CHAPTER 2

The transforming energy system

2 The transforming energy system

Key highlights

- This chapter discusses opportunities and challenges arising as a result of a rapidly evolving energy system.
- Powerlink is playing an active role in the energy transformation by strategically planning the transmission network, guiding and shaping the power system, and enabling opportunities as Queensland moves to a lower carbon future.
- Powerlink has worked with the Queensland Government in the development of the Queensland Energy and Jobs Plan (QEJP), including the establishment of new Renewable Energy Zones (REZ) and providing input on the transmission implications of possible developments in the power system. Powerlink continues to inform and provide context to broader technical aspects associated with the energy transformation.
- Powerlink's long-term strategic planning considers a staged approach of low regret investments and remains focused on delivering safe, reliable and affordable services taking into account:
  - the central role the transmission network will play in enabling the transformation to a lower carbon future
  - dynamic changes in the external environment including continued growth in variable renewable energy (VRE), customer energy sources including rooftop PV systems, and broader shifts to electrification and decarbonisation within Queensland industries
  - the condition and performance of existing assets, and planning the network in such a way that it is best configured to meet current and future energy needs while maintaining the flexibility to adapt as the network evolves.

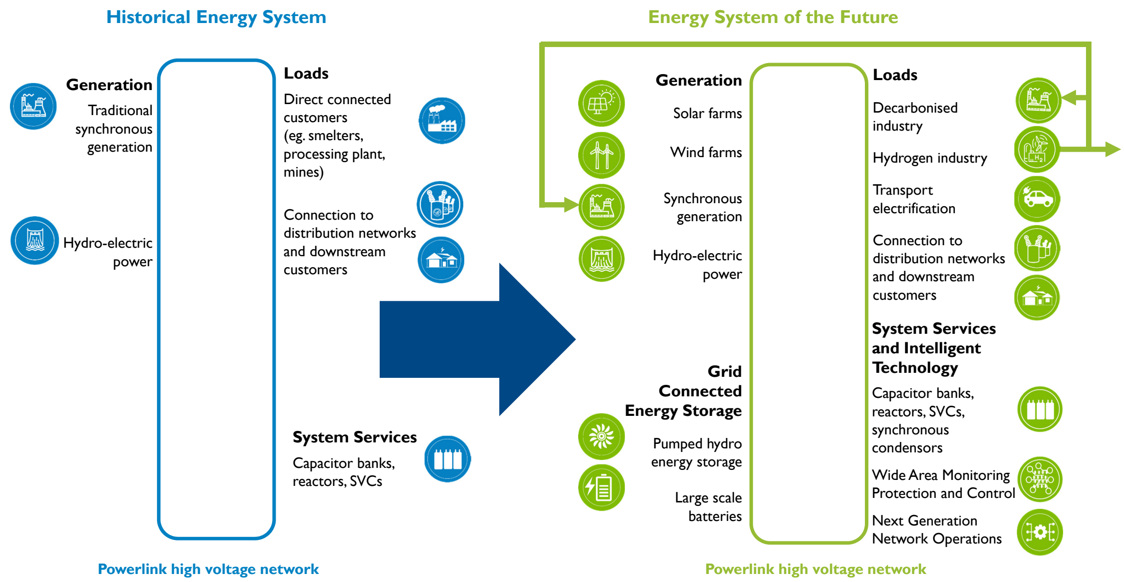
2.1 Introduction

The transformation of the energy system within Queensland to one underpinned by clean, sustainable and affordable renewable energy is well underway. The share of large-scale VRE within the State continues to increase with significant growth in grid-connected solar and wind farms. The uptake of rooftop PV systems continues to be strong. A number of corporations have committed to the decarbonisation of existing fossil fuelled operations and processes either through electrification or clean fuel substitution to leverage Queensland's abundant renewable energy resources. A new industry based on hydrogen is also emerging.

The Queensland transmission system is central to the efficient transformation to a lower carbon future. The energy system of the future will be characterised by a mix of technologies and infrastructure along the entire energy supply chain as part of the transformation to net zero emissions. It will look considerably different to the energy system in the past with large-scale renewable generation, battery energy storage systems, large-scale Pumped Hydro Energy Storage (PHES), decarbonised industrial loads, emerging green hydrogen markets, electric transportation, distributed consumer energy sources, and innovative intelligent control and orchestration all being integral components of the decarbonised energy system.

The transmission system has a critical role to play as a central platform and enabler for the energy transformation. As the Jurisdictional Planning Body (JPB) and Transmission Network Service Provider (TNSP) within Queensland, Powerlink is playing an active role in shaping the electricity system of the future through collaboration with Government and key industry groups, guiding network and non-network investment, providing technical advice, and overseeing investigation and studies for key infrastructure critical for the energy transformation.

Figure 2.1 Energy system of the future



2.2 Queensland Energy and Jobs Plan

The Queensland Government has published the Queensland Energy and Jobs Plan (QEJP), which outlines how it intends to meet the Queensland Renewable Energy Targets (existing and new targets) and more broadly achieve transformation to a lower carbon future.

