Foreword from the Minister for Energy

Western Australia is leading the way towards a low carbon future. As part of our commitment to achieving net zero greenhouse gas emissions by 2050, the McGowan Government is driving changes to our energy markets, investing in critical mineral discoveries and facilitating the uptake of renewable generation, energy storage and distributed energy resources including electric vehicles.

These initiatives will play a major role in helping industry, government and the community achieve decarbonisation. Central to their success is the electricity transmission network.

Electrification of industries, transport and homes is key to reducing greenhouse gas emissions. Western Australia has some of the best and most reliable renewable energy resources on the planet. But having world-leading renewable energy is only one piece of the puzzle – it needs to be connected to where it will be used.

The State-owned Western Power network is vast, secure, reliable and remains the lowest cost way of transporting electricity. The major powerlines that span from Geraldton to Albany and east to Kalgoorlie are the backbone of our economy in the South West and will continue to be for decades to come. However, the powerlines need to reach the locations where wind blows the strongest and sun shines the brightest. Similarly, the network must expand to new locations to cater for emerging industries such as hydrogen production and lithium mining, while also meeting the demands of existing industrial power users looking to expand and decarbonise rapidly.

This South West Interconnected System (SWIS) Demand Assessment shows how much the transmission network will need to transform to meet industrial demand for green electrons over the next 20 years. Industry stakeholders have shared their expansion and electrification plans with us to build a picture of future load growth and overall electricity demand in the SWIS. Using this information, we have modelled the optimal mix of renewable generation and storage required to meet this anticipated demand, and identified the network augmentations necessary to transport that electricity.

This modelling builds on the 2020 Whole of System Plan, the next iteration of which was due to be delivered at the end of 2023. However, recognising the urgency of action on climate change, the State Government brought forward this SWIS Demand Assessment to gain earlier insights.

Since the first Whole of System Plan was delivered at the end of 2020, the world has changed. Industry decarbonisation ambitions have strengthened and accelerated, governments around the world have set ambitious greenhouse gas reduction targets, and concepts around establishing new green industries such as renewable hydrogen are translating into policies and action. The SWIS Demand Assessment revisits the infrastructure needs of the SWIS in relation to renewable generation, storage and network requirements to support this transition.

The resulting picture is exciting, with huge potential to connect new renewable generation and storage projects that will support new and existing industries and create new jobs.

But the SWIS Demand Assessment is only the first step in the journey towards transformation of the grid. Government is committed to working with industry to confirm their network capacity needs, with a focus on minimising the cost of new network build being passed onto households. However, to ensure these assets are delivered in a timely manner, the Government has already committed Western Power to undertake early planning works in the northern, central and eastern areas of the network.

The McGowan Government looks forward to working with industry to build on the SWIS Demand Assessment, supporting their decarbonisation efforts and helping Western Australia transition to a low carbon future.

Hon. Bill Johnston
Minister for Mines and Petroleum, Energy, Corrective Services, Industrial Relations
Overview

The SWIS Demand Assessment is an initial assessment of potential future electricity demand required over the next 20 years to meet industry and Government commitments of achieving net zero greenhouse gas emissions by 2050. A Treasury-led Taskforce, with support from Department of the Premier and Cabinet, Energy Policy WA, Western Power, the Department of Jobs, Tourism, Science and Innovation, and the Department of Water and Environmental Regulation, oversaw the delivery of the SWIS Demand Assessment.

The SWIS Demand Assessment complements the 2020 Whole of System Plan by looking at the future growth of electricity demand that is largely driven by industry action on climate change. Since 2020, commitments to reduce greenhouse gas emissions at global and national levels have strengthened, along with introduction of legislation to underpin these commitments. The McGowan Government has announced the retirement of the State-owned coal generation fleet by 2030 and plans to introduce climate change legislation. All of these factors are driving acceleration of the decarbonisation plans of the State’s major industries.

Using renewable electricity is one of the most cost effective ways of moving to a net zero future. Through consultation with existing and potential new industry stakeholders, a range of potential demand scenarios were considered. Under all scenarios Western Australia’s main transmission network would need to grow significantly to meet industrial demand. The ‘Future Ready’ scenario shows peak demand around the SWIS if the Future Ready scenario was selected as the basis for developing a network vision for the coming decades. From there, Western Power worked to identify the transmission network augmentation required to transport the necessary volumes of electricity to meet industry and Government commitments of achieving net zero greenhouse gas emissions by 2050.

