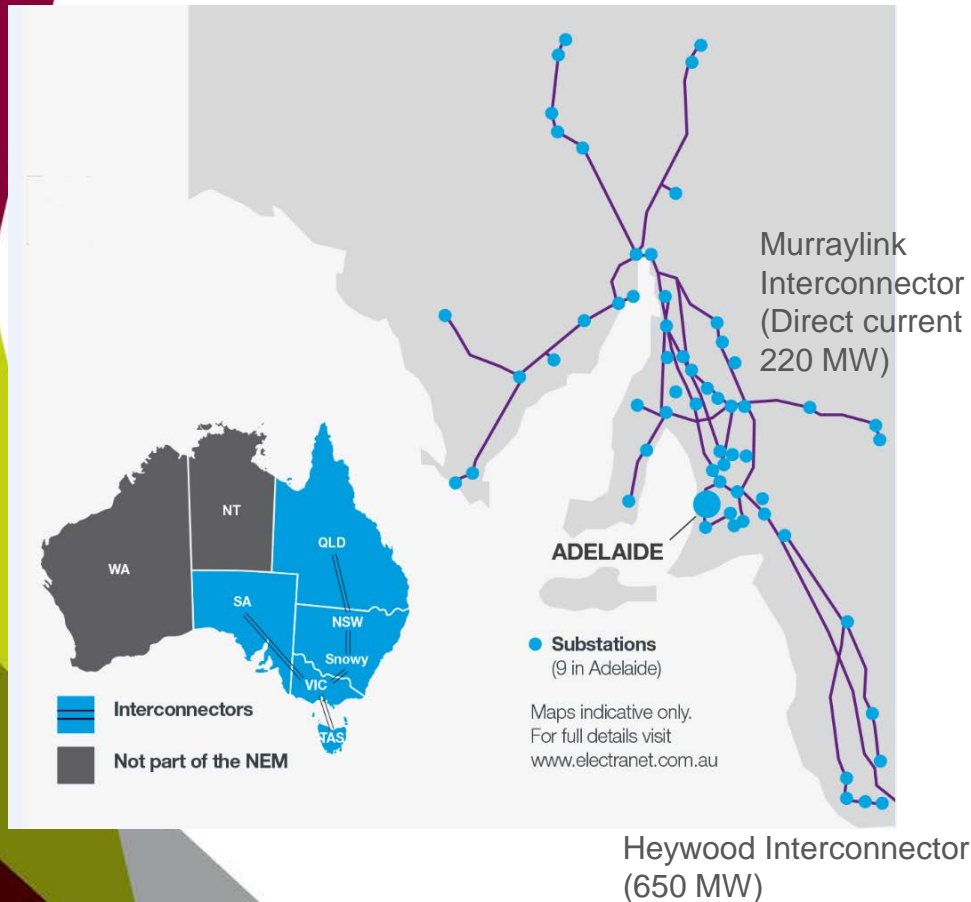
Steve Masters
Chief Executive

Drivers and identified need

Rainer Korte
Executive Manager Asset Management

South Australian context

SA is at the forefront of experiencing energy transformation



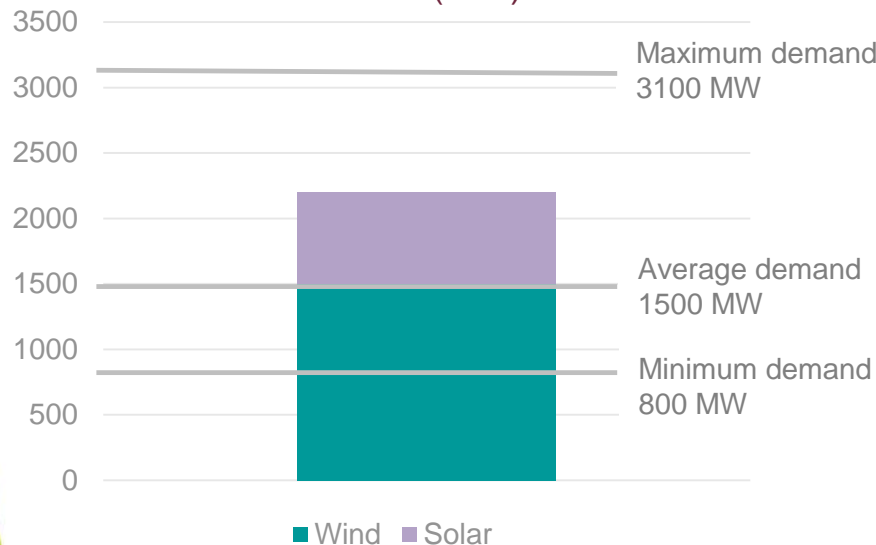
- > Leading integration of renewable energy with abundant high quality resources
- > Closure of coal fired power stations
- > Reliance on gas generation and impact of higher gas prices
- > Higher wholesale electricity market and futures prices in SA
- > Recent SA separation events leading to heightened concerns about power system security
- > SA Government and AEMO have introduced new measures to manage power system security
- > Ongoing policy drivers to lower carbon emissions and new technology are driving energy transformation

NEM – National Electricity Market; AEMO – Australian Energy Market Operator

Renewable energy integration

New challenges are emerging from the combination of high levels of intermittent generation and a relatively isolated and weakly interconnected system

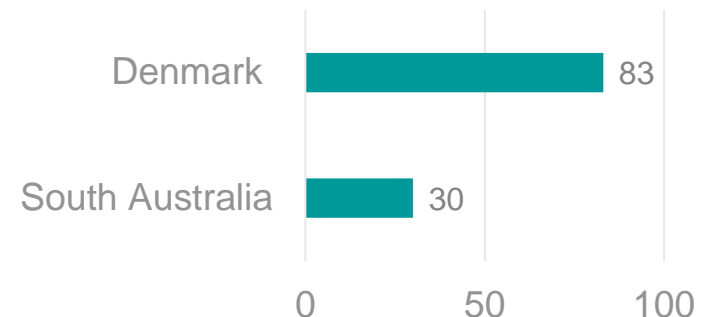
Intermittent generation capacity relative to demand (MW)



Wind plus solar generation capacity is...

