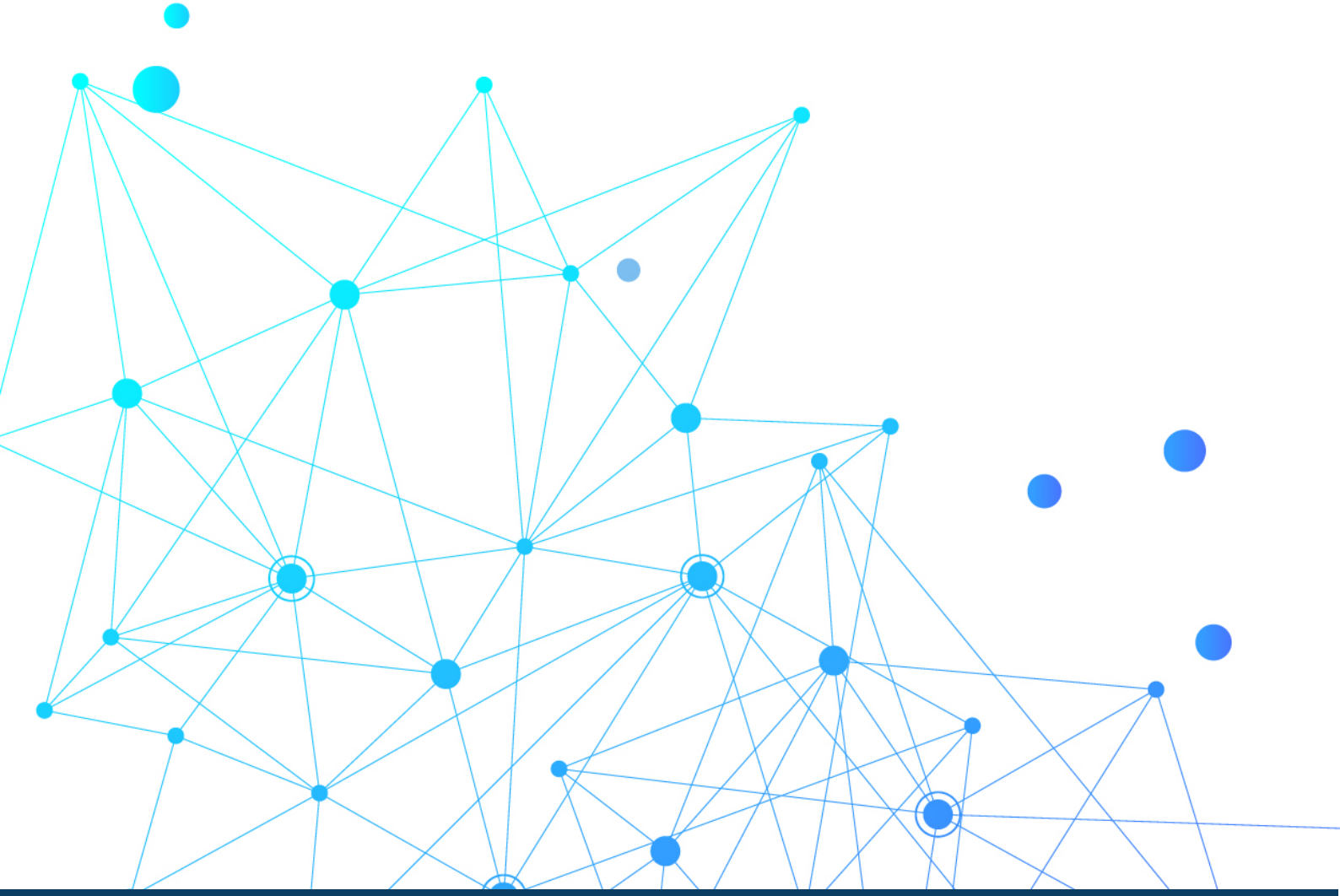
GOVERNMENT OF WESTERN AUSTRALIA

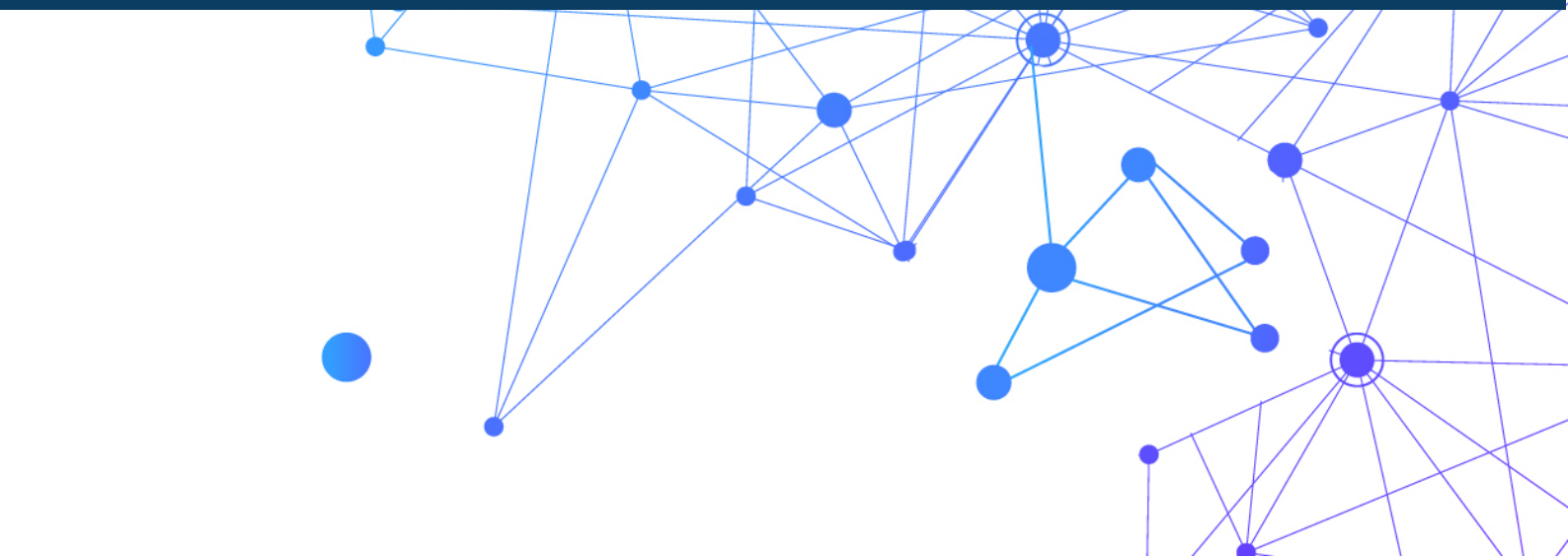
Energy Transformation Taskforce



Whole of System Plan Modelling Scenarios

Information Paper

August 2019



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Contents

1. Summary

- The Energy Transformation Implementation Unit has engaged with stakeholders on the four Whole of System Plan (WOSP) modelling scenarios that were presented on 12 July 2019; *Cast Away, Groundhog Day, Techtopia* and *Double Bubble.*
- Overall feedback was positive, and as a result, the four scenarios were approved by the Energy Transformation Taskforce on 26 July 2019. Stakeholders have provided valuable input on assumptions, and we will factor these into the modelling.
- The two main themes that emerged from stakeholder feedback were:
    1. investment signals and viability; and
    2. future generation mix (specifically thermal generation retirements).

  With regard to these two key themes:
    - for each scenario the WOSP will outline where congestion on the network is expected and provide an assessment of the least cost investment to meet demand, subject to security and reliability constraints; and
    - the recently announced retirements of the Muja C units in 2022 and 2024 will be incorporated into the modelling assumptions. The model will be used to inform further potential retirements, with consideration to commercial viability. Sensitivities on key variables such as coal prices and alternative retirement dates may be considered.
- Other questions stakeholders raised related to:
    - impact of DER in the modelling;
    - emissions reduction;
    - impact on essential system services; and
    - role of demand side management.
- A summary of all stakeholder views, and how the Energy Transformation Taskforce proposes to accommodate this feedback, is provided in this paper. Findings will be shared with stakeholders throughout the WOSP development process.
- The next step in the WOSP development process is finalising the modelling inputs and assumptions with input from interested stakeholders via one-on-one meetings.
- Contact us on (08) 6551 2397 or energytransformation@treasury.wa.gov.au if you would like to provide further feedback or arrange a one-on-one meeting.

