Smart Network Overview

Part of the Energy Queensland Group

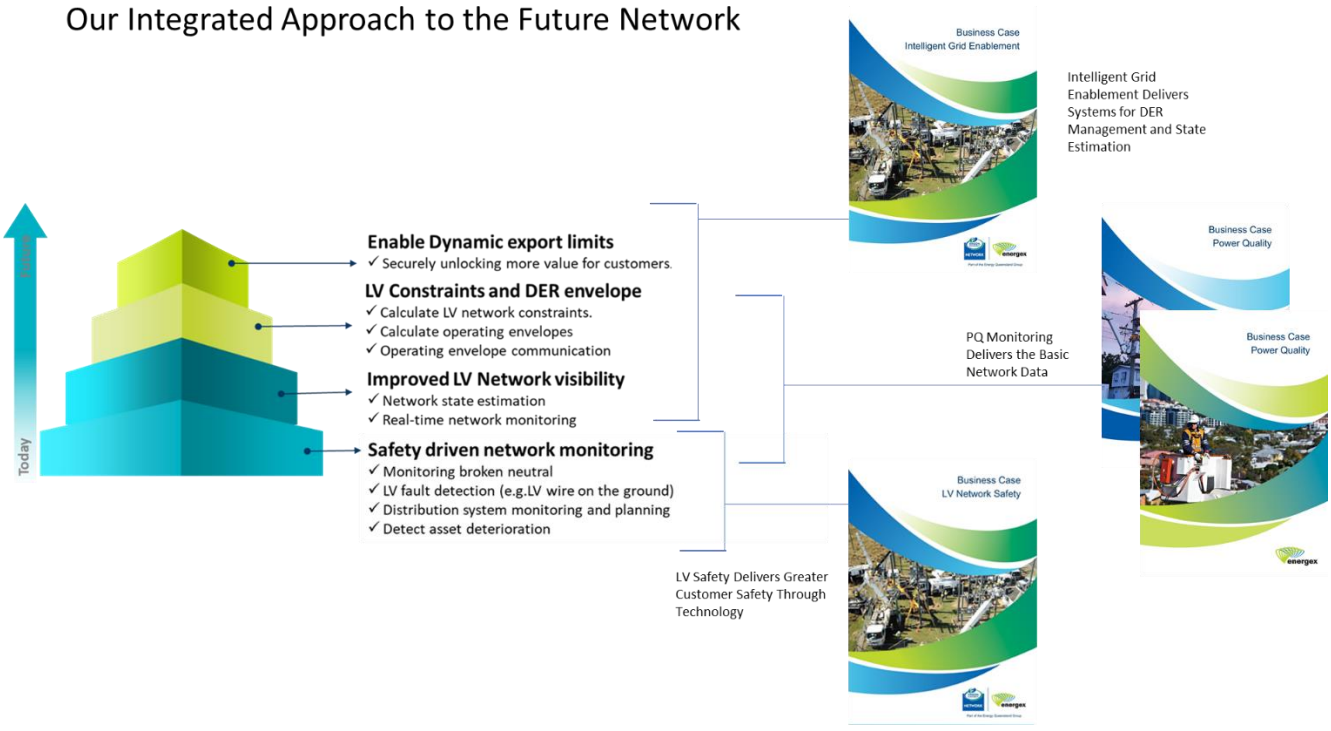
Executive Summary

Energy Queensland Limited (EQL) has developed a range of initiatives to ensure that we are ready for the future. This future involves increased Distributed Energy Resources (DER), increased two-way power flows, emerging network challenges, and above all, more involvement by our customers in their energy outcomes.

Our customers already have more roof-top PVs per capita than anywhere else in the world, and we are facing many challenges in dealing with the issues that this creates on the network. However, this is only the beginning of the changes in terms of how our customers use electricity and drive their own outcomes through managing their demand, interacting with the network and controlling their electricity costs. We need to embrace these changes and be ready and able to facilitate the changes for our customers rather than just reacting to what happens next.

This document provides an overview of our strategies and plans for the smart network of the future. By no means will this plan be completed during the 2020-25 regulatory control period, however we need to start the journey of getting ready for the future smart network and all of the interactions with our customers that come with this.

This document provides some insights into our thinking and provides linkages between the strategies and our individual business cases and plans that form part of our Regulatory proposal for the 2020-25 regulatory control period.



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1. Introduction

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1.1 Purpose of document

This document provides an overview of our strategies and plans for the smart network of the future. By no means will this plan be completed during the 2020-25 regulatory control period, however we need to start the journey of getting ready for the future smart network and all of the interactions with our customers that come with this.

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1.2 Scope of document

This document is not a business case but rather provides an overview of our strategies and plans. It highlights the business cases that we've submitted as part of our Revised Regulatory Proposal (RRP), and shows the linkages between these business cases and out overall plan.

