# DMIA Case Study

## *Solar Enablement Initiative (MV Visibility)*

Part of Energy Queensland

### Project outline

Distribution Network Service Providers (DNSPs) are facing the challenge of connecting increasing levels of Distributed Energy Resources (DER) to the grid. DER includes rooftop solar photovoltaics (PV) systems on homes and businesses, large scale solar and wind farms and batteries. DER contributes to progressively more dynamic and unbalanced distribution networks over which DNSPs have historically had only a limited visibility. In the past, patterns of electricity usage and generation were far simpler so the network could be designed and operated safely and reliability without a great deal of information about what was happening at its extremities. The presence of significant numbers of DER throughout the suburbs can impact the quality of electricity supplied to consumers as well as the stability of the broader electricity grid. This transition has driven the need for networks to explore more data-driven ways in which they can obtain network visibility to better support operational decisions. Distribution System State Estimation (DSSE) is one such option.

The Solar Enablement Initiative sought to test the application of a novel DSSE engine to achieve visibility of medium voltage (MV) networks using data currently available to DNSPs. In addition, the work explored how improved network visibility could be applied to better ascertain the impacts of future DER connections with the goal of enabling additional energy to be exported to the grid.

The project scope covered the implementation of DSSE on seven medium voltage networks across three DNSP partners. Three 11kV feeders in Energex (Queensland), two 22kV feeders in United Energy (Victoria) and two 11kV feeders in TasNetworks (Tasmania). The involvement of multiple DNSP partners allowed the development of a solution that was able to work on differing network topologies and with differing measurement data inputs.

Project partners and funding organisations: Australian Renewable Energy Agency, The University of Queensland, Queensland University of Technology, United Energy, TasNetworks, Energy Networks Australia, Australian Power Institute, Aurecon and Springfield City Group.

### Project outcomes / findings

Key project findings are:

- DSSE was successfully implemented on all trial networks handling deficiencies in network model accuracy, differing type and density of measurement data and varying feeder topologies
- The algorithm solves sufficiently quickly to enable near real-time state estimation
- Offline estimation for the most complex of the trial feeders solved in 20 seconds. The single feeder model was 170% the size of the model for the entire National Electricity Market highlighting the magnitude difference in scale when applying state estimation to distribution networks.
- The value of different sources of time-series measurement data as an input to state estimation varies. For MV state estimation the highest value measurement data was sourced from low

voltage (LV) connected distribution transformer monitors and inline MV feeder devices with voltage and power flow measurements. This finding will help to inform the rollout and configuration of future network monitoring devices.

- The accuracy of estimates varied depending on the density and source of measurement data, the complexity of the network and how extensively the network model was refined. Voltages estimated at the terminals of distribution transformers ranged from ±0.5V to up to ±5V.
- A PV Analysis Tool was developed to run an automated power flow analysis to find the maximum PV hosting capacity at a point on a feeder based on a shortlist of critical cases identified using DSSE. This analysis enables a prediction of the likely voltage and capacity impacts of a new PV connection overlaid on historical feeder performance.
- The project also developed Uncertainty Analysis, Estimation Diagnostics, Critical Case Identification and a Constraints and Optimisation engine which could be employed in the future for DER orchestration.

## Next steps

Energex and Ergon Energy Network are pursuing a broader implementation of the state estimator as developed through the Solar Enablement Initiative. This work is being undertaken through the Expanded Network Visibility Initiative and seeks to improve visibility of the network at both medium and low voltages.

Rights to commercialise the state estimator developed through this initiative have been granted to GridQube.

## More information

- ARENA's project page: https://arena.gov.au/projects/increasing-visibility-of-distribution-networks/
- For more information on Energex's role in the Solar Enablement Initiative contact terese.milford@energyq.com.au
- For general enquiries about DMIA: demandmanagement@ergon.com.au.

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