

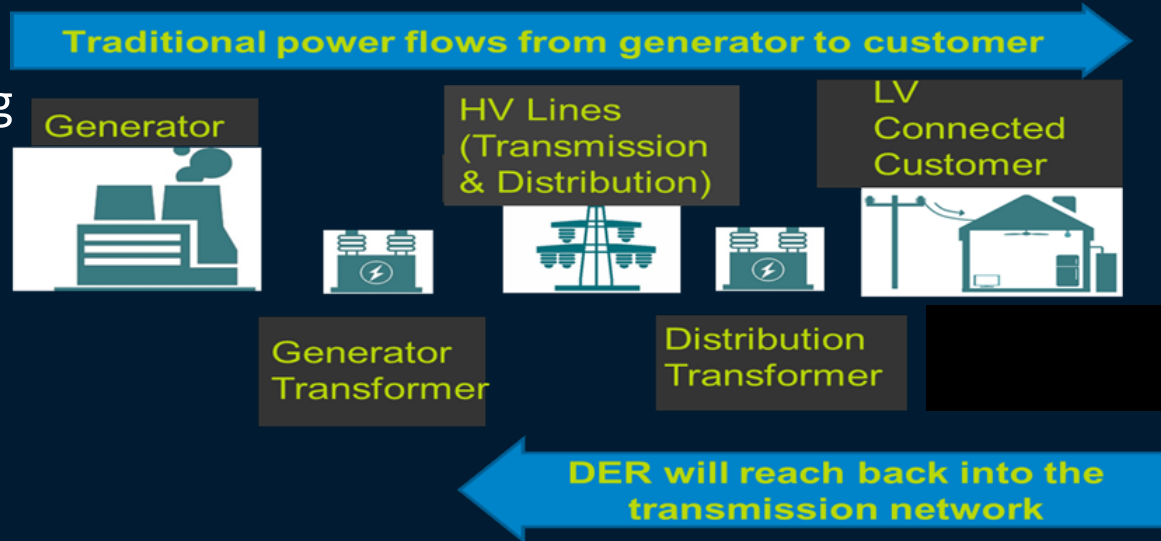
# Distribution network transformation to support DSO evolution

27 March 2019



# Today's focus is LV Distribution

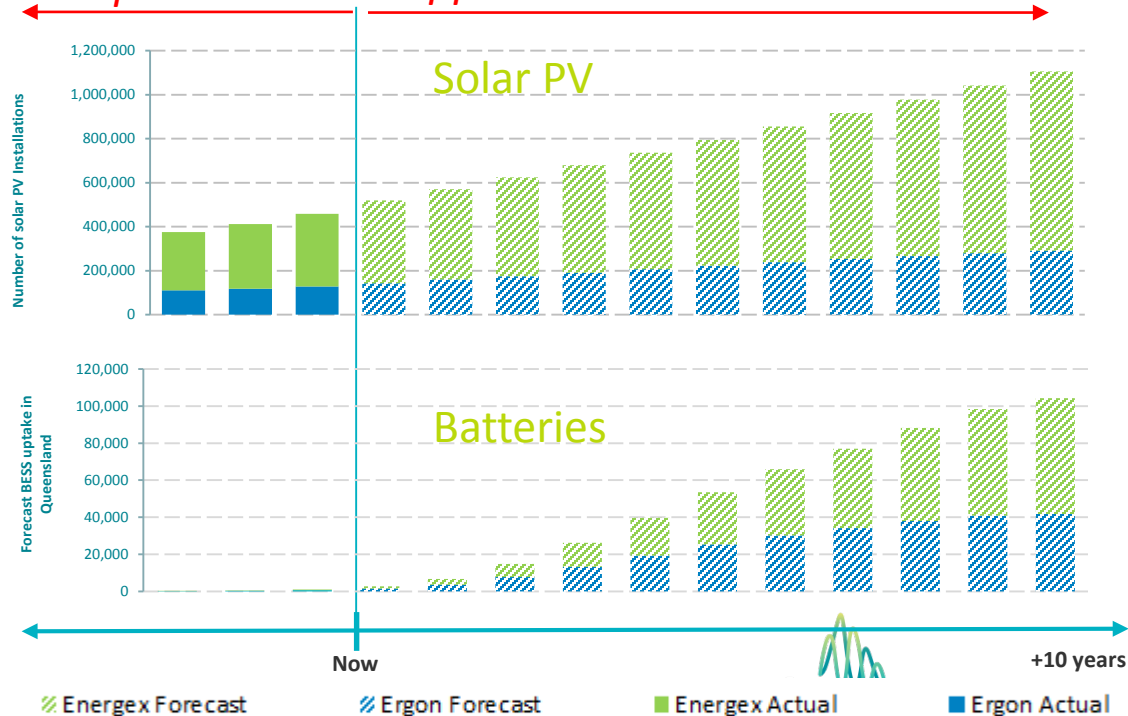
- The Queensland Context
- Mind the Gap “Transitioning to 50% renewables by 2030”
- Safety by design is the vision for 2030
- EQL is progressing no regrets actions to deliver technology, data analytics, and market reform