1.3 Energy Queensland Strategic Alignment

This document should be read in conjunction with our broader strategies and plans, including:

- Energy Queensland, *Corporate Strategy [1.001],* (31 January 2019).
- Energy Queensland, *Future Grid Roadmap [7.054],* (31 January 2019).
- Energy Queensland, *Intelligent Grid Technology Plan [7.056],* (31 January 2019).
- Energy Queensland, *Low Voltage Network Monitoring Strategy [7.080],* (31 January 2019).

It also draws on the Electricity Network Transformation Roadmap (2017) released by the Energy Networks Association (ENA). More recently, the Australian Energy Market Commission (AEMC) identified the integration of DER into energy markets as the key focus of their 2019 Economic regulatory framework review, which also highlighted that failure to provide a grid that enables customer choice and adoption of these technologies poses a strong risk of increasing costs to customers in future (AEMC, 2019).

2 An Overview of Our Future Network Challenges

2.1 The Current Trends and Challenges

The figure below shows the current trends and forecasts for roof-top solar PV and batteries in Queensland. To date this trend has been driven by attractive infeed tariffs, plus rising electricity prices. However, more recently other market forces are further accelerating the increases in renewable generation. Queensland (the Sunshine State) has abundant solar energy resources and when combined with ongoing electricity price affordability concerns for our customers, the growth is forecast to continue. Queensland has a target of 50% renewables by 2030 and this will drive both roof-top and larger scale PV installations. Technology costs are reducing as the world-wide uptake of solar PV and batteries is driving down costs.

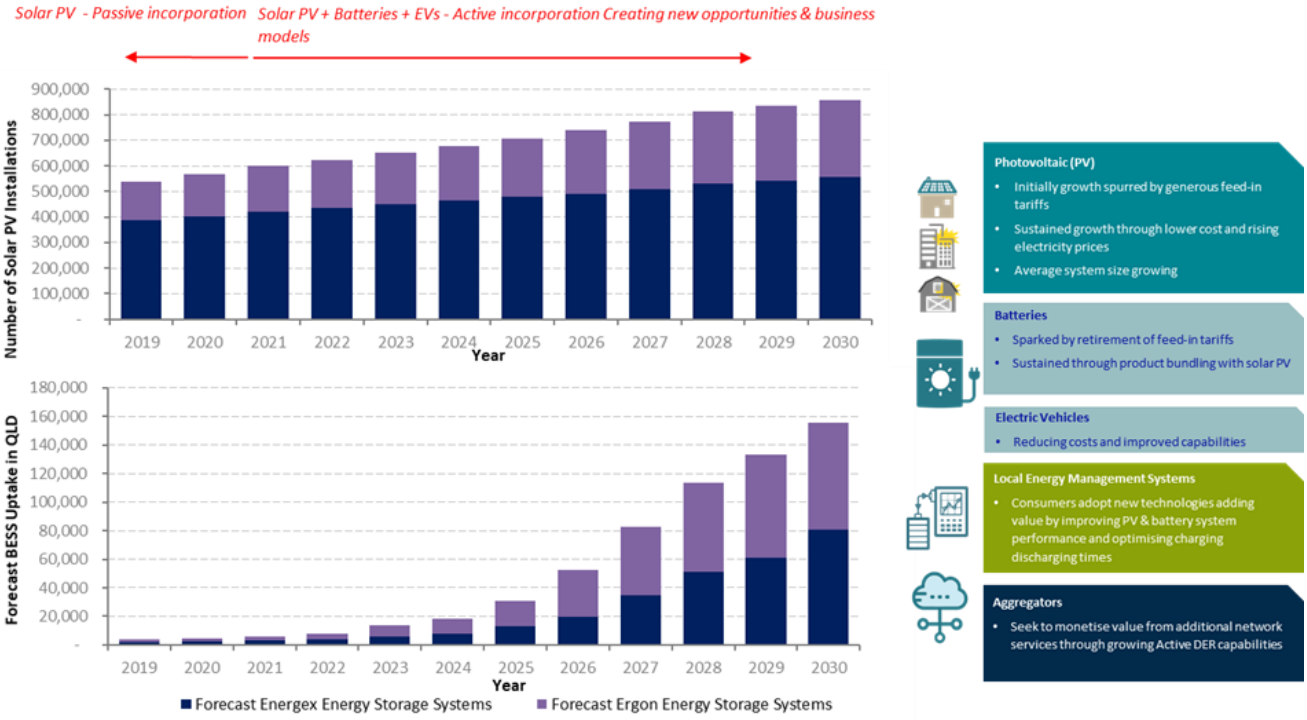

Figure 1: Growth in Solar PV and Batteries

This growth has already created significant challenges in our networks, with voltage complaints related to solar installations rising, reverse power flows occurring in many parts of or Low Voltage (LV) and some parts of our High Voltage (HV) networks. These trends will continue and left unaddressed we will be in a position of rising costs, just reacting to the many issues that will arise in future years.

Combined with these new challenges, we also face significant existing challenges with our networks. Some assets are ageing and present maintenance and renewal challenges. Left unaddressed, these challenges will again leave us reacting to failures and with increasing costs. Safety is our main priority in terms of our ageing assets – we have many safety challenges and significant renewal of our assets is required. We want to use technology to assist in this process to ensure that we are simply not just building more and more of the same assets – we need to have smarter approaches to enable us to provide safer community outcomes at a lower cost.

