

# deX Program

Final Report

30/09/2021

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The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

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# Executive summary

The ARENA-funded deX Program was a two and half year program that culminated in the realisation of deX as a commercially viable, digital distributed energy resources (DER) integration and management platform. Today deX is a software product that is being used to register, view, control and verify thousands of previously latent DER.

In the relatively short life of this Program, the DER landscape has evolved significantly, particularly in Australia but also overseas. This transformation has had a considerable impact on electricity networks as well as the wider industry. In parallel, while the development of deX has progressed significantly it also needed to adapt to the rapidly evolving circumstances to ensure it remained relevant and was able to support the wider energy transition taking place.

The first year of the deX Program was largely focussed on developing the foundational components of the platform to enable and maximise the DER registration, visibility and control functionality, and to ensure subsequent scaling and complexity could be supported.

In mid-2020, eighteen months into the Program, it was considered a timely juncture at which to assess and review the scope and priorities of the deX Program. This review was particularly important given the rapidly changing DER landscape. All deX functionality was assessed for its relevance, state of maturity and criticality. This review coincided with the Covid-19 pandemic which understandably also impacted the development of certain aspects of deX. As a result of the review, the priorities and direction of deX were redefined. The revised strategy focussed development on addressing the challenges of device registration, customer permission, customer churn and network compliance and resulted in deX reaching an advanced level of maturity, scale and specialisation in 2021.

Commercial relationships have also progressed significantly during the life of the Program and, with the maturity and scale that the platform has now reached, enabled multiple agreements to be realised. deX to now making a meaningful contribution to mitigating the impacts from DER while also harnessing the potential to generate new value streams.

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# Introduction

The deX Program commenced in March 2019. ARENA contributed \$8,316,449 million over two and a half years to accelerate the development of deX - via the Decentralised Energy Exchange (deX) Program. This funding contributed to the total project value of \$17.2 million to enable scaling up of the deX platform in Australia through select partnership projects with governments, networks and technology vendors.

deX is a digital software platform that enables electricity grids to support the growing increase of renewables such as rooftop solar, electric vehicles (EV) and other DER. deX provides key capabilities to register DER, which enables visibility, control and coordination of those DER. deX also enables retailers, networks and other aggregators to register customer DER into their Virtual Power Plants (VPPs), monetise those customer devices, and ensure DER meet network compliance obligations and protect the network.

deX enables customer consented and registered DER to be visible to network and market operators, to be contracted for grid services, or to be controlled in critical grid events. The types of services that DER can provide - and which deX can enable at scale - include supplying energy during peak demand, provision of frequency services, and network services.

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# Program Outcomes

The objectives for the Program were to be achieved through the following Outcomes:

- (a) Improved ability of distribution networks to host DER at higher levels of penetration.
- (b) Increased visibility, predictability or control of DER for the Australian Energy Market Operator (AEMO), Distribution Network Service Providers (DNSPs) or other relevant entities to optimise power system operation within secure technical limits.
- (c) Demonstrated value of registration of DER, including for contracting, trading and forecasting.
- (d) Increased opportunity for customers, electricity networks, market operators, government and market regulators to view DER information and influence DER operations to support the safe, reliable and economic operation of the grid.
- (e) Demonstrated value of new technologies and business models for creating opportunities for market participants.
- (f) Improved understanding, and active knowledge sharing of, the operating requirements for DNSPs, VPPs and market operators in the context of high penetration DER and associated regulatory or market design considerations.

The above outcomes were primarily achieved through the development and deployment of the registration, integration, visibility and control functionality that were delivered during the life of the deX Program. Collectively, these features enable DER at scale to be hosted, viewed, verified, controlled and leveraged for market purposes. Further details regarding the realisation of each outcome are provided throughout this report.

