Government of **Western Australia**
Energy Policy WA

Reserve Capacity Mechanism Review Working Group

Meeting 2023_09_21

21 September 2023

Working together for a **brighter** energy future.

Meeting Protocols

- Please place your microphone on mute, unless you are asking a question or making a comment
- Please keep questions relevant to the agenda item being discussed
- If there is not a break in discussion and you would like to say something, you can use the ‘raise your hand’ function in Teams or comment in the meeting chat
- Questions and comments can also be emailed to EPWA - Energy Markets energymarkets@dmirs.wa.gov.au after the meeting
- The meeting will be recorded and minutes will be taken (actions and recommendations only)
- Please state your name and organisation when you ask a question
- If you are having connection/bandwidth issues, you may want to disable the incoming and/or outgoing video

Agenda

	Item	Responsibility	Type	Duration
1	Welcome and Agenda	Chair	Noting	2 min
2	Meeting Apologies/Attendance	Chair	Noting	2 min
3	Scope of this review	Chair	Noting	5 min
4	BRCP Reference Technology Review	RBP	Discussion	45 min
5	General business	Chair	Discussion	5 min
6	Next Steps	Chair	Noting	5 min

Scope of the Review

- **Review outcome 9 of stage 2 of the RCM Review requires the Coordinator review the appropriateness of the reference technologies for:**
  1. the Peak Capacity product; and
  2. the new Flexible Capacity product.
- **The first review must be conducted to set the reference technologies before the Flexible Capacity product can be implemented.**
- **The objective of the review is to determine the reference technologies for the Peak and Flexible BRCP which:**
  - provide efficient investment signals to ensure system security and reliability; and
  - ensure that customers don't overpay for the desired system security and reliability by selecting the most efficient new entry technology.
- **Using the benchmark technologies to determine the actual BRCPs remains an ERA process.**

4. BRCP Reference Technology Review - Overview

Approach

1. Establish a long list of technologies
2. Define the requirements that must be met to provide Peak Capacity and Flexible Capacity
3. Create a short list of four technologies for each capacity service
4. Identify cost data (based on the existing BRCP determination approach) for each of the four technologies when delivering each capacity service
5. Identify additional data for determination of net Cost of New Entrant assessment
6. Conduct market modelling to inform proposals on reference technologies and Gross/Net CONE
7. Develop Reference Technology and Gross/Net CONE proposals.

EPWA has completed Steps 1- 4.

Reference Technology Long List

Generation Technologies	
OCGT (Heavy Duty)	Lithium Based BESS
OCGT (Aeroderivative)	Vanadium Based BESS
High Efficiency Gas Turbine (HEGT)	Pump storage
Reciprocating Engine	Solar thermal
CCGT Once Through Steam Generator (OTSG)	Solar PV
CCGT Drum SG	Wind
Fuel Cell	

Fuels
Liquid
Natural Gas
Solar
Wind
Hydrogen

Note: Nuclear excluded

4.1 BRCP Reference Technology Review - Requirements

Capacity Service Requirements

To establish a short list and to establish the BRCP Cost parameters for this list a definition of the required services was required. EPWA developed these requirements based on current and projected system characteristics.

Peak Service – Non Storage

Parameter	Setting	Comments	Impact on Short List
Operational Duration	14 hours with 3-day recharge		Liquid storage size Requirement for gas transport contract / line pack
Operating Temperature	41° Celsius	Existing	Site capacity
NOx emissions	150 mg/ m3	DWER approval at Kwinana	Requirement for Dry Low NOx or water NOx control
Carbon emissions intensity	0.55 tCO2e/MWh	Based on latest proposal for emissions thresholds	Excludes diesel fuels and heavy duty gas turbines.
Capacity factor	10%	Based on DSM meeting last tranche of peak demand, and this facility meeting the next portion of the LDC.	Operational life considerations

Capacity Service Requirements

Peak Service – Storage

Parameter	Setting	Comments	Impact on Short List
Operational Duration	4 Hours	Match existing requirements on ESR technology	Battery storage
Operating Temperature	41° Celsius	Existing	Site capacity
NOx emissions	None	Not required	Emissions accounted for at generation, not at charge
Carbon emissions intensity	None	Not required	Emissions accounted for at generation, not at charge
Capacity factor	10%	Based on DSM meeting last tranche of peak demand, and this facility meeting the next portion of the LDC.	Operational life considerations