2.2 Moving Towards Our Future Electricity System

We think that our approach to the future must be focussed on what our customers want and need. The figure below shows how we think we should move forward.

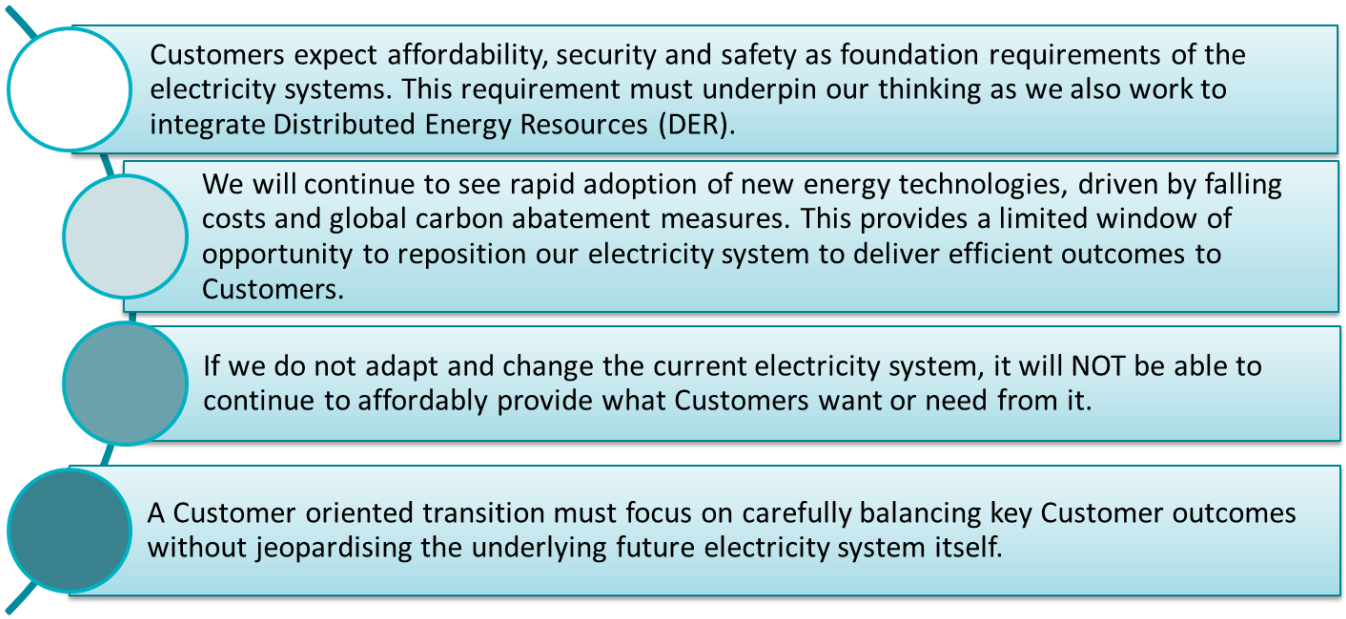

Figure 2 : Our Customer Centric Approach

Our approach in the past has been to design our systems and processes around the needs of the network. This is unlikely to be successful in the future as we're now dealing with an interactive environment and many participants including our customers, energy retailers and other third parties. We recognise that we need to assess our challenges and build our future technology around the needs of the customers.

