Flexible Services Program: Lessons Learnt

CitiPower Pty Ltd, Powercor Australia Ltd
and United Energy Services Pty Ltd
Milestone One: ARENA Advancing Renewables Program.

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1. Executive summary.

The Flexible Services Program (the Program) aims to demonstrate the capabilities needed to deliver effective, scalable solutions to manage minimum demand events and provide flexible services to our customers.

The Program will demonstrate these capabilities through the deployment of three unique trials and is part funded by the Australian Renewable Energy Agency's (ARENA) Advancing Renewables Program.

A high-level summary of the capabilities being developed under each trial, in addition to a brief status report, are summarised below:

- **Hot Water Load Control Trial (HWLC):** Coordinate and schedule the timing of controlled hot water loads via our smart metering systems to align with periods of low demand and high solar generation. In other words, load shifting from nighttime to daytime to help mitigate minimum system demand challenges.

  Progress to date: Completed a small, internal trial to measure customer impacts and develop a market state of play of hot water unit technologies.
- **Flexible Exports Trial (FET):** Implement new technologies and systems and develop capabilities to offer trial customers solar export limits greater than their existing static limits via Dynamic Operating Envelopes (DOEs). The trial will utilise near real-time data generated by our smart meters to issue DOEs that maximise exports whilst managing local network constraints.

  Progress to date: Delivered installer engagement and customer on-boarding strategy, in addition to defining the customer requirements for trial participation including customer eligibility criteria.
- **Low Voltage Distributed Energy Resources Management System (LV DERMS)**: Develop processes to support the seamless connection of flexible solutions and investigate, test, and technologies that enable FET and scaled flexible services including minimum demand management via DOEs.

  Progress to date: Developed functional requirements and solution architecture needed to accommodate FET and a scalable solution.

At the time in which all milestone one targets were delivered; the following lessons were captured by our subject matter experts:

- Working with customers and stakeholders throughout the Program to educate and communicate the benefits of flexible services is essential as Distribution Network Service Providers (DNSP) transition to the role of Distributed System Operators (DSO).
- Customer eligibility for participation in the FET and HWLC trial has decreased due to site compliance, technology, applicable tariffs, customer benefits, and logistical issues.
- Designing customer onboarding processes by working with the solar industry including Original Equipment Manufacturers (OEM) and installers will help facilitate a more collaborative, standardised, and functional solution.
- Enterprise Distributed Energy Resources Management Systems (DERMS) available in the current market do not provide the full functionality needed to support our requirement to produce a scalable solution.
- Maintaining the compliance of inverter settings for DOE enabled devices will be critical to maintain network management functions.
- Data quality of our customer databases through the correct management of data collection processes will also be critical to network management. Accurate data capture techniques will help provide an accurate picture of network performance due to flexible services.

2. Purpose.

The purpose of this document is to report on the current progress of the Flexible Services Program to the Australian Renewable Energy Agency (ARENA) and relevant stakeholders, including the lessons learned as of milestone one.

Project Title.	Flexible Services Program.
Recipient.	United Energy.
Report.	Lessons Learned Report #1.
Project Participants.	• South Australia Power Networks (*SAPN) (ABN 13 332 330 749)* • Powercor *Australia Ltd (ABN 89 064 651 109) (Powercor)* • CitiPower Pty Ltd (ABN 76 064 651 056) (CitiPower).
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3. Program overview.

Our customers' desire for a renewable energy future has redefined the role of electricity distribution. While providing safe, reliable, and affordable electricity supplies is our priority, how we do it involves significant innovation in managing the increasingly complex and sophisticated system behind it.

Customers are the key drivers behind the energy transition. Residential solar currently makes up 75 per cent of the 723 MW of renewable energy connected to the United Energy network[1]. In CitiPower and Powercor, residential solar makes up 58 per cent of the 2.6GW of renewable energy installed across both networks[2].

As more households and businesses install rooftop solar and other types of customer energy resources each year, we must balance the combined energy of intermittent renewable energy with the development of new network management systems. In addition to electricity utilisation, DNSPs must also find both permanent and dynamic solutions that address minimum operational demand.