Capacity Service Requirements

Flex Service - All

Parameter	Setting	Comments	Impact on Short List
		Must meet all Peak Service Requirements	
Ramp rate	100% capacity in 30 min	Estimated requirement after ESS support short term ramps	Excludes some CCGT
Start time	30 minutes	Start time within ESS response. Time of zero makes similar to the ESS service	Excludes CCGT
Minimum online generation	25%	Not technically required but minimizes market impact. No worse than ESS requirements.	Excludes CCGT
Capacity factor	Daily operation	Flex service required daily	Increases variable costs

Technology Short List

Flex Service	Peak Service
Super Aero GT (HEGT) on gas	Super Aero GT (HEGT) on gas
Reciprocating engines (15MW) on gas	Reciprocating engines (15MW) on gas
Lithium BESS	Lithium BESS
Vanadium BESS	Vanadium BESS
CCGT with OTSG	Aero GT (e.g. LM6000) on gas

The existing Siemens OCGT 160MW generator has been excluded as it does not meet the 0.55 tCO2e/MWh requirement. It is included in the following analysis as a point of comparison.

Scale of reference technology

Scale is defined by economic use of fuel and electrical connections. A facility bigger than about 200MW could result in an increase in the Contingency Reserve Raise requirement.

Natural Gas Supply is most economically delivered by proximity to existing pipelines, and Each technology has a slightly different efficient size.

Network connections support different maximum scales as per the table below.

Voltage	Maximum Scale
22kV	15MW
132kV	100-150MW
220kV	150-200MW
330kV	200-500MW

We have assumed that there is limited or no 132kV new connection capacity close to existing gas pipelines. This leaves 220kV and 330kV as the feasible new connection options for a facility of any significant size.

The costs of a new 220kV connection and a new 330kV connection do not have major effect on the cost of a new facility, but a 330kV connection could support a larger facility.

Discussion – connection location

- Connection costs are ultimately a matter for the ERA BRCP process, but this project needs assumptions to determine the appropriate technology.
- Some proposed projects do not involve a new connection, but rather installing new equipment at an existing HV connected site to make better use of existing DSOC.
- Capacity connected in this way would have lower connection costs than a new standalone facility but relies upon development by an existing participant at an existing site.
- Alternatively, smaller (15 MW) lithium BESS connected to existing medium voltage substations could provide a range of Network Control Services. This revenue is currently very difficult to estimate and is not considered in the analysis below.
- When Western Power starts procuring network services through the NCESS framework, the technical specification and cost would be transparent, and could be accounted for in a future benchmark technology review.

Assumption: Standalone facility with a 330kV connection, with new gas Facilities at ~200MW total, though made up of smaller units.

Economic Life

Peak Service (10% capacity factor during small number of peak intervals)	Economic Life
Super Aero GT (HEGT) on gas	25 years
Reciprocating engines (15MW) on gas	25 years
Lithium BESS	25 years
Vanadium BESS	25 years
CCGT with OTSG	25 years

Flex Service (daily cycling)	Economic Life*
Super Aero GT (HEGT) on gas	25 years
Reciprocating engines (15MW) on gas	25 years
Lithium BESS*	25 years
Vanadium BESS	25 years
Aero GT (e.g. LM6000) on gas	25 years