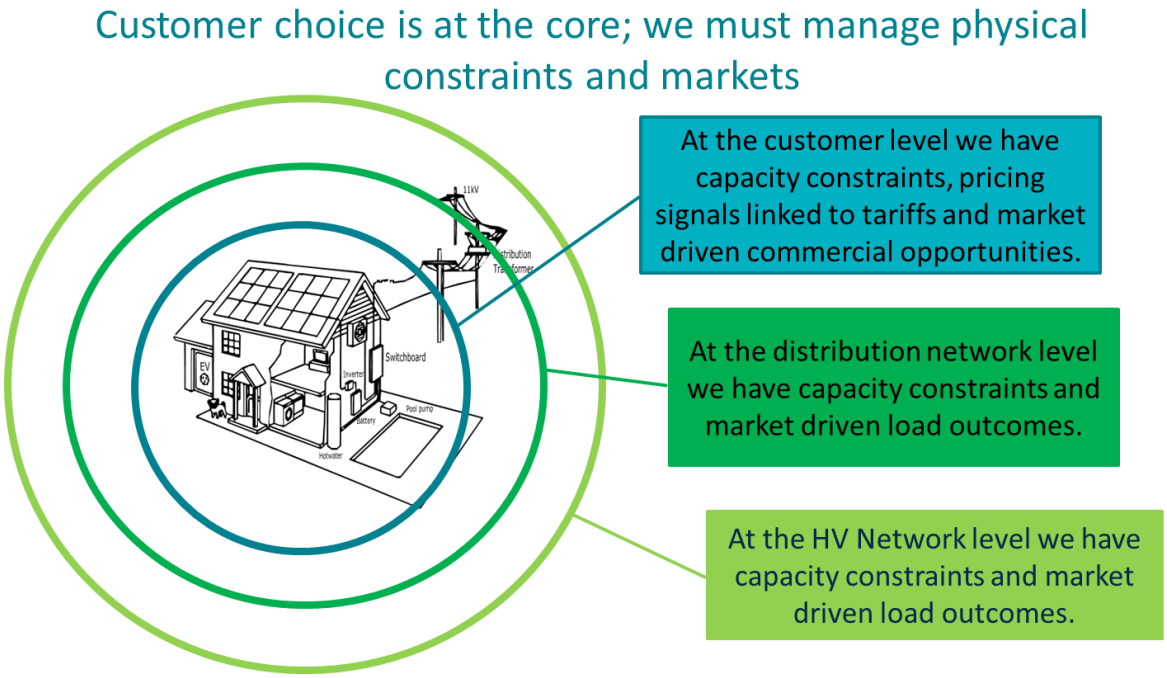

Figure 3: Our Multiple Levels of Challenges

3 Our Proposed Approach to Building Our Smart Network

3.1 First Steps

We recognise that we cannot build all of our systems and processes for the future immediately. These systems will need to grow and develop over time, in light of emerging customer requirements, network challenges and available technology. However, we need to take some steps now to prepare for the future and address some immediate challenges, while keeping an eye to the future.

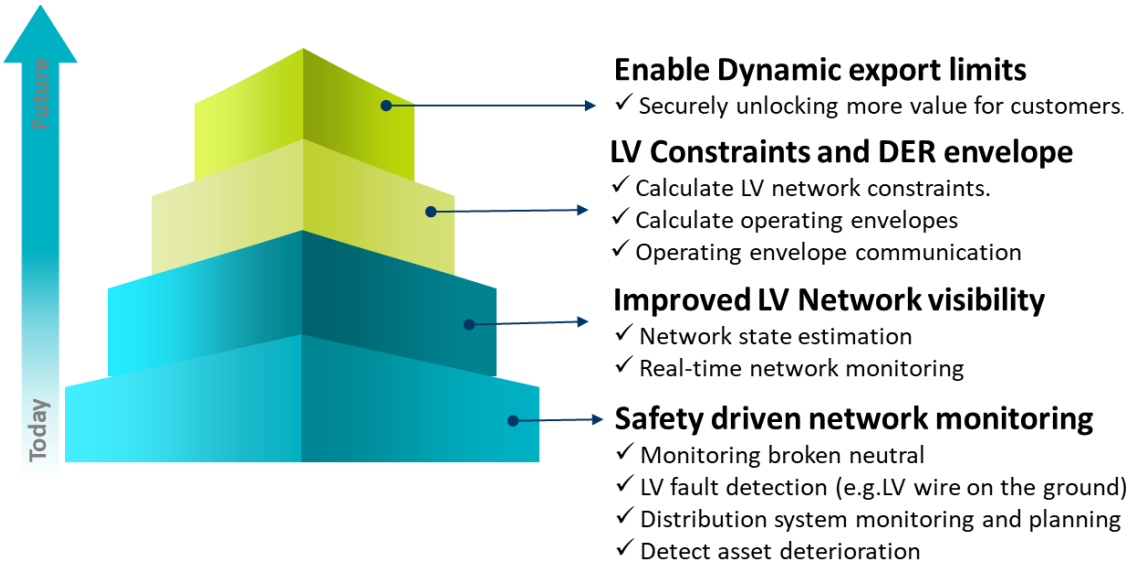

Figure 4: Our Staged and Strategic Approach to Building for the Future

Our proposed approach is:

- Do the necessary, underpinning development work in the next 5 years to start building systems that will suit the needs of the future customer.
- Where possible, deliver systems now to address immediate challenges and needs.

As shown in Figure 4 above, these first steps include dealing with immediate safety issues, obtaining the critical data to deal with our customer voltage issues and building systems that will enable us to be more proactive in our network planning. This will assist with reducing our investments in more network through better understanding the limits and constraints in the network plus delivering the required safe outcomes for the community.

3.2 Low Voltage Safety

We are in the process of developing some trial systems to address our immediate issues plus developing our platforms and analytical capabilities for the future.

Customer and community safety are critical to Energy Queensland. We have drivers in terms of Electrical Safety legislation, and because customer safety is an important underpinning requirement of running an electricity network. We need to strike a balance between spending money on replacing ageing network assets, and using smart systems to avoid safety incidents in other ways. We are of the view that both are required – we need to keep the basic network well maintained and replace critical assets, as well as minimise our expenditures through use of LV Safety monitoring. A trial in now underway to test the technology - this measures voltage and current parameters in the network

and provides indications and alarms in the event of an LV neutral failure. While the trial is focused on detecting neutral related faults, the insights and analytical capabilities gained from this trial would be incorporated into other parts of the business including power quality, outage management and more agile interaction with the customers. Traditional asset replacement fails to provide these benefits.