100 attendees at the Industry Forum from **52 organisations** across the energy sector

20+ meetings with interested stakeholders to discuss the proposed modelling scenarios

6 written submissions in response to the proposed modelling scenarios

2. Background

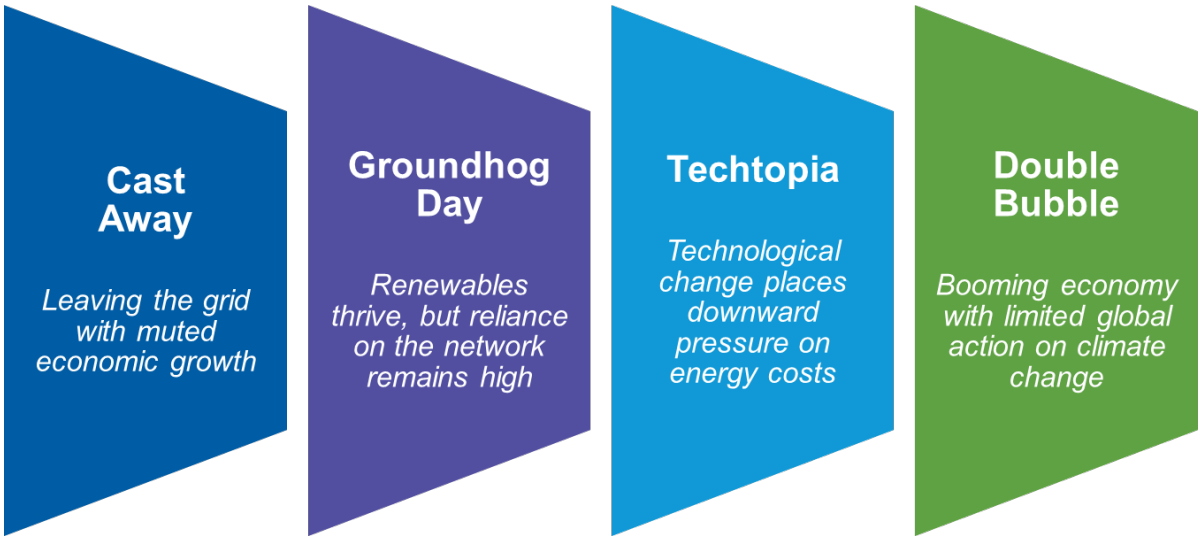
In March 2019, the Minister for Energy announced that an inaugural Whole of System Plan (WOSP) will be developed to help shape Western Australia's energy future. The WOSP is being delivered by the Government's newly-formed Energy Transformation Taskforce (Taskforce), supported by the Energy Transformation Implementation Unit (ETIU).

The WOSP will set out how best to manage and coordinate the transformation occurring throughout the electricity supply chain today and over the coming decades. The plan has a 20-year outlook and will focus on the South West Interconnected System (SWIS), which supplies electricity to more than 1.1 million homes, businesses, and major industrial energy users[1].

The WOSP will present a view on the generation and network investments that may be required to meet future demand. It will be used to inform future infrastructure investment requirements, regulatory decisions, and policy and market development initiatives. It will also assist in managing the security and reliability impacts of transitioning from traditional energy sources to new, smaller-scale, distributed and lower emissions technologies.

The inaugural WOSP will be based around four modelling scenarios, which have been developed by the ETIU, with support from Western Power and the Australian Energy Market Operator (AEMO). The four scenarios, titled: *Cast Away, Groundhog Day, Techtopia* and *Double Bubble*, each represent credible and predictable scenarios that represent potential future demand, and technological developments that will impact the supply of, and demand for grid-connected electricity in the next 20 years.

Figure 1: WOSP modelling scenarios



The four scenarios were presented to stakeholders at an Industry Forum in Perth on 12 July 2019. Over the past eight weeks, the ETIU has also held a number of one-on-one

[1] Australian Energy Market Operator Wholesale Electricity Market Fact Sheet, March 2018.