* Refer discussion on maintenance and degradation impacts on following slides

Economic Life and Treatment of Major Overhauls

Economic life assumptions

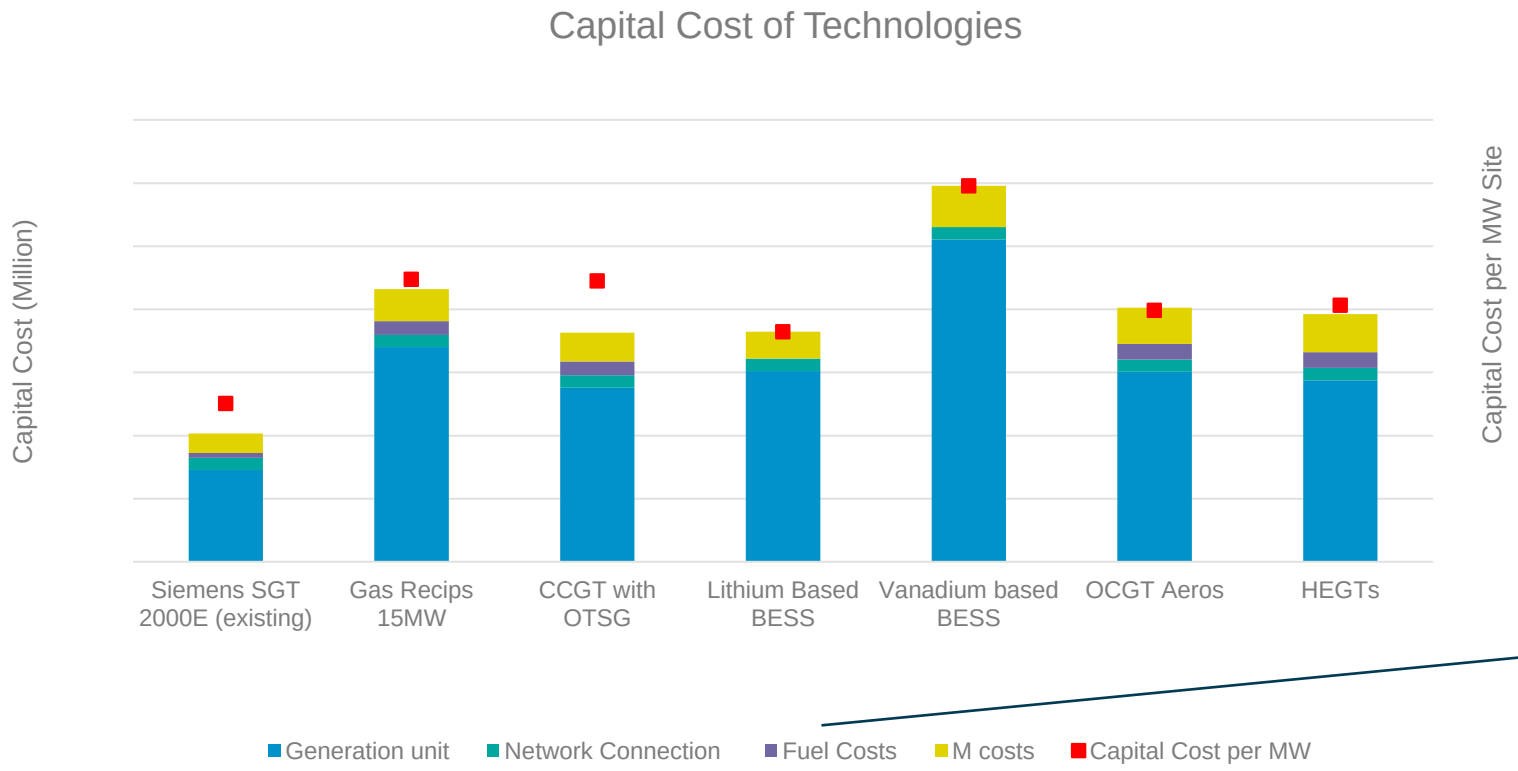
- While assumed economic life is a matter for the ERA component of the BRCP review, this project needs assumptions to support the economic modelling.
- The current BRCP procedure uses a 50-year life, but this project will assume gas generation has an economic life of 25 years, driven by WA's 2050 net zero target.
- It may be possible to extend life beyond 25 years by using green fuels (hydrogen/biogas), but the availability and cost of doing so is far from certain.

Major overhauls as a variable cost component

- Flexible Capacity providers will incur greater maintenance costs than peak providers. These costs include reducing the time between major overhauls and cell replacement. Under the current BRCP calculations, these maintenance costs are recovered from the energy market as variable costs.
- The following analysis assumes that the costs of all major overhauls and end of cell life replacements are recovered by energy market charges (including the BESS buy/sell spread). These costs are excluded from capital costs and will be considered in the economic analysis.