This Program seeks to identify new technologies and network management practices to ensure all forms of distributed energy resources are integrated efficiently and flexibly in a system that benefits all customers. By providing seamless access to our networks, our networks can continue to manage more demand on our network while delivering safe, reliable, and affordable power to our customers.

The Program seeks to develop commercially feasible, technically acceptable, and customer-centric approaches to address minimum system demand through three trials detailed below*:*

[1] Source: https://www.unitedenergy.com.au/what-we-do/sustainability/.
[2] Source: https://www.citipower.com.au/about-us/sustainability/.

3.1 Hot Water Load Control Trial.

Using our smart metering system, this trial aims to build our capability to coordinate and schedule the timing of controlled hot water loads to align with periods of low demand and high solar production. This trial seeks to understand the benefits of dynamic hot water load control by quantifying how much load can be shifted from night to the day, how customer agreements can be adjusted to appropriately incentivise customers, and how demand flexibility affects customers' electricity bills and amenity.

3.2 Flexible Exports Trial.

Build new technology systems and develop our capabilities to offer near real-time DOEs that enable eligible customers to increase their solar exports above their current static limit. This will help network utilisation by optimising solar generation connected to the low voltage network, remove the use of low, static export limits, and enable increased exports whilst ensuring network limits (thermal and voltage) are not breached.

3.3 Low Voltage Distributed Energy Resources Management System.

Investigate and develop requirements for an LV DERMS platform that will seamlessly connect and enable flexible services to solar systems at scale. This platform will enable our capability to remotely orchestrate solar generation to manage localised network constraints and minimum demand.

3.4 Program progress.

The program deliverables are detailed below for each of the trials:

- HWLC has completed an internal trial to identify customer impacts, develop a market state of play of hot water technologies, and review similar trials completed in Australia to inform later stages.
- FET has delivered the installer engagement and on-boarding strategy. In addition, we have defined the customer requirements for trial participation including customer eligibility criteria.
- LV DERMS has developed a solution architecture design and evaluated the solutions required to deliver FET. We have also evaluated a scalable solution that enables flexible services in the long-term including minimum demand services.

4. Current lessons learnt.

The below chart outlines all lessons learnt in relation to our project objectives and current progress. This assessment is developed according to its situation, action, and value generated.

4.1 HWLC Trial.

No	Type	Situation	Action	Value generated
1	Project objective	The objective of HWLC is to utilise our controlled hot water fleet to support system stability issues in the electricity network related to minimum demand.	A desktop assessment was conducted to understand how many customers/controlled hot water units can be control and to quantify the load increase that can be generated based on the current number of controlled load tariff customers and the total load	This assessment revealed that several customers on the controlled load tariff do not have an active load that can be controlled. The assessment also revealed that most of the load under the controlled load tariff scheme is an electric storage tank hot

			generated at night by hot water units.	water unit, with a small number of floor heating slabs.
2	Project objective	Key lessons learned from previous trials by other parties unearthed concerns around impacts to customers' hot water supply and their electricity bills.	An internal pilot was conducted to measure the impact to customers' hot water supplies and to estimate the bill impact. The outcome of this pilot has informed the next phase of the project.	The internal pilot found there were no significant impacts to customers' hot water supplies under various load shifting scenarios. The financial impact was not determined during the pilot due to a lack of data points and uncontrolled variables.

4.2 Flexible Exports Trial.

No	Type	Situation	Action	Value generated
1	Project objective	With a trial of 100 residential customers and large dispersion in residential locations, presents a low value initiative to solar installers for the trial. This has resulted in poor response to requests for pricing. This has limited our understanding of installation concerns from a broad range of installers.	As a result of the low volume of responses to the initial communication, we contacted a solar installer who had previously undertaken works for us. They are a larger organisation with the capacity to perform the ad hoc work required for FET and have the capability to support our appointment and communication requirements. Working with a larger installation provider will allow us to use multiple installers to obtain different perspectives of the installation challenges and learnings.	Our approach revealed the need for targeted communication with the solar installation workforce to improve our understanding of their capabilities. The current knowledge gap between both parties increases the importance of solar installer's role in the future roll-out of FET. This has led to further works within our business to help improve installer's understanding of Flexible Exports, future operations of the grid, and what it means for the industry.