Powerlink has worked closely with the Queensland Government in the development of the plan, including the establishment of Renewable Energy Zones and providing input on the transmission implications of possible developments in the power system. Powerlink continues to inform and provide context to the broader technical aspects associated with the energy transformation.

Powerlink is also been actively involved and is supporting a number of significant initiatives and collaborative works within the energy industry. These include development of AEMO's Integrated System Plan (ISP) and various Australian Energy Market Commission (AEMC) Rule changes and reviews.

2.3 Renewable Energy Zones

A Renewable Energy Zone (REZ) is a geographic area which has significant high quality renewable resources, suitable topography and available land to support the efficient connection of a number of large-scale renewable energy projects. Development of a REZ allows multiple grid-scale renewable energy developments to be connected in the one location realising economies of scale and enabling the connection of grid-connected renewable energy in a more cost-effective and coordinated manner. The development of REZs also streamlines implementation of renewable energy projects by leveraging off common infrastructure.

Queensland is an attractive location for grid-scale VRE generation as the State is rich in a diverse range of renewable resources. The establishment of REZs enables large-scale renewable generation, transmission grid, energy storage and firming, and ancillary system services to be coordinated and optimised to maximise the potential capacity of renewable energy in the most cost efficient manner possible whilst reducing investment risk and financing cost for developers.

2.3.1 QREZ

As part of the Queensland Government's COVID-19 Economic Recovery Plan, the Queensland Government has committed $145 million to establish three QREZ regions in northern, central and southern Queensland to help facilitate the energy transformation.

Powerlink has been working closely with the Queensland Government to identify strategic transmission investments that can maximise the capacity and cost efficiency for renewable energy and decarbonisation opportunities. The guiding principles for Powerlink in development of the QREZs include:

- optimising the existing capacity of the transmission network to provide scale efficient infrastructure for renewable energy development
- developing REZ in areas where shared network transmission capacity enables access to the market
- efficiently developing REZ to match regional loads to minimise losses
- seeking diversity in VRE generation sources to optimise firming services so as to ensure continued reliability and security of supply at the lowest cost to customers
- engaging with communities within the decision-making process to minimise environmental and landholder impacts, and deliver benefits for local communities.

2.3.2 QREZ Proposed Framework

The Queensland Government with input from Powerlink has proposed a framework for unlocking additional renewable generation in the State. The State Government Technical Discussion Paper presented the desired QREZ model attributes. Under the proposed model, recommendations would be provided to the Queensland Minister for Energy on investigation areas. The Minister would then provide a market and community notice to engage with industry and community on these investigation areas and test locational feasibility.

The engagement will inform Powerlink in assessing and recommending the investigation areas and REZ infrastructure to be progressed for further development. Supported by the recommendations, the Queensland Minister for Energy would then declare the REZ. At this point the QREZ framework would be applied to the nominated area and infrastructure with relevant information released in a draft REZ Management Plan (RMP). Engagement will occur on the draft RMP with the declared REZ design and parameters published in the final RMP.

The Queensland Government also released a Community Consultation Paper on QREZ identifying four proposed local benefit principles for community feedback. This framework continues to be under development incorporating feedback from consultation processes.

2.3.3 Northern QREZ

In May 2021 it was announced that the Queensland Government would direct $40 million of committed funding in transmission line infrastructure to establish the Northern QREZ, with Neoen's Kaban Wind Farm identified as the first Northern QREZ project. The transmission augmentation work involves energising one side of the existing 132kV coastal double circuit to 275kV operation. The development of the northern QREZ will increase renewable hosting capacity within the area by up to 500MW opening the region for further investment.

Powerlink has completed public consultation for the funded augmentation, with submissions to the consultation supportive of the establishment of the Northern QREZ. This REZ provides additional benefits including improving reliability of supply to the Cairns area. The establishment of the Northern QREZ through upgrading of the third circuit to 275kV operation is scheduled for completion by November 2023 (refer to Table 11.3).

2.3.4 Central QREZ

The Central QREZ has potential hydrogen and existing energy-intensive industries which are looking to decarbonise through either electrification of existing processes and/or conversion to loads powered by renewable energy.

The Central Queensland REZ covers a strong part of the network where the existing Gladstone and Callide synchronous generators are connected. This REZ is connected via a meshed 275kV network between Bouldercombe, Calliope River and Calvale 275kV substations, and was identified within the 2022 AEMO ISP as having high quality solar and wind resources.

Powerlink is currently progressing a number of connection enquiries to develop wind, solar and battery energy storage projects within this area. As outlined in the QEJP, Powerlink will progress transmission investment within Central Queensland to support renewable energy and decarbonisation in the area. This investment includes the construction of a new 275kV double circuit transmission line between Calvale and Calliope River substations which will unlock up to 1800MW of renewable hosting capacity. Powerlink will also invest in the 275kV system to the Banana area west of Calvale substation to further unlock an additional 1500MW of renewable energy hosting capacity, and the establishment of synchronous condensers in the Gladstone zone to provide system strength to support VRE development.

