LESSONS LEARNT REPORT 1: SMART ENERGY HUBS

Shell Energy Smart Energy Hubs Deployment Project

Shell Energy Retail Pty Ltd
ABN 87 126 175 460

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This project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

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Glossary of Terms

Term	Definition
BESS	Battery Energy Storage System
CAPEX	Capital Expenditure
DERM	Distributed Energy Resource Management
DCM	Demand Charge Management
DNSP	Distribution Network Service Provider
DR	Demand Response
DRSP	Demand Response Service Provider
DROM	Distributed Resource Optimisation and Management
DUID	Dispatchable Unit Identifier
FCAS	Frequency Control and Ancillary Services
FMW	Flexible Megawatt
FMWh	Flexible Megawatt Hours
LF	Load Flexibility
HVAC	Heating, Ventilation and Air Conditioning
HVAC&R	Heating, Ventilation, Airconditioning and Refrigeration
OPEX	Operational Expenditure
PCMS	Power Control and Management System
RERT	Reliability and Emergency Response Trader
SCADA	Supervisory Control and Data Acquisition
WDR	Wholesale Demand Response
WDRM	Wholesale Demand Response Market

Background

Smart Energy Hubs optimise the entire energy ecology for each customer site. Rather than implementing discrete energy projects over time, Smart Energy Hubs combine the right mix of solutions for more significant energy efficiency gains and greater reduction of emissions and costs at each site. Solutions include:

- Optimisation of energy-intensive equipment,
- Installation or optimisation of solar PV systems,
- Battery energy storage systems,
- Thermal inertia solutions,
- Automated demand response capabilities,
- Electrical vehicle (EV) infrastructure development, and
- Creation of energy certificates to offset project costs.

This report is part of the Smart Energy Hubs Deployment Project which is partially funded by ARENA. The funding contract term is 15 July 2022 to 30 September 2024.

The purpose of this Deployment Project is to track progress on commercialising Smart Energy Hubs to close the current funding gap on CAPEX to enable this solution to scale without ARENA funding. By September 2024, Shell Energy aims to show a 70% reduction in the ARENA funding gap. This is likely to be realised through cost reductions, and increased revenue.

Executive Summary

The adoption of flexible demand in Australia for commercial and industrial customers is currently done on a technology-by-technology basis rather than as an integrated solution for customer sites. There is limited awareness of emerging forms of flexible demand involving turning large equipment into smart direct (energy) load control (DLC) devices and battery energy storage and solar PV curtailment. Furthermore, these emerging forms of flexible demand are not currently participating in AEMO market schemes for distributed energy resources such as the Reliability and Emergency Reserve Trader and Wholesale Demand Response. These new forms of flexible demand are relatively untapped and there is significant latent capacity in commercial & industrial sectors that can be unlocked by the end of 2025 to address upcoming network and market challenges. Realising revenue for all distributed energy resources at a customer site across all electricity market services and emissions schemes is key to closing the commercialisation gap. To commercialise Smart Energy Hubs, Shell Energy will implement approx. 21.5 megawatts of flexible demand capacity, pursue three regulatory reforms, and seek to demonstrate three new market services to unlock flexible demand market value.

Shell Energy has engaged Seed Advisory to consult with stakeholders from across the energy sector to identify the regulatory reforms and new market services to be pursued through this ARENA program. In terms of new market services, the three identified all relate to distribution network services, which Shell Energy intends to trial across at least two distribution network service providers in two or more states. Shell Energy has already engaged two distribution network service providers and continues to engage with several others who have expressed interest in being involved in this initiative. Shell Energy intends to continue to engage these distribution network service providers to deliver on the ARENA program objectives by carrying out new market service trials that increase the paid services able to be delivered by flexible demand resources.

To achieve the flexible demand capacity and undertake the trials of new network and market services, Shell Energy will develop and deploy 40 Smart Energy Hubs. ARENA has chosen to provide grant funding for Shell Energy's Smart Energy Hubs implementation program, to close the commercial funding gap for this flexible demand solution to scale. This program intends to increase

the participation of commercial and industrial customers in flexible demand services at a material scale by 2025, to solve upcoming market challenges.

Smart Energy Hubs in this program aggregates Solar PV, Battery Energy Storage Systems, electric vehicle chargers, and large energy-using equipment, combined with smart controls strategies to deliver an integrated solution for customers. This integrated commercial solution is operated to realise maximum benefits across market revenues, network services and customer savings under a flexible business model designed to meet customers' financial objectives.