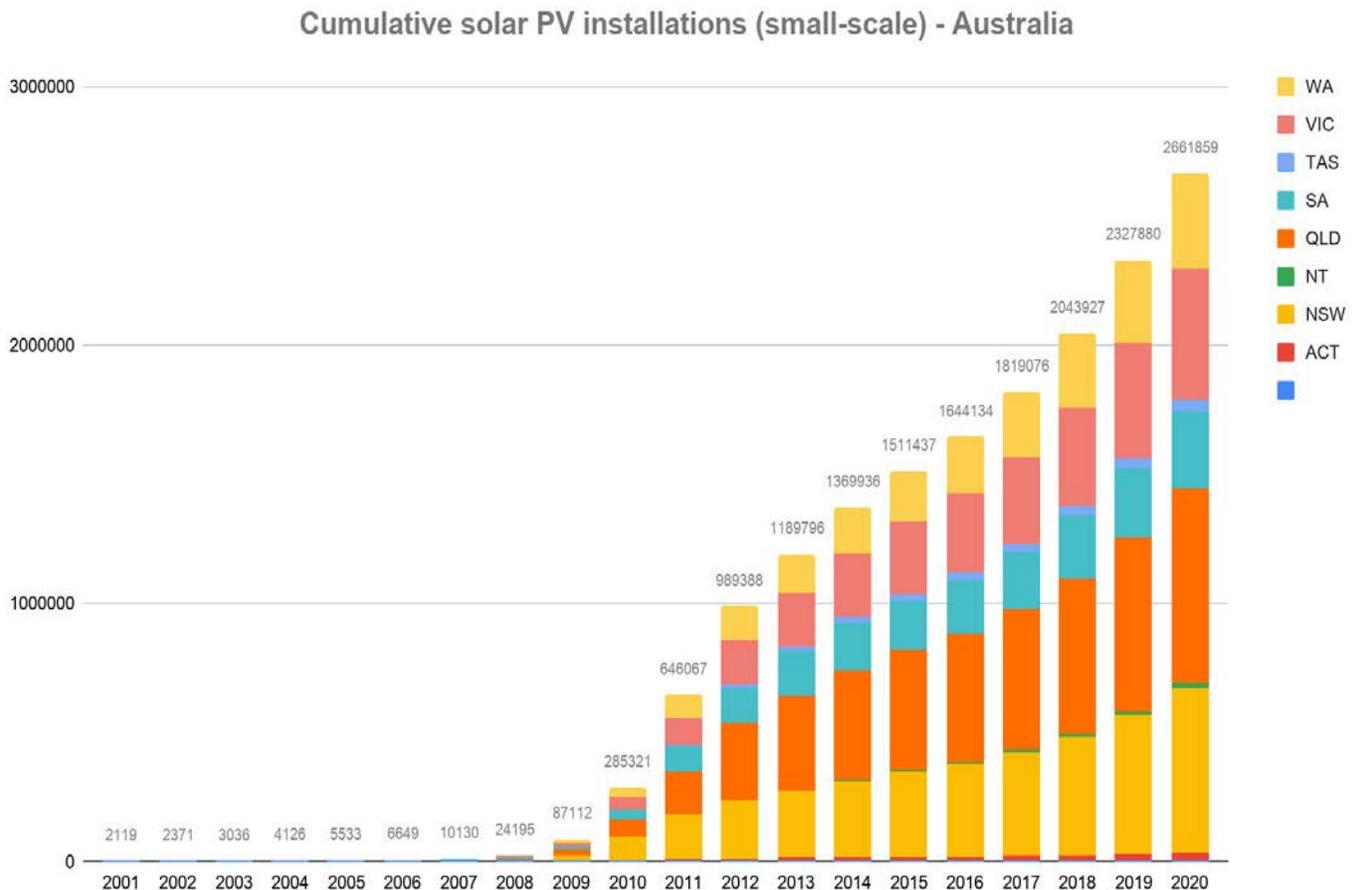
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# deX and the DER Landscape

Since the deX Program commenced, the uptake of DER around the world has been increasing at an accelerating rate. Currently in Australia, over 2.6 million households have solar photovoltaic (PV) and that number increased by 365,000 in 2020 alone. This equates to a 2 GW 'virtual' power station in one year.



Source: Clean Energy Regulator, Small Scale Installations 2021

A number of factors are contributing to this exponential growth including reduced equipment costs, sustained policy support and net-zero emission targets. The Australian Energy Market Operator (AEMO) released its annual Electricity Statement

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of Opportunities (ESOO)<sup>1</sup> on 31 August 2021 and in it forecast an additional 8.9 GW of distributed solar PV capacity will be installed by 2025 (on top of the current installed capacity of around 14 GW) in its Central scenario. As households and businesses supply more of their own energy from distributed PV and storage they will draw less electricity from the grid. This has significant implications for electricity networks, market dynamics and the wider industry. As this penetration of distributed PV continues to accelerate, AEMO forecasts that all NEM mainland regions will experience minimum operational demand – the lowest level of demand from the grid – in the daytime during the next five years. The challenges and opportunities created by this falling minimum demand will be experienced earlier than had been previously expected.

On release of its ESOO, AEMO CEO Mr Westerman said “Without additional operational tools, AEMO may no longer be able to operate the mainland NEM securely in all periods from 2025 due to a lack of security services when demand from the grid is so low. These conditions may occur earlier than 2025 under abnormal network conditions, such as network and generation unit outages, possibly associated with bushfires or storms.”

To ensure the ongoing and uninterrupted supply of electricity, it is more critical than ever that DER is integrated into the network in a secure, coordinated and cost-effective manner. deX has been designed and is equipped to address and mitigate these very real and immediate challenges, such as minimum system load conditions, by curtailing solar at scale during periods of high penetration and/or low demand. deX is also able to control DER via dynamic limits, flexible export control, and remote disconnect and reconnect functionality, and is capable of facilitating Frequency Control Ancillary Services (FCAS).