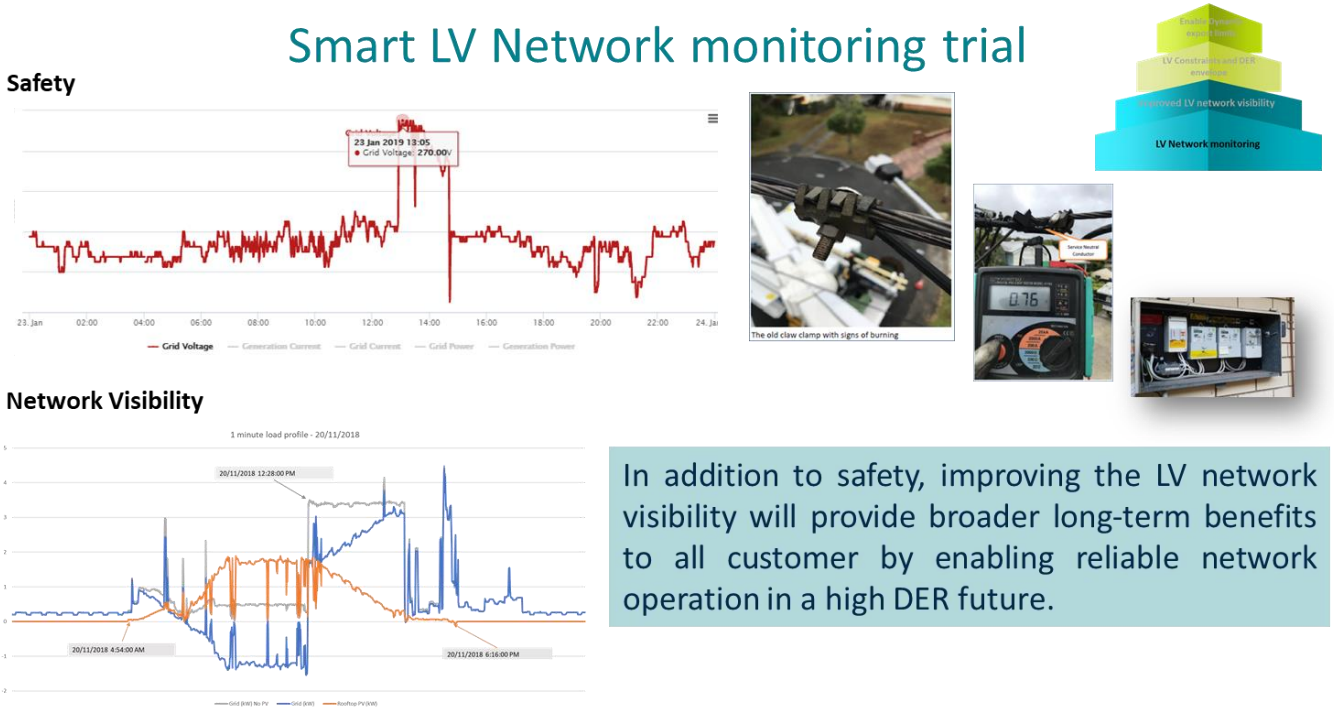

Figure 5: LV Safety Trial

3.3 Power Quality Monitoring

We're dealing now with many customer power quality (PQ) issues. These include:

- Voltage complaints due to overvoltage in areas of high PV penetration
- Voltage fluctuation / disturbance problems causing interference to customer appliances
- Connection enquiries for larger PV systems
- Connection enquiries for other distributed energy resources and battery systems

As the amount of DER grows, these issues will become more widespread and we need to be able to respond to deliver what out customers need.

In the past we've dealt with these issues through traditional approaches of obtaining field measurements through manually-installed data loggers, conducting back-office simulation studies to determine operating parameters and designing solutions to augment the network to address whatever limitation we've found. This approach has sometimes led in the past to conservative design assumptions, and more network augmentation than is sometimes required in practice.

We need to move in the future to a more proactive approach whereby we understand the interactions of the network and our customers, where the problems are now and where they are likely to emerge in the future. This will enable us to determine how much new PV can be connected for example and what we need to do on the network to resolve any issues. This proactive approach will optimise the existing capacity in the network by providing immediate and continuous information about the network performance. It will also allow us to resolve issues that do arise more quickly and with less direct expenditure on the network.