2.3.5 Southern QREZ

The Southern QREZ has significant potential for grid scale VRE development with a diverse mix of industries and energy sources. The REZ is close to large load centres in South East Queensland and the interconnector to New South Wales. This region has strong network and existing capacity to connect new projects, and good wind resources which will complement existing solar, storage and other generation. The MacIntyre Wind Precinct connection project is scheduled for completion by 2024 and will create renewable hosting capacity up to 2,000MW. The facility will be one of the largest on-shore wind farms in the world upon completion.

The Wambo Wind Farm is a proposed renewable development located in the Western Downs local government area. Stage 1 of the project proposes 250MW of generating capacity. The 275kV connection to the Wambo Wind Farm will allow up to 1,850MW of renewable hosting capacity in the area. Other proponents have expressed interest in the area and Powerlink is progressing a number of connection enquiries.

2.4 Energy Storage

Energy storage and firming services will form an integral part of the future mix of technologies in Queensland. These services appropriately located and sized will increase the reliability of supply from intermittent generation sources by shifting energy to manage peaks and troughs associated with weather conditions, consumer demand, and other factors.

The energy system of the future will comprise a mix of firming services ranging from PHES, grid-connected battery energy storage systems (BESS), community battery systems, residential household batteries, and dispatchable generation sources (such as gas fired or hydrogen fuelled generation). PHES are utility scale energy storage systems which deliver hydro-electric power generated through the release of water from an upper reservoir to a lower elevation reservoir, and store energy by using the same machines to pump water from the lower reservoir to the upper reservoir. These systems are generally larger in scale and provide longer duration energy storage whereas battery systems provide energy at smaller storage scales over shorter periods. Both technologies will also provide critical system security services necessary to support the transmission network as part of the energy transformation.

2.4.1 Pumped Hydro Energy Storage (PHES)

The QEJP includes the investment of two large PHES projects to enable the transformation of the energy system in a reliable and cost-effective manner for the longer term. The long lead times for the development of pumped hydro storage facilities means that work is required at the current time to ensure that Queensland has sufficient large-scale energy storage available in future.

Powerlink has been leading detailed design and business case development of the Borumba PHES facility for the Queensland Government. The Borumba site is located south west of Gympie, and was selected as the first site for detailed design and cost analysis following a state-wide assessment of potential pumped hydro locations.

The Borumba PHES facility will play a crucial role in the transformation of Queensland's energy system. Preliminary assessments indicate that the facility could be capable of generating up to 2GW of power for a period of 24 hours. The site is located in proximity to several existing transmission corridors within southern Queensland, and is strategically located to provide firming and system support services for significant renewable energy generation development in the southern QREZ.

Due to the scale of generation and storage capacity, new transmission infrastructure will be required from the facility to two substation sites in south east Queensland. Powerlink and the Queensland Government are committed to engaging early and often with the community and other key stakeholders to ensure the project delivers, not only the best outcomes for Queenslanders, but also those who live in the region. A number of information sessions have been held with the community in this region and a Stakeholder Reference Group has also been established to seek further input and feedback. The outcomes of the extensive engagement to date is helping inform the detailed analytical studies and transmission connection investigations being undertaken for the project.

The QEJP has also announced the development of a second PHES facility located within north Queensland with the preferred site in the western Pioneer Valley area with upper reservoirs located at the head of the Burdekin River catchment. This second PHES will have an energy storage capacity of 5GW over 24 hours making the facility the largest in the world. The facility is expected to be delivered over two stages, with the first stage (2500MW/60GWh) being delivered by 2032 and the second stage (2500MW/60GWh) completed by 2035. The PHES will connect to a new 500kV backbone transmission system required for large-scale transportation of renewable energy and storage across the State.

The Queensland Government has set aside $273.5 million (including $203.5 million of new funding) to advance the Borumba and Pioneer-Burdekin PHES projects. This funding will support detailed engineering and environmental investigations, community engagement and early access works, and build on the work progressed to date on the Borumba PHES project. The Government has announced the establishment of a new publically owned entity (Queensland Hydro) to progress these PHES foundational investments.

Powerlink also has also been engaged by Genex Power Limited (Genex) to undertake a range of activities relating to a 275kV electricity transmission line and associated substations for the connection of the Kidston Clean Energy Hub located in north Queensland (approximately 270km north west of Townsville). This renewable energy facility includes the construction of a 250MW/2000MWh PHES facility (K2-Hydro) currently scheduled for completion within the 2025 financial year.

In addition to the above, there are also numerous smaller capacity and shorter duration PHES projects being proposed and developed by the private sector. These proposals will also form important components of the energy transformation within Queensland.

2.4.2 Battery Energy Storage Systems (BESS)

Grid-scale battery energy storage systems supported by advanced inverter technology will play a greater role in the future transmission network providing system security services such as shorter term energy storage, frequency regulation, voltage control, virtual inertia and system strength. Grid-forming batteries can play a constructive role in increasing the hosting capability of inverter based renewable generation and supporting the secure operation of the power system.

Grid-scale batteries can also play a role as virtual transmission lines (VTLs). This offers the potential to alleviate transmission congestion and defer the need for future network augmentations. Battery services can also be used to manage the impact of network outages by reducing constraints on generation, and potentially provide other support and ancillary services for the transmission network.