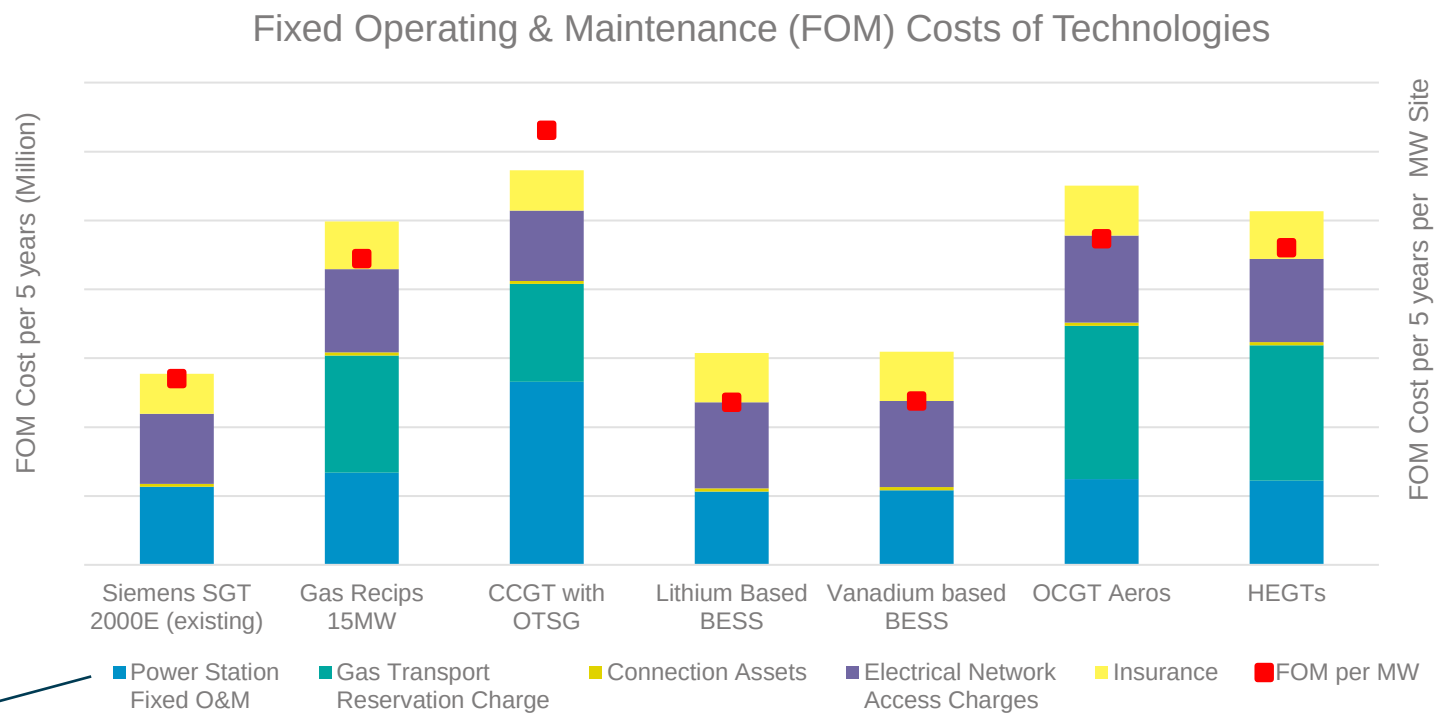
4.2 BRCP Reference Technology Review – Initial Costs

Capital and Upfront Costs



Includes capital cost for a gas lateral with capable storage for 14 hours supply. Aero technologies include a gas compressor

Fixed Operating Costs



Gas transport reservation charge included to allow sufficient gas for ~4h/day, or 14h on one day then two days with no operation