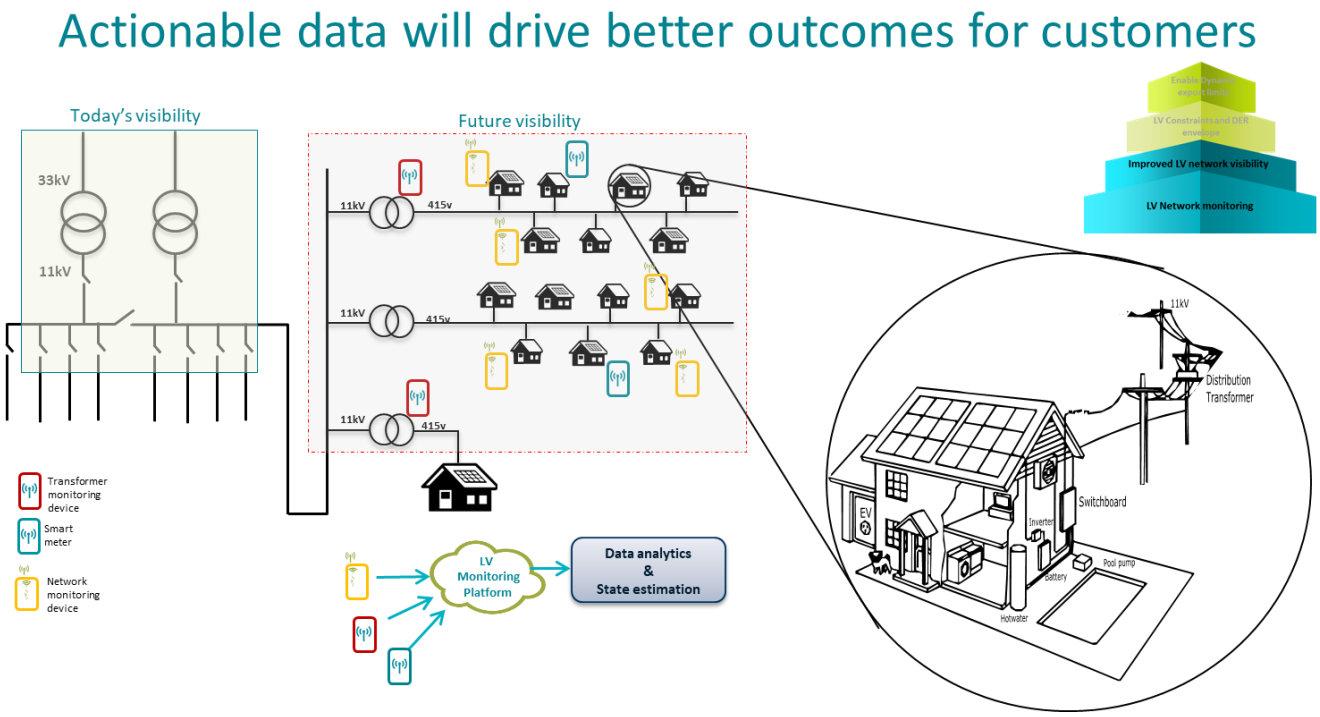

Figure 6: Power Quality Monitoring Data

We've been increasing the amount of PQ data available for some time. This has involved the installation of PQ monitors on our transformers and in parts of the LV network. These monitors provide data back to our central systems to enable us to carry out remote analysis of network performance. This data is already valuable, but we need to increase the extent of our coverage to ensure that we understand critical network performance across all areas for our customers.

3.4 Applications That Support Our Customers

With the available data coming from our various field systems, we need to start building our applications that will enable us in future to support our customers' needs.

We have a range of future applications that will support our customers, including:

- LV Safety – as described above.
- Demand Response System (DRS) – this system will enable interface to our customers who want to respond to market signals for a lower price. We already do this through our existing Audio Frequency Load Control (AFLC) systems, however these systems do not provide the full flexibility required by our customers, retailers and other market participants into the future.
- Low Voltage Management Platform (LVMP) – this platform will use real time measurements from the field (limited number of sensors) to develop a State Estimation model and determine what limits are near to or are being exceeded, where spare capacity exists and what we need to resolve for our customers.
- Distributed Energy Resource Management System (DERMS) – this application will use real time quantities to enable dynamic export capacity determination, again optimising the capacity of the existing network to support our larger customers avoiding the need to augment the network in some cases.

