Who is Energy Queensland?

- 7,342 employees
- 464 total apprentices
- 2.25 million connected customers
- 738,000 regional retail customers
- 1.5 million customer calls answered
- 178,000km overhead powerlines
- 29,000km underground power cable
- 5,300km power poles
- 3 network control centres
- 33 standalone power stations
- 550,000 small-scale solar energy systems connected
- 25 total large-scale solar renewable systems connected
- 5,086MW south east peak demand
- 2,612MW regional Queensland peak demand
- 34,000GWh electricity delivered a year
Delivering on the Commitment of 50% Renewables by 2030. At Energy Queensland we are committed to achieving the vision of ‘Electric Life’ by 2030. The goal is to support customer choice on a new energy future.
• Cloud cover significantly reduced the output of Uterne solar power station
• Cloud cover reduced the output of embedded rooftop solar installations

“Pushing too much electricity into a grid can cause blackouts”

The huge flow of solar power on sunny days is threatening to destabilise Perth’s power grid, prompting state-owned operator Western Power to pay businesses to use electricity on weekends and solar farms to turn themselves off

Minimum system demand is increasingly impacting system security
Modelling for Queensland Clearly Demonstrates the Need for Action to Mitigate the Risks Arising from the continued and rapid decline of Minimum System Demand

Results for Queensland looking at additional solar PV
Effect of additional solar PV on distribution of residual demand, QLD

- PV is driving domestic minimum demand to levels below minimum generation threshold
- Powerlink modelling demonstrate the increasing risk of minimum system demand including the challenging of meeting minimum and maximum demand requirements on the same day
By 2025 there is likely to be 6GW of renewable generation connected to EQL networks” – Total Peak Summer Demand ~7GW
Midday Minimum System Demand will reach zero; there are now more Minimum Demand Days than Maximum Demand Days – this is an immediate whole of system issue.
DER Integration: Opportunities for Distribution Networks

**Traditional Supply**

- SWER networks deliver secure supply

**Short - Medium Term**

- DER delivers benefits to remote customers

** Longer Term**

- Microgrids or single customer standalone systems deliver low cost, secure and sustainable energy

- DER and Microgrids can deliver a more efficient, reliable and sustainable outcome for “fringe of grid” customers; initially connected and then disconnected as technology evolves.

- This opportunity has no material impact on the overall grid stability challenges
DER Integration: Challenges for Distribution Networks

For LV Networks Maintaining voltage within acceptable limits is increasingly a challenge.

North Maclean Zone Substation

Reverse Power Flows – an Emerging Driver of Thermal Limitations

Burrum Heads 11kV Feeder
With current pricing signals adding batteries with rooftop PV does little to mitigate either peak demand or minimum (max negative) demand. Tariff reform and/or coordination of battery operation is required to optimise LV networks and align outcomes with whole of system requirements. Tariff reform is also required to ensure “fair” outcomes for all connected customers.
The consumer vision of a better energy future consisted of five elements: Affordable; Simple; Easy to Manage; Clean; Inclusive.

Customers are at the core – technology adoption is driven from the core.

Distribution networks are the fabric of a shared and inclusive DER future.

EQL continues to progress no-regrets customer focused actions to deliver on today’s challenges with “an eye to the future”.

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Large scale generation and transmission networks remain critical; but the continued growth of DER requires urgent action.

Enable dynamic DER connections
Dynamic network operating envelopes
Improved MV&LV Network visibility
Safety driven network monitoring

Distribution networks are the fabric of a shared and inclusive DER future
Springfield – A planned community in SEQ targeting zero net emissions by 2038

Development details:
- 3,000 ha
- 30 minutes west of Brisbane CBD
- 40,000 citizens (2018)
- 2038 Growth ambition 115,000 or ~ 35000 Households
- $85 billion total planned investment
- Direction to achieve zero net energy or zero net carbon

Existing Network Infrastructure:
- 2 33/11kV zone substations
- 17 x 11 kV feeders
- Peak demand x MV.A

There are many paths to zero net energy – all require capital investment.
<table>
<thead>
<tr>
<th>Scenarios modelled</th>
<th>Limiting total demand (MVA)</th>
<th>Residential average customer import (kWh)</th>
<th>Residential average customer export (kWh)</th>
<th>Residential net energy (GWh)</th>
<th>Business import (GWh)</th>
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<tbody>
<tr>
<td>Base</td>
<td>87.3</td>
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<td>4,142</td>
<td>43.3</td>
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<tr>
<td>Solar</td>
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<td>10,120</td>
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<tr>
<td>Orchestrated Solar and Storage</td>
<td>-83.4</td>
<td>4,189</td>
<td>8,708</td>
<td>-140</td>
<td>140</td>
</tr>
</tbody>
</table>

Orchestrated solar and storage delivers the lowest NPV cost; worst NPV cost is ~300% higher

Note: Battery Energy Storage System modelled based on data from Harris Crossing estate in Townsville
DER Integration: Dynamic Operating Envelopes

- Active DER enables new opportunities to optimize the energy value chain:
  - Manage loads on local transformers with overload limits and avoid fuse operation.
  - Leverage DOE to also manage constraints anywhere in the value chain

- Commercial solar - 50kW array on Cleveland Depot
- Pilot enables dynamic export from the PV
- Enabled via:
  - existing EQL IT/OT systems; and
  - $99 IoT gateway on site with 4G modem

[Graph showing Transformer SP15180-C TR1 Daily Profile with negative flows increasing]

[Image of solar array and IoT gateway]
DER Integration: Dynamic Operating Envelopes

DOE % limit is published to a Web Site

Transformer load is maintained with rating and fuse limits
Real Time LV Monitoring is Required at the Distribution Transformer and at Customers Connection Points

In addition to safety, improving the LV network visibility will provide broader long-term benefits to all customers by enabling reliable network operation in a high DER future.
DER Integration: DSSE enables network visibility without 100% monitoring

- DSSE is a process for estimating the most probable electrical state of a network at any point in time using known network properties (conductor types, lengths, connectivity) and available measurement data.
- Can be used for historical/forecast analysis or in real time for Dynamic Operating Envelopes.
- DSSE provide VISIBILITY to enhance & enable….

![Diagram showing network visibility and coverage scenarios](image-url)
DER Integration: DSSE in Action

DSSE produces accurate virtual distribution transformer monitors across the MV feeder with just 25% penetration of physical monitors.

Pilot feeder had 36 accurately estimated transformers from just 8 physical monitors.
Key take outs

1. Regardless of future energy market scenarios, customer expect a safe and reliable and sustainable supply of electricity from the networks. – *Trust is essential*

2. Engineering analysis is essential to underpin the architecture of the future Grid – *The role of distribution networks has changed and a new optimised architecture is required to limit the risk of stranded investment.*

3. Distribution networks now have a role to play in supporting grid stability – *Tariff reform, battery storage connected to LV and 11kV networks and Demand Management repurposed to shift load into peak solar periods are part of the future*

4. Distribution networks can also support real time dispatch of generation and storage through Dynamic Operating Envelope Technology – *Distribution led DOE can support DER operation within local level and overall system constraints*

5. The rate of change is accelerating and market reform and real time markets alone are unlikely to deliver optimised investment decisions and cannot deliver within the required timeframe – *We need active progress on market development, tariff reform and a re-engineered energy value chain to manage the transition to 50% renewables by 2030 and at some time in the future Zero Net Energy*

6. Minimum system demand is a clear and present danger – *Queensland must take coordinated action now to maintain the joint commitments to enable a renewable future and deliver energy security*
Questions

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