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<sup>1</sup> [2021 Electricity Statement of Opportunities. AEMO](#)

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# Technical Achievements and Challenges

With ARENA's support deX has evolved from a concept, an idea, a way of viewing the challenges in our sector - to the market leading solution for DER integration and management: Australia's solar backstop. It is a real and tangible example of where technology is leading the path to a lower emissions Australia.

Since the deX Program commenced, the deX product suite has developed from a concept into a technology. Through continuous research and development, practical implementations, and rollout at scale, the scope of deX has been refined and honed to reflect the needs of Australia today, and establish the foundations for future approaches.

In particular, deX Vision and deX Connect have reached advanced states of maturity and are now commercial products which GreenSync is licensing. The foundational elements of deX Command and deX Markets have also been developed and the basic functionality for both are now in production. GreenSync is in a position to progress these applications further when circumstances are appropriate.

In order for the deX product suite to be progressively developed over the duration of the Program, it was critical to first ensure that the underlying foundations of the platform were robust and able to support the long-term scalability, connectivity and operability objectives. This initial effort was also required to ensure that the necessary interactions between deX Connect, deX Vision, deX Command and deX Markets could be facilitated as development progressed. To ensure this fundamental functionality could be maintained as the complexity of deX grew, the core components of the platform also needed to be periodically reinforced.

While there have been many opportunities for deX over the life of the Program, they have not all necessarily and/or equally been the most pressing or value generating functions for our clients today. As deX has been designed and iterated upon, the functionality has been refined and focused to best address current issues and the needs of our users, specifically in the areas of device registration, customer permission, customer churn and network compliance.

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## deX Connect

deX Connect establishes an open access digital protocol (and associated physical standards) allowing all DER technologies to participate, create standard contractible services and ensure cybersecurity. To date, deX Connect has successfully completed certified integrations with 12 technology vendors and deX partnerships have reached 118 organisations.

These vendor-integrations enable DER devices, with customer consents in place, to be registered in deX, and in doing so unlock access to value for the device owners as well as support to the retailers, aggregators, market operators or networks who contract their services. Specifically, a contracted 'deX Registrar' can register and make visible devices via deX Connect so that they may be used in other deX applications. They can then be contracted, via an aggregator or retailer for grid services, unlocking new value streams for device owners such as energy generation during peak demand, managing frequency or grid voltage, or reducing network constraints.