4.3 LV DERMS.

No	Type	Situation	Action	Value generated
1	Project objective	LV DERMS is a new concept to our customers and the Victorian solar community – specifically, with regards to the way we operate our network from static connections to flexible services while addressing minimum demand events.	After assessment of the change drivers, it was determined our key stakeholders are solar installers and OEMs. The key messages surrounding the benefits and technical requirements to enable FET and dynamic solutions that support the reliability of network and the Victorian system during minimum demand events.	Stronger focus among all stakeholders on industry readiness and engagement to support the implementation of LV DERMS.
2	Project objective	Our capability to connect customers at scale is a key priority. If the utility server is utilised as the business-as-usual solution, it will likely connect to thousands of end-devices within two to three years. Capability within our networks and the boarder industry to support this scale is paramount.	We have conducted detailed engagement and various tender approaches to test the viability of utility servers. Tender processes were also tested through robust assessments with several Subject Matter Experts (SMEs) across the business and approved through governance committees with senior management.	Cross collaboration across several business sections within the company has informed the proposed solution, establishing buy-in while bringing LV-DERMS closer to a business-as-usual solution.

(i) LV DERMS and Flexible exports: Industry engagement

To prepare Installers for readiness with compliance obligations for our LV DERMS we have identified that videos, webinars, and other materials have benefited the industry and helped improve awareness.

We have also engaged with OEMs at a one-to-one level to support onboarding into our new systems. This process will help support compliance and approvals with CEC (Clean Energy Council) and CSIP-AUS.

In addition, we have also presented at the SEIA (Solar Energy Installers Association) Victoria conference in Bendigo demonstrating how our energy system and risk profile is changing with minimum demand and presented on new compliance requirements for CER devices on our networks.

4.4 Lessons summary

Our initial estimate of the customer base and eligibility for trial participation has decreased due to compliance, technology, and logistical related issues as we continue to progress with the trial. Our focus will shift to ensure that we have the correct incentives in place to attract customers to sign-up to FET.

The assessment of the HWLC control trial customer eligibility has reduced due to identifying customers who are on a controlled load tariff but do not have any controllable loads. We have identified two main reasons why the active loads are not operational:

1. Solar retailers & installers have suggested to customers with controlled load to rewire their hot water load to main meter. This would justify solar retailers & installers to sell larger system.
2. Customers replaced their electrical hot water unit with gas unit, either as part of equipment failure or knockdown rebuilds. Typically, distributors are not notified when this occurs.

In addition, there is limited understanding in the industry as to the underlying reason a DNSP would implement solutions for flexible services and the related benefits to customers. Engagement with various stakeholders will help improve our understanding of network issues, including emerging minimum demand challenges, realising the benefits of flexible solutions, improving the customer experience, and collaboration with the solar industry.

5. Review of technical, regulatory, legal, commercial, social, and consumer lessons learnt.

The below chart outlines the lessons learnt from each trial through the assessment of technical, regulatory, legal, commercial, and consumer challenges. This information is analysed according to its situation, the action undertaken, and the total value generated.

5.1 HWLC Trial

No	Type	Situation	Action	Value generated
1	Commercial	The control of hot water loads is expected to impact the wholesale market, which affects the risk exposure of electricity retailers. This is, however, subject to our overarching load shifting strategy which already has market controls in place. There is a need to ensure all retailers operating in Victoria are not exposed to the price volatility in the wholesale market due to daytime load shifting.	An industry newsletter was sent to all retailers operating in Victoria seeking their feedback on our overarching hot water load shifting strategy.	We received several items of feedback from retailers which shaped our load shifting strategy. This has also helped increase the support of retailers in this trial.
2	Legal /regulatory	To quantify exactly how much flexibility DNSPs have within	A review was performed on the following legal and regulatory instruments:	It was determined that the current legal and regulatory framework provides