- 145% of average demand
- 275% of minimum demand

Interconnector import capacity relative to peak demand (%)

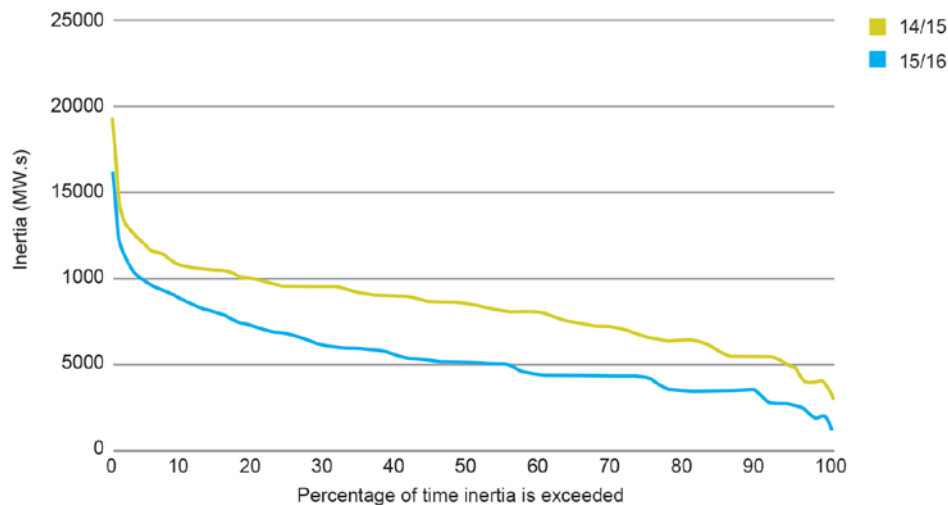


International experience shows that stronger interconnection is needed to support increasingly high levels of intermittent generation and to support energy transformation

System security

New measures are required to manage emerging system security challenges

Changes in South Australian system inertia



Source: AEMO

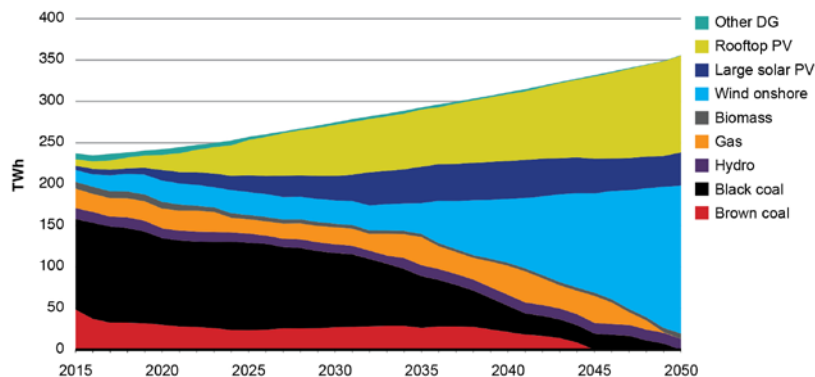
AEMC – Australian Energy Market Commission

- > In August, AEMO reported growing SA exposure to high rate of change of frequency (RoCoF)
- > On 12 October, the SA Government introduced a 3 Hz/s RoCoF limit to protect against the non-credible loss of the Heywood Interconnector
 - the resulting Heywood Interconnector limit has bound about 20% of the time
- > On 2 December, AEMO introduced a new system strength measure for SA
- > AEMC Future Power System Security work program is underway, including a number of Rule change proposals

Looking to the future

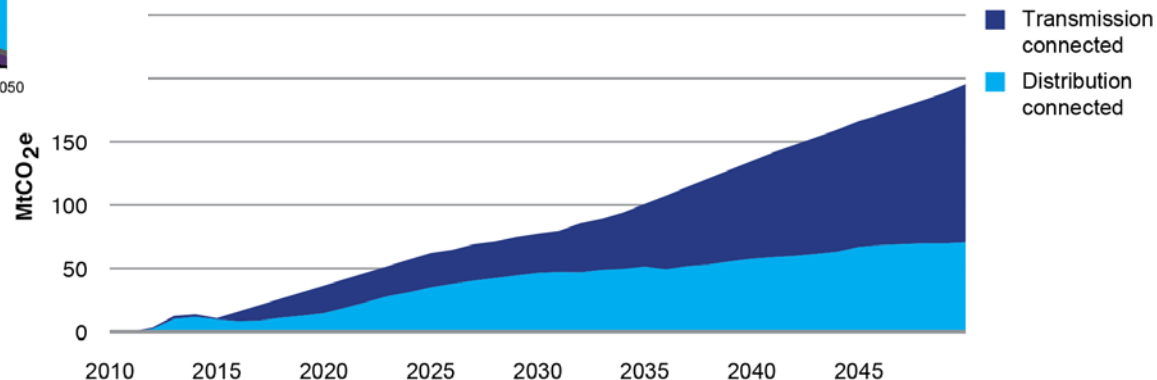
A strong, reliable and more interconnected transmission network will be more important than ever

Plausible projection of Australia's changing generation mix to 2050



Large scale renewable energy will play a significant role in the changing generation mix and coal will continue to be a significant energy source for 20+ years

