Project EDGE | Fairness in DOE Objective Functions

Executive Summary Report

April 2023

Summary of detailed report available at: https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/project-edge/project-edge-reports-1

Introduction

Purpose of this document

- This document is intended to convey the findings from the Project EDGE Fairness in DOE Objective Functions study in a way that is accessible to a wide audience of management, policy and non-technical stakeholders. It can be read stand-alone without diminishing understanding of the key results. The accompanying detailed report is available on AEMO's Project EDGE webpage

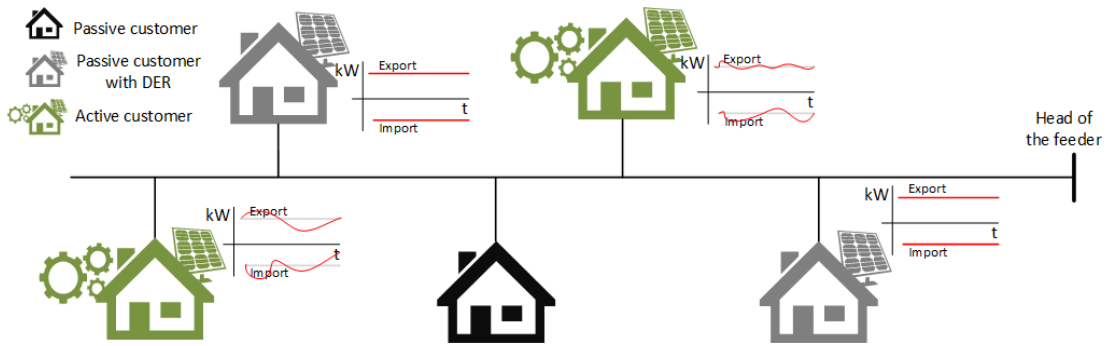
What is a Dynamic Operating Envelope (DOE)?

- A Dynamic Operating Envelope is defined as dynamic power export or import limit at the customer's connection point. DOEs are calculated by the DNSP.
- Customers agree to receive Dynamic Operating Envelopes (DOEs) via their connection agreement during constrained times. DOEs, also known as Flexible Export Limits, are currently available in South Australia to allow greater customer solar export most of the year in exchange for less export during some periods of the year where less network capacity is available. During these periods, DOEs are a tool to defer network investment costs that increase all customers' electricity bills.
- Currently, the default static limits on DER are conservative by design, however DOEs will allow DNSPs to consider location and temporal factors when assigning DER capacity; This can lead to greater customer solar exports overall.

What is a DOE Object Function?

- A DOE Objective Function is used in the calculation of DOEs as a method of allocating spare network among participating DER customers. Objective Functions can produce different allocations among customers depending on the 'objective' that is used.