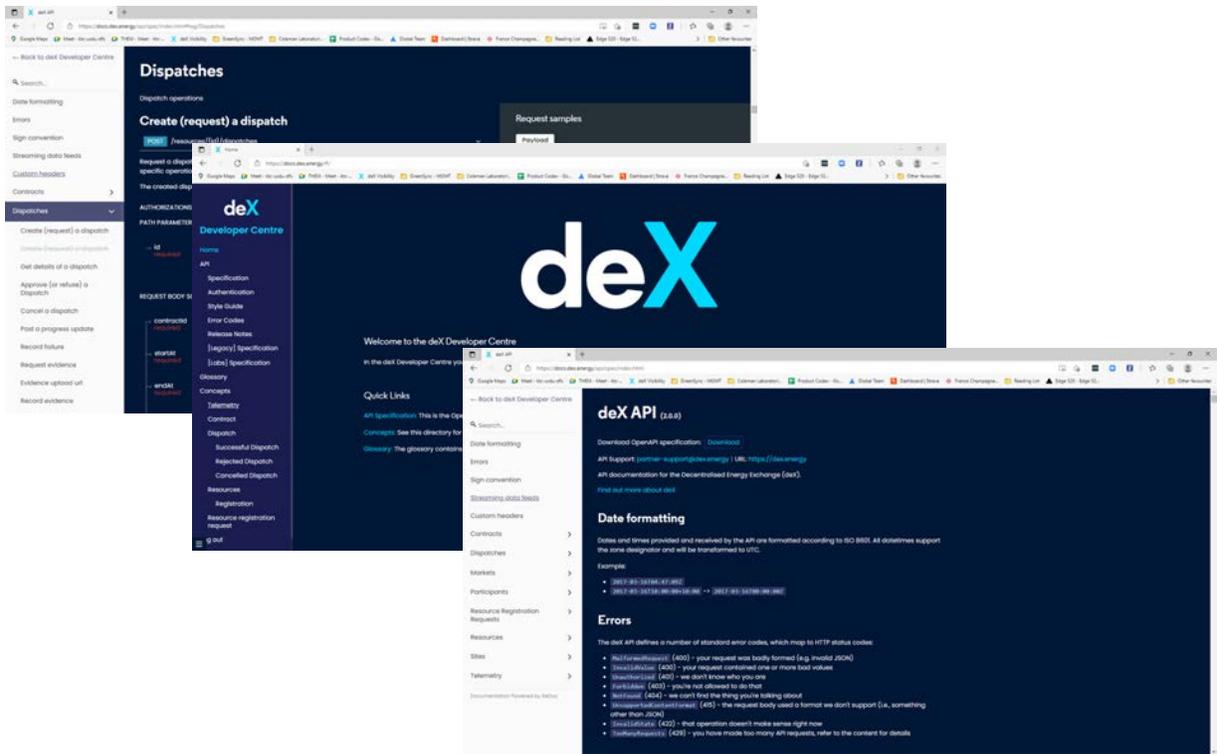
## Achievements

The deX Developer Centre was launched in 2019. The Centre is a self-service support hub that helps provide DER vendors with the best possible developer experience for the deX Application Programming Interface (API). The Centre provides all the necessary materials needed when working with the deX API (e.g. onboarding, registration and API key provisioning) in order to ultimately integrate with deX. It has content for all API stakeholders no matter where they are in their user journey as well as the tools to manage and maintain the relationship with technology vendors using the API. It covers the entire spectrum of the integration journey from how the data is processed, like date formats and error handling, through to how contracts, dispatches and telemetry are triggered and managed.

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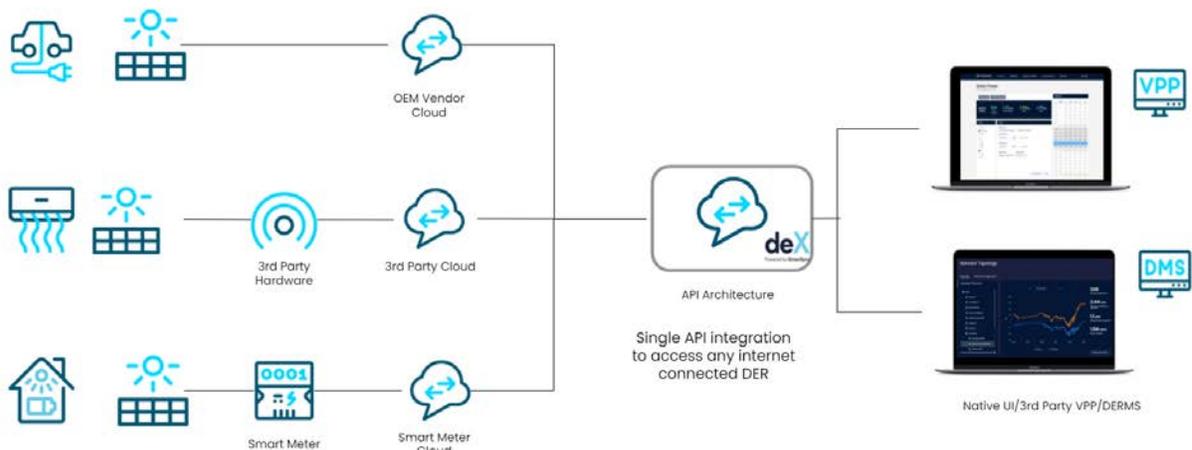
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The deX Developer Centre Interface

The deX application programming interface (API) enables DER to be connected to the deX platform and for interactions such as registration, control and verification to be facilitated.



The deX API and DER orchestration

In March 2020 the Developer Centre was enhanced to make it both more secure and easier to use. Email-based password-less authentication was implemented to confirm a user's identity and grant access to the deX Developer Centre.

In September 2020 the deX registration pathway was further enhanced with the deployment of the Device Registration Application. The Application was developed to enable an automated, streamlined registration process that can be performed out in the field at the time of installation. This approach reduces the need for manual effort and the potential for human error. The decision to build the Application was made after consulting with industry and learning that one of the greatest pain points in the device registration workflow was the onerous and manual nature of the process.



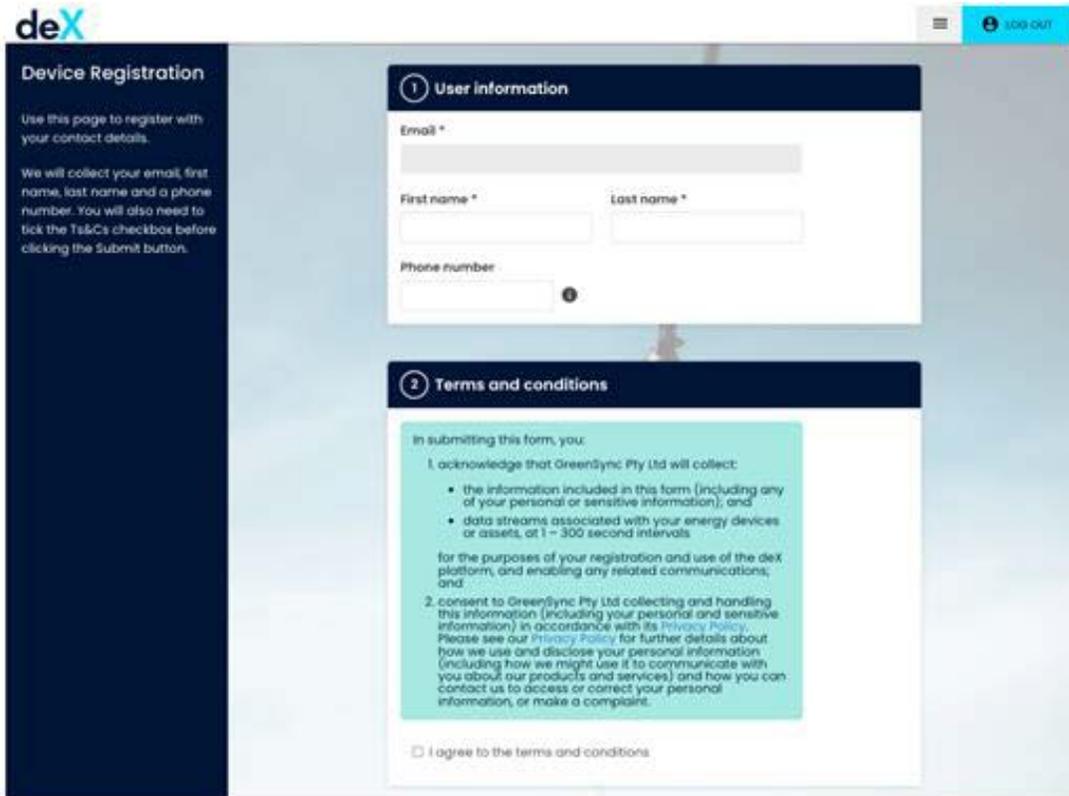
The deX Device Registration Application – example displays

