Flexible Exports for Solar PV

Lessons Learnt Report 2

SA Power Networks

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Glossary

Term	Definition
ARENA	Australian Renewable Energy Agency
AEMO	Australian Energy Market Operator
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
API	Application Programming Interface
CSIP	Common Solar Inverter Profile
CSIP-AUS	Common Solar Inverter Profile - Australia
DAPR	Distribution Annual Planning Report
DER	Distributed Energy Resources
DNSP	Distributed network service provider
IEEE2030.5	IEEE Standard for Smart Energy Profile Application Protocol
IP	Intellectual Property
MSO	Model Standing Offering
NEM	National Electricity Market
PV	Photovoltaic
SEG	Small Embedded Generator
SIRG	Solar Industries Reference Group
TS129	Technical Standard – TS129 Small EG Connections Technical Requirements

Acknowledgement

The “Flexible Exports for Solar PV” project (‘the Project’) is a collaboration between SA Power Networks, AusNet Services, Fronius, SMA, Solar Edge and SwitchDin. The Australian Government, through the Australian Renewable Energy Agency (ARENA), is providing $2.09m towards to this $4.84m project under its Advancing Renewables Program.

Disclaimer

This Project received funding from ARENA as part of ARENA’s Advancing Renewables Program.

1 Introduction

On 1st July 2020 ARENA and SA Power Networks entered into an Advancing Renewables Program Funding Agreement number 2020/ARP009, under which SA Power Networks, and all collaboration partners, have obligations to consider and issue quarterly lessons learnt reports. Aurecon, the knowledge sharing partner, prepares these reports on behalf of SA Power Networks and project partners. Lessons will be captured throughout the lifecycle of the Project and are expected to cover a range of topics. These may include commercial, technology, policy, community engagement learnings and more. The intended audiences for these lessons learnt reports are:

- ARENA, AEMO, AEMC, AER - to understand the performance of distributed energy resources (DER) projects and impact on the market.
- Victorian and South Australian Governments and policy makers - to understand policy and regulatory barriers and opportunities associated with DER.
- Energy industry - to understand market opportunities associated with DER impacts and business models.

This second lessons learnt report will cover the activities during project development such as creating effective customer messaging, modifying the model standing offer (MSO), adopting the agile delivery methods to deliver the trial and improvements that could be made to the CSIP-AUS implementation guide. It is intended for those undertaking a similar project. By sharing this information, the Flexible Exports for Solar PV project aims to advance the industry's understanding of how DER, such as rooftop solar, can be managed in constrained network areas.

2 Project Overview

2.1 Project Summary

The Flexible Exports for Solar PV project ('the Project') is a demonstration project seeking to help integrate increased quantities of rooftop solar into Australia's electricity network.

Most current rooftop solar systems across Australia lack the ability to intelligently control the amount of electricity exports to the network. At certain times in the year, too much electricity is generated in the middle of the day and exported back to the network and is unable to be absorbed by loads in the local area. As a result, the local distribution networks in areas with high rooftop solar uptake can become congested. To avoid exceeding the technical limits of the network and manage this issue today, energy networks impose zero or near-zero energy export limits on new solar systems in congested areas.

As more Australian households install rooftop solar and network constraints increase, more new solar customers will face limits that prevent them from exporting electricity back to the network. This can create an inequitable system where early adopters of rooftop solar 'use up' the available grid capacity, and late adopters are constrained.

The aim of this Project is to provide a new option for customers connecting solar PV in areas of the network that are already at capacity, who are currently required by Distribution Network Service Providers (DNSP) to limit their systems with a permanent zero or near-zero export limit.

This new flexible option will enable customers to export energy most of the time, and only reduce exports during specific periods when the network is constrained, thus maximising export capacity for solar customers and making more cheap, renewable energy available for all electricity customers to take advantage of.

SA Power Networks, in collaboration with AusNet Services, three market-leading inverter vendors (Fronius, SMA and SolarEdge) and one inverter gateway provider (SwitchDin) are co-developing an end-to-end technical solution, using smart inverter technology. The system will enable customers' inverters to automatically adjust their export limits every five minutes based on a localized, dynamic limit signal provided

by the DNSP. The Project will also develop a new flexible customer connection offer, and test customer understanding and acceptance during a 12-month field trial.