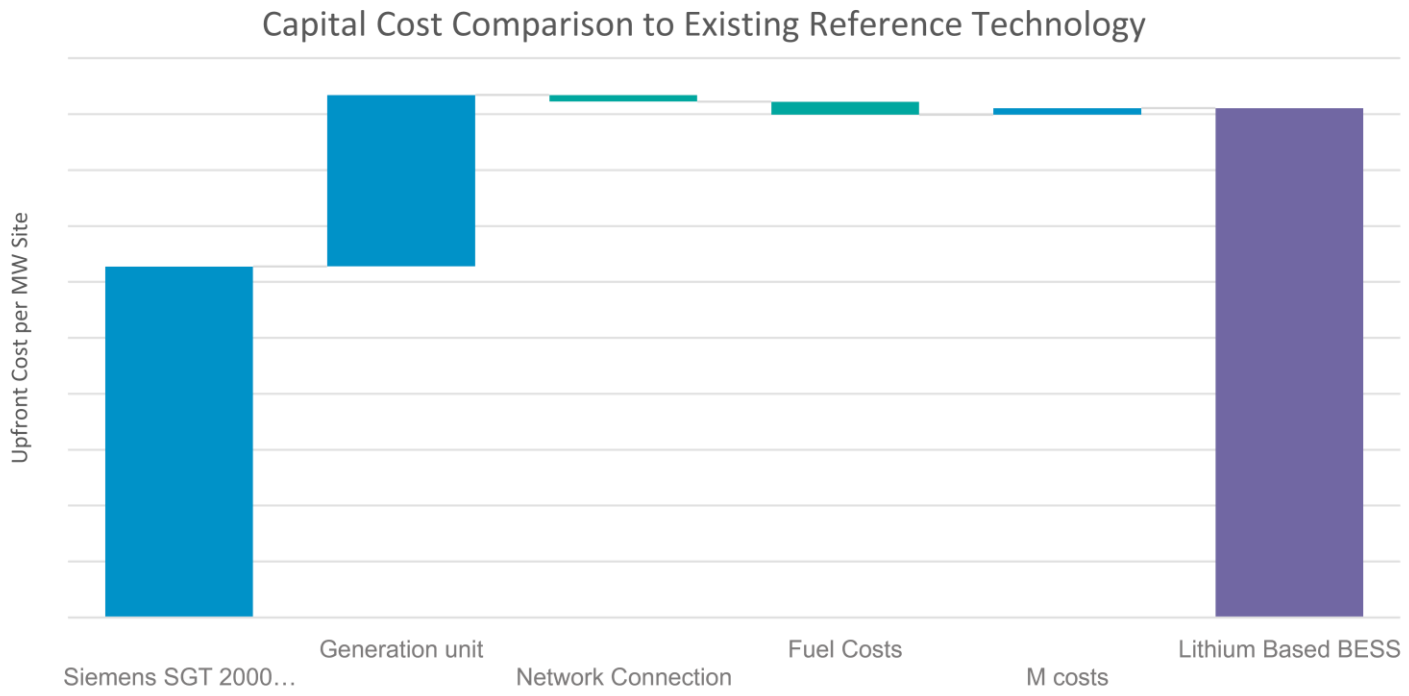
For storage Western Power TRT3 (Bidirectional for Storage) adopted with price as TRT2 (Entry Service).

Likely BRCP Technology Outcomes

The following are the cheapest new entrant technologies on a gross basis

Peak Service	Flex Service
• Lithium BESS • 200MW / 800MWh • Connected at 330kV	• Lithium BESS • 200MW / 800MWh • Connected at 330kV

Changes in Capital Costs – Lithium BESS



Cost changes

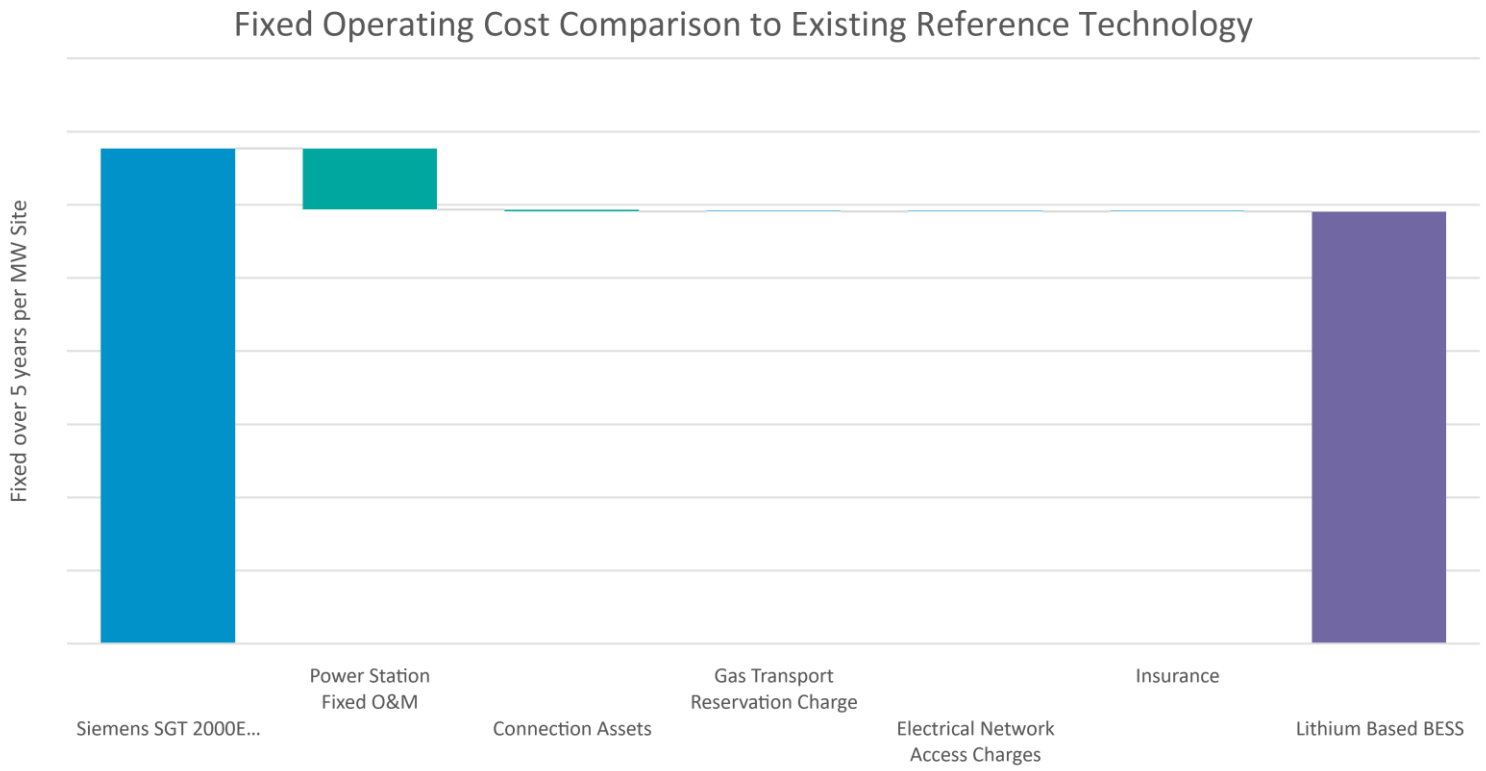
Generation Unit
- Cost of 200MW/800MWh BESS