To complement the Device Registration Application, the Device Registration Portal was deployed in November 2020 to provide consumers with an online option for device registration.

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The deX Device Registration Portal user information page

In mid-2020 a review of the API integration methodology was undertaken to ensure deX would be able support the growing volume of DER being registered in the platform and ensure it would be able to accommodate the forecast scale on an ongoing basis. The deX platform architecture allows for there to be no limit on the number of DER types that can be added to the platform. Adding further DER types is currently limited by a lack of technical sophistication on the part of the DER which is preventing them from being able to integrate and thus operate on the platform.

The integrations have become increasingly important and urgent as the uptake of DER has exponentially grown along with their impact on the security and stability of the grid. The increased energy being fed back into the network from the increase in DER, if not managed, can lead to voltage spikes which can cause tripping and temporary outages. The Australian Energy Market Operator (AEMO) released its annual Electricity Statement of Opportunities (ESOO) in August 2021. The report confirmed that critical system risks are increasing due to the accelerated installation

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of distributed PV and the subsequent drop in minimum demand across the NEM (refer to the Markets and Regulations section of this report for further details).

The integrations enable DER to be registered in deX and for customer consent for visibility and control to be authorised and managed. At its most fundamental, without integrations, any DER platform is unable to control DER and thus also unable to help protect the grid.

## Challenges

Developing a useful Device Registration Application that provided both a good user experience and captured all the necessary information was a time consuming exercise that required extensive consultation. In particular, ensuring all necessary permissions/consents were captured and implemented was critical from a statutory and privacy perspective. Legal advice was sought to ensure that all obligations were addressed. Identifying and understanding deficiencies in the existing registration processes and workflows was complex and also time consuming. It was important that these shortcomings were identified at the outset and taken into consideration when developing the Application so that the end product was useful, compliant and would ultimately be widely adopted.

The maturity of a vendor's API can vary greatly and vendors have also been known to make changes to their API without prior notification. This created a number of technical and operational challenges both while undertaking an integration and once each integration was in production. To ensure understanding, agreement and ultimately adoption of consistent API specifications, we worked extremely hard to foster excellent working relationships with our partners' key technical staff. We took a proactive approach and initiated certain technical discussions before some commercial arrangements were finalised to ensure the integrations could commence as soon as possible. We now have regular, recurring meetings with all our vendors to ensure open two way communication and that productive relationships are maintained.

As the number of integrations and registrations rapidly grew in the first half of 2020, experience told us that consistent deX API specifications that all vendors could build

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to were required. Deep thinking was undertaken in mid 2020 to develop robust integration specifications that would ensure the long-term stability and scalability of the deX platform. This was a preemptive effort to address the rapidly increasing number of DER in the platform before the situation became unwieldy.

It is standard practice for vendors to place rate limits on the number of requests that can be made to their API within a certain time period. This is an essential component of internet security and also helps to maintain efficient performance levels. Work is undertaken during both the integration and operational phases to ensure we understand the performance of each vendor's API. This is primarily done by conducting a number of dispatch scenarios so that possible issues from the limits are identified and avoided.