# The Queensland Context – continued high take of PV and forecast increasing uptake of new DER (Batteries)

*Solar PV - Passive incorporation*

*Solar PV + Batteries + EVs - Active incorporation Creating new opportunities & business models*



## Photovoltaic (PV)

- Initially growth spurred by generous feed-in tariffs
- Sustained growth through lower cost and rising electricity prices
- Average system size growing



## Batteries

- Sparked by retirement of feed-in tariffs
- Sustained through product bundling with solar PV

## Electric Vehicles

- Reducing costs and improved capabilities



## Local Energy Management Systems

- Consumers adopt new technologies adding value by improving PV & battery system performance and optimising charging discharging times

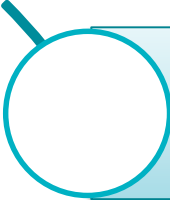


## Aggregators

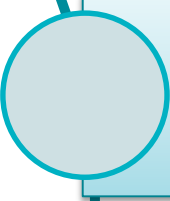
- Seek to monetise value from additional network services through growing Active DER capabilities




# Moving towards our future electricity system




Customers expect affordability, security and safety as foundation requirements of the electricity systems. This requirement must underpin our thinking as we also work to integrate Distributed Energy Resources (DER).



We will continue to see rapid adoption of new energy technologies, driven by falling costs and global carbon abatement measures. This provides a limited window of opportunity to reposition our electricity system to deliver efficient outcomes to Customers.



If we do not adapt and change the current electricity system, it will NOT be able to continue to affordably provide what Customers want or need from it.



A Customer oriented transition must focus on carefully balancing key Customer outcomes without jeopardising the underlying future electricity system itself.

# Collaborate to innovate! Technology alone isn't enough –

We must rethink the design fundamentals and deliver the simplest possible solution that optimises the use of existing network capability



2019

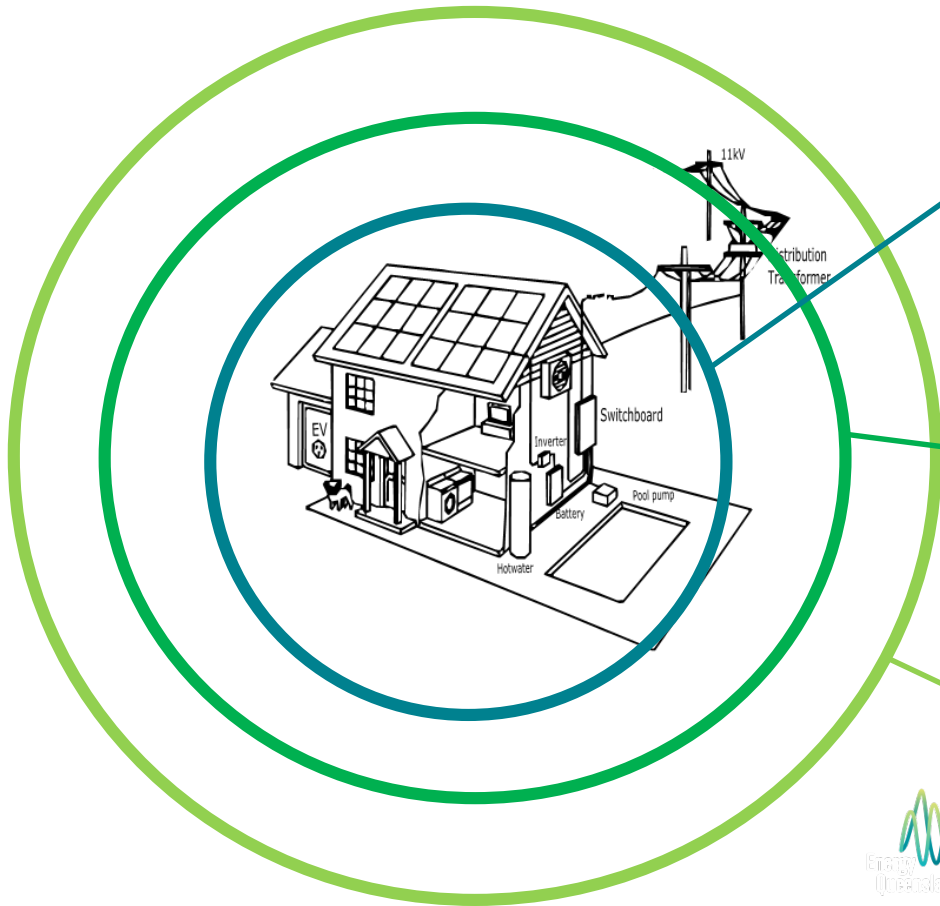


2030



- ✓ High penetration of DER to enable 50% renewables
- ✓ Bi-directional power flow
- ✓ Electric vehicles
- ✓ Digital assets
- ✓ Intelligent devices
- ✓ Smart houses/cities
- ✓ Peer to peer trading
- ✓ ...