Quantity of electricity sector abatement by network sector



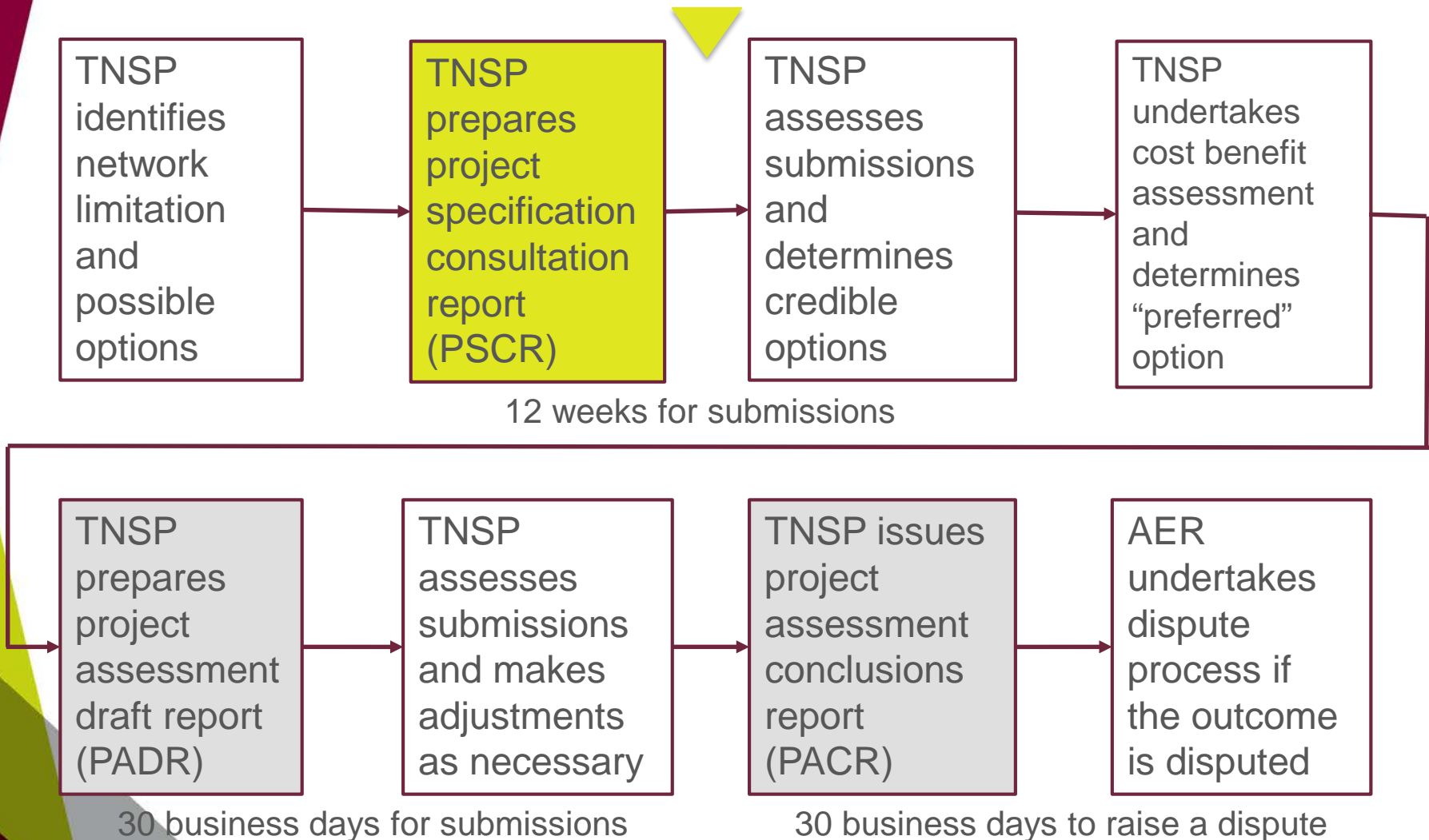
Source: CSIRO and Energy Networks Australia, Electricity Transformation Roadmap: Key Concepts Report, December 2016

Identified need for RIT-T study

- > **Improve wholesale market competition** in South Australia and deliver positive price impacts for customers
- > **Improve system security** by reducing the risk of widespread loss of supply when South Australia becomes islanded from the NEM (through loss of the Heywood Interconnector)
- > Provide access to a more diverse range of supply sources, allowing greater **sharing of reserves across regions** and **improving fuel and supply security** for South Australia
- > Open up access to more renewable generation to **help Australia meet its renewable energy targets**

RIT-T process

We are here



TNSP = Transmission Network Service Provider

Next steps

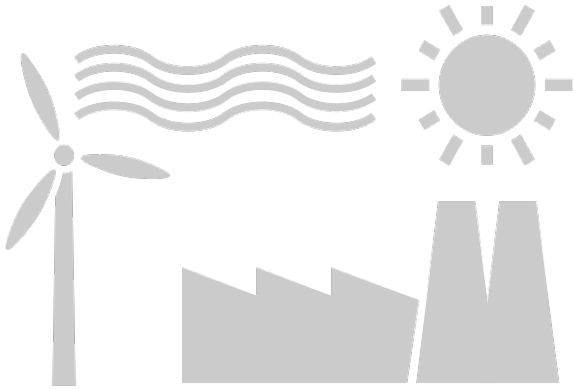
ElectraNet is committed to running an open and transparent process to find the best options to support South Australia's energy transformation

Milestone	Timing
Project Specification Consultation Report (PSCR) published	7 Nov 2016
Public forum	8 Dec 2016
Market Modelling Assumptions Report published for consultation	Week commencing 19 Dec 2016
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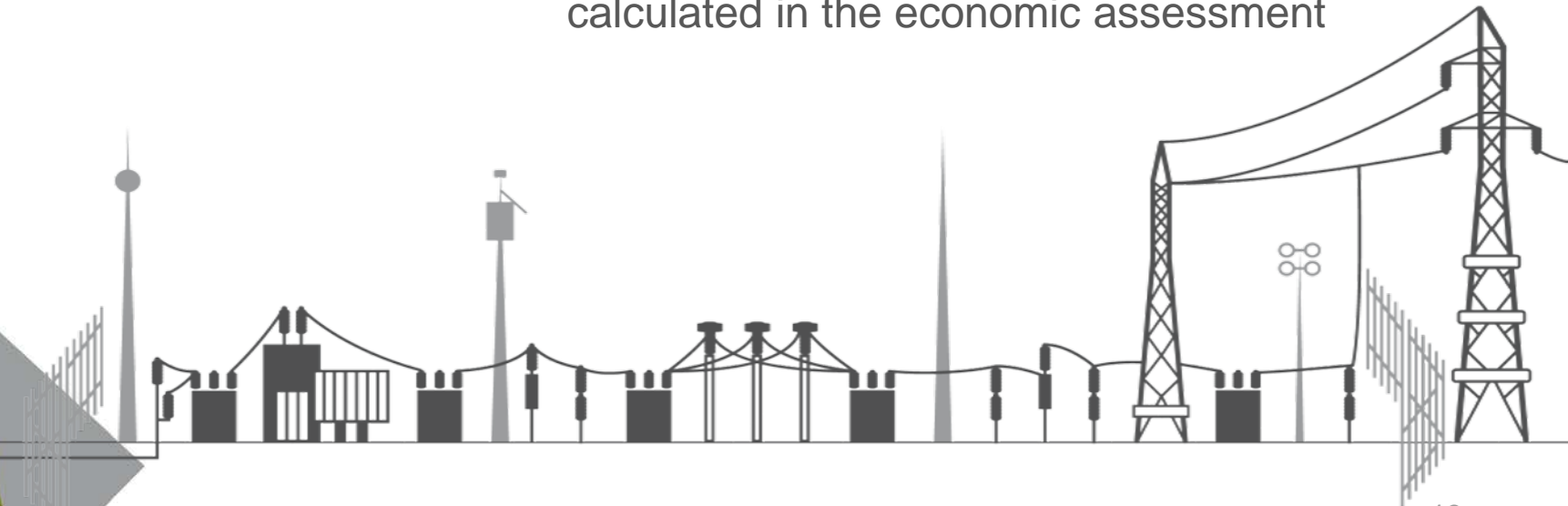
Exploring options