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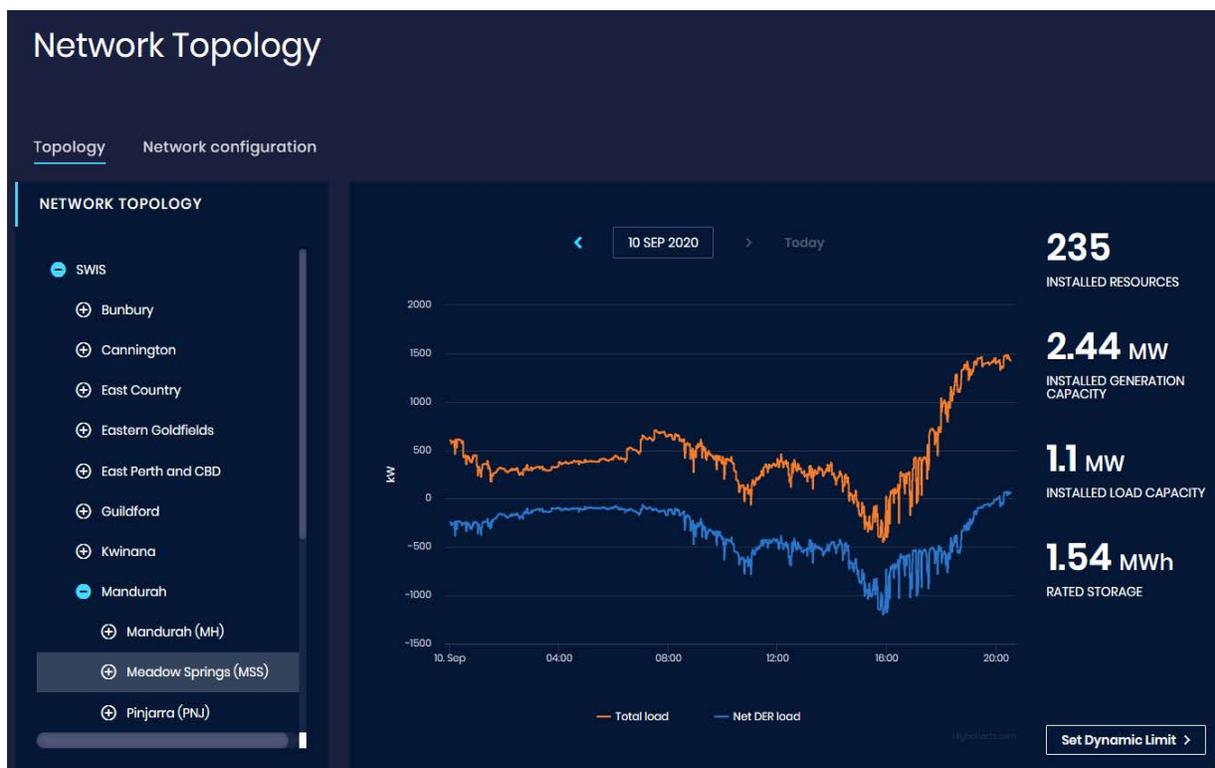
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## deX Vision

deX Vision is the overarching term that encompasses all deX products and services for network and system operators. The deX Vision application and the deX for Distribution Networks product offering provides Distribution Network Service Providers (DNSPs) with the capability to manage the impacts of DER on their networks. This application's feature set represents an essential, foundational capability for distribution businesses who wish to bridge the transition to a customer-oriented Distribution System Operator (DSO) operating model.

deX Vision works with existing network management systems to enable the management of both aggregated and unaggregated DER across the network at scale. In near real-time, both static and dynamic DER information showing the capability, telemetry and impact of DER can be viewed. Through mechanisms in deX that can adjust DER behaviour, DER can be employed to provide services to the network such as energy exporting to ensure that the network is maintained within technical limits.



The Network Topology interface in deX Vision

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## Achievements

deX Vision is the most mature and sophisticated of the deX product suite. It enables DER to be controlled via multiple methods including dynamic limits, flexible export control, and remote disconnect and reconnect functionality. It also provides access to DER telemetry for planning, forecasting, optimisation and remote monitoring.

The ability to control DER via deX Vision is a profound achievement that has been validated in the last 12 months with its real world application to remotely disconnect and reconnect DER in South Australia during a minimum demand event in that State (refer to the Case Study section of this report for further details). The realisation of this control functionality was the result of multiple feature releases that progressively expanded on the capability in deX. In particular, a great deal of time and effort was put into addressing Dynamic Connection Agreements (DCA) and their application within deX. One of the key challenges and limitations with the current approach to DER is that the vast majority of customers' systems are connected to the network with static connection limits. DCAs represent a critical tool in addressing the above issue through a transition to dynamic limits. For more details see the GreenSync authored [DCA for DER discussion paper](#)<sup>2</sup>. Developing and releasing this functionality has been one of our most significant achievements and greatest contributions to the transition to and future state of DER on the network.

Over 2019 significant enhancements were made to the network topology functionality in deX Vision. These additions provide the network/DSO with new grouping tools to improve the efficacy and efficiency of DER management across the network. This enables grid operators to interact with DER with greater accuracy and consequently improve network protection and reliability.