		the current legal and regulatory framework to shift hot water loads to daytime, a legal and regulatory assessment was performed.	• Tariff Structure Statements • Pricing Proposals • Standard connection agreements • Other contracts between DNSPs, retailers, and customers • Policies in relation to controlled loads and the controlled load tariff. Following this review, we assessed what is possible and permissible under the current framework and whether further actions are needed to enable the proposed load shift.	enough flexibility to allow changes to the controlled load switching periods without any changes to the tariff structure, pricing proposals, contracts, and policies.
3	Technical	A network assessment was required to understand the impacts of load shifting to the distribution network and to determine the differentials between permanent and dynamic load shifting strategies.	A simulation of a conservative load shifting strategy using smart meter data and data analytics was performed. A review of our system capabilities and requirements was performed alongside an impact assessment to enable permanent or dynamic shifting. Consultation with retailers around the proposed strategy was also conducted.	This review revealed we have the capability to implement either a dynamic or permanent load shifting strategy. Retailer engagement showed that they prefer a strategy that provides load predictability, with minimal impact to their customers and to their operation.
4	Consumer.	Before proceeding to the roll-out phase of the trial, we wanted to understand any impacts to customers because of the proposed shift including impacts to hot water availability and electricity bills.	We conducted a pilot to develop a proof of concept and objectively assess the impact of various load shifting strategies on hot water temperatures and customers' electricity bills.	The pilot showed that various load shift strategies did not affect customer's hot water supply. Due to the limited data points available, we could not conclude any financial impacts. This will be investigated further in later phases of the trial.

As part of our HWLC preliminary trial we reviewed the impact of energy bills in relation to shifting load during the day. Considering the multivariant nature of energy consumption some data points are missing to understand the full assessment on pricing. Some of the limitations on data points include:

- Number of trial participants
- Occupancy changes
- Change in familial circumstance (e.g., new family member)
- Change in hot water appliance usage.
- Installation of new appliance requiring hot water (e.g., dishwasher)
- Weather variability compared to baseline, leading to different heat losses.

5.2 Flexible Exports Trial

No	Type	Situation	Action	Value generated
1	Regulatory	There is significant regulatory interest in the impacts of the trial on the customer and how we are communicating with customers. This is to ensure customers can fully understand Flexible Exports before consenting, while providing networks with an additional layer of compliance against their new obligations.	The trial agreements were written in plain English to clearly identify the objectives of the trial, the changes to the customer's connection agreement, and the benefits they will receive. The agreements were shared with the regulator for their feedback.	This has confirmed the customer need for greater visibility of how the Flexible Exports Trial is changing their export capability, informing our customer engagement strategy to obtain specific and direct feedback from our customers throughout the trial.
2	Technical	The technical requirements for current fixed export installations are not being fully adhered to, resulting in significant numbers of non-compliant export limited installations. Non-compliance includes incorrect installation or configuration of solar system hardware resulting in the in-ability of the installed system to adhere to export limits as prescribed in the customer' connection agreement.	Customer sites will be excluded from the trial because it cannot be confirmed if their solar installations are technically capable of being able to operate flexible exports.	The assessment highlighted the need for more targeted industry training on the technical requirements of export constrained installations. It has also raised the need to increase installation compliance monitoring.
3	Technical	Compliance with fixed export limits is currently low, resulting in a lower-than-	Include sufficient incentives for eligible customers to sign-up to the trial by increasing the sign-on bonus	Understanding there is a low level of export compliance has informed the need for targeted

No	Type	Situation	Action	Value generated
		expected number of customers who are eligible for the Flexible Export Trial.	and investing in customer marketing activities.	training for the installation workforce. It also has reinforced the need for more comprehensive compliance monitoring and management systems to improve our understanding of localised exports on our networks and improve our ability to optimise DOEs in the interest of customer. With new compliance obligations being applied to all new installations as part of the Victorian Government Emergency Backstop requirement, where all new or upgrading solar installations are required to be controllable by the DNSP, it is our expectation that export limit compliance will be able to be more effectively managed. This however does not prevent non-compliant installers still operating in our network. A reform or framework that provides clear rules to prevent non-compliant installers operating in our networks will also support increased compliance. This could operate as a penalty or incentive mechanism through rebates.

5.3 LV DERMS.

No	Type	Situation	Action	Value generated
1	Technical	Onboarding inverters into LV DERMS in collaboration with Original Equipment	OEMs have highlighted the DER installation and registration process as a significant challenge. The existence of diverse	OEM onboarding has helped improve the effectiveness of our communication with OEMs.