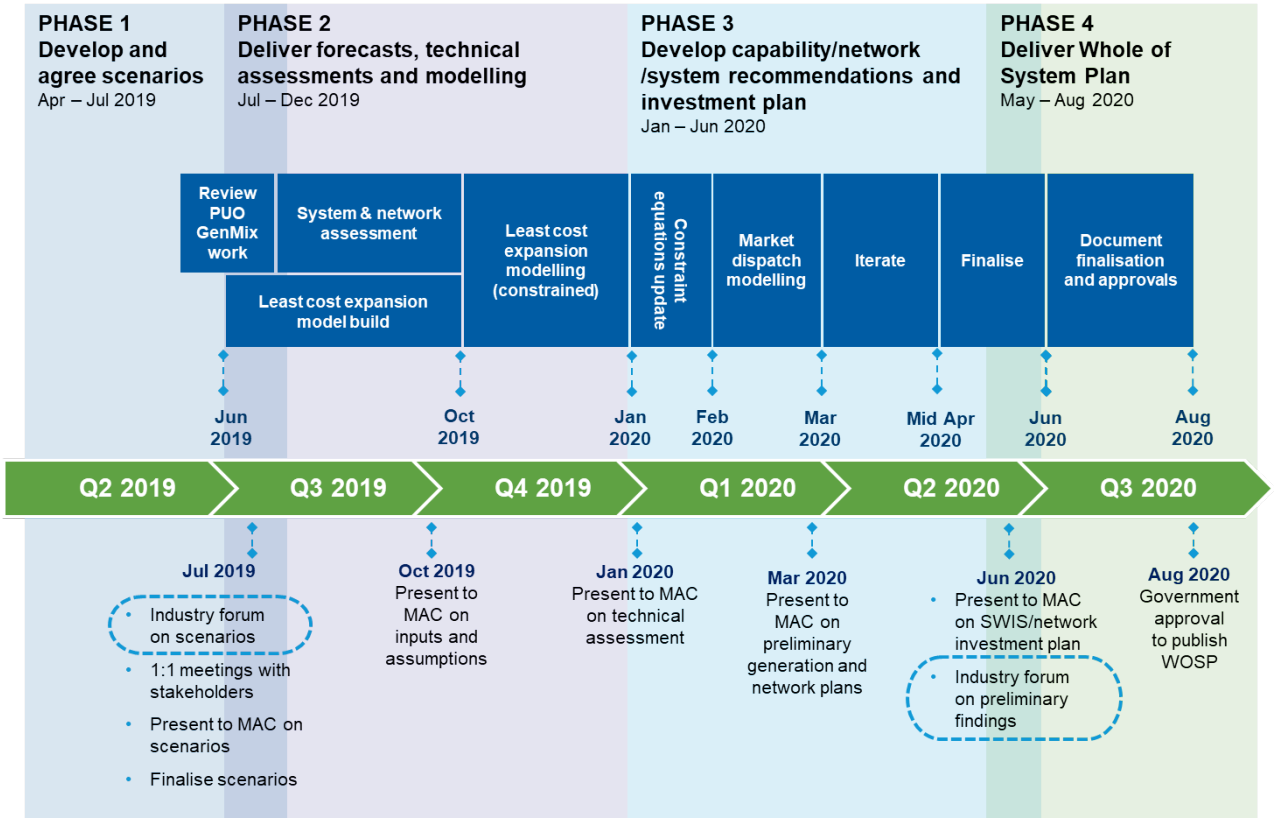
meetings with interested parties, to hear their views on the four scenarios, and understand what factors are important to them when developing the WOSP.

Overall feedback was positive, and as a result, the four scenarios have been approved by the Taskforce. The scenarios will form the basis of the demand modelling to be conducted in partnership with Western Power and AEMO over the coming months.

An overview of stakeholder feedback, including how we plan to factor this feedback into the WOSP development, is provided in section 4 of this document.

The four scenarios will underpin development of the inaugural WOSP, which we expect to publish during the third quarter of 2020. We will monitor and re-assess the validity of the scenarios as we progress. Explanation of the four scenarios is provided in section 3. Opportunities will be provided for all interested stakeholders to review and provide feedback on the WOSP at key stages. The WOSP development timeline and engagement milestones are shown in the following diagram.

Figure 2: Major project milestones



This inaugural WOSP is an initial step in our State's energy transformation. It is intended for the WOSP to become a single, consistent reference point for consideration in all future capacity and network investments, and regulatory and energy policy decisions in the SWIS. The forecasts contained in the WOSP will be used to inform various decisions to in-turn promote the most efficient and effective production, transportation, usage and pricing of electricity in Western Australia's South West over the next 20 years.

3. Scenarios

The four scenarios: *Cast Away, Groundhog Day, Techtopia* and *Double Bubble* were selected from over 50 potential scenarios developed by Western Power relating to different permutations of economic, demographic and technological change.

To distil all the variables down to four meaningful scenarios, we worked with Western Power and AEMO to identify four suitably diverse, but entirely feasible scenarios. The WOSP will model a range of possible future states to determine the "least regret" investment options, rather than attempting to determine a precise "expected" future. This view has been supported by stakeholders during the recent engagements.