2.2 Project Methodology

The Project aims to accelerate the development of an Australian standards-based approach to flexible feed-in management for solar PV across the NEM (National Electricity Market). To achieve this, the project scope was designed to advance both the technical and commercial maturity of the next generation of smart inverters and develop the customer offer and customer experience of participating in a flexible exports scheme.

The high-level approach is as follows. The project is currently nearing the end of the planning, technical and customer offer development activities, in preparation for the commencement of the field trial in mid-2021.

1. Planning and standards development

- Since there are no Australian standards established at the time of project commencement, the first phase of the Project comprises planning activities and the co-development by the partners, in consultation with industry more broadly, of the technical standard to be used to communicate flexible export limits between the DNSP and smart inverters.

2. Technical development

- Once the communication standard has been substantially agreed, the partners will implement the standard through the development of a flexible exports capability. This capacity is to be built into Australian products from Fronius and SMA, market-leading inverter manufacturers, and would enable current and prospective customers in constrained network areas to export their energy.
- The Project will also develop a 'retro-fit' option using the SwitchDin gateway device which will enable a range of existing inverters without native integrations to be converted from static to flexible export limits.

3. Customer offer development

- In parallel with the technical development, SA Power Networks and AusNet Services will develop in consultation with other DNSP's customer representatives and other industry stakeholders, a new flexible connection offer for solar customers. The offer will set out the key parameters of a customer's network connection agreement and can inform other DNSPs and industry on how to structure a Customer Offer to support the flexible exports service.

4. Field trial

- As this represents a new connection option for solar customers, the Project will seek to understand the end-to-end customer journey, from the point at which a customer is first presented with a flexible connection option in the up-front conversation with their solar installer, through the customer's choice of suitable inverter options, to the customer's experience over a full year of operation.
- Through the 12-month field trial, the project will test the viability of this kind of connection arrangement and refine the associated technologies and customer service to the point of maturity at which this can be offered as a standard service across the NEM.

3 Key Lessons

This is the second lessons learnt report for the Flexible Exports for Solar PV project. The learnings in this report cover the activities during project development such as creating effective customer messaging, modifying the model standing offer (MSO), adopting the agile delivery methods to deliver the trial and improvements that could be made to the CSIP-AUS implementation guide.

The four (4) key lessons discussed are as follow:

- **Lesson #1: Customer messaging must be broad and deep to cater for audiences at different levels of engagement.**
  - Consider simplified messaging and engaging an independent group to bring clarity to the project's narrative.
  - Cater for different knowledge levels across the stakeholder base and provide sufficient material so that stakeholders find material that suits their levels of engagement and enthusiasm.
  - Provide stakeholders a variety of content to engage with, and sufficient options so that stakeholders can become educated in a method that suits their needs. This includes material in a variety of formats, offering webinars at different times of the day and developing on-demand learning.
- **Lesson #2: To enable flexible exports under the current regulatory framework, the model standing offer (MSO) needed to be modified**
  - A DNSP's MSO may require amendments to enable specific features of Flexible Exports.
  - DNSPs may wish to consider if aspects of the MSO should be aligned across Australia. There may be value in standardising on items such as technical specifications and some parameters across all states while providing flexibility around other parameters such as the default export limits which may be dependent on the area and the local constraints.
  - The project will publish SA Power Network's MSO on the project website once AER approves it. This may provide an entry point for DNSPs looking to modify their customer connection offer to include dynamic exports.
- **Lesson #3: Agile delivery methods are helpful when undertaking a project in this space as it's new and the risks/challenges/opportunities are unknown**
  - Where the project is faced with a rapidly changing context and environment and multiple interdependencies, an agile based delivery process may be valuable not only for the technical development activities but also for the broader, non-technical aspects of the project, allowing the cross functional project team to work through complexities and adapt the activities and aspects of the approach iteratively as the project progresses.
  - An agile based approach allows a more efficient & effective use of skilled resources in addressing changing internal and external circumstances than would otherwise occur, reducing rework and increasing visibility of activities in the areas of industry stakeholder management, business change and multi-vendor interfaces.
- **Lesson #4: Various aspects of the CSIP implementation guide (and therefore CSIP-AUS) are open to interpretation. Need to provide clarity around these aspects in the final CSIP-AUS.**
  - The CSIP standard in California (Rule 21) includes some ambiguity and test procedures which are not suitable for Australian conditions, and do not test the functional aspects of inverter response.
  - The CSIP-AUS should include provisions to address any ambiguity within the CSIP and define the functional performance requirements to ensure the end-to-end functionality is robust and practical.