# Customer choice is at the core; we must manage physical constraints and markets

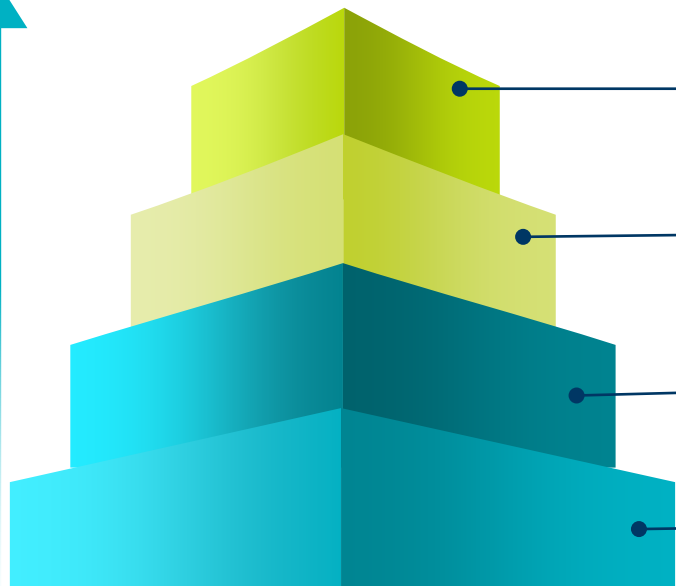


At the customer level we have capacity constraints, pricing signals linked to tariffs and market driven commercial opportunities.

At the distribution network level we have capacity constraints and market driven load outcomes.

At the HV Network level we have capacity constraints and market driven load outcomes.

# EQL's no-regrets actions are customer focused to deliver on today's challenges with "an eye to the future"



## **Enable Dynamic export limits**

- ✓ Securely unlocking more value for customers.

## **LV Constraints and DER envelope**

- ✓ Calculate LV network constraints.
- ✓ Calculate operating envelopes
- ✓ Operating envelope communication