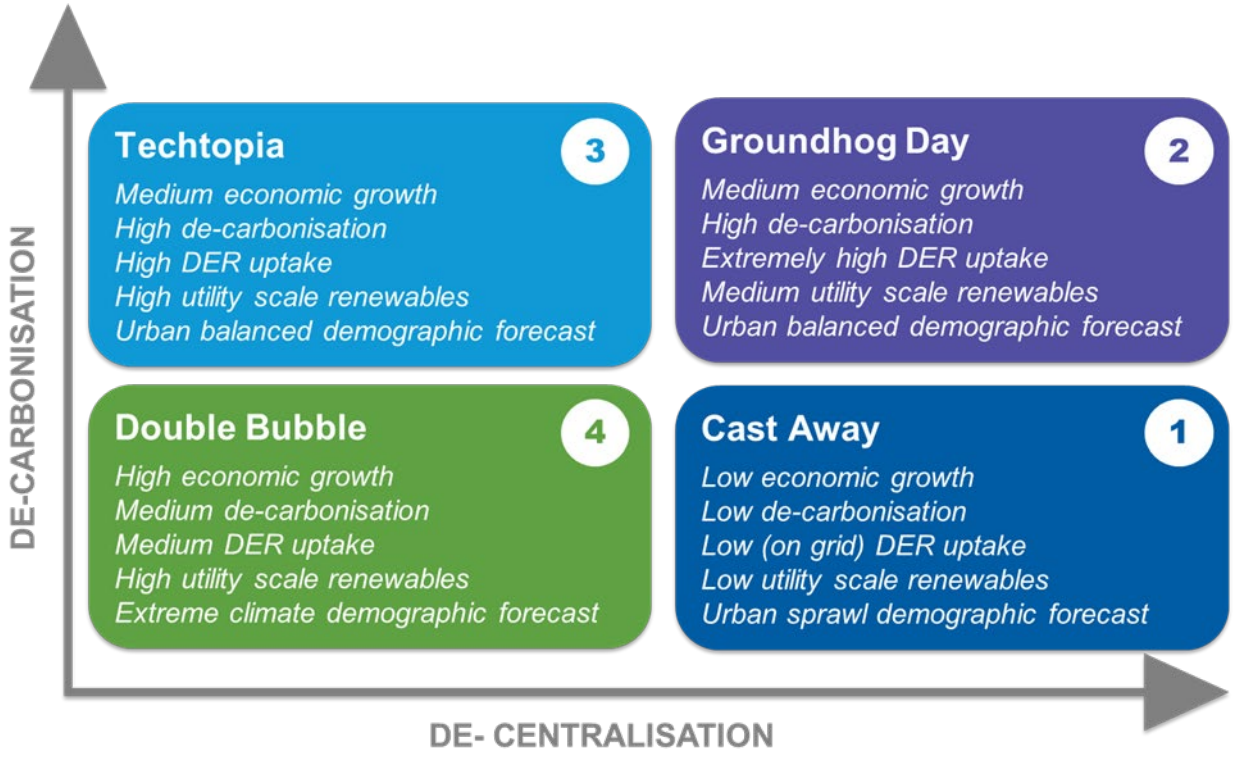
When choosing the scenarios, we focused on the following critical factors:

- economic growth underlying volume;
- demographic drivers underlying demand and location; and
- large scale renewable generation and distributed energy resources (DER) uptake, which are driven by both the price and advancement of technology.

We then selected four scenarios that represent different rates of transition in two critical issues facing the energy sector:

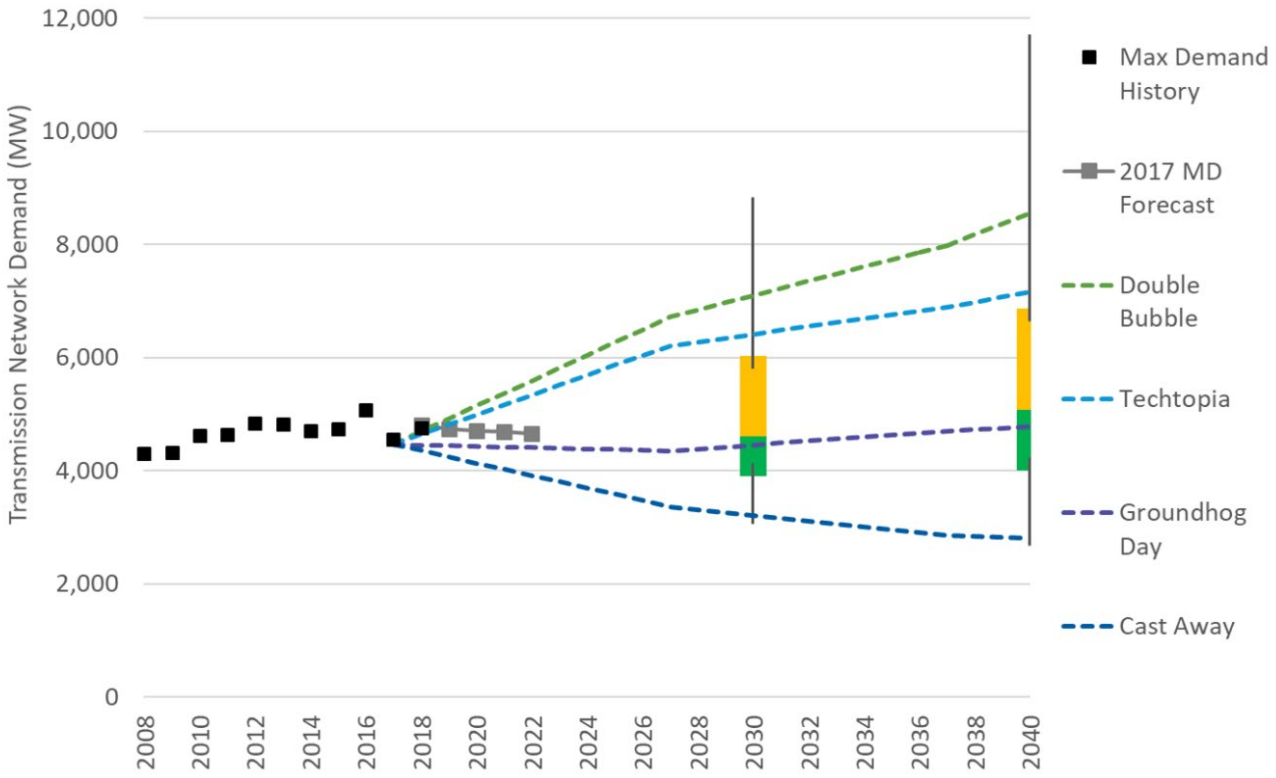
1. de-carbonisation – the shift from traditional forms of thermal generation; and
2. de-centralisation – the trend for consumer disconnection from the main network grid, and the emergence of more microgrids and standalone power systems.

Figure 3: De-carbonisation vs De-centralisation Matrix



As shown in the following chart, these four scenarios result in four disparate, yet credible forecasts of electricity demand growth (or decline).