		Manufacturers (OEM) is an essential step. The selection of the Utility Server may affect the registration and installation process of on-site Distributed Energy Resources (DER) across DNSPs/DSOs and throughout any trial and business-as-usual solution.	installation processes among different DNSPs and DSOs raises the risk of improper installation and non-compliance. Consequently, OEMs have indicated a preference for implementing a standardised installation process.	The development of a standardised approach and quality controls has supported customer engagement activities from marketing through to OEM onboarding. This has helped bring the development of Flexible Exports and LV-DERMS closer to customer needs.
2	Technical	Enterprise Distributed Energy Resources Management Systems solutions in the market do not meet our internal functional requirement to deliver a scalable solution.	Reviewed our internal capability to deliver alternative solutions that fulfill the functional needs of the system.	Detailed review of the system architecture has identified the need to develop some of the functions internally including the DOE Engine, Scheduler and DER user interface.

5.4 Lessons summary.

The Program's learning themes obtained as of milestone one are:

- Designing customer on-boarding processes to facilitate a more collaborative and standardised approach will benefit the solar industry and ultimately customers.
- Working closely with OEM providers will help support end-solutions and operational functions.
- Ensuring our networks are clear to solar installers on the technical requirements of fixed export installations remains an important feature of our solar strategy. It is critical that processes are communicated and adhered to so that we can maintain compliance, support network management functions, and optimise DOEs to its full capability.
- Development of high-quality data collection processes into our customer database will underpin the accuracy of our network management functions. Accurate data will help inform impact assessments of rooftop solar network performance and how flexible services can be best utilised.
- Our initial assumptions of customer compliance were underestimated at the initiation of the trial.

6. Implications for industry and future projects.

The following section reviews the progress made to date for each of the trials and summarises the key learnings that we believe should be shared broadly with industry.

When delivering customer-facing IT systems that require scale, it is critical that a robust plan is in place and tested for its successful implementation. Establishing a program workforce that is aligned against the same objectives will help deliver the desired outcomes and strategically steer the platform toward a successful solution.

The customer interface and the practicalities of onboarding stakeholders should be considered in the early stages of the program so that change management processes can be sufficiently embedded along project timelines.

6.1 Hot Water Load Control.

HWLC can potentially provide a cost-effective method to unlock more solar hosting capacity in the network and mitigate the risk of minimum demand.

Shifting our fleet of controlled hot water devices to the daytime will also increase its exposure to, on average, lower wholesale prices. This would have an indirect effect on customers' electricity bills by increasing competition with retailers. However, there must be protections in place to ensure load shifting does not result in any adverse impact to customers, to the local network, (including daytime overload when solar is low leading to potential loss of supplies for customers at a street level, and undervoltage events) or to retailers.

6.2 Flexible Exports Trial.

The onboarding stage of the trial has revealed a need for increased education among solar installers and OEMs regarding the benefits to customers and the need to address minimum demand requirements.

Careful consultation is also required to manage the impact of incorrect data of inverter limits on the network and on their customers. The importance of communicating the correct settings of inverters is essential to the effectiveness of network planning. Data will become critical once Flexible Exports becomes a standard customer offering and fundamental to network planning assumptions.

Further work is required to develop robust training on installation requirements. Solar installer training will become critical to network management and future flexible export implementation.

6.3 LV DERMS.

The proposed operating solution being developed for this trial will be the first of its kind in the Australian market. This comes with the underlying challenge to adopt a utility server that is an appropriate market fit.

To ensure our design review process was rigorous, we explored a range of national and international providers and performed a detailed assessment of their suitability against our desired program outcomes. Moreover, we concluded that the enterprise Distributed Energy Resources Management System currently available does not fully meet our required functionality around scale. To avoid internally developed solutions in the future we have engaged with developers detailing our short to medium term roadmap so they can continue to work on solutions relevant to industry needs.

As a result, we chose to only procure the utility server from a service provider, with the intention to either enhance existing systems or build them internally for other components including the DOE engine, scheduler, and DER user interface.

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