DER Enablement stage 2 technical report

Report overview – April 2022

Renew's DER (Distributed Energy Resources) Enablement Project –generously funded by Energy Consumers Australia[1] – arose from a desire to better understand the technical problems that can arise when increasing numbers of rooftop solar PV systems (and other DER) lead to high levels of electricity exports into local networks. We were concerned that some of the strategies electricity distribution networks were using to manage the problem were negatively impacting households more than necessary, so we wanted to better understand the problems and the potential solutions in order to form a view on a way forward that maximised consumer benefits while still maintaining safe, secure and reliable operation of the grid.

Stage 1

For the first stage of the project, Renew engaged Energeia to:

- investigate the range of technical problems associated with or surfaced by high rates of DER feed-in;
- understand the range and costs of remediation options for these problems; and
- identify – as much as possible –the types of approaches that deliver maximum customer benefit while remediating the problems in different types of networks and at different levels of DER penetration.

Working with key stakeholders, we documented around two dozen problems and a similar number of remedial strategies. Modelling identified a number of strategies that were most cost-effective in most situations, but also determined that situational factors lead to significant variance in both the problems that manifest and the solutions that work.

The work also identified that more sophisticated system-wide and forward-looking modelling was needed to fully examine the issue and to map the whole suite of approaches – technical, policy, regulatory, and market – needed to reach a future where DER penetration is at the optimal level for maximum consumer benefit in a safe, secure and reliable grid. This was the purpose of the Stage 2 project.

Stage 2

The second stage of the project is building on the findings and recommendations of the stage 1 project by using its DER abatement cost and efficacy data to inform whole-of-system modelling to determine optimal DER integration pathways to maximise consumer benefits while maintaining network security and reliability. This will enable us to identify the policy, regulatory, market, and technical barriers to maximise consumer benefit by enabling DER integration into the energy system.

Phase 1 of stage 2 was the whole-of-system technical modelling undertaken by Energeia after extensive engagement with key stakeholders. Phase 2 will be a series of engagements with consumer, industry, and government/regulatory stakeholders to guide renew in interpreting the implications of the technical report and developing

[1] This project was funded by Energy Consumers Australia (www.energyconsumersaustralia.com.au) as part of its grants process for consumer advocacy projects and research projects for the benefit of consumers of electricity and natural gas. The views expressed in this document do not necessarily reflect the views of Energy Consumers Australia.

recommendations for future advocacy and systemic change to unlock the optimal future for Australian households.

The technical report

The technical report describes the outcomes of the modelling conducted by Energeia for Renew for the stage 2 project and discusses the main barriers to achieving optimal DER enablement.

The modelling outcomes

The modelling approach compared the expected growth of DER with the current policy and regulatory settings (based on the *Step Change* scenario from AEMO's *Integrated System Plan*[2]) with an idealised optimal *Consumer High DER* scenario based on plausible favourable technology development and price paths consistent with achieving a least-cost mix of DER, network and generation resources and limited only by cost-effective DER integration strategies. **The Consumer High DER scenario is not a forecast**, but a theoretically plausible 'best of all possible worlds' future state for 2035 and 2050.

> *By estimating the size of the prize without considering the associated barriers, it can be used to inform decision-making regarding the prioritisation of any policy, regulatory, industry and institutional reforms needed to achieve the identified optimal levels of DER investment.*[3]

Key findings from the modelling are that, in reaching this possible future:

- The optimised rate of DER adoption is lower than the current rate of adoption, but increases over time
- Optimised DER adoption reduces distribution and transmission network capacity requirements significantly (by 23%)
- Significant curtailment of solar PV and wind occurs, but there is still economic value in rooftop solar exports on average
- Wholesale spot prices become increasingly negative during periods of high solar PV generation, relatively low load and inflexible generation
- Managed (orchestrated) DER plays a major role in shifting load to the middle of the day and minimising curtailment[4]
- Annual NEM consumption declines in steps from 2036, in step with the exit of inflexible coal generators, which reduces the curtailment of the higher rooftop solar PV capacity in this scenario.[5]
- Enabling VPPs to meet reliability and security of supply will support timely exit of aged generation, e.g. coal and gas

The amount of curtailment predicted means it's critically important to have more sophisticated control that can curtail exports without curtailing self-consumption.

Key barriers

Energeia identified three main types of barriers to achieving the *Consumer High DER* scenario.