While the Smart Energy Hubs program has implemented a robust strategy, it should be noted that there are a number of risks regarding the successful delivery of the project objectives. These include supply chain changes that impact on costs, changes in market conditions that impact on revenues, ability to achieve regulatory reforms, and Distribution Network Service Provider (DNSP) willingness to collaborate on our proposed trials. Shell Energy's development of a critical mass of flexible demand capacity should support overcoming the above risks and provide adequate proof points for the full demand flexibility value stack to be unlocked.

Lessons Learnt

Technical

1.1.1 Impacts of available network export capacity on flexible load generation assets

Objective: Smart Energy Hubs include energy storage and generation assets, notably Battery Energy Storage Systems (BESS) and solar. The sizing of BESS is highly sensitive to available network export capacity. Sizing the BESS to site load only in terms of minimising export, inhibits realising economies of scale in BESS procurement and installation.

Detail: Shell Energy, through its site feasibility studies of Smart Energy Hub tranche one and two candidate sites, has identified the sensitivity of BESS sizing to available network export capacity. This is driven by value streams across multiple markets exhibiting linear growth alongside BESS capacity (MW). This runs counter to the conventional wisdom of demand response activities which leverage generation assets to reduce site load in high demand or generation shortfall periods. Allowing the generation asset to move beyond reducing site demand toward site export, permits BESS sizing to reach natural efficiencies of scale.

For example, if a BESS is designed to 200kW to offset site load only, while the exported energy (kWh) is valued at zero and market value of the demand response (kW) is ignored, the benefits of increased capacity are marginal. However, as pre-configured installed BESS cabinets come in discrete package sizes of 50kW and 250kW, this results in a site deploying 200kW as four systems incurs significant additional cost of deployment relative to one packaged 250KW. These costs per cabinet are predominantly, civil engineering, structural foundations, interconnection and supporting electrical works. By assigning value to the demand response capacity in conjunction with reduced implementation costs the 250kW system can deliver additional flexible capacity at a lower cost per unit of capacity.

Accepting the premise that a flexible demand exceeding the sites load is valuable, the need for ready access to information on constraints is crucial. While some DNSPs provide fast and free preliminary feedback; the majority will not provide indicative capacity until a grid connection application is submitted. Not only does this inhibit optimisation of a Smart Energy Hub's Flexible Demand Capacity upfront, but it also creates additional barriers such as increased engineering work and further commercial approvals processes. We are alleviating these issues by engaging DNSPs bi-laterally on known constraints based on initial site selection and submitting grid connection applications at the start of the design process. This will speed up the to design and implementation of flexible demand capacity.

Implications for future projects: Alleviation of these issues within the Smart Energy Hubs implementation project will reduce the capital costs of future Demand Response BESS as it will leverage the network infrastructure capacity.

Conclusion: Determination of flexible demand capability of a Smart Energy Hub should not be limited to site load, rather it should be based on best economics within the boundaries of network constraints. Early access to available export capacity can reduce cost and implementation barriers to significant additional volumes of flexible demand.

1.1.2 Qualification of suitable locations of Battery Energy Storage Systems within commercial and industrial sites

Objective: Smart Energy Hubs is seeking to layer additional value streams to their flexible demand assets by relying on equipment deployed alongside BESS. Ensuring a candidate location is suitable to hosting BESS is an effective tool for determining if a site is suitable for becoming a Smart Energy Hubs.

Detail: Shell Energy's engineers have identified several features of candidate locations of Smart Energy Hubs that act as strong positive and negative signals of their suitability to host BESS. The implementation of BESS at a Smart Energy Hub is a key enabler of the realising the maximum multi asset/multi market approach to value optimisation, as it is the asset that delivers the highest income. Features that support site selection are physical space supporting an appropriate BESS configuration and proximity to existing infrastructure such as switchboards, solar generation and point of supply.

Physical space impacts on targeted capacity and needs to take account of physical access, fire management (clearance zones) and physical asset protection. At smaller capacities, physical space requirements are driven by the 50kW BESS format containing standalone battery and inverter cabinets, with each requiring its own access and space on a structural foundation. Whereas a 250kW package returns to a higher density single inverter cabinet and single battery cabinet configuration. This significantly reduces the overall space required per kW as packaging, fire management and physical protection requirements shrink considerably by reducing the number of systems deployed.