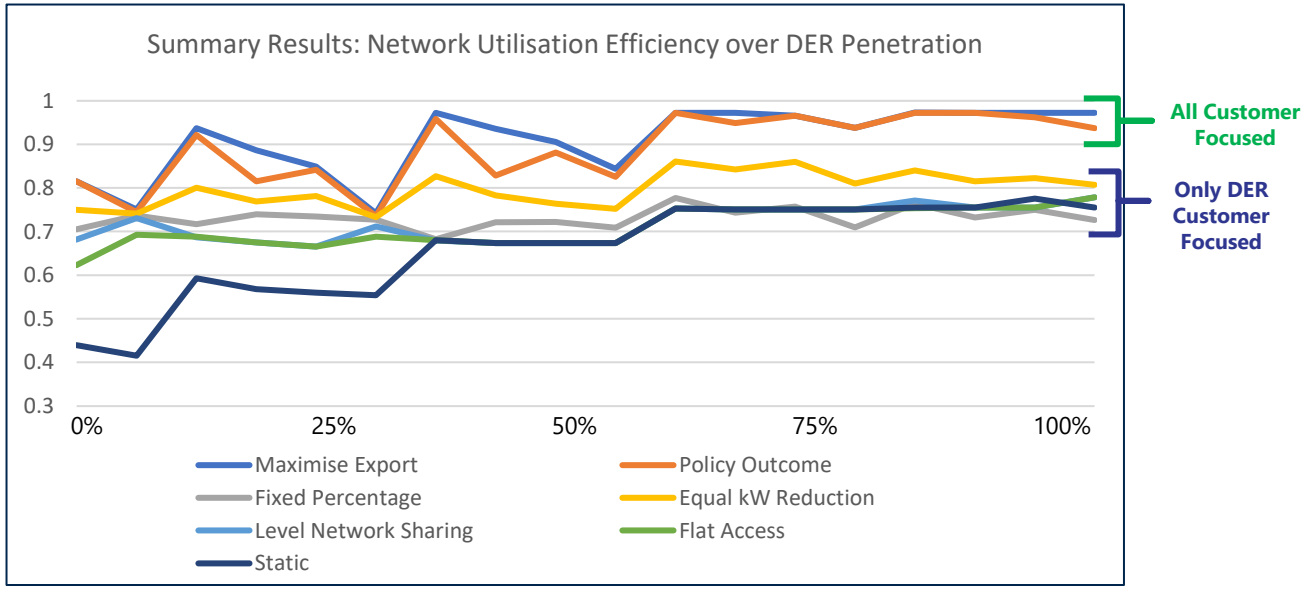
Conceptual illustration of operating envelopes by customer type



Importance and Relevance of the DOE Objective Function Study

- The Fairness in DOE Objective Function Study completed by the University of Melbourne looks at the network allocation capacity that is applied across a spectrum DOE Objective Function options. The study shows there will only be a difference in results between the DOE objective functions if network congestion is encountered when allocating capacity.
- In these infrequent circumstances, DER customers will still be able to self-consume their solar as only exports are being managed in times of network congestion.
- The fundamental questions asked in the study are:
    - How does/should a DNSP **allocate the available capacity** amongst all participating DOE customers?
    - Does this capacity allocation between participating customers **need to be fair to maintain social license?**

This work examines the technical, economic, and fairness impacts of a DNSP utilising different DOE objective functions to allocate network capacity among customers.



Key Study Discussion Points

1. **Fairness** has different meanings to different people & with different financial outcomes for DER and Non-DER consumers. Should this be measured by:
    - Fairness only for customers with DER receiving a DOE

    OR

    - Fairness for all customers existing in the network including those who own DER

2. Increasing system **efficiency** will also likely lead to better outcomes/be fairer for all customers in general

DOE Objective Function Framework

The objective of a DOE is to share spare network capacity between participating DER customers. This framework presents different options on how to share spare capacity between DER customers during times of network congestion and outlines the impact on DER and non-DER customers in line with the study.

Key Study Discussion Point: Fairness has different meanings to different people & different financial outcomes for DER and Non-DER consumers. Should fairness be measured for customers with DER receiving a DOE or for all customers existing in the network who pay for this infrastructure?

Maximise Export

Considers: Fairness from whole-of-consumer & system' perspective not the *individual* DER perspective

Outcome: Some sites receive greater export capacity than others to **maximise** the total export and overall benefit to all consumers, including those without DER.

Policy Outcome

Considers: Fairness to all customers from a policy perspective

Outcomes: Each DER weighting is considered by integrating policy factors such as emission reduction

Fixed Percentage

Considers: Fairness by same percentage allocation, from an individual DER asset perspective

Outcomes: Consumers are allocated the same percentage of their DER asset size, those with larger DER are allocated more total kW capacity

Equal kW Reduction

Considers: Fairness by the equal reduction of DER Customer exports by the same number of kW

Outcomes: Could result in less total export across the NEM. Absolute capacity limits instead of equal percentage equalise financial impact to DER Customers. Those with larger DER receive more capacity

Level Network Sharing

Considers: Fairness is attempted by sharing equal network capacity across DER customers with some reallocation capacity that cannot be used

Outcomes: Could result in less total export across the NEM with a diminished benefit to non-DER customers.