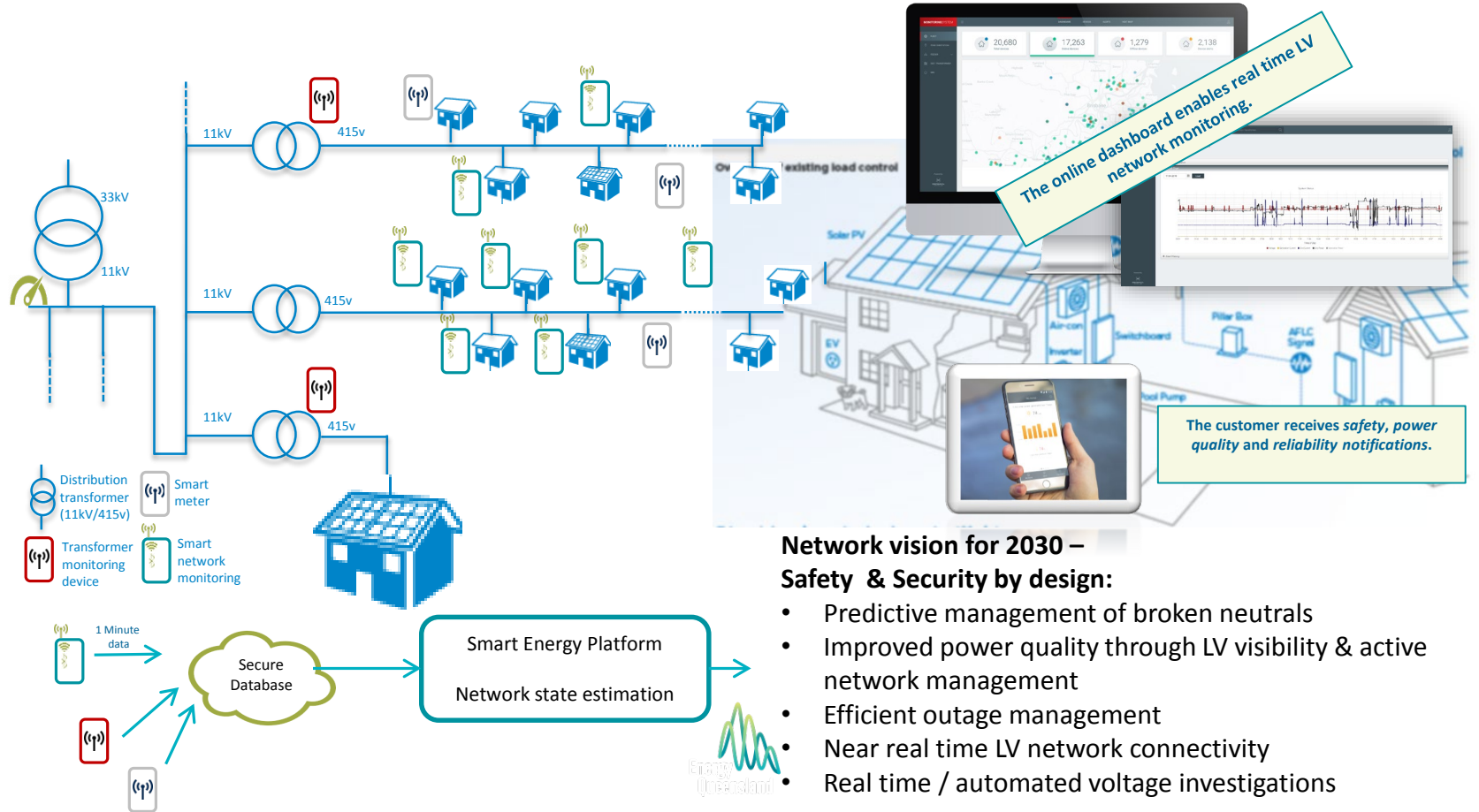
## **Improved LV Network visibility**

- ✓ Network state estimation
- ✓ Real-time network monitoring

## **Safety driven network monitoring**

- ✓ Monitoring broken neutral
- ✓ LV fault detection (e.g. LV wire on the ground)
- ✓ Distribution system monitoring and planning
- ✓ Detect asset deterioration

# Ensuring our network delivers safety by design ; and enables all customer energy needs, a low carbon future effective integration of grid connected DER



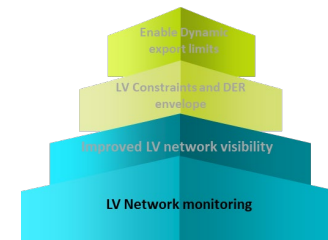
## Network vision for 2030 – Safety & Security by design:

- Predictive management of broken neutrals
- Improved power quality through LV visibility & active network management
- Efficient outage management
- Near real time LV network connectivity
- Real time / automated voltage investigations