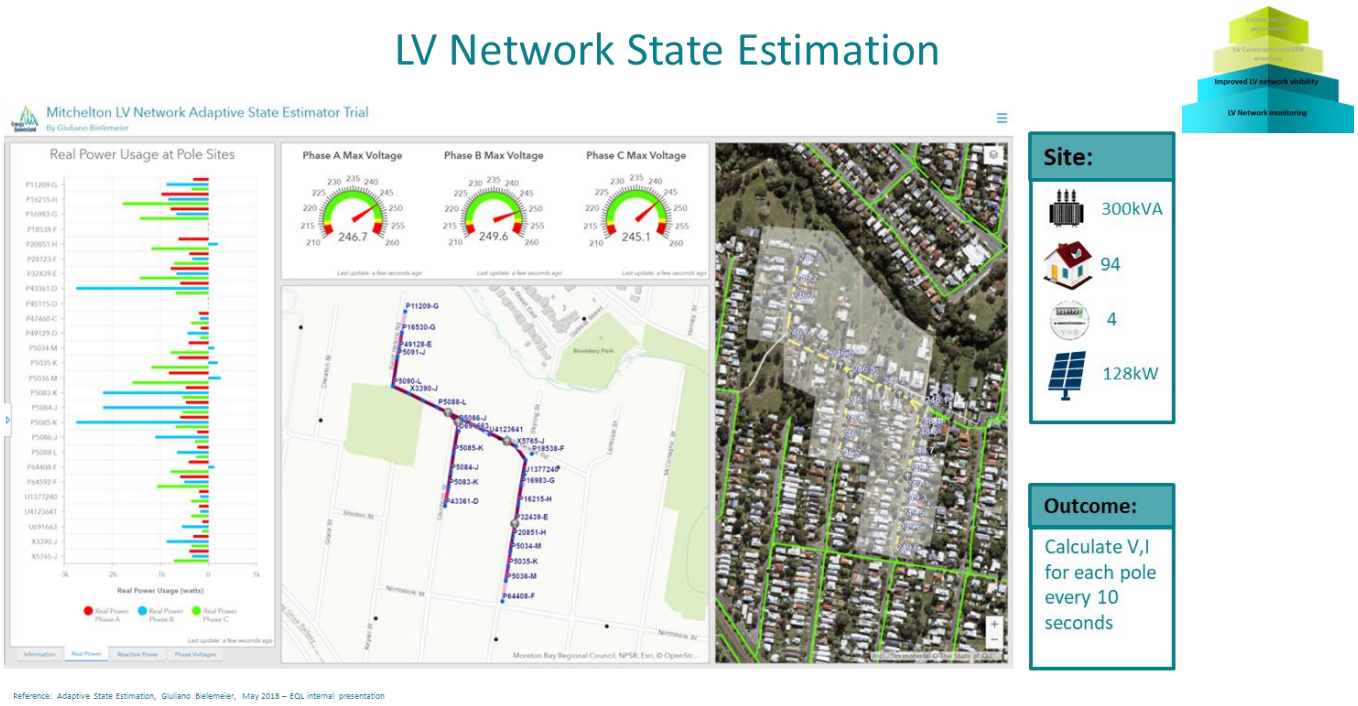

Figure 7: Estimation of Network Performance in Real Time

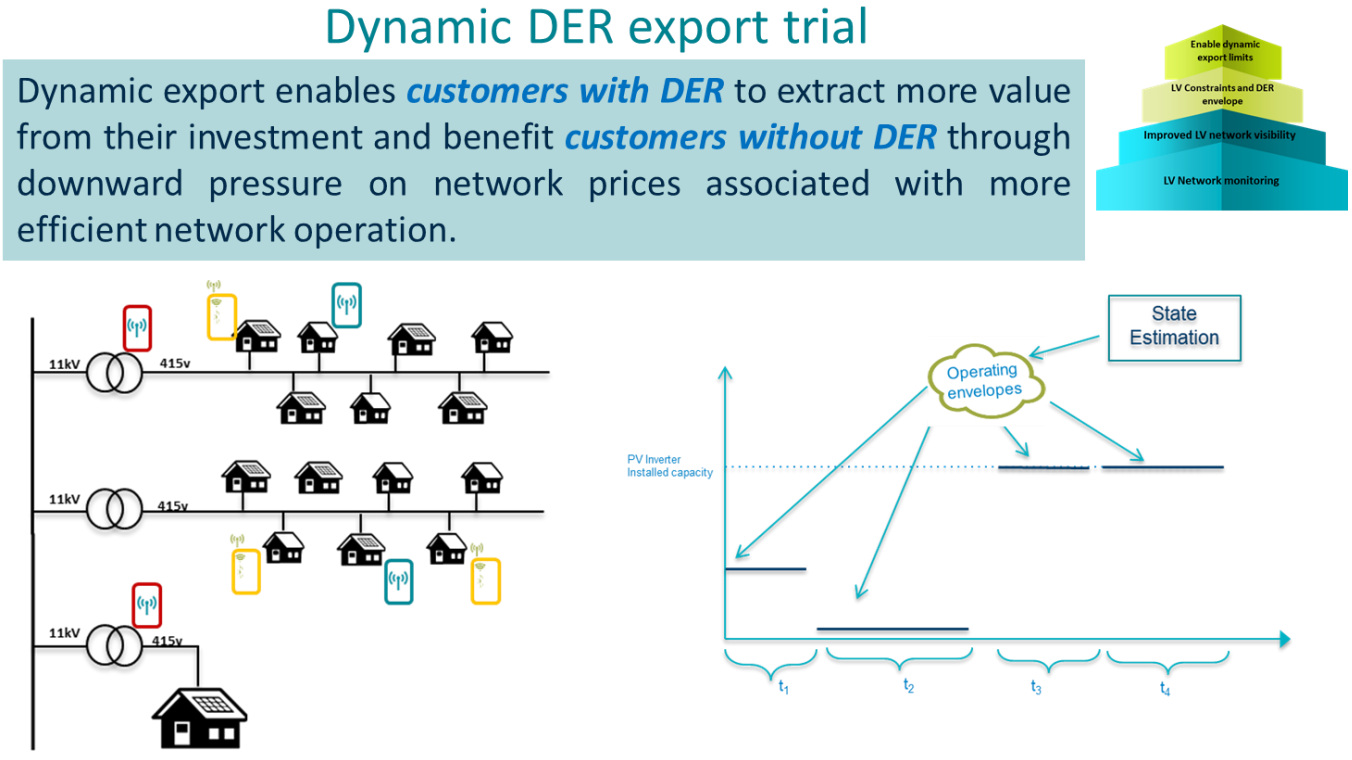

Figure 8: Enabling DER in Real Time

4 Our Integrated Approach

The diagram below shows how each of these systems is delivered in business cases as part of our 2020-25 regulatory proposal. We believe that the investment in these business cases represents a

measured approach in preparing for the future while addressing our current challenges. We have deliberately set out to ensure that our expenditure is not over-lapping or duplicated. Rather each proposal forms part of our overall approach.

