

Strategic Scope OT Environment Enhancements 2020 – 25 January 2019



Part of the Energy Queensland Group

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1. Project Summary

Work Request Description	OT Environment Enhancements		
Work Request Number	1352414	Work Request Required by Date	
Initiating Work Group	Intelligent Grid Solutions	Strategic Scope Contact	
Business Owner	AS&P		
Direct Value:	\$4.55M		

NOTE: – This document does not constitute approval of any funds or financial delegation. It is used to provide a high-level description and justification of an allocation of funds in future years. The direct value presented above is in \$18/19 direct dollars.

2. Existing Arrangements / Background

This initiative is based on the strategies defined in the Future Grid Roadmap and the Intelligent Grid Technology Plan. From these strategies, a technology solution and its associated costing and benefits have been described below.

Currently, both Energex and Ergon have significant operational technology infrastructure to manage the operational networks. These environments are designed and scaled to support the current operational requirements. However, these existing environments do not cater for the future expansion of information and device growth and the focus on actively managing the power networks. OT environments consist of physical hardware such as data centre racks, computing and associated networking hardware and cabling, software environments which include operating systems such as Windows and Linux, virtualised environments, and a significant number of support applications such as back up services, identity management, local storage for applications, and user interface support.

The Energex OT environment operates over two data centres in Brisbane with a traditional computing server, SAN storage model housed in a traditional data centre rack arrangement. This arrangement only covers tools and supporting infrastructure as the primary application for Energex is the Distribution Management System which operates on its own dedicated computing infrastructure. The current Energex OT environment is sufficient to support the current needs but does not have the computing resources to host new applications and increases in data storage beyond the DMS application.

The Ergon Energy OT environment also operates over two data centres and was upgraded in the 2015-20 period to a hyper-converged technology environment. The hyper-converged environment was chosen as it has a functionally smaller footprint (i.e less racks) and higher density computing. This environment supports a seamless and fault tolerant virtualised environment to exist for applications and storage which is ideal for critical environments such as OT. The Ergon Energy environment has spare capacity to support new capabilities (applications) for the early part of the 2020-25 period but will require some modest investment to support growth.

The ICT industry is moving to hyper-converged environments as it provides the following benefits:

- Combining storage, networking and computing (CPUs) into a single hardware “device”.

- Scaling the “devices” into a space 1/10th of an equivalent of a traditional data centre layout – this significantly reduces cost.
- Automatic fault tolerance across the environment compared to additional hardware required in traditional ICT setups. This again significantly reduces cost and simplifies delivering high availability software platforms such as those used in the OT environment.

To solve the capacity constraint issues in the Energex OT environment, the Ergon Energy OT environment is being used for any research projects or technology trials or initiatives that are running in the Energex power network.

The long term goal (towards the end of the 2020-25 period and into the 2025-30 period) will be to consolidate the Energex and Ergon OT environments into a single EQL OT environment and to rationalise the 4 data centres to 3 or potentially 2 and utilise more cloud-based infrastructure services for low and medium critical applications.

3. Rationale / Benefits

The Intelligent Grid Technology Plan describes the drivers for better real-time information associated with the power network, which includes more accurate network forecasts for better targeting of traditional augmentation and maintenance, better operational intelligence for areas such as outage management, and active management of the customer connected elements of the network (Low Voltage) to support increased hosting capacity.

Traditionally the majority of OT data was generated inside High Voltage substations. To meet these objectives, there needs to be a significant increase in sensors and other data collection from outside the substations. This includes increased monitoring at distribution transformers, more active regulation devices (such as LV regulators, LV Statcoms), and more customer data through direct sensing and through use of 3rd parties.

This growth in data requires operational technology infrastructure on which to operate and manage the systems and applications that will use this data. This proposal focuses on augmenting both networks' OT environments, with the majority of the investment targeting the Energex network as it currently has limited sensing outside the substation and so has limited OT infrastructure to support the growth in sensing that is planned.

By continually expanding the OTE capability this allows other initiatives (such as the Intelligent Grid Enablement program and Low Voltage Safety and Monitoring) to occur by providing a common set of infrastructure.

The initial benefits occur in the period by enhancing Energex's OT capability with hyper-converged technology so that it can support the growth in data (eg network metering) as well as for technology trials. Once the two environments are on similar virtualised environments, work can be done to rationalise the infrastructure providing one OT infrastructure across both networks for the 2025-30 period. This will reduce both augmentation costs and lifecycle costs in this area for that period.

Customer benefits include:

- Longer term reduced operating (lifecycle costs) associated with managing the technology of an intelligent grid. This will impact the network charges, causing a reduction in costs.
- More flexible (lower) costs associated with new initiatives that support customer choice by optimising the technology stack (on premise versus private versus public cloud).