Queensland's first large-scale BESS was connected to Powerlink's transmission network at Wandoan South Substation and Vena Energy have now commenced commercial operation of the facility. A number of additional large-scale grid connected BESS are in various stages of connection and construction within Queensland.

Powerlink also has implemented an innovative commercial and technical model to guide the market on network services for grid-scale battery energy storage devices. In early 2021, Powerlink published an Expression of interest (EOI) to enable the development and construction of storage solutions that benefit customers and enable the wider energy transformation. This process involved Powerlink and proponents collaboratively developing technical and commercial models to maximise the overall value of grid-scale batteries to the power system and customers.

As part of this model, Powerlink has offered BESS proponents the opportunity to construct and install BESS at beneficial locations in the network in return for network support mechanisms. In actively supporting the development of BESS, Powerlink is seeking to establish synergistic relationships with commercial operators to enable scale and scope efficiencies and achieve the objectives of both network technical requirements and commercial outcomes for investors.

CS Energy and Powerlink have partnered to implement the largest utility-scale battery in the State as part of this work to make the energy network more secure and stable, support the shift to renewables, and contribute to reducing electricity costs to customers. The 200MW/400MWh battery will be installed at Powerlink's Greenbank Substation located within the Moreton zone in south east Queensland.

Powerlink is progressing the EOI to identify additional partnerships for BESS installation within Queensland, with the preference for up to two sites located within central and north Queensland to accommodate utility scale battery systems up to 200MW/400MWh. It is envisaged the commercial and technical arrangements developed as part of this process may be made available to other new and existing grid-scale batteries, as well as other flexible resources to provide required technical and network support mechanisms.

2.4.3 Comparison of Energy Storage Systems

The energy system of the future will require a variety of storage devices ranging from large-scale pumped hydro storage, grid-scale and community battery energy storage systems, and customer energy resources (including residential battery devices). The potential hybrid adoption of battery storage capability within electric vehicles and hydrogen storage are also future potential storage mechanisms.

An indication of the relative sizes of energy storage for existing and proposed storage infrastructure projects within Queensland are shown in Figure 2.2. Pumped hydro and battery energy storage devices are also able to provide a range of transmission and system security services, including system strength, inertia, frequency and ancillary control. These services are critical for the secure operation of a lower carbon energy system.

Figure 2.2 Relative energy storage capacities of PHES and BESS

2.5 Electrical demand changes

The electrification of major industrial processes, mining operations, and transportation will be an integral component of Australia's pathway to net zero emissions. Access to a secure, cost-effective and reliable transmission network will be pivotal in enabling sectors the opportunity to electrify operations with renewable generation sources, and for Queensland to transform into a renewable hydrogen exporter.

The electrification of existing fossil fuel operation and processes presents the primary avenue for decarbonisation. It has been estimated that around 20% of the energy needs of existing Queensland industries are currently met through electricity, and that around 60% of Queensland's energy consumption has the potential for direct electrical substitution through use of existing and emerging commercialised technologies. The remaining 20% of consumption within the State comprises of energy that is expected to require further technological development for electrical substitution.

2.5.1 Decarbonisation through Electrification

The nature and concentration of energy use across the State varies considerably depending on the category of customer. There are significant mining operations within the Central West and North zones, and electrification of mining operations will impact on transmission capacity requirements to these, and within, these areas (refer to sections 9.2.1 and 9.2.2). LNG extraction and compression facilities are concentrated within the Surat and Gladstone zones, and there are significant opportunities to decarbonise these processes through electrification (refer to Section 9.2.3).

The transportation sector presents one of the largest opportunities for decarbonisation. The adoption of electric vehicles (EVs) presents the shortest term opportunity for increasing electrification and decarbonisation. The charging behaviour and patterns for EVs has the potential to either support or challenge network requirements from the grid. The management of electric vehicle (EV) charging will be important to optimising the utilisation of the existing network, particularly within the Moreton and Gold Coast zones.