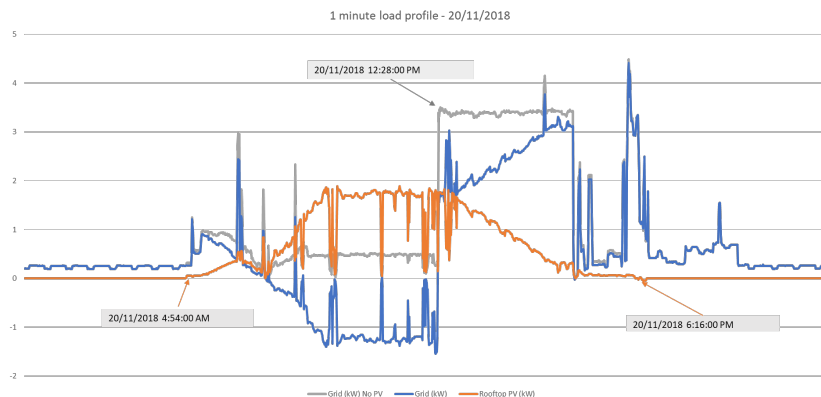


# Smart LV Network monitoring trial

## Safety

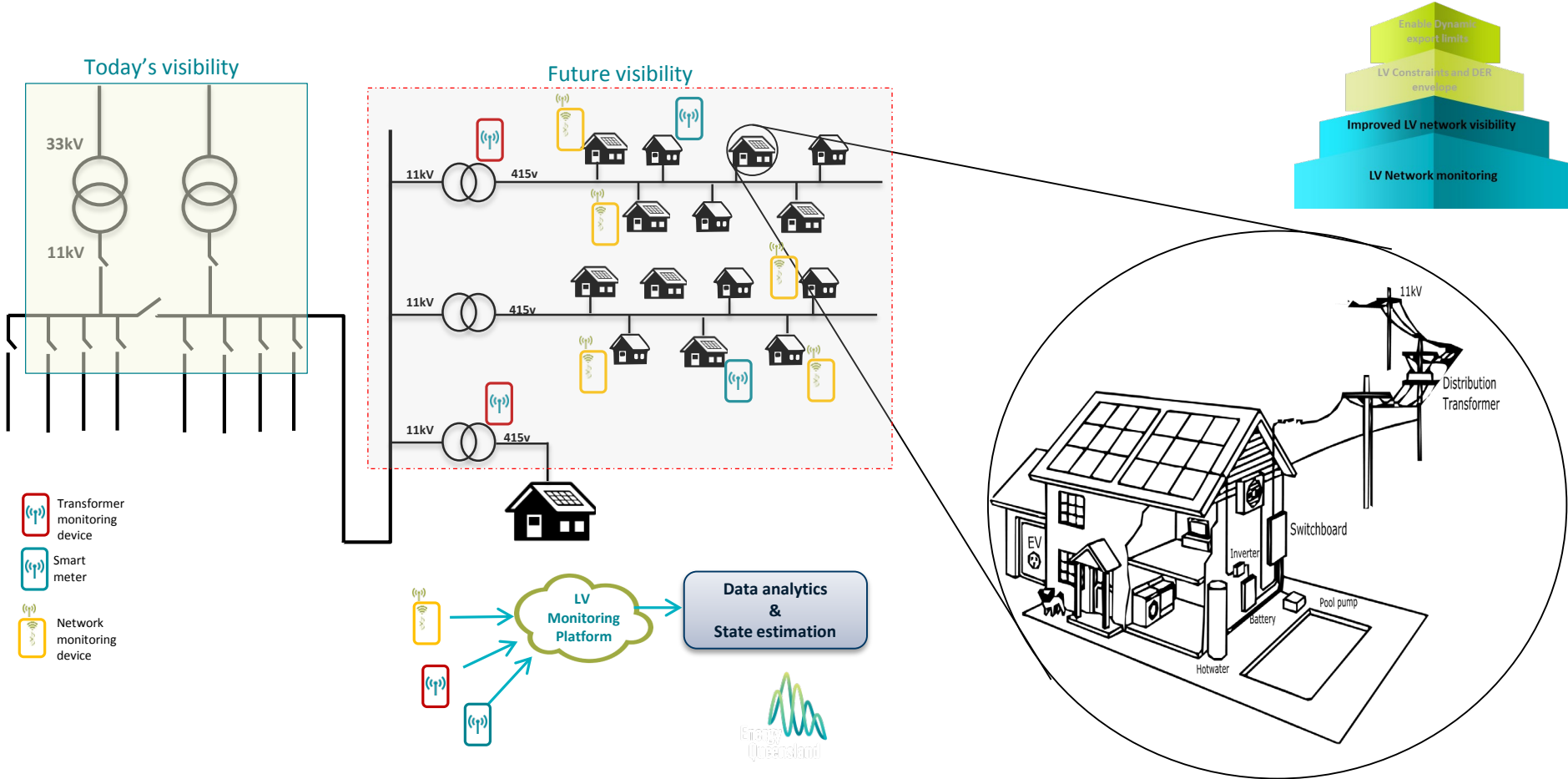


## Network Visibility

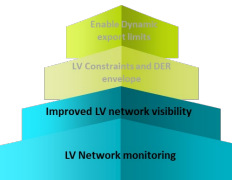


In addition to safety, improving the LV network visibility will provide broader long-term benefits to all customer by enabling reliable network operation in a high DER future.