The next sections provide additional detail around each lesson.

3.1 Lesson #1: Customer messaging must be broad and deep to cater for audiences at different levels of engagement.

Knowledge Category:	**Commercial / Communication**
Knowledge Type:	Customer offer development
Technology Type:	Not applicable
State / Territory	National

Key Learning

While developing and refining the project's customer messaging, the SA Power Networks project team have developed a greater understanding of the key elements required to effectively and meaningfully engage with customers and the wider industry.

The narrative developed for the Flexible Exports initiative often serves as an educational piece and requires the messaging to strike the right balance of technical and customer friendly language to suit the target audience. This is particularly important to promote the uptake of the new Flexible Exports offer, ensure installer compliance across the industry and remain consistent across all public communications e.g. Distribution Annual Planning Report (DAPR).

For customers, the project developed simple, high-level narratives which highlight the key components in Figure 3-1. The language must be clear, short, and crisp as customers may not be well versed in the technical aspects and may only be concerned about details that they believe are relevant to their situation.

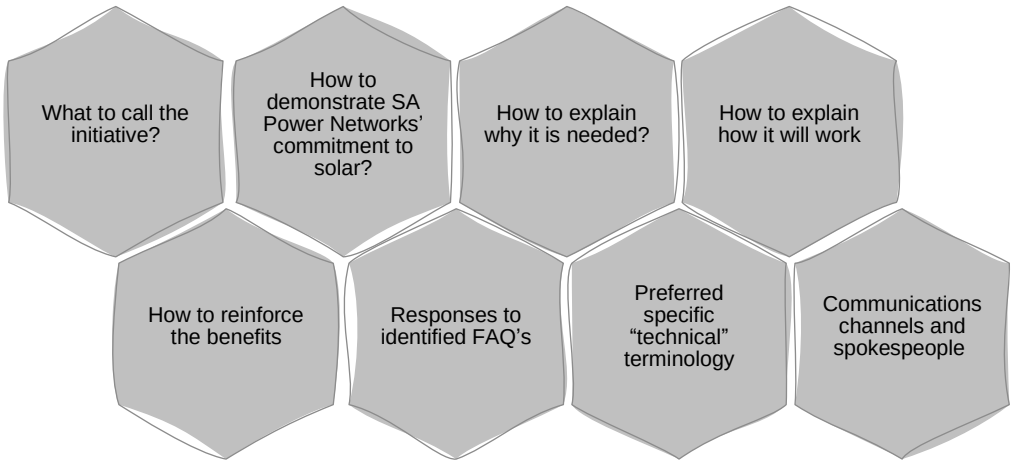


Figure 3-1 Specific communications components the project tested with the customer community

Through the course of the project, the team utilised the services of a copy writer to further simplify their 'high level' messaging and to distil the content down into key details. The team has learnt that their exposure and inherent knowledge of the project has created a bias and shifted the team's perception of what constitutes 'entry level' knowledge and what the key details are.

In addition to tailoring messaging to suit the audience, the team have also learnt to consider the learning platform to cater for a broader subset of stakeholders. This includes a need to provide alternative times to engage with the content (morning, afternoon and evening) and develop on demand material.

Process Undertaken by the Project

SA Power Networks have undertaken an iterative approach of testing and refining the customer messaging through the course of this project.

Newgate Research Group have led this exercise by conducting research among stakeholders and community members to understand prevailing opinions on solar in SA and solar exports, assess reactions to the Flexible Exports concept and inform messaging development about it.