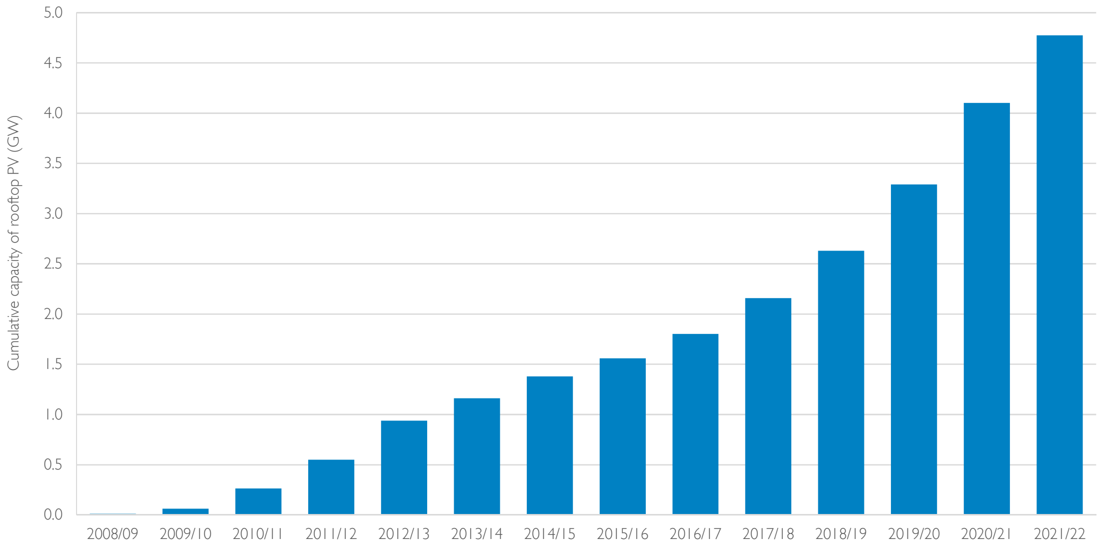
EVs have the potential for dual purpose application in terms of being both mobility and household distributed energy sources. EV battery capacities are generally larger than required for typical household daily use, and it may be possible to leverage this capacity to smooth daily demand usage patterns and rooftop PV output. Both residential battery systems and electric vehicles have the potential to optimise transmission and distribution network utilisation under appropriately designed orchestration incentives and mechanisms.

2.5.2 Rooftop PV and Distributed Energy Sources

Residential and commercial loads are generally located within built up urban and township areas, with continued uptake of rooftop PV systems and distributed energy sources having the greatest impact to demand and energy patterns in these areas.

Queensland has one of the highest penetrations of rooftop PV systems in the world. The current installation rate is approximately 700MW per annum with the average installation size within residential households increasing over time. The uptake of rooftop PV systems is expected to continue with the most recent 2022 Queensland Household Energy Survey (QHES) indicating that 26% of participants intend to purchase new or upgrade rooftop PV systems in the next three years, and 92% indicated they would replace their existing panels with similar sizes or larger if their current system failed. Around 48% of survey participants indicated they would replace their existing system with a higher capacity system if their current system failed.

Figure 2.3 Cumulative capacity increase of Queensland rooftop PV (1) (2)

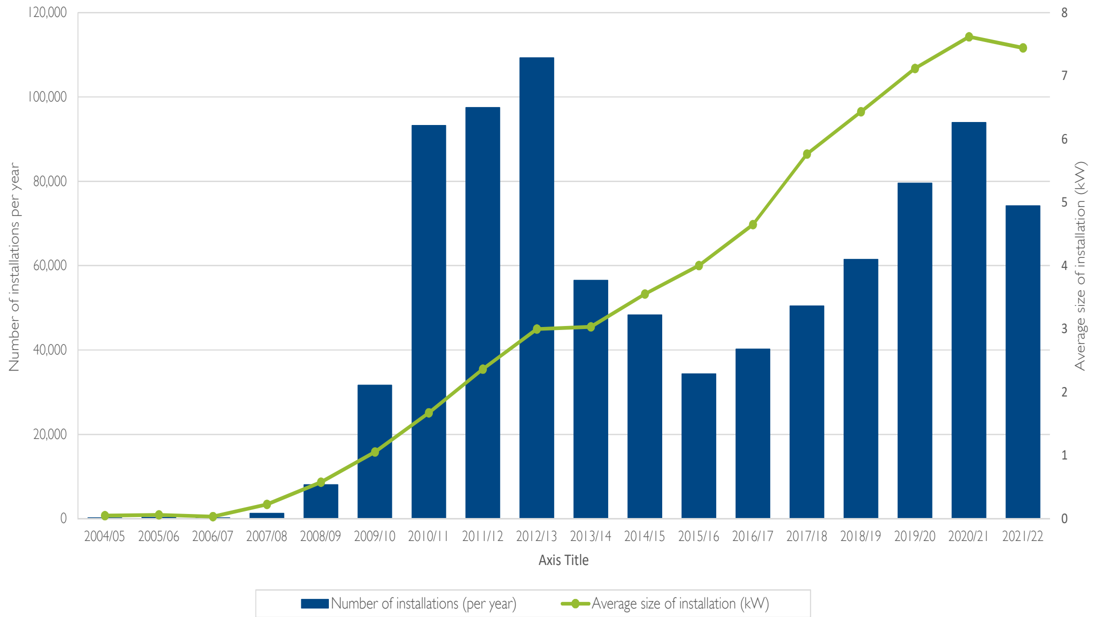


Notes:

(1) Source: Clean Energy Regulator.

(2) Note that registrations generally lag installations and hence data for FY2022 may be slightly understated.

Figure 2.4 Annual installation rates and average sizes for Queensland rooftop PV (1) (2)



Notes:

(1) Source: Clean Energy Regulator.