In the course of developing deX Vision, an evaluation engine was built to automate the process of contract calling to provide certainty that the required expectations were delivered. An evaluation engine evaluates a set of existing contracts with service providers and - subject to a set of constraints - determines an optimal dispatch strategy to achieve a certain objective. The evaluation engine can be formulated in a number of ways, such as cost, diversity, fairness and simplicity, and has been designed and built to be extensible so that new functionality can be added.

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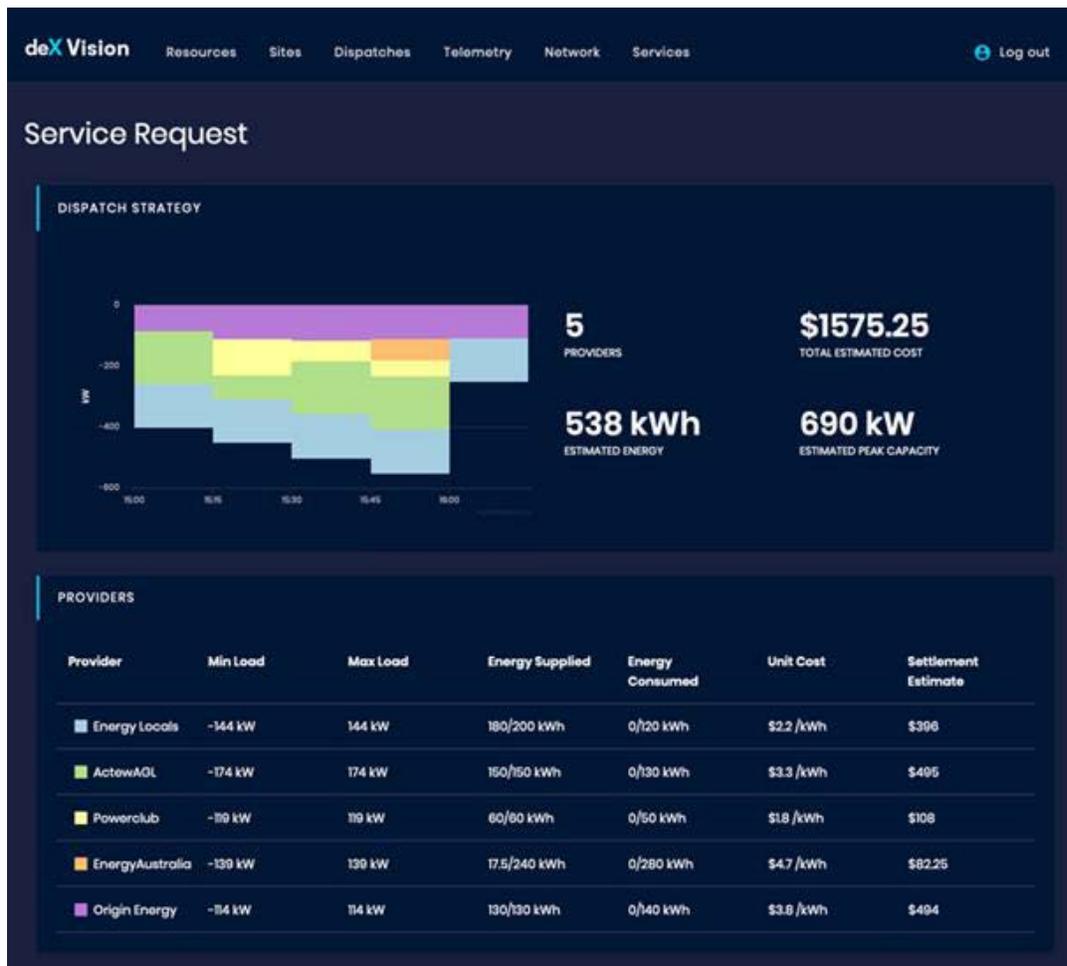
<sup>2</sup> <https://info.dex.energy/dca-discussion-paper>

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The evaluation engine proved to be an extremely useful development tool that was used to verify certain deX Vision functionality. It was able to demonstrate that deX can receive DER requests and is able to approve/reject such requests, can automate the calling of forward option contracts to meet a service requirement and identify dispatch combinations that will meet service requirements. The realisation of this functionality ultimately culminates in the ability for deX to protect the network from PV generation and VPP behaviour via Dynamic Limits, and from overloads by calling on Forward Option Contracts.



The Evaluation Engine dispatch view in deX Vision

A series of improvements to the deX registration pathway were developed and deployed over the first half of 2021. These enabled registration, contracting and control of DER to be automated. These features enable non-technical users to

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perform a task previously only able to be undertaken by a developer. The end result is a low touch solution with a simple interface that enables a user to quickly register DER and generate business-to-consumer (B2C) contracts. The realisation of this functionality has streamlined the end-to-end process and made deX Vision the user-friendly commercial product that it is today.