Figure 4: Maximum transmission network demand

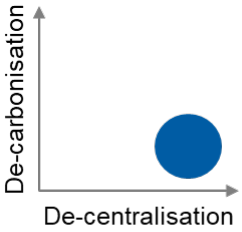


Source: Western Power

Note: For illustrative purposes, we have used maximum transmission network demand as a proxy for changes in broader energy demand in the SWIS. We recognise that maximum demand is only one signal of network utilisation and energy consumption, and that there are additional demand characteristics such as average demand and seasonality that will help inform investments in generation plant.

Each scenario is discussed in more detail in the following sections.

Scenario 1: Cast Away



PROFILE

- Low economic growth
- Low de-carbonisation
- Low (on grid) DER uptake
- Low utility scale renewables

Leaving the grid with muted economic growth

The Cast Away scenario assumes a subdued economy characterised by low economic growth in the mining and non-mining sectors, and minimal population growth.

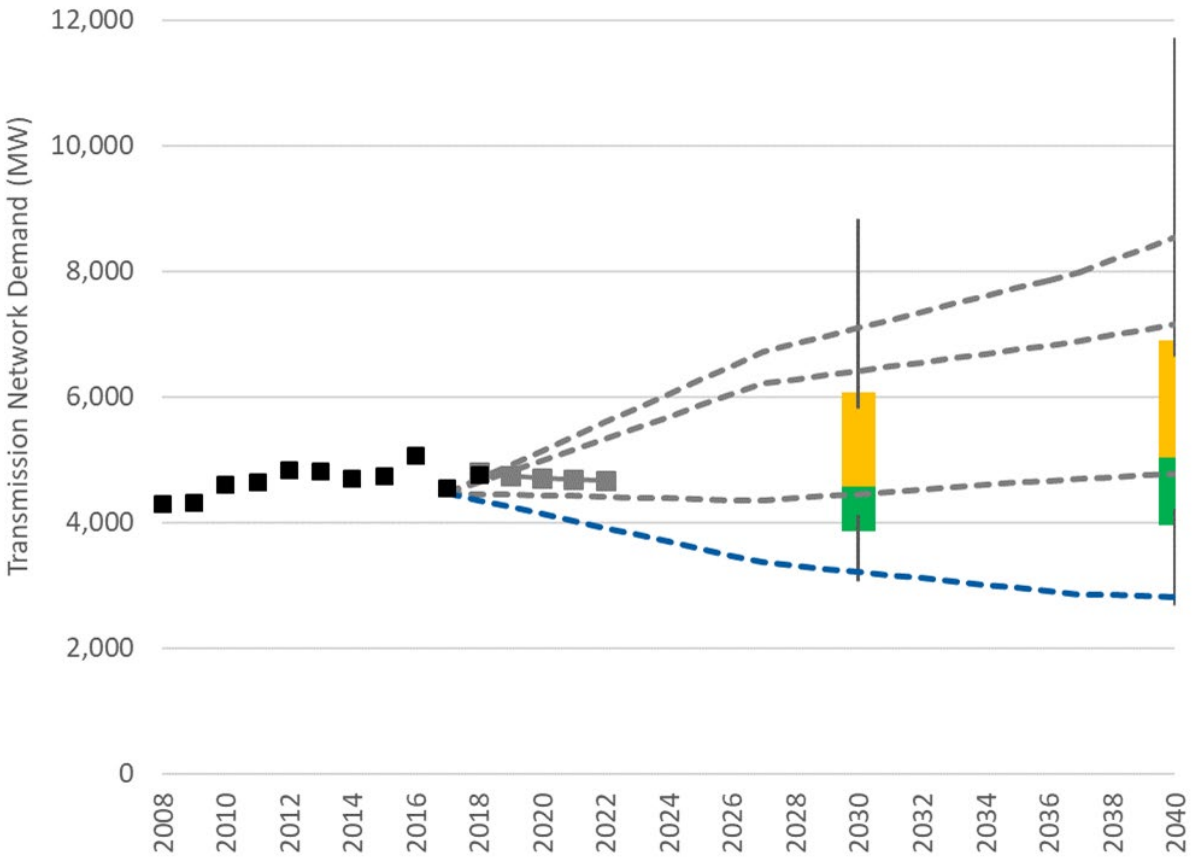
In the Cast Away scenario, consumers are becoming increasingly self-sufficient, which is driving urban sprawl through the desire for low-density living to facilitate rooftop photovoltaic (PV) generation and battery storage.

This results in a significant increase in the number of consumers leaving the grid, which results in a high level of self-supply and a low overall network demand in the SWIS.

Network demand continues to decline as consumers leave the grid.

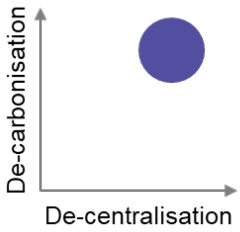
In terms of supply, weak economic conditions stall investment in utility-scale renewable generation projects.

Figure 5: Maximum transmission network demand – Cast Away



Source: Western Power

Scenario 2: Groundhog Day



PROFILE

- Medium economic growth
- High de-carbonisation
- Extremely high DER uptake
- Medium utility scale renewables