- The additional capability will facilitate the Intelligent Grid Enablement program which ultimately provides customers with greater choice in the way they utilise their assets (eg home, DER etc).

4. Drivers

The key element of the Electricity Network Transformation Roadmap is Intelligent Networks and Markets. The aim is for networks to provide a suite of grid intelligence and control architectures to animate distributed energy resource markets and well as providing system security.

The Future Grid Roadmap defines 2020-25 as the period where there will continue to be significant growth in PV and new growth in batteries and a smaller impact with EVs. The feedback from EQL's community is that they expect to be able to have more freedom and flexibility on how they use their investments with the distribution network enabling this capability and not providing roadblocks such as zero export.

The chart below shows the expected growth rates. This translates into growth in data that Energex and Ergon Energy will need to collect process and take action on within the OT environment. In terms of scale, the current OT environments manage at the substation and HV feeder level which is approx. 800 substations and 4500 feeders. When moving into the customer centred networks this scales to over 140,000 Low Voltage networks with each network having multiple segments.

Based upon current research trials in the Energex network, a combination of sensing and machine learning (state estimation) will provide real-time data at the site equivalent of every power pole in the network. This means the OT Environments will be handling data from in excess of a 1,000,000 locations in near real time.

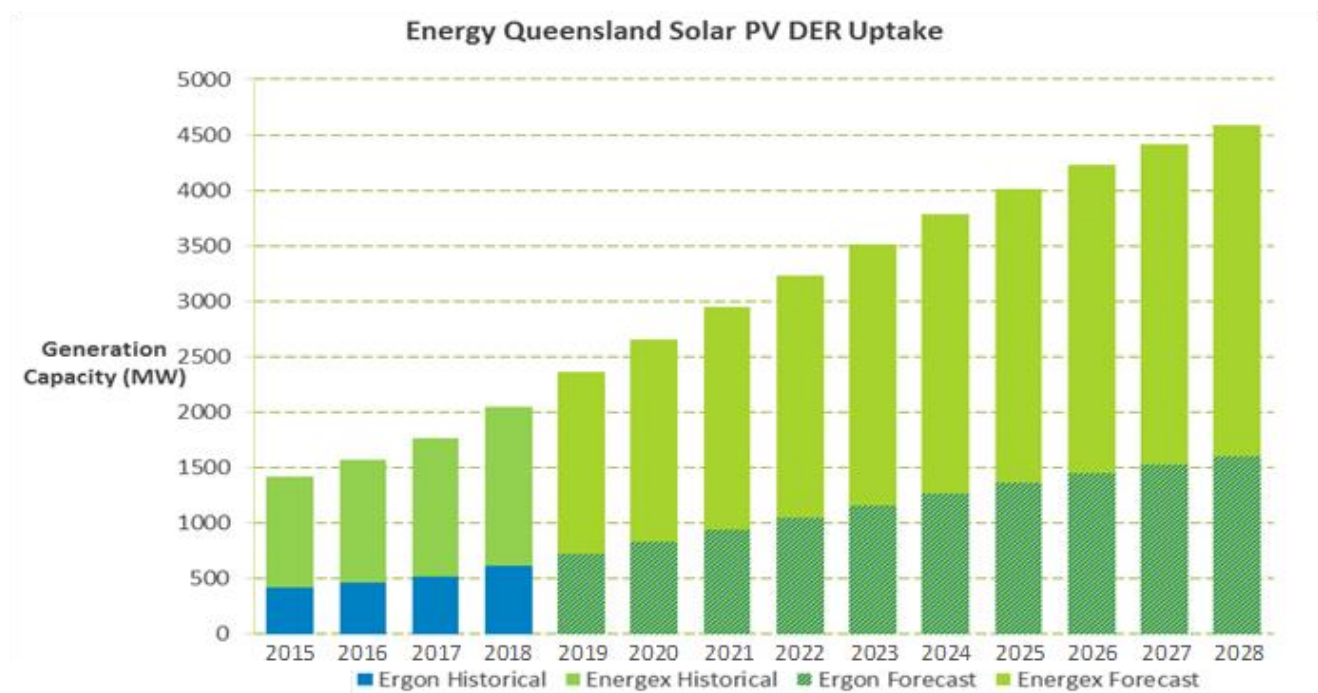


Figure 1 – Energy Queensland Solar PV DER Uptake

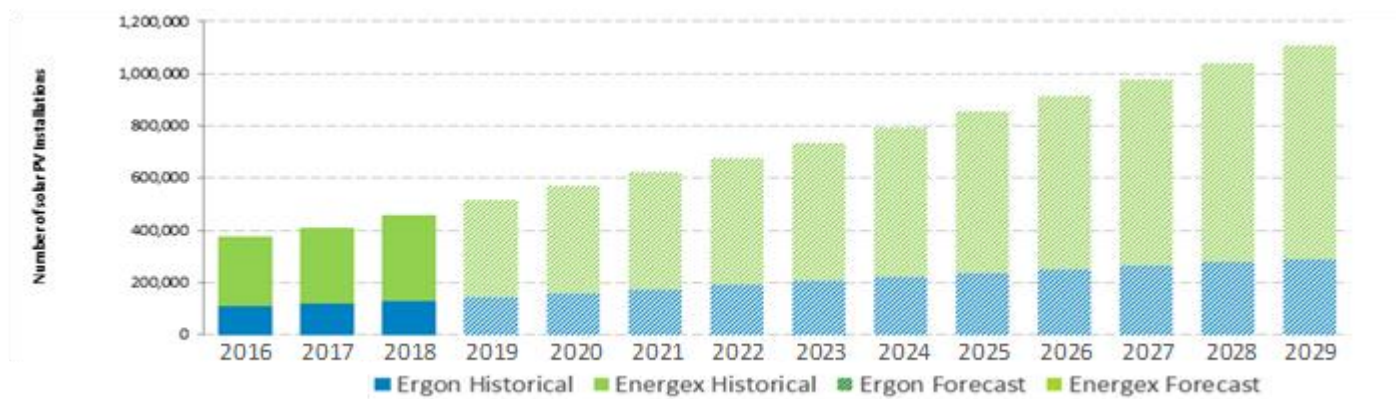