Network Connection
- Same cost for more delivered MW

Fuel Costs:
- Avoid costs of 14 hours liquid storage

M Costs:
- Avoid some approvals costs but higher insurance (based on Generating Unit Capital)

Changes in Fixed operating Costs – Lithium BESS



Cost changes

Power Station FOM
- Lower fixed operating costs of BESS

Connection Assets
- Same fixed costs for larger output reduces per MW cost

Gas Transport
- No charge (same as liquid Siemens)

Discussion

Implications of analysis

- The existing 160MW OCGT with 14 hours of liquid fuel remains the least cost new entrant until the 0.55tCO2e / MWh emission threshold becomes binding on new entrant generators.
- The new benchmark technology will be higher cost than the existing due to:
    a. Carbon intensity target excluding liquid fuels, resulting in higher capital costs and/or gas transport charges
    b. Materially lower economic lives (25 years vs 50 years).
- There appears to be little difference in capital and fixed costs for Peak Capacity and Flexible Capacity:
    - All shortlisted technologies (Heavy OCGTs, Gas-fired Reciprocating Engines, Aero-derivative Gas Turbines and Battery Electric Storage Systems) can meet the requirements of both services.
    - The different operating profile required for the Flexible Capacity will result in increased costs from more frequent maintenance requirements, where every cycle and hour of operation brings the facility closer to a major overhaul. However, this increased maintenance requirement is usually apportioned as a variable cost component, and therefore can be incorporated into energy offers.

Key assumptions

Decisions for this review:

1. In the medium term, it seems reasonable to assume that the top of the Load Duration Curve will be served by DSPs and existing liquid fueled generators installed before the carbon emission limits. Is it reasonable to assume that the BRCP reference technology will not be the last resort dispatch generator?
2. Is 200 MW a reasonable size assumption, considering other power system operation concerns?
3. Should the new benchmark technologies take effect before or alongside emissions thresholds? Is there any likelihood that new liquid fueled plant would be built given other EPA limits?

Assumptions made by this review for consideration by ERA when setting BRCP:

1. Economic life for new entry, including treatment of major overhaul costs
2. Connection location (existing site or new connection)

4.5 BRCP Reference Technology Review – Next Steps

Next Steps

1. Finalise additional data for determination of net Cost of New Entrant assessment.
2. Conduct market modelling to inform recommendations on reference technologies and Gross/Net CONE
3. Develop Reference Technology and Gross/Net CONE proposals.

We're working for Western Australia.