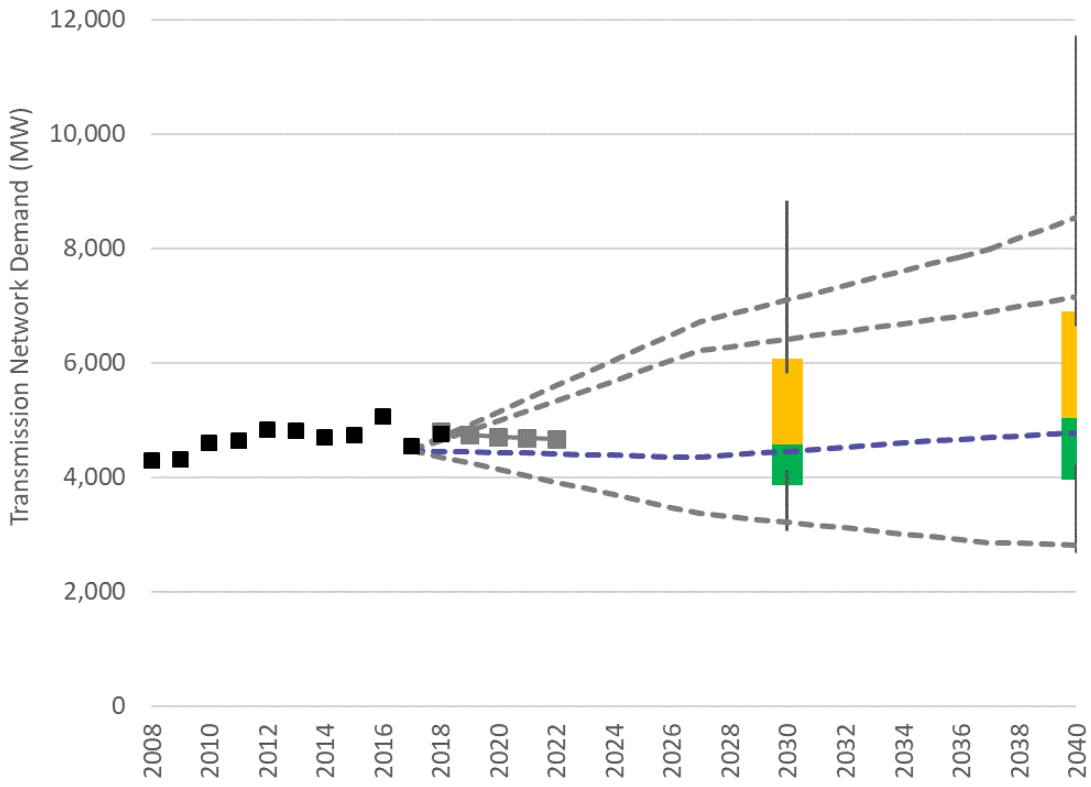
Distributed energy resources thrive, but reliance on the network remains high

Of the four scenarios, Groundhog Day is the one that most closely resembles the status quo. A moderate increase in mining spurs economic growth, with commensurate growth in the non-mining sector as consumer confidence increases.

Groundhog Day sees relatively balanced urban spread; however, population density increases in inner city locations, which places pressure on electricity infrastructure in these areas. Government policy settings promote a move away from fossil fuels, which combined with the relatively healthy economy, sees investment in DER thrive and DER costs continue to fall, with approximately three quarters of consumers installing rooftop PV generation and battery storage, along with other new technologies.

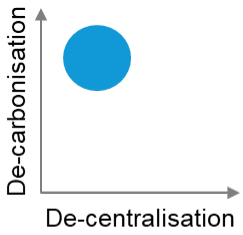
Despite the proliferation of DER, consumers maintain high reliance on the grid. The network peak shifts to winter. Batteries play a minor role in winter, as most batteries are flat by the time the winter peak occurs. Energy throughput declines because consumers are able to self-supply a significant portion of their demand for most of the year. With an increasing proportion of energy supplied by DER and government policy driving the shift away from thermal generation, the SWIS experiences rapid decentralisation and decarbonisation resulting in minimal network demand growth.

Figure 6: Maximum transmission network demand – Groundhog Day



Source: Western Power

Scenario 3: Techtopia



PROFILE

- Medium economic growth
- High de-carbonisation
- High DER uptake
- High utility scale renewables

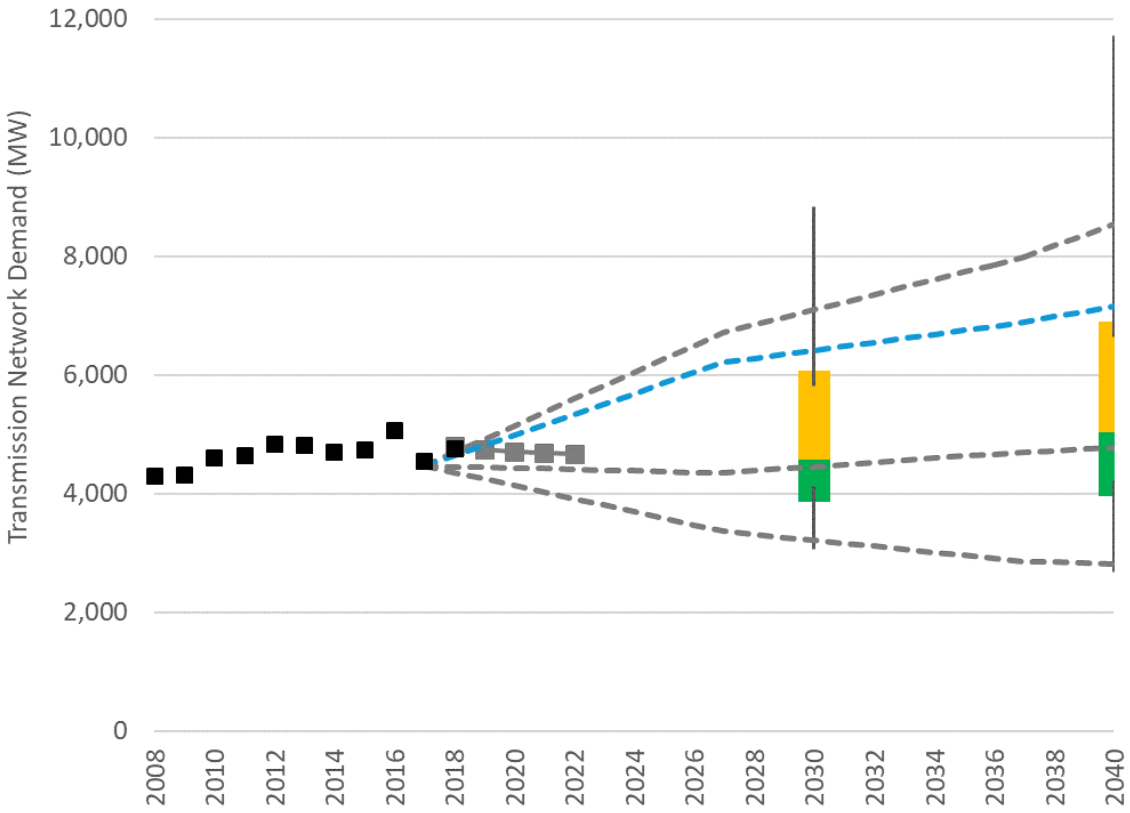
Technological change places downward pressure on energy costs

The Techtopia scenario forecasts medium economic growth, driven by a moderate increase in both the mining and non-mining sectors. Techtopia sees a proportionate increase in population growth that is evenly balanced between metropolitan and regional centres.