The research has revealed that stakeholder attitudes to SA Power Networks and their reactions to Flexible Exports are broadly positive. However, several stakeholders feel that customer attitudes towards SA Power Networks are often negative with some believing they are anti-solar and are punishing consumers by limiting their exports or taking control of their generated power. These perceptions are reinforced as many customers have little to do with SA Power Networks and they do not understand their remit nor the challenges SA Power Networks face in delivering power. The research identified the need for SA Power Networks to educate the public about grid uses and the need for change. Other key components the narrative must include are outlined in Figure 3-1 above.

Once the specific messaging components were tested and the narrative clarified, a copywriter was engaged to further refine the messaging. The copywriter simplified the narrative, removing unnecessary details, making it clear and concise. The simplified messaging was shared with the SA Power Networks' Customer Consultative Panel, Connections Working Group and Solar Industry Reference Group to gather feedback and align wording where required. The project found that while it was important to frame the message in a positive manner, there is a potential to create unrealistic expectations if the negative aspects of the change for customers is not clearly articulated, which can result in misunderstanding and disappointment.

In addition to a traditional media release, the project will also publish website material, FAQs, infographics, animations, and a series of in-person events and webinars to cater for different audiences. These artifacts can be found on **SA Power Networks website** under the "Future Energy Section". An infographic summarising the Flexible Exports project objectives and customer offer is provided in Appendix A.

Considerations for future projects

Future projects may wish to consider simplified messaging and engaging an independent group to remove unnecessary details and bring clarity to the project's narrative.

It is also important to acknowledge the different knowledge levels across the stakeholder base. As a DNSP, the solar industry is the conduit to the customers, and it is important they have the information and support required for them to communicate the value of the new Flexible Exports offer to potential customers.

In addition, the richness and depth of stakeholder engagement is equally important. By providing stakeholders a variety of pathways to engage with the content, customers and installers can become educated in a method that suits their needs. This includes providing alternatives for timing (morning, afternoon, and evening), development of on-demand learning and establishing chat lines and hotlines to seek out help.

3.2 Lesson #2: To enable flexible exports under the current regulatory framework, the model standing offer (MSO) needed to be modified.

Knowledge Category:	**Legal**
Knowledge Type:	Customer offer development
Technology Type:	Not applicable
State / Territory	National

Key Learning

The Model Standing Offer (MSO) is an AER approved document that forms a contract to define the terms and conditions for retail customers applying for a small generator basic connection service. All DNSPs are required to define terms and conditions for basic connection services under the national electricity rules (NER) Chapter 5A. Currently, the MSO for basic connection services is standardised across all customers and does not capture variations in export type offers. To capture the legal liabilities of enabling smart inverters/DER to respond to critical energy events the MSO needed to be modified to include additional terms and conditions.

Two key gaps have been identified in the current MSO framework:

- The flexible exports connection offer will be limited to areas where the network is constrained. The current MSO does not recognise that connection arrangement could vary according to geographical area and so this needed to be incorporated. Equally it was important to build in the flexibility to change which geographical areas were constrained or not constrained due to the changing nature of the network. Specific areas were not captured in the MSO revisions and only reflected in the online Small Embedded Generator (SEG) application tool.
- The technology specifications and parameters required to enable flexible exports – e.g. performance specifications, communication protocols and security requirements for inverters. Whilst the MSO outlines the functional requirements, specific technical requirements are captured in the Technical Standard (TS129). It was not always clear which requirements belonged in each of the documents.

Process Undertaken by the Project

SA Power Networks modified their existing MSO to include definitions of the different kinds of connection areas, separating them into two categories – the traditional offer with a 5kW limit per phase and two constrained area offers, with a static limit (1.5kW limit per phase) or a flexible limit 1.5kW to 10kW service. The inclusion of the technology specifications and parameters were also captured.

Understanding and articulating the proposed changes was a lengthy exercise and involved various internal stakeholders, the project partners and internal legal review. Once the draft changes and inclusions had been agreed upon, it was sent to an external legal representative to draft the MSO. A final series of internal legal reviews were conducted prior to submitting the amended MSO to the AER for approval.

The draft MSO sets the very high-level functional requirements and is written to account for scaling up the service following the trial. It is unlikely to change as the project develops more detailed requirements.