Hugo Klingenberg
Senior Manager Network Development

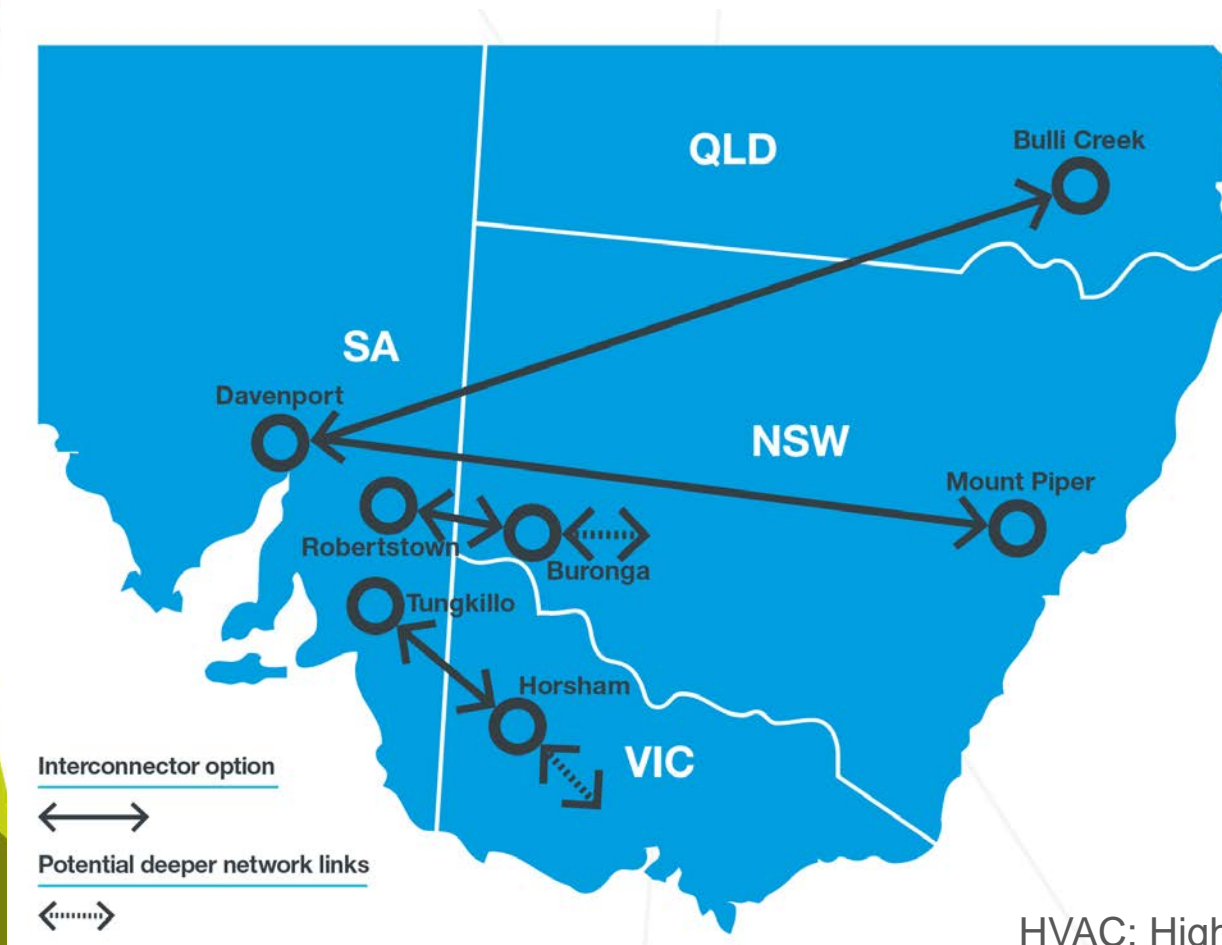
Network and non-network options



- > Both network and non-network options will be explored during the technical and economic assessment
- > We will make use of industry expertise to help refine the non-network options
- > Net benefits for all options will be calculated in the economic assessment



Credible interconnector options



- > Both HVAC and HVDC options will be considered
- > Additional capacity from 300 to 2,000 MW
- > Indicative costs of \$500m to \$2,500m
- > Non-network options will be considered

HVAC: High voltage alternating current

HVDC: High voltage direct current

Credible interconnector options

Option	Length (km)	Indicative Capex (\$m)	Notional Increase in capacity (MW both ways)	Estimated construction time (years)	Potential energisation
Central SA to Victoria (Tungkillo to Horsham, and beyond)	350 - 600	500 - 1,000	300 - 650	1-2	2021
Mid north SA to NSW (Robertstown to Buronga, and beyond)	350 - 800	500 - 1,500	300 - 1,200	1-2	2021
Northern SA to NSW (Davenport to Mt Piper)	1,100 - 1,300	1,500 - 2,000	1,000 - 2,000	2-3	2022
Northern SA to Queensland (Davenport to Bulli Creek)	1,450 - 1,600	2,000 - 2,500	1,000 - 2,000	2-3	2022

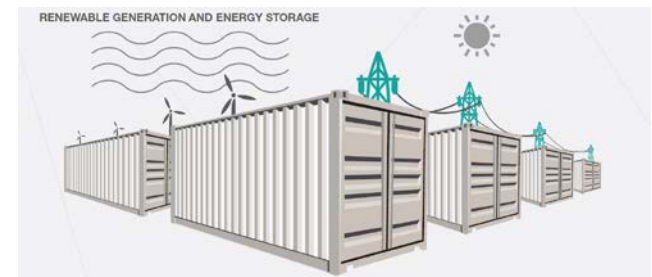
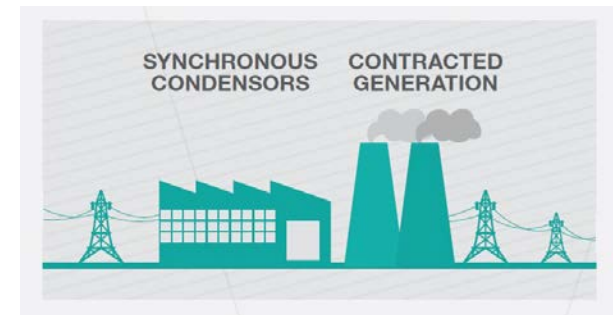
Special Protection Scheme

A Special Protection Scheme (SPS) is required to support both network and non-network options

- > SPS is required to manage a non-credible trip of existing or new interconnectors
- > SPS will involve rapid disconnection of load or generation to maintain a stable power system, following a major system disturbance
- > Additional control equipment may need to be installed at multiple locations across the system