The uptake of rooftop PV generation is lower under this scenario than under the Groundhog Day and Cast Away scenarios. In Techtopia, there is better utilisation of network and generation assets as a result of smart appliances, which flatten the load duration curves and lead to lower network tariffs. Other technology in the pipeline means some consumers may choose alternatives to PV systems. Therefore, the rate of residential DER installations is lower.

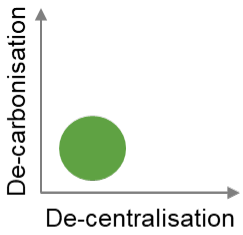
In Techtopia, advances in technology lead to a reduction in the cost of utility-scale, grid-connected renewable energy sources. When coupled with strong environmental policy, this drives a marked shift away from thermal generation, but retains the economic benefits of economies of scale offered by large-scale production resulting in growth in network demand.

Figure 7: Maximum transmission network demand – Techtopia



Source: Western Power

Scenario 4: Double Bubble



PROFILE

- High economic growth
- Medium de-carbonisation
- Medium DER uptake
- High utility scale renewables

Booming economy with limited global action on climate change

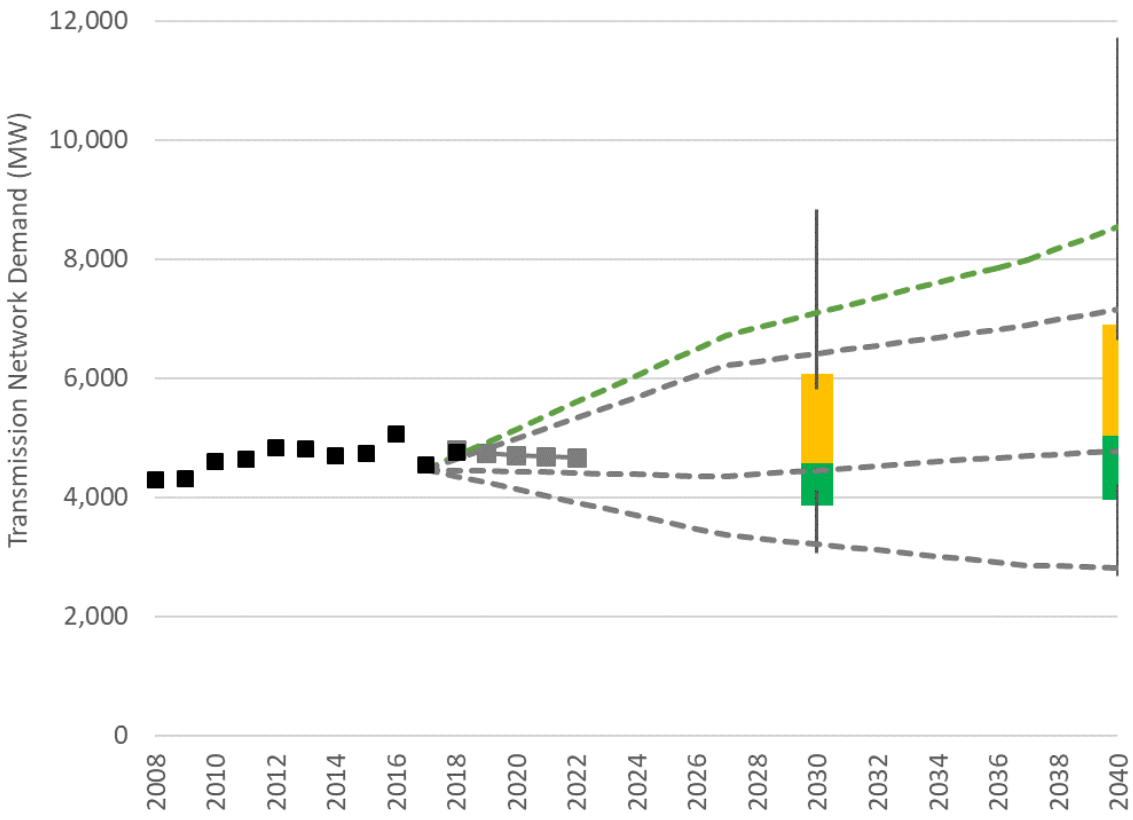
The Double Bubble scenario provides the opportunity to test investments to the maximum.

Under this scenario, booming economic growth in both mining and non-mining sectors drive a significant increase in energy demand.

This pressure on demand is further compounded by the prevalence of extreme weather events in the north of the State, which drives a further population shift towards the south west. There is much slower growth in residential rooftop PV generation and batteries than in the Groundhog Day and Cast Away scenarios, although there is a more accelerated uptake in Electric Vehicles (EVs).

Growth in energy consumption and peak demand drives investment in utility scale renewable generation projects and technologies. This growth in investment leads to a reduction in energy costs, resulting in subdued overall residential DER growth.

Figure 8: Maximum transmission network demand – Double Bubble



Source: Western Power

4. Stakeholder Feedback

To help finalise the modelling scenarios, the ETIU engaged with the energy sector through various channels.

- An Industry Forum was held on 12 July 2019, which covered what the WOSP is, how it will be developed, and the proposed modelling scenarios.
- Stakeholder feedback was encouraged and sought from interested parties including market generators, market customers, contestable customers, advocacy groups, and financial providers via one-on-one meetings and written feedback.
- The final scenarios were presented to the Market Advisory Committee on 29 July 2019.

Stakeholders have generally been supportive of the WOSP and the four modelling scenarios. Many questions around inputs and modelling considerations were raised, however two main themes emerged, namely:

1. investment signals and viability; and
2. future generation mix (specifically thermal generation retirements).