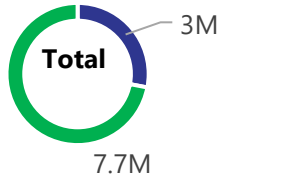
Flat Access

Considers: Fairness by allocating the same network capacity among DER customers even if they cannot use it.

Outcomes: Could result in the lowest total export across the NEM with a diminished benefit to non-DER customers due to some allocation that cannot be used (customer's DER not large enough).

Impact: A higher total Network Capacity Allocation will be reached and be more efficient as Fairness is applied to all consumers who pay for the grid via their electricity bills (~10.7m). Under these options, some DER customers may receive more allocation than others during times of network congestion.

NEM customer breakdown (2022)

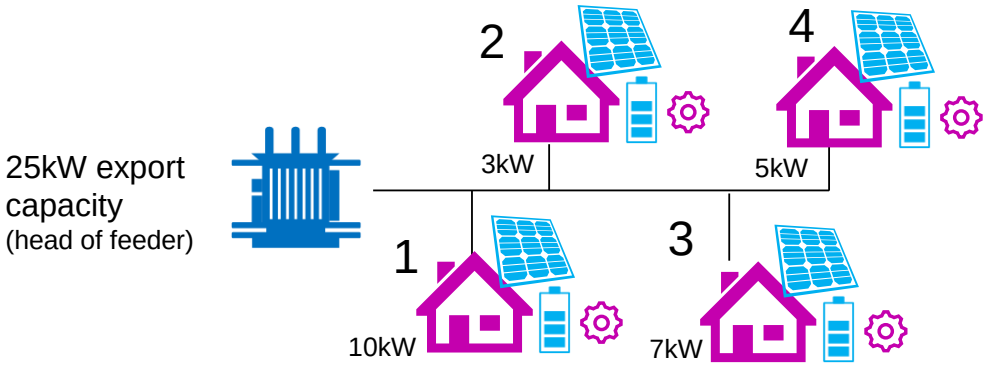


- DER Customers (e.g Solar PV)
- Non DER Customers

Impact: A lower total Network Capacity Allocation will be reached and be less efficient as Fairness is applied only to customers with DER and DOEs (up to ~3m). Under these options, all DER customers are treated similarly, weighing allocations toward the smallest DER. This reduces the total network capacity allocated and therefore benefits to all, including non-DER customers.

Illustrative Results

The illustration below visualises representative study results across the DOE Objective Function Framework



Maximise Export Illustrative Example

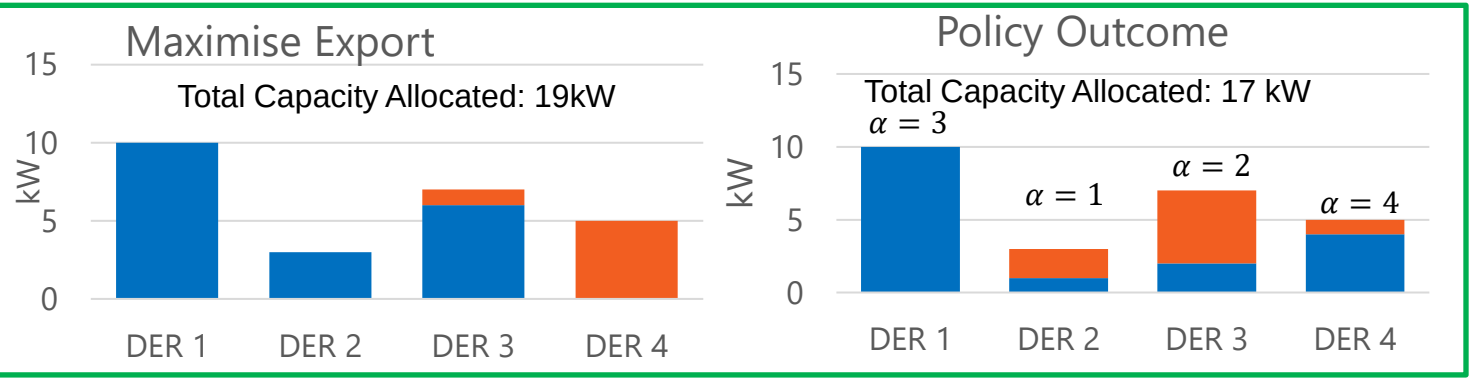
The DER at the head of the feeder receive (10kW), and those at the end of the feeder (closer to House 4) miss out on being assigned spare export capacity. The DER at the head of the feeder receives priority because of its physical proximity to the transformer. Network physics mean DER closer to this point will be better able to export in full and therefore represent the most efficient allocation of spare capacity. Full capacity cannot be allocated due to electrical losses, impacting the ability to export for DER further down the feeder.*