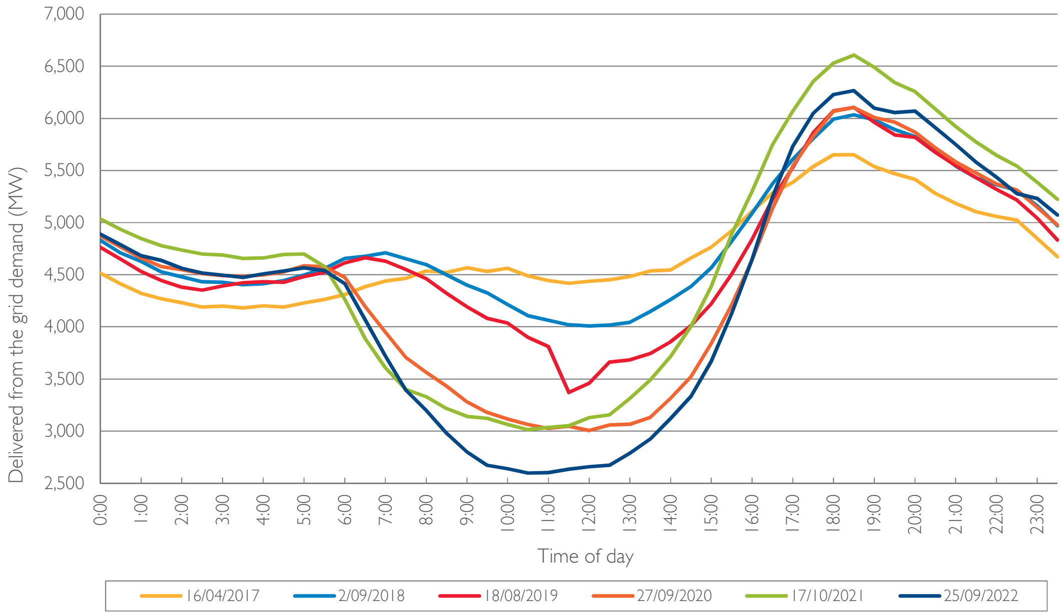
(2) Note that registrations generally lag installations and hence data for FY2022 may be slightly understated.

The installation of small scale rooftop PV systems and distribution connected solar farms has progressively changed the characteristics of daily demand required to be supplied by the Powerlink transmission network. Historically the delivered load profile has generally seen daily peaks occur during the mid afternoon or evening periods. However the cumulative effect of small scale solar renewable energy has the effect of hollowing the daily demand profile during the day time period. This contribution ceases during the evening when the sun sets.

This effect is more likely to be prominent within Queensland during the lower day time demand in the winter and spring seasons. The term 'duck curve' was first coined by the Californian Independent System Operator to describe the effects of utility scale solar power generation on the shape of the daily net load profile, and is a characteristic experienced by transmission networks globally where there has been a significant level of embedded highly correlated PV renewable energy systems. Figure 2.5 depicts the change in daily load profile of the transmission delivered profile within Queensland.

Minimum demand during the day has continued to decrease with the progressive installation of rooftop PV and distribution network solar system connections. However, maximum daily demand has continued to increase in line with underlying load growth since the contribution of rooftop PV tapers off towards the evening. This has resulted in an increasing divergence between minimum and maximum demand which needs to be met and managed by large-scale generation and the transmission network. With the expected continued uptake of residential and commercial rooftop PV installations, and in the absence of significant levels of demand shifting or distributed energy storage, minimum demand levels are expected to further decrease with a continued widening between maximum and minimum demand.

Figure 2.5 Transmission delivered annual minimum demand for the Queensland region (1)(2)



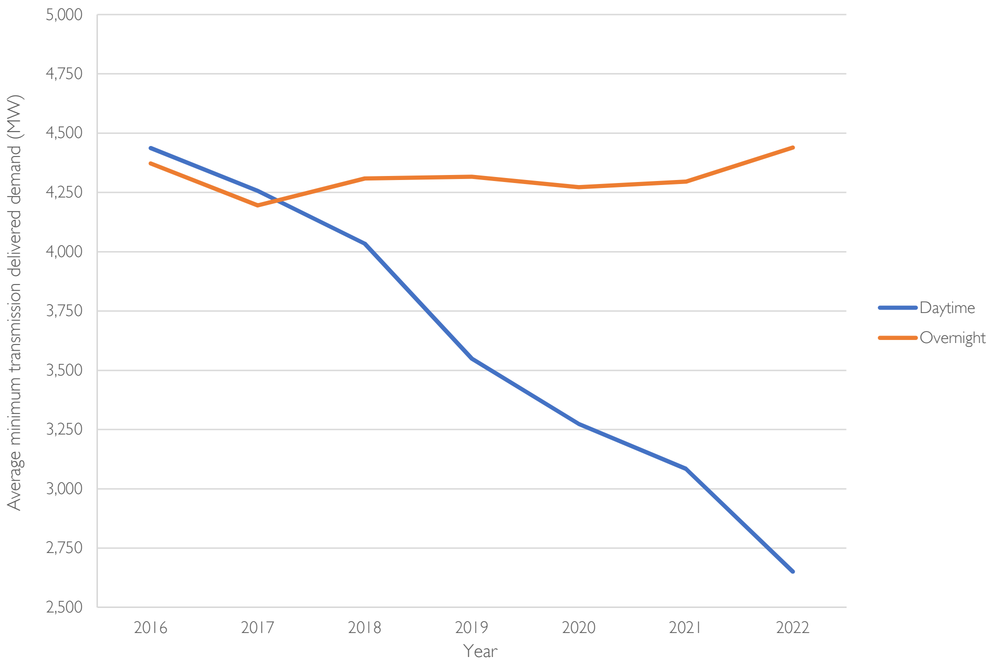
Notes:

(1) Minimum demand can be caused by abnormal conditions as depicted in the 2019 trace when lowest demand coincided with a large industrial load being out of service.