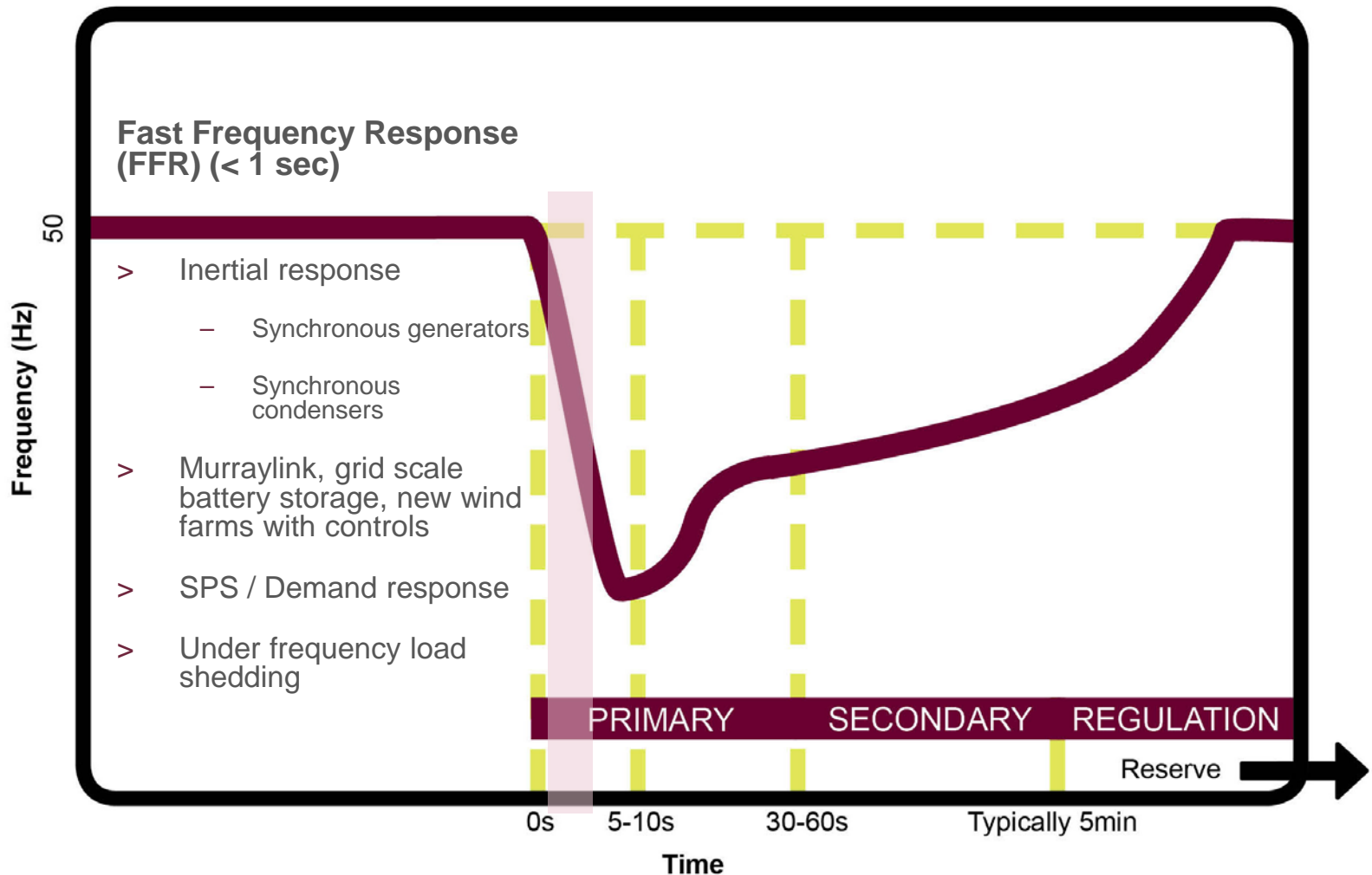
Exploring non-network options

- > Non-network options can provide system security benefits...
 - Fast frequency response
 - Management of extreme power system conditions
 - System strength
- > These are high priority challenges for energy transformation in South Australia
- > Non-network options may also be able to provide other market benefits



Fast frequency response

A number of existing and new technologies can provide this service



Examples of non-network solutions

Indicative requirements to manage a SA separation event

Potential combination of non-network options	Interconnector event (650MW supply – demand imbalance)	Generation and interconnector event (1100MW supply – demand imbalance)
Synchronous generation (Providing inertia, system strength, dynamic reactive support and spinning reserves)	400 MW / 2000 MWs	600 MW / 3000 MWs
Synchronous condensers (Providing inertia, system strength and dynamic reactive support)	2000 MWs	3000 MWs
Murraylink, grid scale batteries, new wind farms with controls (Providing FFR, dynamic reactive support and some spinning reserves)	100-200 MW	200-300 MW
SPS / demand response (Providing FFR and assisting frequency recovery)	100-300 MW	200-400 MW
Under frequency load shedding (Assisting frequency recovery)	200-300 MW	300-500 MW