Implications for future projects: Selecting sites for physical footprint availability for BESS will be a key consideration. This will be considered in early stages of feasibility, as enabling 250kW BESS formats for supermarkets will simplify the implementation of a Smart Energy Hub.

Conclusion: BESS location and packaging should be considered as early as possible in a feasibility study. A site where the financial model supports 150kW of capacity may not physically accommodate the six required cabinets. A 250kW solution of two cabinets may be physically supported by the location provided the increase in capital investment is feasible.

Stakeholders

1.1.3 Subject matter experts & enabling capability building energy ecology and implementation of multiple load flexibility technologies

Objective: Smart Energy Hubs is seeking to integrate a range of distributed energy resources behind the meter at a customer site to deliver and create flexible demand. This requires cross functional development of a solutions for the site location and effective use of and communication between relevant subject matter exports.

Detail: Each Smart Energy Hub includes several features that historically have been implemented on a technology-by-technology basis. This has resulted in each Smart Energy Hub implementation becoming a large cross-functional project with many contributors. The scope of this program is wide, crossing multiple state boundaries and business units within Shell Energy's Energy Solutions business. Maintaining engagement between subject matter experts and recently onboarded program contributors is key to being open to opportunities in terms of flexible demand capacity and cost per unit of flexible demand realised within a Smart Energy Hub.

Implication for future projects: Shell Energy will look to onboard the subject matter experts for each resource (e.g. HVAC – a BMS technician, HVAC&R - a specialised mechanical engineer, BESS and solar - a specialised electrical engineer, UPS and back-up generators - a specialised electrical engineer) into the program. This will support functional areas to keep moving on their scopes across engineering feasibility studies, detailed designs, installation, dispatch integration and even setting up asset management for scale.

Conclusions: Onboarding key subject matter experts will be key to enabling the intended outcomes and scalability. This will be achieved by creating an informal matrix structure to close capability gaps and systematically upskilling the project team to enable greater autonomy.

1.1.4 Onboarding of site operations personnel & technical service providers

Objective: Implementation of Smart Energy Hubs at scale necessitates early engagement by senior customer stakeholders, and obtaining permission to undertake early works to validate site suitability. This creates the need for early onboarding of site-level stakeholders to ensure ease of access to site, ready site information and access to local site operations teams.

Detail: Customers of the Smart Energy Hubs implementation project submit several candidate locations for each tranche to be screened for suitability. The inherent complexity in establishing a Smart Energy Hub often requires the validation of site records and local conditions by site inspection. For tranche 1 sites, these inspections typically proceeded smoothly with initial prospecting. However, when it became necessary to pivot to alternative locations to meet the timelines of the program, sites were not as well informed. This led to difficulties with fulfilment of requests for information, access to assets such as switchboards or plant rooms, and a lack of understanding of the aims of the Smart Energy Hub project by site operations staff. This can expose the project to risks of delay at the feasibility stage, while a lack of understanding of Smart Energy Hubs can present some unique risks with site operations stakeholders. Site operations stakeholder risks include significant inertia to adjust existing operating procedures which are typically geared towards reliability, which is often not aligned with unlocking maximum demand flexibility. Additional work to demonstrate understanding of the site operations stakeholders including earlier onboarding should be considered to remediate these issues.

Implications for future projects: Early engagement of site operations stakeholders is recognised as an important activity to de-risk implementation timelines as part of any implementation. Complete access to appropriate site personnel alleviates the risk of missed demand flexibility opportunities and unforeseen constraints known to local personnel. As Smart Energy Hubs expand to industrial sites more broadly, co-development of a specific implementation should involve a customer-side subject matter expert. Additional time to understand the existing site operations and additional demand flexibility opportunities can be co-designed with site stakeholders to enable easier implementations.

Conclusions: Customer candidate locations should include additional information such as site operations manager, any appropriate specialised site operations personnel, and landlord contact, if landlord approvals are required. Implementing a communication plan will help to ensure all key stakeholders are engaged. Site operations stakeholders will likely require technical engagement and are best placed to co-design technical documentation required and unlocking them as available resources is key to the project’s success.

Appendix 1 Shell Energy Supplementary Information

Lessons learnt register

Lesson #	Lesson Category	Lesson Application	Report number
1.1.1	Technical	Impacts of available network export capacity on flexible load generation assets	1
1.1.2	Technical	Qualification of suitable locations of Battery Energy Storage Systems within commercial and industrial sites	1
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