(2) 2022 trace based on preliminary metering data up to 3 October 2022.

Continuation of this trend is likely to present challenges to the energy system. Generators are increasingly required to ramp up and down in response to daily demand variations more frequently. Decreasing minimum demand will lower the amount of synchronous generation that is able to be online and this could further impact on voltage control, stability, system strength, inertia and the ability for available generators to meet evening peak demand. There may be opportunities for new technologies and non-network solutions to assist with power system security challenges, and these type of services could offer a number of benefits to the energy system including reducing the need for additional transmission network investment.

Figure 2.6 Increasing divergence between day time minimum demand and overnight demand (1)



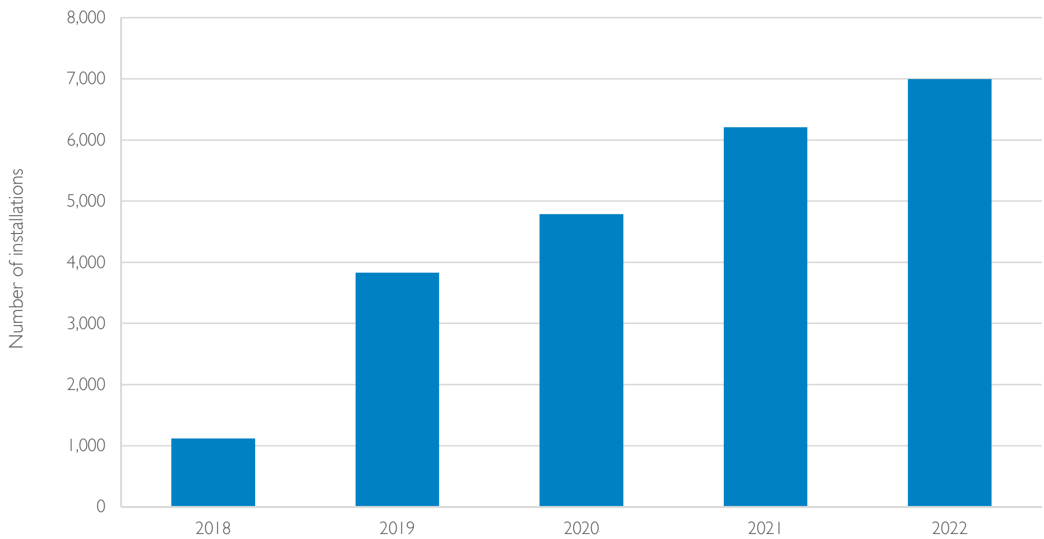
Note:

(1) Average of the five lowest demand days per calendar year for day time and overnight based on delivered from the Queensland transmission grid demand.

(2) 2022 figures based on preliminary metering data up to 3 October 2022.

Residential household batteries have the potential to help smooth daily demand profiles and improve the utilisation of the network where appropriate incentives are in place. The small-scale battery segment is continuing to build steadily in Queensland with almost 7,000 battery installations currently reported within residential households (refer Figure 2.7).

Figure 2.7 Residential battery uptake within Queensland (1)



Note:

(1) Source: Clean Energy Regulator.

Powerlink, Energy Queensland and the Queensland Government recognise the need to ensure that investments and measures to address minimum demand are complementary, and that energy storage across the supply chain (transmission, distribution and consumer level) need to operate in a coordinated manner. Orchestration of technologies across the different supply chain levels, including large-scale generation and storage, demand side management (DSM) and time of day shifting, customer energy and storage sources, and 11.00am charging will be key to optimising utilisation and performance of the energy system.

2.5.3 Emerging Hydrogen Industry

The Queensland Government is committed to working with industry to accelerate the development of hydrogen related industries, including the production and export of hydrogen and manufacturing of associated hydrogen industrial components. Queensland is well placed for the development of a range of hydrogen production and secondary supporting manufacturing industries due to the prevalence of large-scale renewable energy development, available land, and proximity to ports particularly within the Townsville, Gladstone, and Brisbane Trade Coast areas. Potential markets include both domestic hydrogen to decarbonise existing industrial processes and establishment of new hydrogen export markets.

Powerlink and the Queensland Government are supporting a range of significant hydrogen developments in Queensland. Key activities for Powerlink include:

- project development for the connection of renewable hydrogen facilities within the Brisbane Trade Coast Area
- a hydrogen electrolyser manufacturing facility within Gladstone
- large-scale production facilities for green hydrogen and ammonia within the Gladstone State Development Area (SDA).

Powerlink has experienced increasing customer interest over the past year associated with the decarbonisation of industrial processes through electrification and the emerging hydrogen industry within Queensland. Potential developments associated with electrification and hydrogen are significant, and the Queensland transmission network is expected to play a central role in enabling the decarbonisation of industry, and the development of both domestic and export hydrogen markets.