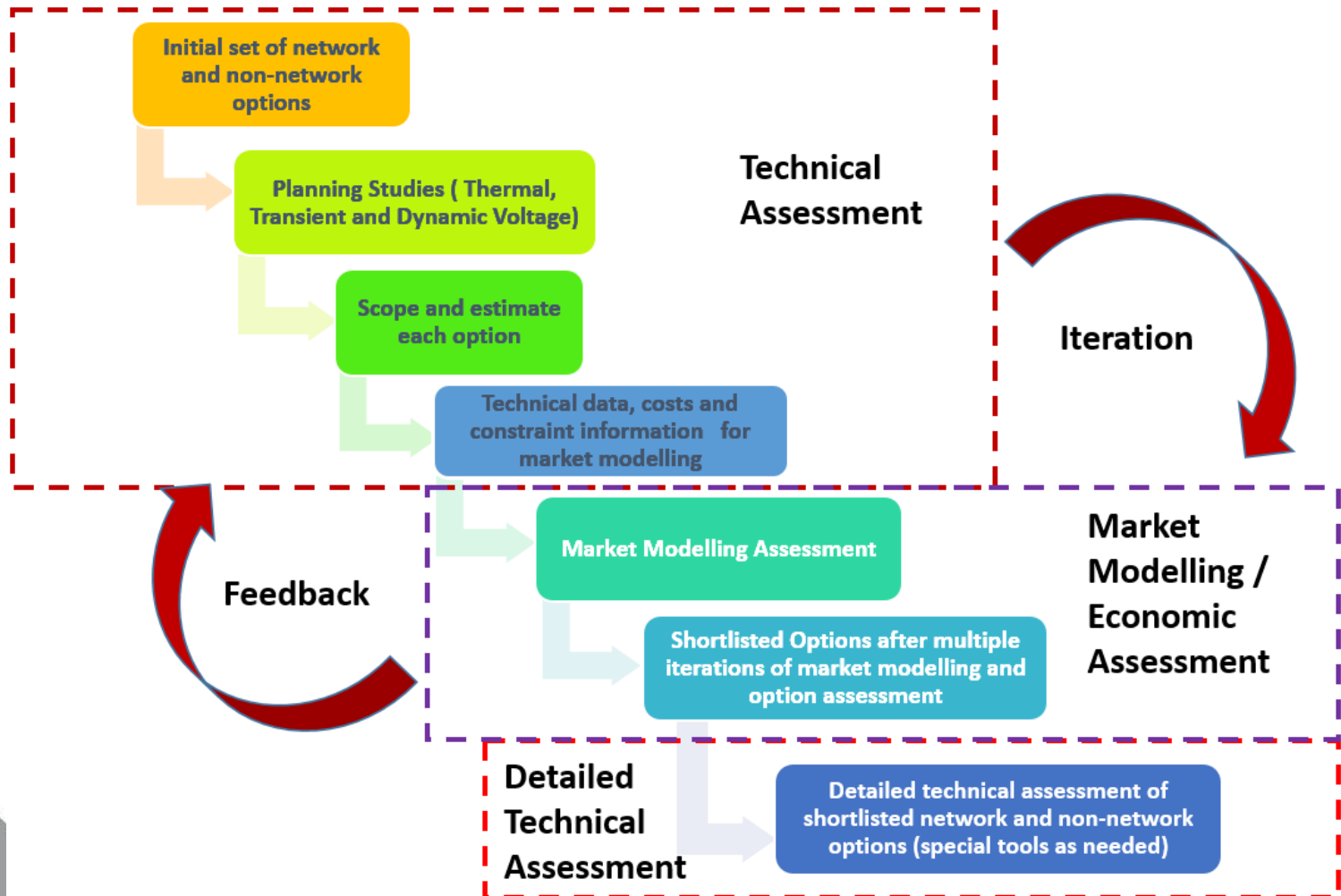
Hybrid network and non-network solutions

- > Combinations of network and non-network options will be assessed to ensure appropriate staging of solutions and optimal outcomes
- > The merits of non-network options will be specifically assessed either on their own or in combination with other non-network or network options

ElectraNet is interested to hear about any non-network options that meet technical requirements and can make a **material** contribution to the identified need

Assessment methodology

An iterative process to test and refine options



Assessing market benefits

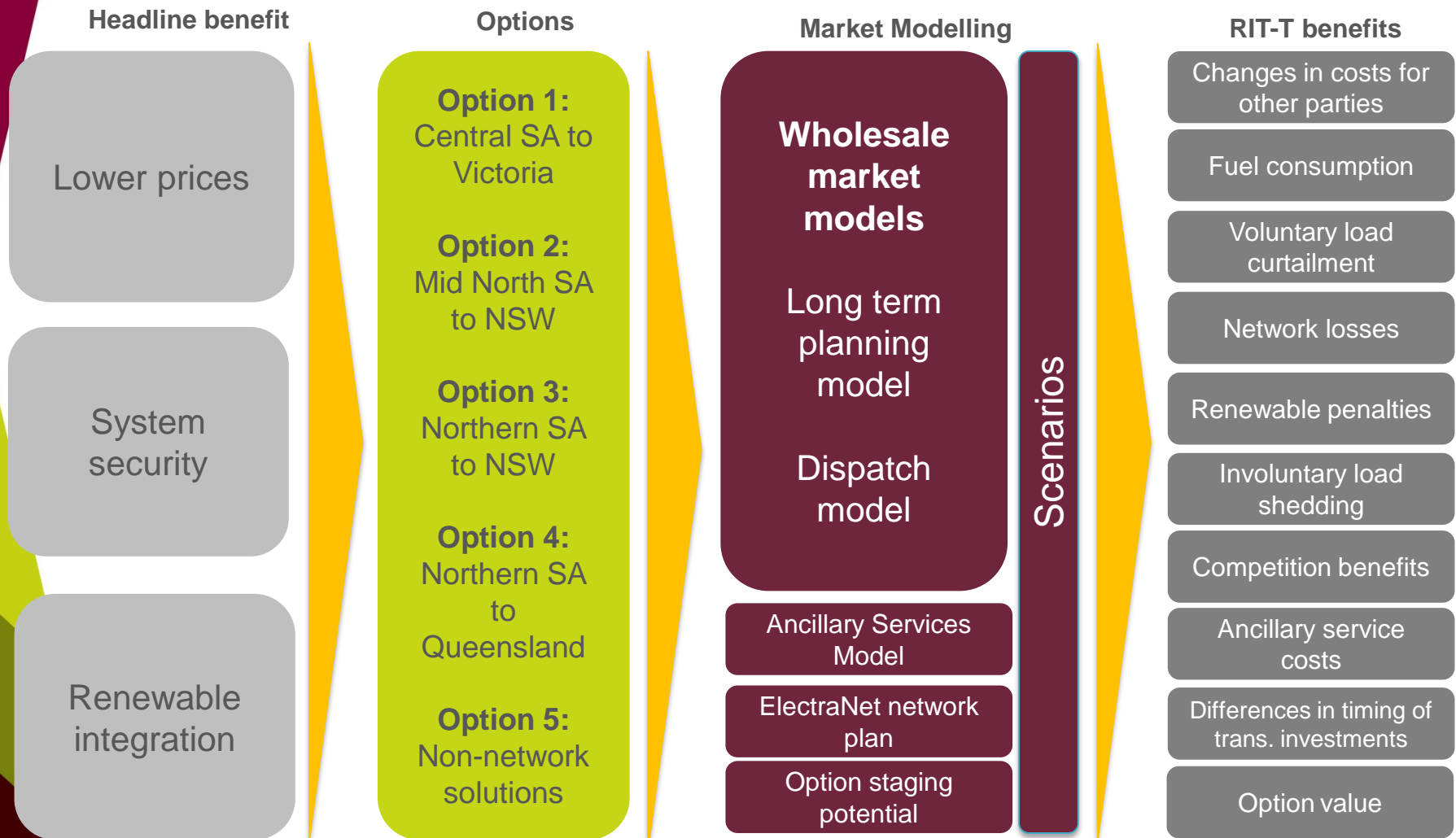
Approach and assumptions

Brad Harrison
Principal Market Analyst

Outline

- > Headline benefits
- > A phased approach
- > Market modelling assumptions report