AusNet Services undertook a similar process but instead of modifying the MSO directly, an offer letter has been developed to accompany the existing MSO and capture the key terms of the trial. At the end of the trial, AusNet may revisit a formal modification to the MSO to facilitate a more permanent flexible export offering.

This approach has been adopted as the operative contractual terms of the current AusNet Services MSO are loosely aligned with the proposed offer for the flexible export trial. Changing the operative terms of the MSO

requires AER approval and so, AusNet Services adopted an offer letter which, in combination with the existing MSO, set out the key terms of the trial. Equally, as the flexible export trial is for a limited period only, the term of the offer letter can be expressed for a fixed period which matches the term of the trial; AusNet can then use any learnings from the trial to implement a wider offering of flexible exports, which may include formal amendments to the MSO.

Considerations for future projects

Although the current regulatory framework supports connection offers that are dynamic in nature such as the Flexible Exports approach tested in this project, each DNSP's MSO will likely require amendments to enable this.

This may be relevant for future projects as there has been general agreement through the course of the project's DNSP working group, that certain aspects of the MSO should be aligned across Australia.

One area where consistency may provide value, is around the specification of export limit technical parameters across all states where equipment must perform the same way to simplify compliance for equipment manufacturers operating nationally. This could include aspects such as the fail-safe behaviour of a smart inverter in the event of a communications loss and should be specified in a prescriptive manner to prevent detrimental impacts to the grid. SA Power Network's MSO captured the requirement for fail safe behaviour at a conceptual level, leaving the specific details on the mechanism and technical parameters to be defined in SA Power Network's related technical specifications (TS129).

An example of a parameter that may vary between MSOs may be the default export limits which would be dependent on the area and the local regional constraints.

The project will publish the MSO on the project website once the AER approves it. This may provide an entry point for DNSPs looking to modify their customer connection offer to include dynamic exports.

3.3 Lesson #3: Agile delivery methods are helpful when undertaking a project in this space as it's new and the risks/challenges/opportunities are unknown

Knowledge Category:	**Project management**
Knowledge Type:	Project development
Technology Type:	Not applicable
State / Territory	National

Key Learning

The implementation of DER integration technology is not well understood, leading to a project environment with high levels of change. Due to the complexity of delivering a project in this space, the team has learnt that a more agile delivery methodology for the non-technical aspects of the project would be better suited.

Whilst SA Power Network's technical system components have been delivered via a well-established agile delivery team the other aspects of the project had been planned to occur in a more waterfall fashion. With high levels of uncertainty, developing, and adhering to a detailed plan created at the beginning of the project has proven impractical to account for the many changing interdependencies and emerging information; a delivery approach involving smaller agile scrum style increments allowed for adapting to the changing internal and external landscape e.g. Smarter Homes regulations and other changing processes.

Some project functions with well-defined processes have retained their previous conventional approaches e.g. risk management, governance and procurement management etc) have retained the more conventional project delivery method to enable the project to continue to integrate with the broader organisation.

The team have found the blended project delivery approach to work well.

Process Undertaken by the Project

SA Power Networks and AusNet Services have both adopted a similar hybrid, agile project management framework due to the high level of unknowns, uncertainty and interdependencies encountered early in the project (i.e. organisational restructuring, Smarter Homes regulations). This has resulted in a highly customised level of delivery, establishing incremental deliverables which are then rolled out across the company and integrated across the relevant functions.

A "hybrid-agile" delivery approach was adopted to get the most value out of the Flexible Exports trial. Whilst the project had set clear milestones, the changing nature of the environment and the involvement of highly skilled and in-demand organisational resources warranted an agile approach to minimise rework and integrate outcomes incrementally within the organisation, externally with partners and with other related bodies. Such an approach has enabled higher levels of cross purposing of resources and higher visibility of team activity status allowing a more effective & efficient achievement of outcomes in areas including external stakeholder management, multi-vendor technical integration, business change and aspects of project management.

The agile delivery approach co-existed effectively with other conventional / established processes such as risk management, legal, reporting/governance, and procurement.

This approach has allowed the team to focus on higher priority work, whilst taking on feedback and learnings from the working groups along the way. The smaller, incremental tasks and deliverables allow for shorter learning cycles, testing outcomes and adapting if need be before progressing on the next part of the project.