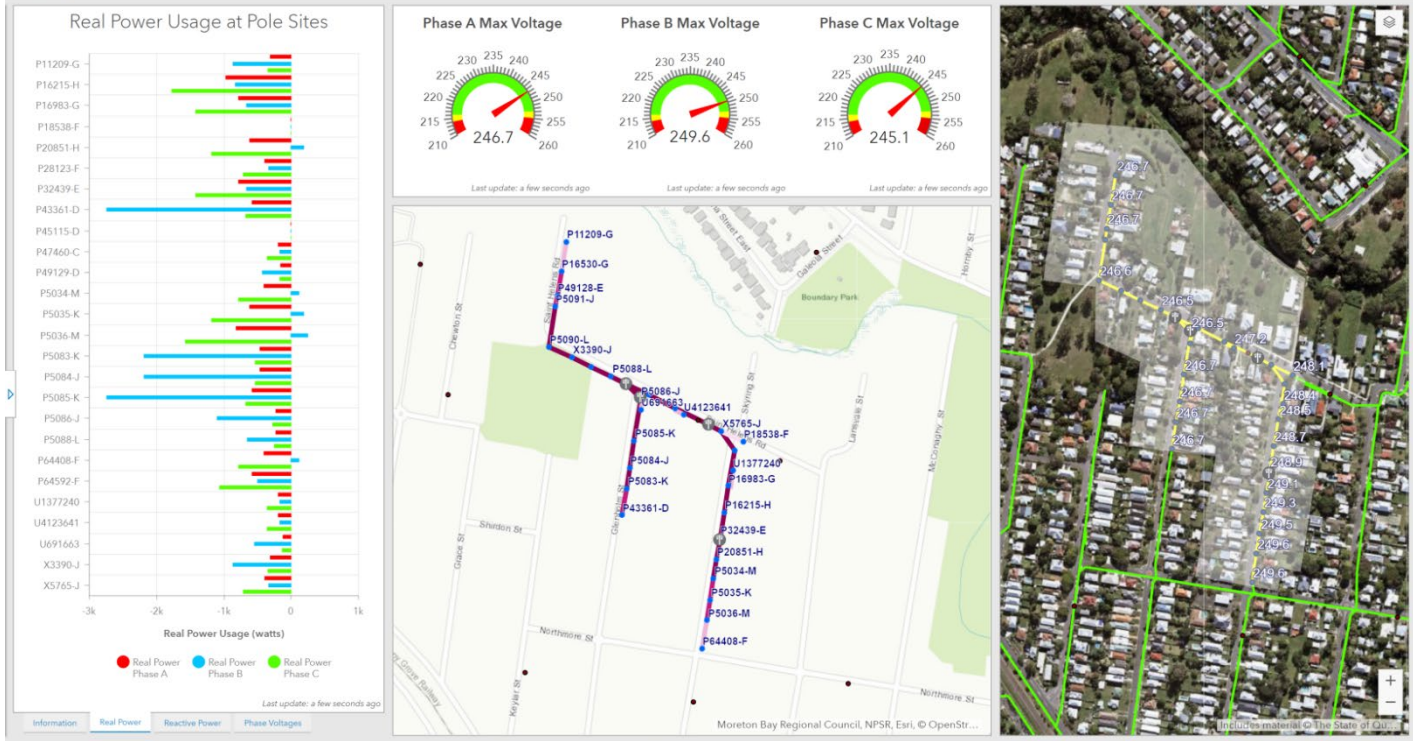
# Actionable data will drive better outcomes for customers



# LV Network State Estimation

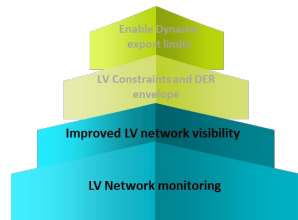


Mitchelton LV Network Adaptive State Estimator Trial  
By Giuliano Bielemeier



Reference: Adaptive State Estimation, Giuliano Bielemeier, May 2018 – EQL internal presentation





# The Evolution of State Estimation

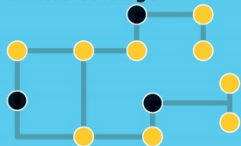
The ARENA-funded Solar Enablement Initiative\* is demonstrating how electricity distributors can enable more export of generation from solar PV systems of 30–1500 kW. Application of a State Estimation Algorithm will significantly enhance a distributor's knowledge of the operational conditions of its feeders. This will facilitate more informed technical assessments of PV connection applications as well as dynamic orchestration, and therefore maximisation, of PV export.



## Measured node density scenarios

● Estimated nodes    ● Measured nodes

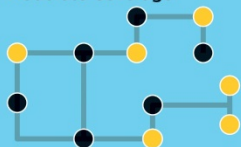
### Limited Coverage



- Uncertainty quantified
- Estimations replace worst-case assumptions.

75% nodes on feeder estimated    25% nodes measured

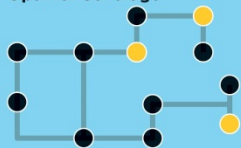
### Moderate Coverage



- Uncertainty reduced
- Decision-making confidence increased.

50% nodes estimated    50% nodes measured

### Optimal Coverage



- Uncertainty negligible
- Decision-making confidence optimised.

25% nodes estimated    75% nodes measured

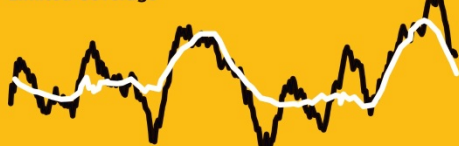
**Note:**  
100% coverage is not necessary to provide sufficiently accurate estimates of conditions on the entire feeder.

## Estimated State vs Measured State

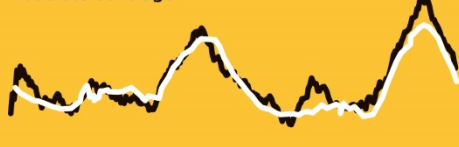
As the number and quality of measurements on a feeder increase, the differences between estimated and measured (actual) values of voltage, current and power reduce.