Headline benefits and RIT-T benefit categories



Phases of analysis

A phased approach ensures we focus our efforts on investigating the options that are more likely to deliver the largest benefits

Phase 1: First-pass assessment

Assessment of representative list of options against an envelope of scenarios and major benefits to identify a short list of options

Phase 2: Detailed assessment of short list of options

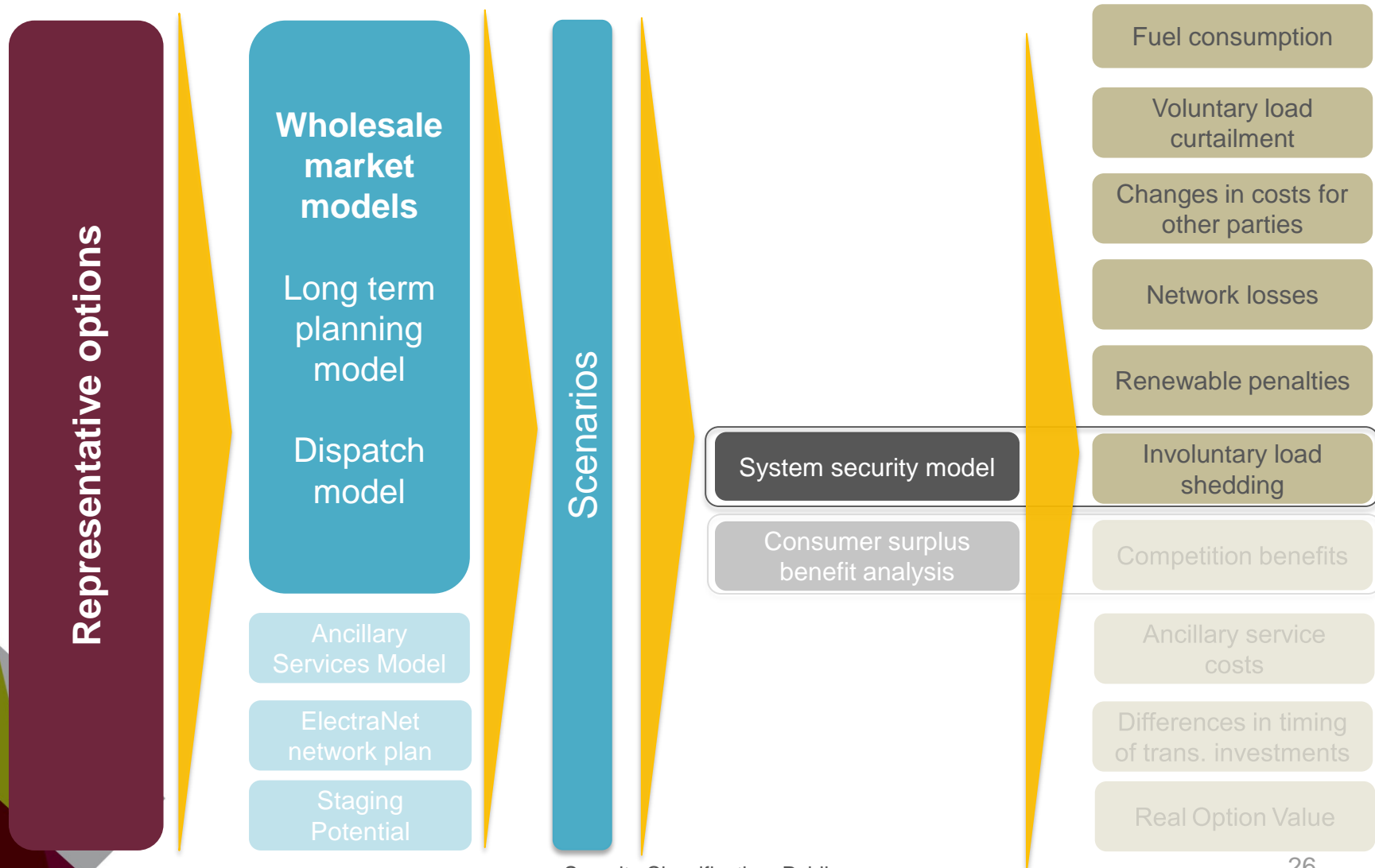
Refinement of shortlisted options (complementary projects) and assessment against a detailed range of scenarios and all benefits assessed

Phase 3: Verification

Targeted analysis to verify whether further refinement of options materially alters earlier Phase 1 assessment

Phase 1: Modelling major benefits

Testing which benefits are most likely to be material



Phase 1: Proposed envelope of scenarios

Do you agree with the proposed first-pass scenarios and key variables expected to have the greatest impact on outcomes?

Variable	High scenario	Central scenario	Low scenario
Gas prices	High gas price	Medium gas price	Low gas price
Electricity demand (including impact from Distributed Energy Resources)	AEMO NEFR High + potential South Australian spot load development	AEMO NEFR Medium	AEMO NEFR Low
Emissions policies	45% abatement from 2005 NEM emissions by 2030 – 100% by 2050	28% abatement from 2005 NEM emissions by 2030 then constant	Renewable Energy Target
Costs of new entrant generators	High costs	Base case costs	Low costs
VCR value – major system disruption	High VCR estimate	Moderate VCR estimate	Low VCR estimate
Length of non-credible supply disruption	Long duration ~ 18 hours (Hawaii, 2008)	Moderate ~ 9 hours (SA, September 2016)	Short ~ 3 hours
SA security obligations	1Hz/s RoCoF	3Hz/s RoCoF	3Hz/s RoCoF

Phase 2 of analysis

Examine the best options in greater detail

Phase 1: First-pass assessment

Assessment of representative list of options against an envelope of scenarios and major benefits to identify a short list of options



Phase 2: Detailed assessment of shortlist of options

Refinement of shortlisted options (complementary projects) and assessment against a detailed range of scenarios and all benefits assessed