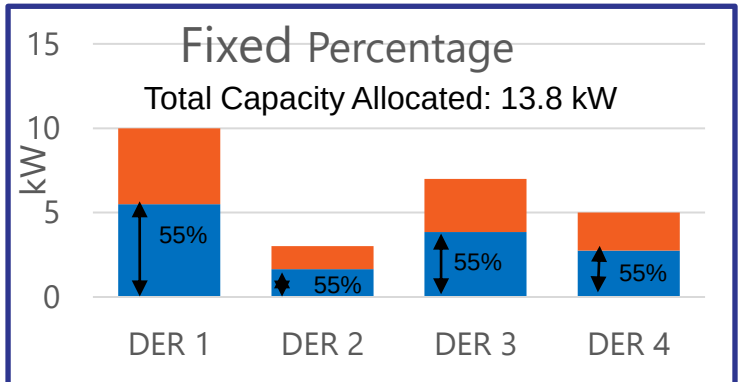
In this function, the total capacity (19kW) that is allocated is the most out of all Objective Functions. But this may result in some participating customers having higher export capacity allocation than others for the duration of this constraint due to their location in the network.

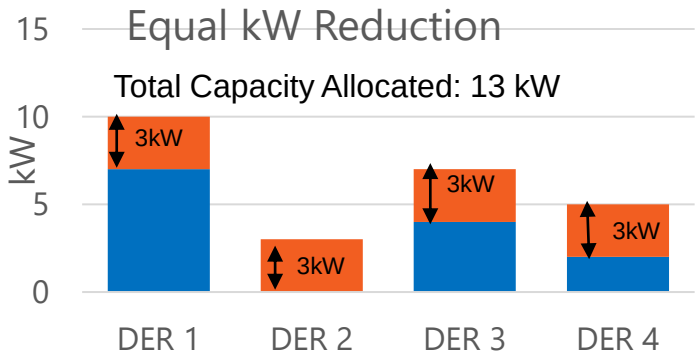
All Customer-Focused

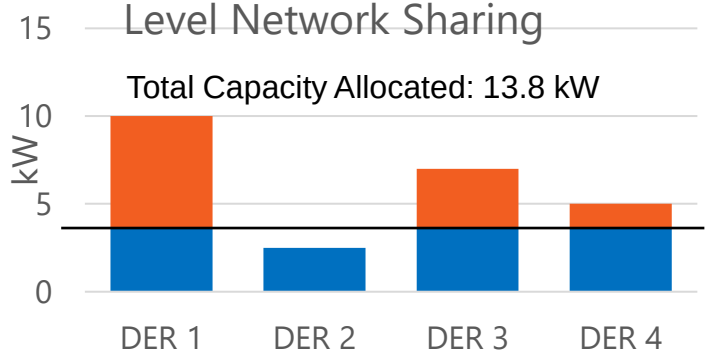
Allocated Capacity Unallocated Capacity Over-Allocated Capacity