— Estimated State    — Measured State

### Limited Coverage



### Moderate Coverage

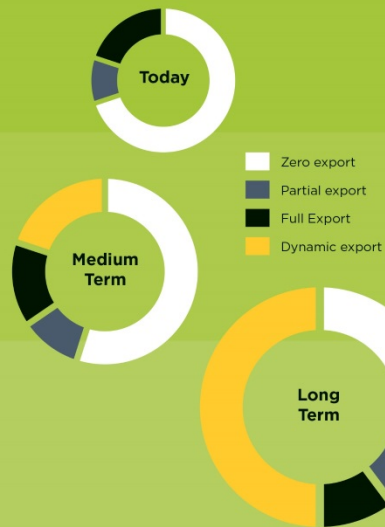


### Optimal Coverage



## Evolving PV export-status mix

The progressive implementation of State Estimation across a distribution network will enable increased connections of, and export from, 30–1500 kW PV systems. State Estimation technology can also be used to dynamically control and maximise export. These benefits will change the PV export-status mix, which will minimise network impacts and enhance customer, market and environmental outcomes.



75% estimated

50% estimated

25% estimated

\*The Solar Enablement Initiative is administered by The University of Queensland.

Other Activity Participants include electricity distributors Energex Limited, United Energy and TasNetworks; Energy Networks Australia; Australian Power Institute; Aurecon; Springfield City Group; and Queensland University of Technology.

# Queensland Integrated Power Platform Project

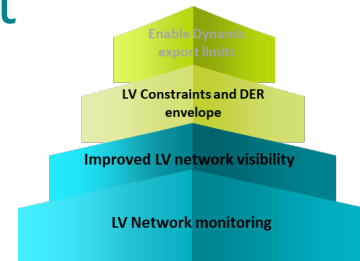
World leading Queensland demonstration of Distribution Level Optimisation encompassing distributed energy resources within the current National Electricity Market regulatory framework



Ability to encompass the end-to-end customer and stakeholder value chain



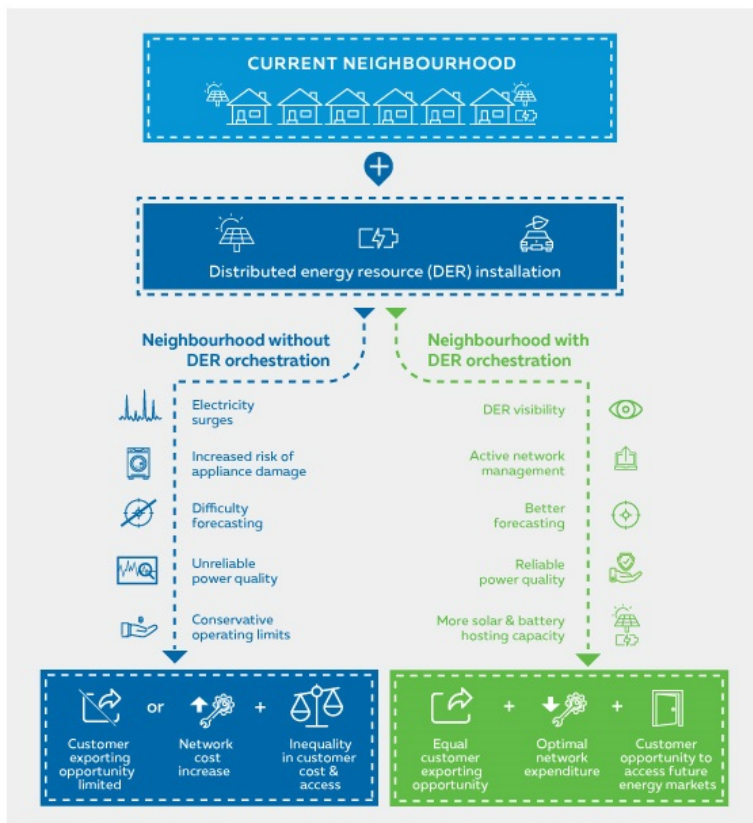
Leveraging the inherent breadth of Queensland's diverse state-wide electricity group - consisting of Energex, Ergon Energy Network, Ergon Energy Retail and Yurika



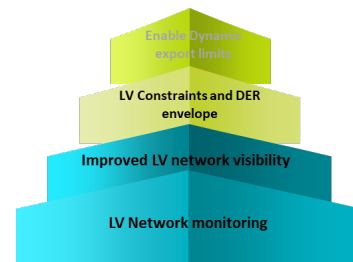
## Objectives:

1. Support system security in an environment of growing passive DER
2. Explore how to maximise benefits to customers by enabling them to participate in multiple markets.
3. Improve the operational visibility to enable optimisation of local network operations.