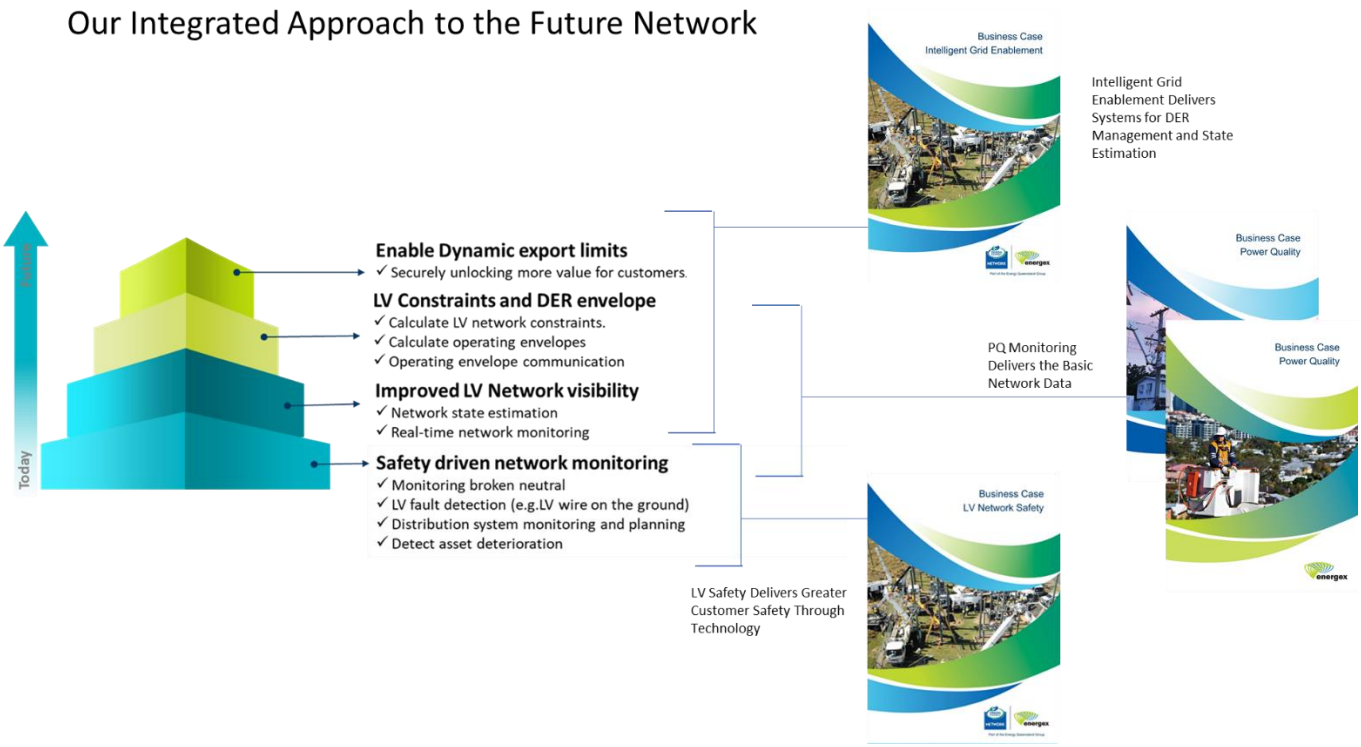

Figure 9: The Coordinated Approach to our Future Network

Appendix A References

Note: Documents which were included in Energy Queensland's original regulatory submission to the AER in January 2019 have their submission reference number shown in square brackets, e.g. Energy Queensland, *Corporate Strategy [1.001], (31 January 2019).*

Energy Queensland, *Corporate Strategy [1.001],* (31 January 2019).

Energy Queensland, *Future Grid Roadmap [7.054],* (31 January 2019).

Energy Queensland, *Intelligent Grid Technology Plan [7.056],* (31 January 2019).

Energy Queensland, *Low Voltage Network Monitoring Strategy [7.080],* (31 January 2019).

Energy Queensland, Business Case *Intelligent Grid Enablement* (December 2019)

Energy Queensland, Business Case *LV Network Safety* (December 2019)

Ergon Energy, Business Case *Power Quality Monitoring* (December 2019)

Energex, Business Case *Power Quality Monitoring* (December 2019)