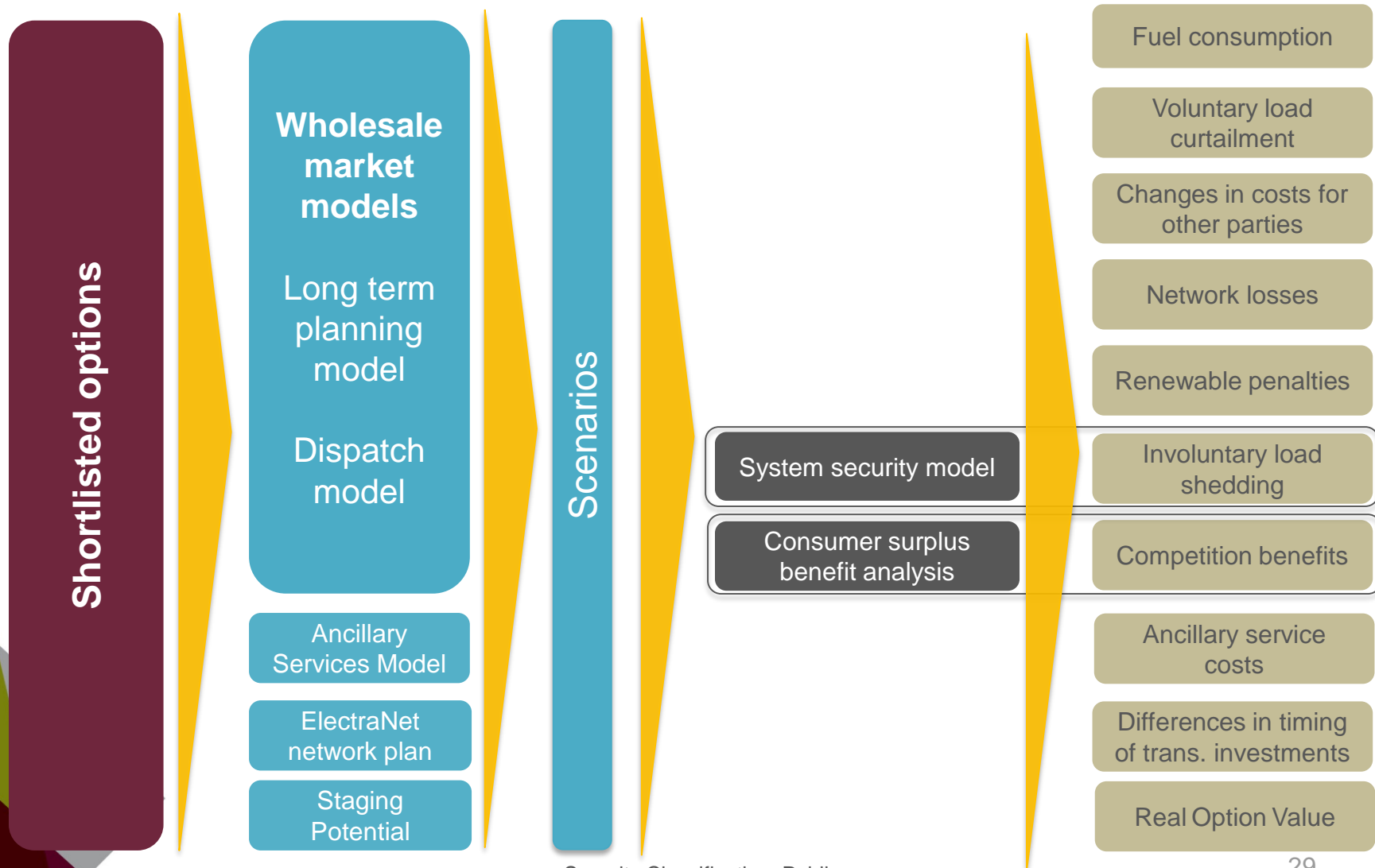


Phase 3: Verification

Targeted analysis to verify whether further refinement of options materially alters earlier Phase 1 assessment

Phase 2: Modelling all benefits

Testing all benefits to see how they influence the results



Phase 2: Detailed scenarios

Phase 2 will test a shortlist of options against a wider range of scenarios

The more detailed scenario analysis will consider...

- > Global, national and state climate change policies
- > Major grid developments across the NEM and in SA
- > Rapid consumer changes
 - Massive storage adoption
 - Internet of Things and tariffs
 - Electric vehicles
- > Generator and load retirements

Phase 3 of analysis

Verify the robustness of the preferred option

Phase 1: First-pass assessment

Assessment of representative list of options against an envelope of scenarios and major benefits to identify a short list of options



Phase 2: Detailed assessment of shortlist of options

Refinement of shortlisted options (complementary projects) and assessment against a detailed range of scenarios and all benefits assessed



Phase 3: Verification

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Economic Modelling Assumptions Report

Additional consultation for greater transparency and early feedback

Report will cover...

- > Overall modelling approach proposed for the RIT-T assessment
- > Key drivers of net benefits in future scenarios
- > Methods of assessing the various RIT-T benefits
- > Wholesale market modelling approach and assumptions

Economic Modelling Assumptions Report

Additional consultation for greater transparency and early feedback

Examples of consultation questions include...

- > Do you agree that the proposed three step phased approach to conducting the RIT-T is fit for purpose?
- > Do you agree that the proposed approach of identifying a broad 'envelope' of scenarios for the first-pass screening is fit for purpose?
- > Do you agree with the approach of excluding options early that clearly deliver less benefits based on first-pass screening?
- > Is the proposed range of future gas price scenarios fit for purpose?
- > Is the framework for estimating system security benefits appropriate?
- > Are there any specific concerns about the proposed approach to modelling emission reduction policies?

Recap on information shared

Rainer Korte
Executive Manager Asset Management

Recap on key messages

- > South Australia is at the forefront of experiencing energy transformation
- > New challenges are emerging from the combination of high levels of intermittent generation and a weakly interconnected system
- > Identified need for this RIT-T process is to...
 - Improve wholesale market competition
 - Improve system security
 - Facilitate renewable energy integration

Recap on key messages

- > Stronger interconnection will support increasingly high levels of intermittent generation and support energy transformation
- > Credible interconnector options have been identified
- > Non-network options can provide system security and other benefits
- > A combination of options may provide the best solution
- > ElectraNet is interested to hear about any non-network options that meet technical requirements and can make a **material** contribution to the identified need

Recap on key messages

- > A fit for purpose phased approach is proposed for evaluating the benefits of the credible options identified
- > ElectraNet will publish a Market Modelling Assumptions Report for consultation and early feedback on how benefits are to be assessed
- > ElectraNet is committed to running an open and transparent process to find the best options to support South Australia's energy transformation

Discussion at tables

Shaun Spinks
Facilitator

8 December 2016

Questions from the floor

Shaun Spinks
Facilitator

Next steps

Rainer Korte
Executive Manager Asset Management

Next steps

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