Assessment approach

A highly consultative approach was used to inform expectations of the use of the SWIS in a decarbonised future.

More than 50 meetings with existing and new mining, critical minerals and processing industries, potential hydrogen producers, and renewable energy project developers were held. These major electricity users provided details of their electrification plans, emissions targets, and expectations of network supply over the coming decades.

With this information, four demand scenarios were developed, each reflecting different outlooks for major loads connecting to Western Power’s transmission network over the next 20 years:

1. **Extreme Growth**: All load growth put forward by proponents occurs, applying the highest load and most ambitious timing assumptions.
2. **High Growth**: All expansion and electrification of existing and new connections put forward by proponents occurs, including rapid connection of hydrogen production loads.
3. **Future Ready**: Includes expansion and electrification of existing connections plus a more conservative estimate of hydrogen loads connecting during the 2030s (assumes additional growth in hydrogen production is not SWIS-connected).
4. **Base**: Load growth is limited to expansion of existing loads and electrification of existing connections.

Each scenario was constructed by adding the different outlooks for major load growth to a forecast of the underlying demand in the SWIS based on the ‘Expected’ scenario in the Australian Energy Market Operator’s (AEMO) 2022 Electricity Statement of Opportunities. This work builds on the modelling framework developed through engagement with energy sector stakeholders to deliver the 2020 Whole of System Plan, with additional network nodes introduced. The SWIS Demand Assessment also considers additional wind resource data, including in areas beyond the existing SWIS footprint, as well as a more refined analysis of land availability.

Figure 1 shows the demand under each of the four scenarios. The generation and storage capacity required to meet demand in each of the scenarios across 14 different nodes in the SWIS was modelled, including the optimal locations for developing a network vision for the coming decades from there, Western Power worked to identify the transmission network augmentation required to transport the necessary volumes of electricity around the SWIS if the Future Ready scenario eventuated.
Load, generation, and storage forecast

There is a need to plan for a future where existing and new industries can continue to grow in a low carbon environment. Industry consultation suggests electricity demand could increase by more than 7 GW, requiring investment in over 50 GW of new renewable generation and firming capacity across the network.

The Future Ready load growth scenario was selected for further development, as it provides a balance between short-term needs and long-term network options. Future Ready reflects a credible representation of SWIS demand through to 2042, as it:

- is based on the expansion and electrification plans of existing connected industrial customers;
- reflects conservative assumptions of SWIS connected growth in new and emerging industries;
- aligns with Government policies and direction with regard to emerging industries (such as hydrogen, green steel, and critical minerals) while balancing uncertainty about the timing and scale of the associated future demand growth; and
- allows for scalability in network capacity if/when significant demand eventuates.

The key load areas, growth drivers, and potential generation and storage requirements are summarised in the following section.

Key load areas: Future Ready

South West

Load growth is anticipated to be strongest in the South West node, with approximately 2.8 GW of new electricity demand expected to connect to the network at load centres between Pinjarra and Bridgetown. The bulk of the increase in the South West is driven by electrification of established minerals and metals industries, particularly alumina.

Central

The estimated 2.2 GW of demand growth in the Central area of the SWIS (from Kwinana to Alkimos) would be largely based around the Kwinana Industrial Area (2.0 GW). Industries in the Kwinana region are seeking to decarbonise, with many signalling their intent to electrify operations via a grid connection.

The pace and extent of grid connection remains uncertain, as the options for decarbonisation are limited by current technology. Major electricity users in the region are exploring options involving low emissions electricity combined with renewable hydrogen technology which, while not yet commercially viable, has potential to evolve over the coming decades. Any new generation and/or energy intensive processes aligned with Government policies and direction which, while not yet commercially viable, has potential to evolve over the coming decades. Any new generation and/or energy intensive processes aligned with Government policies and direction with regard to emerging industries (such as hydrogen, green steel, and critical minerals) while balancing uncertainty about the timing and scale of the associated future demand growth; and

The key load areas, growth drivers, and potential generation and storage requirements are summarised in the following section.

North

Demand growth in the northern parts of the SWIS (from Moora to Oakajee) would be driven primarily by plans to produce renewable hydrogen, with a view to exporting it globally. Government plans to accelerate development of the Mid West Clean Hydrogen Hub in the Oakajee Strategic Industrial Area are attracting significant interest and investment. Approximately 1.7 GW of the expected 1.8 GW increase in load in the region is linked to production of hydrogen. However, it is uncertain what the impact on SWIS demand might be in terms of timeframe, given the need to develop additional infrastructure such as export facilities to realise this industry.