Figure 2 – Energy Queensland Solar PV

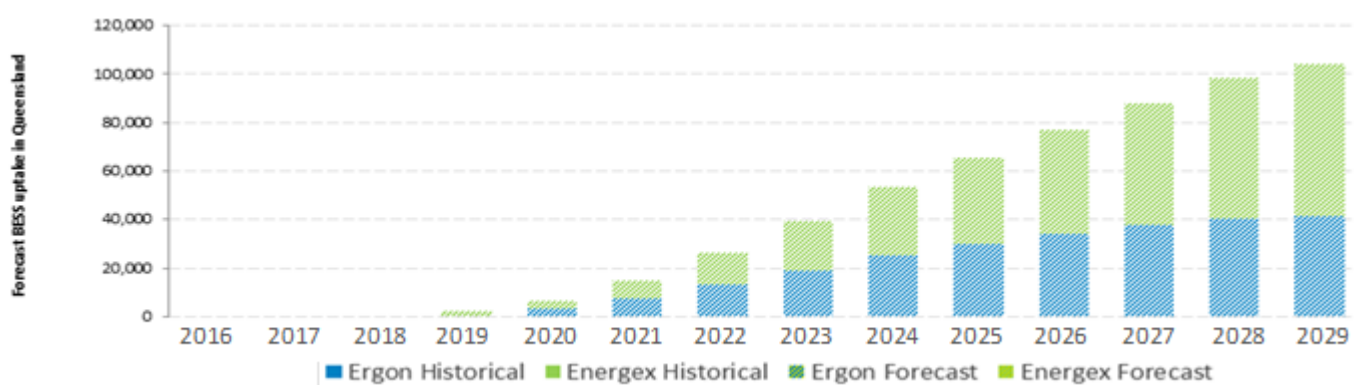


Figure 3 – Energy Queensland Batteries

5. Scope

This initiative is focused on the expansion of platform services (hardware, virtual machines, and networking) as well as harmonisation of services across Energex and Ergon (eg Backup capability for Ergon, Identity management using Active Directory for Energex).

Specifically, the project will do the following:

- Implement hyper-converged technology in the Energex OT environment to be used for new applications (such as those listed in the Intelligent Grid Enablement program). This includes the hyper-converged infrastructure, racks, networking and cabling.
- Expand the existing hyper-converged technology in Ergon Energy's OT environment which only requires the CISCO hyper flex as the racks etc. are already in place.
- Implement a common back-up methodology across both OT Environments.
- Implement Active Directory in Energex's OT environment to allow alignment with Ergon's OT environment.
- Develop a common set of support services across both environments (such as file transfer, storage etc).
- Implement a cloud services model for non-critical applications and for development and test environments.

- Develop a design (but not implement) for a common EQL OT environment and develop a business case for consolidation of data centres in the 2025-30 timeframe.

6. Assumptions

Existing OTE infrastructure is maintained and supported for the existing applications (such as DMS, SCADA etc).

The Unified DMS will exist as a standalone application utilising its own infrastructure and will not be operating on the shared virtualised environments.

7. Supporting Information

This initiative forms part of Energy Queensland's response to meeting the requirements of the ENA/CSIRO Electricity Network Transformation Roadmap.