SA Power Networks and AusNet Services have found this delivery approach to be effective at managing uncertainty for the trial project and to assist with planning for BAU. Weekly or fortnightly team check-ins are

held to define the work for the upcoming period. It is also an opportunity for the team to raise issues and discuss and agree on the minimum requirement for the trial. The more advanced requirements and issues can be parked until there are more resources available. Identifying and noting these requirements at the trial also helps understand the resources and cost to transition the trial service to a scalable operational service with more certainty.

Considerations for future projects

Where the project is faced with a rapidly changing context and environment with multiple interdependencies, future projects may consider an agile based delivery process rather than a waterfall style in establishing a new business service. This allows the cross functional project team to uncover and navigate complexities and define the scope iteratively as the project progresses.

Should this approach be adopted, it is recommended the project team establish a minimum set of requirements and expectations to deliver to as part of the trial. This will enable the project to clearly define what will be delivered as part of the trial and focus on those deliverables.

Further definition and exploration of scope for upscaling or operationalising the service can be undertaken post trial.

3.4 Lesson #4: Compliance with the CSIP implementation guide does not guarantee end-to-end DER interoperability. The CSIP-AUS will need to ensure various additional aspects are considered to ensure robust operation at scale.

Knowledge Category:	**Equipment Certification**
Knowledge Type:	Communication Protocols
Technology Type:	Inverters
State / Territory	National

Key Learning

The project's original intent was to work with the DER API technical working group to adopt the Common Smart Inverter Profile (CSIP) implementation guide for an Australian Context to align with a global communications protocol and application as much as possible to simplify the integration effort for international inverter manufacturers (OEMs). It was expected the CSIP was developed for end to end application and only require minor modifications and additions to make it applicable.

The project has found that while the CSIP test procedure forms a solid foundation for communications protocol compliance, it alone is not sufficient to ensure end to end interoperability. The key limitations identified include:

1. Ambiguity in specification of certain interactions which means that CSIP certification does not guarantee that a compliant client will interact correctly with a compliant server;
2. Further detailed specification is required for certain attributes and enumerators where the CSIP implementation guide refers to the "utility interconnection handbook"; and
3. The CSIP test procedure does not test the physical response of the inverters, nor does it validate that meter readings and inverter statuses reflect the true operating state of the inverter.

This is believed to be a result of the fact that, as far as the project team are aware, the CSIP implementation guide and test procedure has had limited use in any practical deployment at scale; thus, the underlying technical, integration, and delivery risks are not fully understood.

Process Undertaken by the Project

Alongside the API working group, the project team developed an early draft of the Australian adaptation of CSIP (CSIP-AUS) to support the project and ensure consistency across IEEE 2030.5 dynamic operating envelope implementations in Australia. During early testing of this guide with project partners SMA and Fronius California Rule 21 CSIP certified systems, the project team identified a number of differences in interpretation of various aspects of the protocol. This was largely centred around the sequence in which OEM systems retrieved data from the server, and the interpretation of definitions of various attributes and enumerators communicated in the protocol. To distil the ambiguity, the project team developed a detailed interface specification document that could form the basis of an "utility interconnection handbook" as referenced in the CSIP-AUS implementation guide.

During the initial review of the CSIP test procedures, the project team also identified that only the communications protocol was tested, and that there was no consideration for the actual response of inverters to controls or whether meter readings or statuses reflected the true operating state of the system. This has been rectified by bringing real hardware into the testing loop as early as possible, as well as the