Eastern Goldfields

Identified load growth in the Eastern Goldfields is shown to be lower than in other parts of the SWIS, and challenging to estimate given the range of variabilities around industry growth and network requirements in the region. In addition to feedback from existing major network users, the Eastern Goldfields load growth assessment considered the potential demand impact should greater network capacity become available, enabling currently off-grid loads to move away from diesel and gas and electrify their operations.

For the purposes of the demand projections, a 50 km buffer was imagined around the SWIS, with potential loads drawn from within that boundary. This means that the potential electrification needs of off-grid mines further outside the existing SWIS footprint were not captured for this exercise.

Generation and storage: Future Ready

Supply mix

Under the Future Ready scenario, more than 50 GW of new generation and storage capacity would be required to supply load growth in the SWIS by 2042. The overwhelming majority of this new generation capacity is large-scale wind and solar (41.8 GW) as these are the most commercially viable technologies. By comparison, total utility-scale generation capacity in the SWIS in 2022 was 5.9 GW, with approximately 1.2 GW of this being large-scale wind and solar, and 3.1 GW being gas-fired generation.

The modelling shows large-scale solar paired with long duration energy storage (LDES) as the most cost efficient form of firmed renewable generation. This combination is expected to be built across the SWIS. The strongest solar resources are generally in the northern and eastern parts of the SWIS. However, the availability of land and reliable sunshine in the south suggests that up to 11.1GW of solar could also be installed there. Modelling indicates that wind generation build should occur across the SWIS to access diverse wind profiles over the day and year to maximise the availability of renewable generation at any one time.

Due to the intermittency of wind and solar resources, energy storage capacity would be essential to enable excess generation to be stored for when it is needed. The modelling considers two, four and eight-hour duration lithium-ion batteries, and a
The LDES option is based on pumped hydro, which is the most mature and widely deployed storage option available to date. Pumped hydro is challenging in the SWIS given the topography and drying climate. However, early exploration in options for pumped hydro is currently underway by Government. Other technologies are emerging, but these technologies are not yet commercially viable or ready to be deployed at scale. If these technologies do not eventuate, larger quantities of shorter duration storage technologies such as batteries may be required.

Under Future Ready, new renewable generation would be supported by an additional 3.9 GW of new flexible gas generation capacity using reciprocating gas engines. This is a modular, comparatively efficient form of gas generation technology, with a fast response capability. It is a relatively low cost option to provide essential system services and supplement energy storage in firming the intermittent renewable fleet.

Renewable generation hubs

Since the 2020 Whole of System plan modelling was conducted, the scale of the potential renewable energy requirements has shifted. The industry-wide focus on decarbonisation is driving a substantial increase in demand for renewable generation.

Some of Western Australia’s best solar and wind resources are located outside the reaches of the existing transmission network. There is potential to establish renewable generation hubs outside the current SWIS footprint, complementing renewable capacity elsewhere in the SWIS.

The modelling suggests developing new renewable generation hubs in the north, east and south of the SWIS could be part of a least-cost system future as these hubs either:

- achieve a significantly higher capacity factor than other areas; or
- have wind output that is relatively uncorrelated with wind output in other areas (it generally blows at different times of day/year to other parts of the SWIS).

---

**Figure 3: New capacity type**

- Long duration storage (10 hrs)
- Battery (6 hrs)
- Solar PV
- Wind
- Flexible gas
- Existing capacity (little storage)
Network augmentation

As part of this SWIS Demand Assessment, Western Power has developed a high-level vision for turning this modelling into reality. This includes consideration of the commonality, timing, priority, scalability, optionality and deliverability of each key augmentation. An overview of the potential stages of augmentation is provided in the map opposite and in the following sections. Work identified in stages two and three of the network plan are indicative only. They are based on current understanding of the load and generation that may eventuate, and the corresponding network use.

Stage 1
This stage would unlock existing renewable generation capacity, and allow the addition of new renewables to facilitate the orderly retirement of coal-fired generation. Stage 1 represents network build that would be required under all scenarios. Works have already started on a number of investments, and will continue until 2027.

Stage 1 includes:
• Upgrading the northern corridor, building a new line from the metropolitan area to Neerabup, and converting the existing line between Neerabup and Mid West from 132 kV to 330 kV.
• Undertaking critical conversion and reinforcement works in Kwinana and Metro North to support near term load growth.
• Building two new lines from the South East to South West to enable the initial connection of around 1.3 GW of new renewables. This will facilitate further work in Stages 2 and 3 to enable the connection of a further 5.9 GW of new renewables through a generation hub in the south.