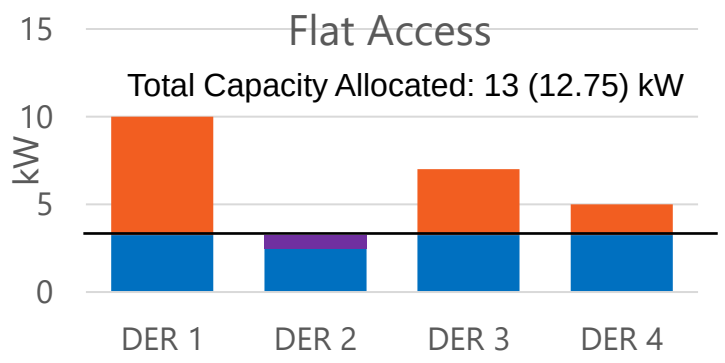
Only DER Customer-Focused







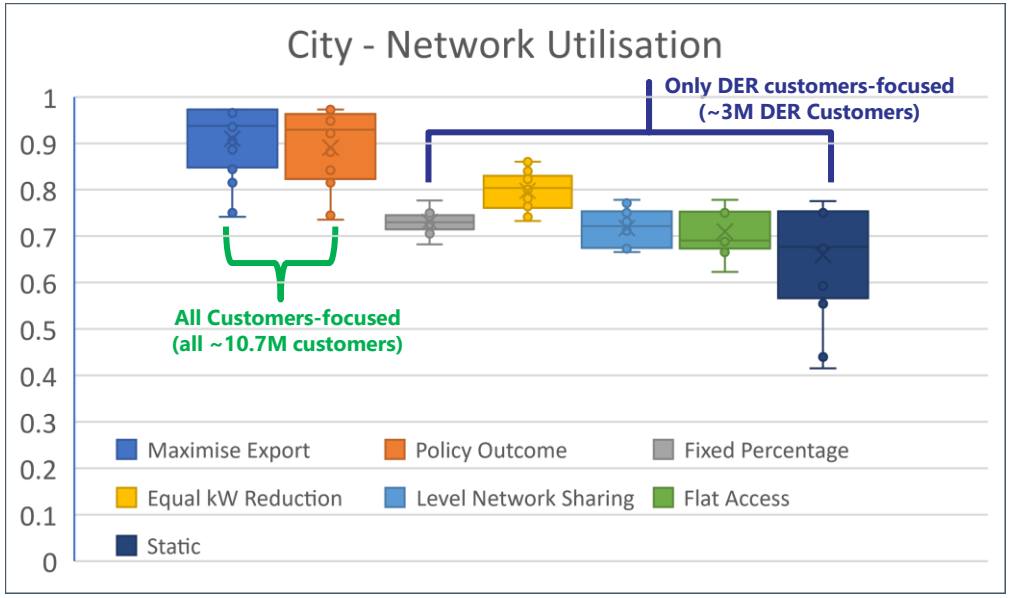




* Further information can be found through the Calculation and Use of Dynamic Operating Envelopes Report alongside the DOE Objective Function Report

Conclusion & Key Takeaways

- Project EDGE applied different DOE Objective Functions over a range of representative networks, DER penetrations, and levels of DER participating in the market via Virtual Power Plants.
- From these applications, the Objective Function results indicate:
  - In general, **calculating DOEs using intuitive concepts of fairness** in relation to participating DER customers only, may reduce the technical and economic benefits that all customers can obtain (via reduced electricity bill increases)
  - This **loss of community benefits** can become **worse over time with higher DER penetration** rates as networks become more constrained, which is exactly when DOEs are most needed
  - Currently some networks static limits may be highly conservative but moving into a high DER future they will need to be further reduced. Network type, DER location, and DER phase connection will all have a significant impact on setting safe static network limits. DOEs could play a role in enabling greater customer solar export in this future
  - By trying to be **fair to a subset of customers** (those with DER and actively participating in the market via VPPs), **benefits (to bills) and fairness to the wider pool of customers and community will likely reduce**



The results from this study have provided tangible research evidence around DOEs.

However, additional actions are required for industry to answer the questions below:

- How to balance the expectations of actively participating customers against those of all customers?
- How can all customers most benefit from the implementation of DOEs?
- How to deal with future changes to static limits, and the grandfathering of current arrangements?

The Project EDGE Customer Insights Study delves into community perceptions around Fairness among DER Customers and Aggregators Services. This report provides further understanding for a customers motivation to join a VPP.