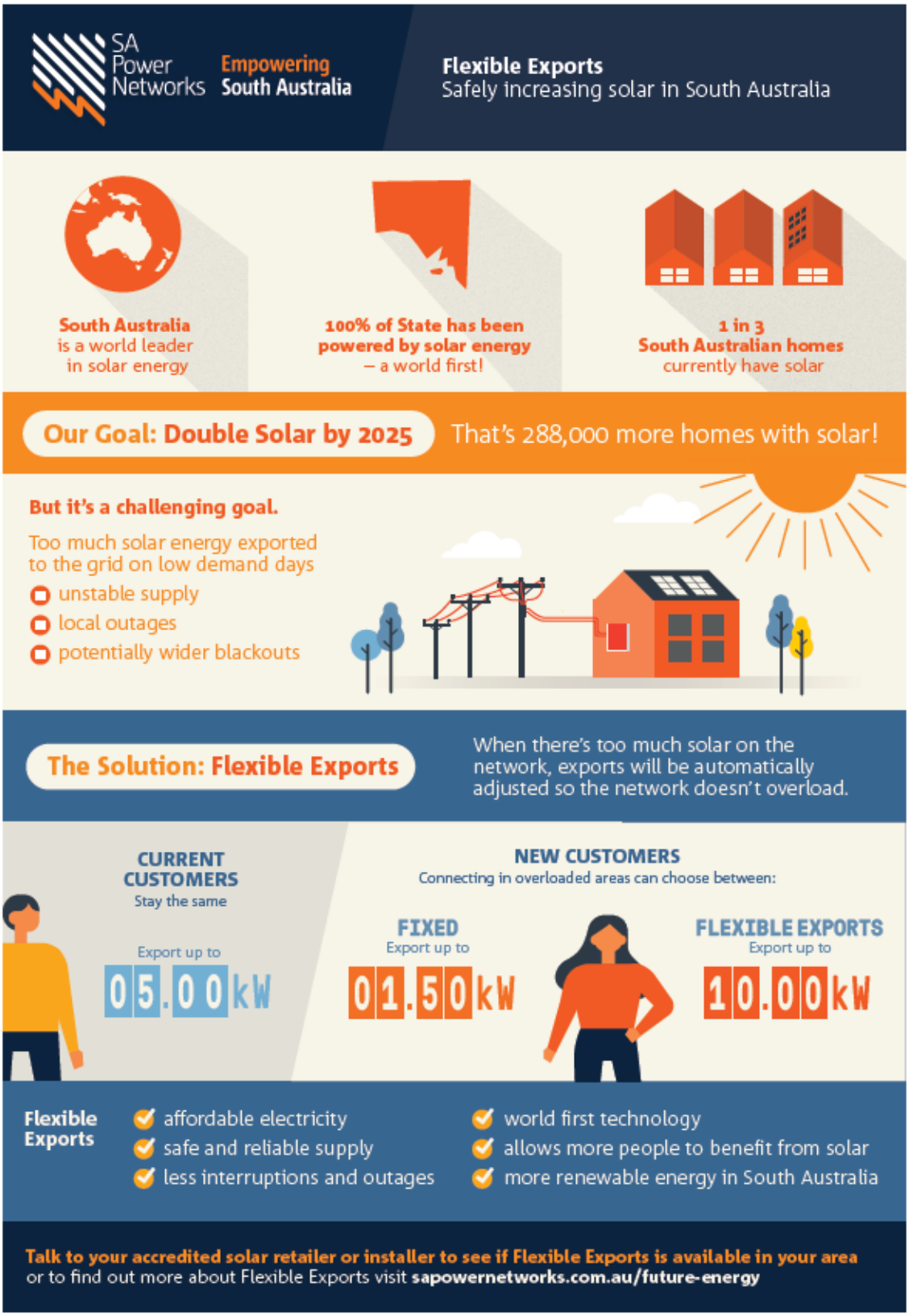
development of a robust system integration test plan that considers full end to end system interoperability from a functional perspective including physical inverter responses.

Considerations for future projects

As was anticipated at the start of the project, the practical application of the draft CSIP-AUS in this project is critical to informing a robust standard, testing and certification process for the application of IEEE 2030.5 in Australia. Considerations fed back into the API working group for developing the CSIP-AUS include:

- The need to distil requirements ambiguity in a reference “utility interconnection handbook” that accompanies the CSIP-AUS document; and
- Functional testing as part of the compliance and certification process for CSIP-AUS, including testing of hardware response in a test laboratory. It is expected that specification and the integration test plan developed in this project, plus learnings from integration testing and the field trial will ensure that the CSIP-AUS and associated compliance ecosystem is robust for application at scale.

Appendix A
Flexible Exports Infographic



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