The electricity network is critical to help decarbonise Western Australia’s existing industries, as well as develop potential new industries aligned with a clean energy future.

The existing transmission network will need to be reinforced to meet the additional demand from those looking to decarbonise. It will also need to be expanded to reach new sources of renewable energy and connect new industry areas to the power system.

The modelling suggests significant investments in the transmission network are required in all directions.

Through the consultation period, multiple stakeholders expressed the view that the northern corridor is an early priority as it will unlock existing renewable (wind) generation, and improve the connection between the primary load centre (the Perth Metropolitan Area and South West) and some of the areas with the highest wind capacity factors. This view was corroborated by the modelling.

Additional network capacity in the southern corridor allows access to a different wind profile than in the north. This diversity of supply, facilitated by the network, helps keep the electricity system secure as well as playing a critical role in supplying demand around the South West and major industry around the Kwinana area.

Upgrades through the eastern corridor are required to provide the region with more reliable access to low emissions grid-connected energy, supporting decarbonisation of the mining, metals and minerals processing loads in the Goldfields.

The lead times to plan and construct transmission infrastructure can be significant, and the modelling shows that each of the existing SWIS corridors require major upgrades to support the net zero future.

As part of this SWIS Demand Assessment, Western Power has a high-level vision for turning this modelling into reality. This includes consideration of the commonality, timing, priority, scalability, optionality and deliverability of each key augmentation. An overview of the potential stages of augmentation is provided in the map opposite and in the following sections. Work identified in stages two and three of the network plan are indicative only. They are based on current understanding of the load and generation that may eventuate, and the corresponding network use.

Stage 1
This stage would unlock existing renewable generation capacity, and allow the addition of new renewables to facilitate the orderly retirement of coal-fired generation. Stage 1 represents network build that would be required under all scenarios. Works have already started on a number of investments, and will continue until 2027.

Stage 1 includes:
• Upgrading the northern corridor, building a new line from the metropolitan area to Neerabup, and converting the existing line between Neerabup and Mid West from 132 kV to 330 kV.
• Undertaking critical conversion and reinforcement works in Kwinana and Metro North to support near term load growth.
• Building two new lines from the South East to South West to enable the initial connection of around 1.3 GW of new renewables. This will facilitate further work in Stages 2 and 3 to enable the connection of a further 5.9 GW of new renewables through a generation hub in the south.
Stage 3

Works from 2034 onward would need to include the following projects:

• Building a new line to connect the renewable generation hub in the Northern Goldfields to the North Country.
• Building a second line connecting Kwinana and Metro North.
• Building a second line between Kwinana and the South West.
• Building two new lines to expand the southern renewable generation hub.

More detailed planning to confirm Stage 3 investments will be developed with industry input.

Stage 2

To facilitate decarbonisation of the modelled load and generation, the following projects are expected to be required to be undertaken prior to 2034:

• Building two new lines from Metro North to North Country.
• Building a new line from Kwinana to Metro North.
• Building a new line between Kwinana and the South West.
• Building two new lines to connect a renewable generation hub in the south.
• Building new lines connecting the Eastern Goldfields to the South West, and extending the network to facilitate the connection of a renewable generation hub in the Northern Goldfields.

More detailed planning to confirm Stage 2 investments will be developed with industry input as part of Stage 1.

Legend & notes

High capacity 500 kV double circuit line across nodal boundary, energised to 330 kV in first instance. Line length in km may vary based on final line routes.

Network upgrade & intramodal work.

The proposed works program is indicative only, and is based on network load growth indications proved by major customers in late 2021, and the modelled generation capacity requirements to meet that load.

The actual work program will vary, and will be developed following detailed network studies and contemporary load forecasts.
Where we are heading

Increasing the capacity of the transmission network is critical to the electrification and decarbonisation of the SWIS. However, it is only one piece of the puzzle. The McGowan Government has invested more than $120 million to kickstart early network planning in the SWIS and complement other initiatives across government to drive a low emissions future.

Reducing emissions

Investment in the transmission network is essential to enable the supply of low emissions electricity to meet demand from all SWIS customers. It is integral to achieving a Government-wide emission reduction of 80 per cent by 2030, and to help the whole economy move towards the net zero emissions by 2050 target.