Other important issues raised by stakeholders were the:

- impact of DER in the modelling;
- emissions reduction;
- impact on essential system services; and
- role of demand side management.

These themes and issues are discussed further in the following sections.

Investment signals and viability

The need for the WOSP to provide signals on when, where and what type of generation and/or technology to invest in, was raised during several one-on-one meetings. Stakeholders also expressed the need for signals on future energy prices, and the importance of a stable regulatory environment when attracting capital funding.

We acknowledge stakeholders' concerns regarding investment signals. One of the primary purposes of the WOSP is to help inform the most effective way to ensure our power system remains secure and efficient. As such, our aim is to ensure the WOSP contains sufficient, credible information that will help investors and infrastructure businesses make prudent investment decisions.

A summary of stakeholders' issues and our responses is provided in the following table.

Table 1: Summary of issues raised by stakeholders – investment signals and visibility

Issue	Response
Transparency and signals for future investment opportunities	For each scenario, the WOSP will outline where congestion on the network is expected and will include an assessment of the least cost investment to meet demand, subject to security and reliability constraints.
Signals on expected future energy prices	The WOSP will provide indications of total system cost to deliver secure and reliable electricity supply over a 20-year horizon (with a primary focus on the first 10 years). There will be some assumptions made in the inaugural WOSP, as some decisions that will affect future energy prices are being progressed in parallel to the WOSP[2]. However, we expect full details of the new market design, including pricing elements will be factored into future iterations of the WOSP.
Project financing considerations	We understand stakeholders will need to obtain funding for new projects and in some cases may need to refinance existing projects, which is difficult in an environment of reform and regulatory uncertainty. We consider that establishing the WOSP, in parallel with delivering the Government's broader energy transformation, will ultimately improve signals for investment. While the transformation period may hold some uncertainty, having a Government-endorsed whole of system plan that sets a reasonable and credible roadmap for Western Australia's energy future should provide a measure of certainty that will aid financing considerations.

Future generation mix

The future generation mix of the SWIS attracted considerable interest from stakeholders. The main issues raised are summarised in the table below.

Table 2: Summary of issues raised by stakeholders – future generation mix

Issue	Response
Fuel security considerations	The available quantity, quality and price of different fuel sources will be incorporated into the modelling to the extent possible. For example, expected gas quantities will be tested against the

[2] Following consultation, the Taskforce will make decisions on elements of market and regulatory design in the WEM. Taskforce decisions, information papers and consultation drafts of rules and regulations will be published on the Energy Transformation website as they are completed https://www.treasury.wa.gov.au/Energy-Transformation/Publications/

Issue	Response
	capacity of existing infrastructure to deliver it and/or any gas infrastructure investment costs will be reflected in the cost of delivered gas. Government is working on gaining a better understanding of the issues associated with coal mine viability. Coal will continue to be required to ensure secure and reliable electricity supplies for at least the next decade or more, therefore it is vital to ensure ongoing viability of the coal mining industry in Western Australia.
Assumptions for the retirement of thermal generation	The recently announced retirement of the Muja C generation units in 2022 and 2024 will be incorporated into the assumptions for all scenarios. Further retirements will be determined by a model based on minimising cost by retiring plant which is not able to remain financially viable when faced with competition from new entrants. Sensitivities on key variables such as coal prices and alternative retirement dates may be considered. The outcomes of the WOSP are to ensure reliability and security requirements are met at least cost, and the recommended generation mix will reflect the need for thermal generation capacity in this context.

Impact of DER in the modelling

There has been strong interest from industry regarding the impact of DER in the WOSP, and how it will be accounted for in the modelling.

The WOSP modelling will determine a least cost investment plan for network augmentation and new generation and storage facilities at the transmission network level only. DER uptake (PVs, storage and EVs) at the distribution level will be considered as an input into the four scenarios for future network demand, but not as an output of the least cost investment plan.

Different types of transmission-connected energy storage (including batteries) will be included as investment candidates in the modelling, where credible information allows us to do so. New storage facility candidates at the transmission level will be included in the modelling where they can be reasonably costed, and the technology is well understood.

Emissions reduction

Some stakeholders have recommended the inclusion of climate and emissions policy as an input to the modelling approach. As there is currently no explicit climate or emissions reduction policy targeted at the electricity sector at either the State or Federal level other than the existing Commonwealth Renewable Energy Target (RET), only the Large-Scale RET will be explicitly modelled in the WOSP. However, the modelling will

provide a view of the different emissions outcomes that may result over the 20-year horizon under the different scenarios.

Impact on essential system services

In one-on-one meetings, some stakeholders asked whether the WOSP will provide costing and pricing forecasts for essential system services.

There will be some assumptions made in the inaugural WOSP as some key decisions that may impact future energy prices and/or demand for new types of services are being progressed in parallel Energy Transformation workstreams. This is particularly the case with essential system services. However, the modelling will be based on the best available information at the time with a view to representing the future design as accurately as possible.

The inaugural WOSP will attempt to measure the aggregate cost of providing essential system services to the market rather than costs of specific services such as Frequency Control Ancillary Services, spinning reserve, etc. Future versions of the WOSP are expected to incorporate the latest market, regulatory and policy settings.

Role of demand side management

Some stakeholders queried how demand side management (DSM) will be factored into the WOSP. The WOSP will provide the requirement for flexible energy such as peaking generation or DSM. It will then be up to DSM providers to assess their ability to participate in this market.

Other issues

Other issues raised by stakeholders are outlined in the following table.

Table 3: Summary of issues raised by stakeholders – other

Issue	Response
Need for a base/neutral scenario	The WOSP will model a range of possible future states to determine the 'least regrets' investment options across a range of feasible scenarios, rather than trying to determine a precise expected future.
Tariff and pricing considerations	The WOSP will provide indications of total system cost to deliver secure and reliable electricity supply over the 20-year horizon (with a focus on the first 10 years). This will help inform advice regarding the lowest sustainable system cost, and the Government will consider how best to recover these costs via appropriate tariff settings. The DER Roadmap currently being developed by the Taskforce will also consider issues relating to tariffs and pricing.