# Project Evolve

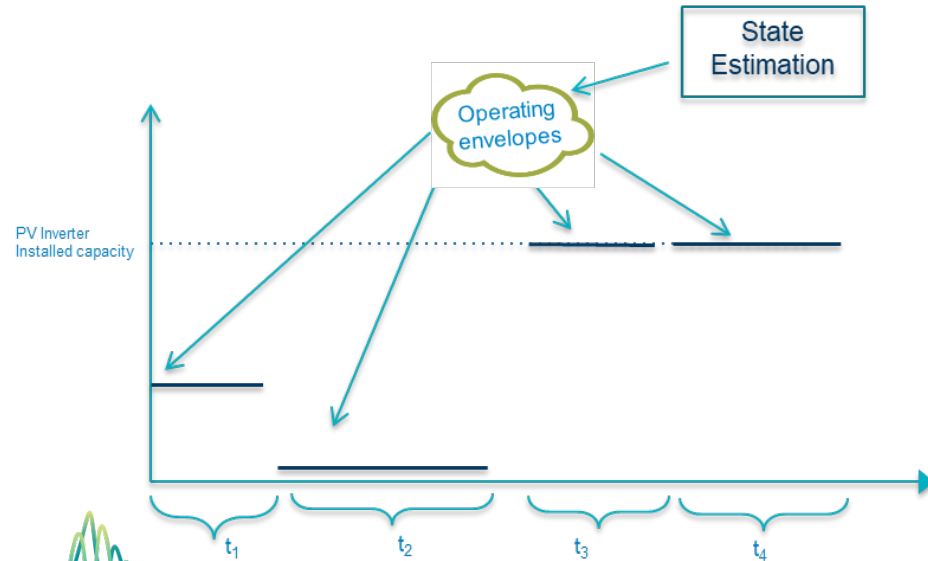
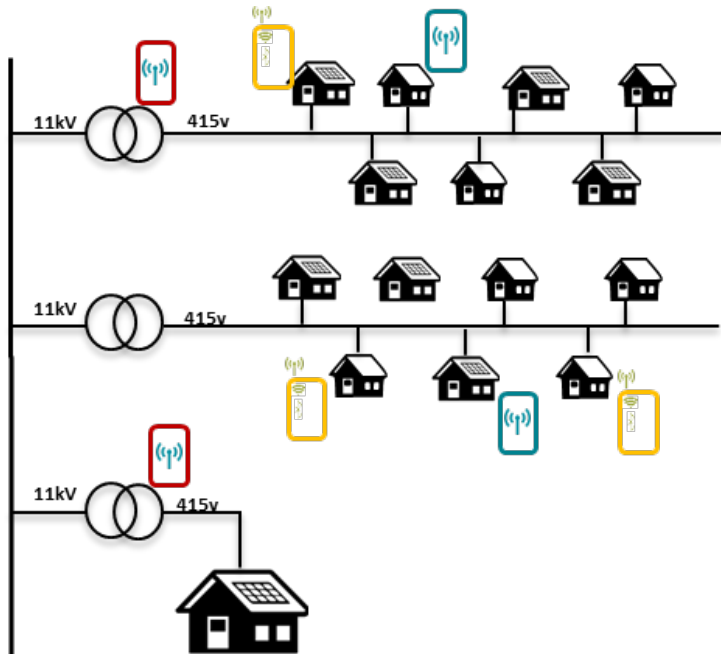
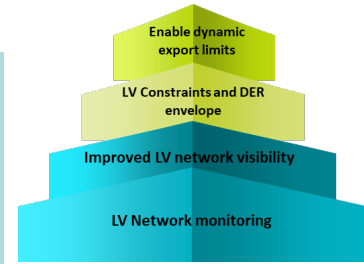


## Capabilities:

- Calculate the real-time and forecast operating envelopes for individual and aggregated DER.
- Development of an API for publishing the operating envelopes.
- Demonstration of an orchestration based approach by a DER providers and aggregators.

# Dynamic DER export trial

Dynamic export enables *customers with DER* to extract more value from their investment and benefit *customers without DER* through downward pressure on network prices associated with more efficient network operation.



# Key Points

- When designing the network of the future we must prioritise safety and security; and
- We must enable customers to choose a low carbon, cost effective and secure energy future noting:
  - ✓ Energex and Ergon Energy networks are already among the highest penetration of roof top PV in the world.
  - ✓ Understanding what is happening in the low voltage network is a key challenge.
  - ✓ Transformer monitors and network devices (complimenting AMI market data) will underpin enhanced data analytics.
  - ✓ Effective use of existing AFLC combined with integration of BESS will support higher penetrations of EG.





# Thank you

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Energy Queensland

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