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[2] The 2020 ISP – the 2021 revised *Step Change* scenarios came out to late to be included in the modelling.
[3] Final report, p. 21
[4] Paraphrased, Final Report p. 21
[5] Final Report p. 31

Things that devalue DER

These regulatory and industry barriers obscure the true value of DER in the system, discouraging investment in DER and DER enablement

- **Tariffs that do not reflect Long-Run-Marginal-Cost (LRMC)**
  - approaches used to calculate LRMC typically take a very conservative approach to classifying costs as marginal, overstating residual costs and weakening price signals
- **Tariffs that do not reflect network congestion periods**
  - time-variant tariffs are poorly aligned with peak demand, further obscuring price signals
- **Tariffs that do not reflect DER integration economics**
  - DER exports can both drive need for enablement investment and offset demand-driven costs, but are not given appropriate price signals – export pricing done right can address this *(through the recent Pricing and Access rule change, if sufficiently nuanced)*
  - local consumption of DER exports attracts the full network tariff despite the much lower cost to serve – local use of system charges would address this
- **Tariff assignment policies that do not require cost reflective tariffs for DER**
  - assigning DER connections (solar, batteries, EVs) to appropriate cost-reflective tariffs from the outset is required (*through the recent Pricing and Access rule change, if sufficiently nuanced)*
- **Investment optimisation methodologies that do not reflect potential value of DER**
  - the *Regulatory Investment Test* – Distribution (RIT-D) generally applies only to zone substation and sub-transmission projects, but the higher LRMC of HV and LV assets would likely favour more non-network solutions including those involving DER strategies.

The absence of systems that enable DER

Planning and operational systems that, when absent, act as barriers to optimal investment and operation DER until they are addressed.

- **Holistic distribution resource plans, e.g. a DAPR inclusive of the LV Network**
  - Distribution planning obligations (e.g. the *Distribution Annual Planning Report,* DAPR) and associated regulatory requirements (e.g. the RIT-D, noted above) only cover a fraction of total network investment – largely the sub-transmission and zone substation levels – thus obscuring much DER opportunity. Leading international jurisdictions, require publicly available holistic distribution system plans that can factor in the value of DER and guide DER investment.
- **Distributed Energy Resource Management Systems**
  - The Consumer High DER scenario requires significant orchestration of loads and DER exports to handle the high levels of DER. Currently some orchestration is possible via networks and Virtual Power Plants (VPPs) working with retailers, Dynamic Operating Envelopes (DOEs) are being explored by networks, and rudimentary export curtailment possible by adjusting voltages to trip PV systems. But overarching Distributed Energy Resource Management Systems (DERMS) will be needed to enable the more widespread and sophisticated orchestration required.
- **Distributed Market Systems**
  - The wholesale electricity market has mechanisms that account for time and locational factors into the value of generation. These do not exist for distributed generation. Establishing network and industry capability to convey the real value of

distributed energy to the market is necessary to achieve optimal levels of DER investment and operation.

Industry incentives that discourage leveraging DER to support networks

Regulatory tools that are structured such that they disadvantage DER indirectly but could become a strong driver of optimal DER investment and operation were they to be addressed.

- **Regulatory incentive schemes and revenue determination**
  - Network pricing regulation uses various incentive schemes to encourage networks to pursue capital and operating cost efficiencies, meet performance targets, and encourage innovation and non-network solutions (which often make use of DER) that deliver real value to users. But while the Demand Management Incentive Scheme (DMIS) – which encourages non-network solutions such as using DER to reduce demand on the network – is worth twice as much per avoided dollar than the Capital Efficiency Sharing Scheme (CESS) – which encourages efficiencies in capital expenditure on assets – DMIS allowances make an insignificant contribution to network revenue: dwarfed by CESS allowance, which in turn are dwarfed by returns on capital expenditure. This appears to be partly due to the low cap on DMIS payments, and partly due to the much greater revenue contribution of capital expenditure that adds to the regulated asset base, a key factor in determining allowable revenues. Regulatory reform is desperately needed to remove barriers to and increasing caps for DMIS, and delinking network valuation from revenue determinations.

The value of DER enablement to energy consumers

The Consumer High DER scenario yields a $25b benefit to consumers over a 15-year period and a $69b benefit over 30 years.[6] This scenario is an idealised possible future – it's not necessarily achievable. But the modelling clearly shows that enabling a much greater penetration of DER than current regulatory and policy settings allow yields a material benefit to consumers and, by virtue of enabling greater renewable energy, a clear carbon benefit. Developing a policy, regulatory, and market change strategy to address the barriers identified is critical if we are to progress toward this future.

[6] Compared to the *Step Change* scenario from the 2020 ISP. The updated 2021 *Step Change* scenario developed for the 2022 ISP was published too late to be included in the modelling. The quantum of consumer benefit would be lower compared to the 2021 *Step Change* because it has significantly more DER penetration. However, the consumer benefit measured against this higher baseline would still be considerable.