2.6 Technical Considerations

The scale and pace of changes to the transforming energy system within Queensland has been significant, and this is presenting technical challenges and new requirements for the power system.

The transmission network has historically been designed for the bulk transfer of energy from large power stations to regional load and industrial centres. However, the development of large-scale grid connected and embedded VRE sources coupled with the rapid uptake of distributed residential and commercial rooftop PV systems are changing generation profiles and power flows. The reduction of synchronous generation sources is impacting the electrical characteristics of the energy system, with challenges presenting in the areas of voltage control, stability, system strength, inertia and ramp rates.

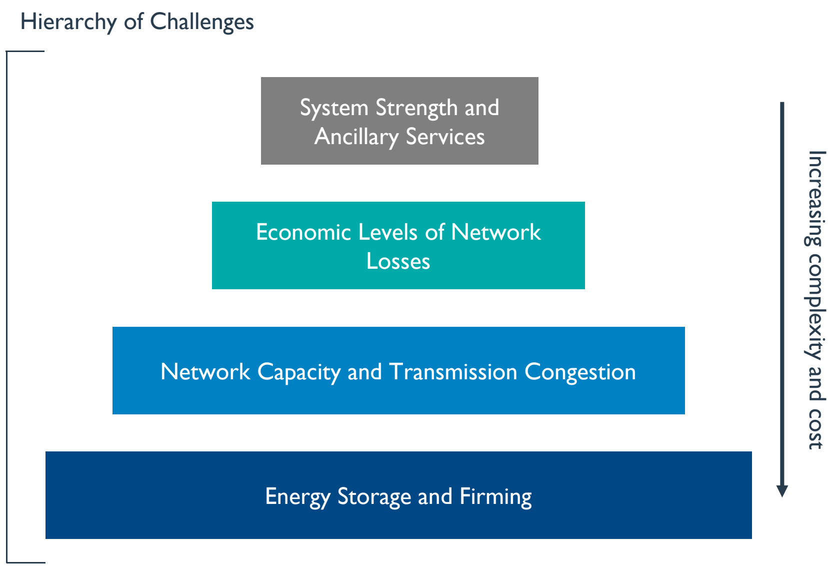
There is a general hierarchy of technical challenges in terms of complexity and cost (refer Figure 2.8). Solutions to these challenges can be multi-faceted, and in many cases require new and innovative approaches. Powerlink has been at the forefront of implementing new approaches and technologies, and guiding and shaping developments in the market to optimise performance and utilisation of the transmission system.

For example, Powerlink has worked with existing and intending renewable energy developers to optimise the control philosophy and settings of plant to improve the renewable energy hosting capacity of areas within Queensland. Powerlink's Large-Scale Battery Services EOI process has also guided the development of grid connected battery storage systems using grid-forming inverters at optimal locations within the transmission network.

Powerlink is also progressively implementing the Wide Area Monitoring Protection and Control (WAMPAC) system to maximise the utilisation of the network, and provide an additional layer of security and resilience to system disturbances and events. WAMPAC has been implemented for system protection services across the central to south Queensland grid section (refer Section 8.3), and further applications for the technology are progressing to more effectively manage the performance of the transmission network.

Powerlink has been managing design studies for the proposed large-scale Borumba PHES facility for the Queensland Government, and collaborating closely with AEMO on the 2022 ISP through technical working groups and other related activities. As outlined in the QEJP, Powerlink will progress the development of a new higher voltage and capacity transmission system (up to 500kV) from north to south Queensland to act as the backbone for efficient large-scale transportation of renewable energy and storage across the State. This new backbone system will be implemented in stages, and provide one of the cornerstones for enabling energy transformation in Queensland.

Figure 2.8 Hierarchy of technical challenges with the energy transformation



2.7 Energy transformation and engagement with our communities

New transmission infrastructure that is needed to be built as part of the transformation to a lower carbon energy system has the potential to create long-lasting benefits for Queensland communities. Powerlink will work closely with Queensland communities to deliver additional local benefits for those impacted by energy infrastructure.

Powerlink is undertaking early and authentic engagement to listen to our communities and other stakeholders and better understand their needs and priorities. Our goal is to develop co-existence arrangements with landholders and seek to provide long-term benefits for the communities in which we operate. Our Community Engagement Strategy underpins this focus on ensuring local benefits and community investment go hand in hand with delivering the new energy future.

2.8 Ongoing transformation

The power system of the future will present many operational, planning, regulatory and market challenges. New frameworks, strategies and infrastructure are required to enable the orderly transformation to a power system which is underpinned by clean, sustainable, resilient and reliable energy at the lowest long run cost to customers (customers also includes consumers in Powerlink's engagement processes).

Powerlink is keeping abreast of new technological developments and collaborating with the Queensland Government, AEMO, Energy Queensland, and other market participants to enable the energy transformation. This will ensure that the high voltage transmission network is capable of unlocking opportunities and benefits associated with a decarbonised energy system to power economic growth, enable market efficiencies, deliver local benefits to communities, and minimise costs to customers.