8. Options Considered

8.1 Do nothing impact

The current Energex's OT Environment is only scaled to support the current business needs. Technology trials (such as network batteries, state estimation etc.) in the Energex network are currently being hosted in the Ergon OTE due to these limitations. When these trials conclude and the decision is made to roll them out across the Energex network there is no capability in the Energex OTE for this to occur. This will then delay implementation as additional funds and time are required to develop the Energex OTE before these initiatives can proceed.

The Ergon Energy OT Environment currently has some spare capability and this is allowing the Energex trials to occur in a timely and cost-effective manner. However, this has reduced the hosting capability for the Ergon network. If no further augmentation occurs, then applications scheduled for 2022 onwards would not be implemented as there was no spare capacity in the environment to host them. This would delay the implementation of the Intelligent Grid Enablement program which is focused on meeting customer needs.

The Do Nothing option would have a negative customer impact as technology trials would take longer to implement and cost more. Customers would not be able to take timely advantage of flexible hosting capacity capability, limiting their choice and flexibility in their investments.

8.2 Option Two - Establish cloud-based computing for non-critical applications

The alternative to utilising on-premises solutions is to outsource the OT environment to "cloud providers". The current pricing model for cloud services is based upon the flexibility to "spin up" and "spin down" environments and only pay for when they are being used. This is extremely useful for development and testing. However when applications run 24/7 such as the OTE, then the costing model for cloud for approximately 50 additional machines and 10TB of storage is in the order of \$3M/year just for the hosting solution.

The additional challenge with a cloud-based model is the additional costs associated with security and telecommunications to allow implementation. Currently, a majority of the data (sensing) is already in the Energex and Ergon OT networks and this would need to be sent to a cloud infrastructure incurring additional telecommunication costs.

It is expected the cloud services will be used as part of the initiative but for non-critical applications and for development and testing.

9. Risk Assessment

The network (business) risk the organisation would be exposed to if the project was not undertaken.

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Without capability increases in the OTEs then new projects will need to fund OTE infrastructure, potentially making the project unviable (eg R&D trials), or new capability will not occur in the network, putting the Intelligent Grid strategic initiatives at risk.	Business Impact	5	5	25	2022

Table 1 – Risk Assessment

Network Risk Evaluation Matrices:

- [Consequence and Likelihood Table](#)
- [Tolerability Scale](#)

The preferred option (OT Environment Expansion) is the right option to reduce this risk, as it provides the additional capacity at the lowest cost to actively manage the growth in additional applications due to the increases in IEDs to manage. This solution removes the requirement to fund growth on a project by project basis potentially making the new project unviable in its own right versus others which were viable due to the spare capacity available.

Risk Assessment Outcome:

The network (business) risk the organisation would be exposed to if the project was not undertaken is not deemed to be as low as reasonably practicable (ALARP). Addressing the risks as detailed above through implementation of the preferred option will reduce Energy Queensland's risk exposure.

10. Delivery Timeframe

It will be delivered as a staged approach across the 2020-2025 period.

The initial priority will be to get the Energex OTE into a hyper-converged platform for new applications and prepare for the rollout of the projects currently in pilot and trial.

- Rollout of Hyper-converged platform in Energex OTE – starting in 2020/21 and expanding each year through to 2024/25.
- Expansion of Ergon Energy's Hyper-converged platform – 2022/23 and 24/25.
- Common back-up methodology – 2021/22.
- Cloud Services model – 2022/23.
- Consolidation of Data Centres – Design only – 2024/25.

11. Project Cost Summary

ENERGEX	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
Labour	\$120,000	\$120,000	\$120,000	\$120,000	\$120,000
Material	\$400,000	\$800,000	\$800,000	\$400,000	\$640,000
Grand Total:	\$520,000	\$920,000	\$920,000	\$520,000	\$760,000

Table 2 – Energex Cost Summary

ERGON ENERGY	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25
Labour	\$30,000	\$30,000	\$30,000	\$30,000	\$30,000
Material	\$100,000	\$200,000	\$200,000	\$100,000	\$160,000
Grand Total:	\$130,000	\$230,000	\$230,000	\$130,000	\$190,000

Table 3 – Ergon Energy Cost Summary

NOTE: The above cost summary is presented in \$18/19 direct dollars.

Appendix 1. Definitions, Abbreviations and Acronyms

BESS	Battery Energy Storage System
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DER	Distributed Energy Resource
DSO	Distribution System Operator
ENA	Energy Networks Association
ENTR	Electricity Network Transformation Roadmap
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
HV	High Voltage (35kV – 230kV AC)
IS	Isolated System
LV	Low Voltage (50V – 1 000V AC)
MEGU	Micro Embedded Generating Units
MV	Medium Voltage (1kV – 35kV AC)
NER	National Electricity Rules
PQ	Power Quality (of the network)
PV	(Solar) Photovoltaic System
QoS	Quality of Supply (to a customer)
SCADA	Supervisory Control and Data Acquisition
ZS	Zone Substation