A fleet-wide test was performed in September 2021 where 5000 DER across five vendors were successfully dispatched to meet South Australia's *Smarter Homes*' obligations. During this test deX performed the largest inverter-based, heterogeneous DER fleet dispatch ever in Australia.

deX Vision also provides, in near real-time, both static and dynamic DER information showing the capability, telemetry and impact of DER for forecasting, baselining and performance benchmarking as well as market validation, settlement and audit requirements. These features ensure deX is a trusted system of record with full traceability and auditability functionality.

## Challenges

Developing the functionality to enable the control of DER at scale was an iterative and complex process. Deep and detailed thinking was done at the outset, and then systematically reviewed as new learnings and insights came to light, making it easier to methodically develop the best functionality over time.

deX Vision has ultimately delivered the functionality to enable DCAs but wider considerations regarding network capacity management, access and allocation persist. These are complex matters that require work from across the industry, but whatever the outcome deX is able to perform the service.

Ensuring deX was able to support the ingestion and output of telemetry at scale as the number of vendor-integrations and DER registrations increased was challenging. To address this we undertook periodic upgrades of the underlying deX database to maintain resilience and performance. There are also administration overheads and monetary costs associated with telemetry that increase as the volume of data being captured rises. We regularly assess arrangements (both in the deX database and operationally) to ensure that the appropriate levels of data are being captured.

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## deX Command

The deX Command application enables retailers, aggregators and energy services companies (ESCOs) to leverage deX integrations to facilitate increased DER fleet visibility and management capabilities as well as the ability to contract and dispatch DER for participation in electricity markets. Additionally, and unique to deX Command, is the ability to respond to DSO contracts, which enables access to dynamic network support opportunities such as real power dispatch to defer network augmentation.

### Achievements

The first deployment of deX Command was in December 2019. The release largely consisted of the foundational functionality required to ensure resilience and support fleet-wide dispatches as well as capture all necessary telemetry.

In September 2020 the functionality to enable Frequency Control Ancillary Services (FCAS) to be managed via deX Command was released. This functionality takes advantage of continuous trading opportunities within the market and in doing so generates higher value for our clients and DER owners. There is increasing interest/demand for Command from Retailers due its ability to enable VPP operations, especially in light of recent sustained negative prices.

### Challenges

Internal experience taught us that to extract value at the macro level, presenting this value clearly and realising this value quickly was key. This was challenging across multiple DER integrations, each with differing data streams and functionalities. To achieve this, it necessitated the development of a back end 'adapter layer', to normalise these variables and present the user with high-level, outcome orientated options.

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## deX Markets

deX Markets allows distribution market operators, both existing and those wanting to move into this space, to buy and sell energy services and operate flexibility service markets, in any jurisdiction. It supports system operators to limit spending on capital assets and reduces costs for consumers through greater capital efficiency. In essence, it provides more flexibility in the management of the network, including contracting with DER owners to turn up/down services in periods where DER operations would otherwise cause issues such as voltage spikes on low voltage lines and thermal overloading of substation transformers.

### Achievements

The foundational back-end contracting functionality to enable registration (both participant and DER); tender creation; customer bidding, contracting, and bid acceptance; contract lifecycle and operation; measurement and telemetry; and settlement activities have been deployed. This work was delivered under the Active Network Management (ANM) System Project as part of a consortium with Smarter Grid Solutions (SGS) and Nexant for UK Power Networks (UKPN).

### Challenges

The evolution of DER markets will drive necessary changes moving forward. The key market concept of contracting has been delivered and deployed, however, further feature development will need to be driven by customer needs as they arise. It is the opinion of GreenSync that over the medium term DER will likely participate in existing markets – rather than DER specific markets.

Delivering this functionality as part of a large consortium across multiple time zones had several challenges. For this reason the implementation of, and adherence to, strict project governance practices from the outset was vital. Detailed roles and responsibilities needed to be documented and agreed to to ensure a clear understanding of accountabilities. Project management practices including meeting cadence, change request processes and escalation pathways also needed to be defined and agreed to, as did universal tools that would enable project documentation to be accessible to all parties at all times.

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# Cybersecurity and deX Platform Security

Since the deX Program commenced, the importance of cybersecurity has continued to grow as cyber threats and attacks have escalated in number and sophistication. With the increase in remote working in 2020 due to the Covid-19 pandemic, its criticality grew further. When the Program was originally conceived, the intent was to seek ISO27001 certification in the third year. In the interim, the direction of deX shifted and the Australia Energy Sector Cyber Security Framework (AESCFS) emerged. As a result of these factors, in 2020 GreenSync undertook a detailed analysis of both options (ISO27001 and AESCSF) and determined that given the rapidly evolving DER landscape, along with changes in the wider industry, technology and direction of deX, the AESCSF was the most relevant and applicable model for deX to adopt.

The AESCSF was established in response to the findings and recommendations of the 2017 Independent Review into Future Security of the National Electricity Market (commonly referred to as the Finkel Review). It has been specifically developed and tailored to the Australian energy sector and is aligned with Australian policy and guidelines. It was developed in collaboration between Australian Energy Market Operator (AEMO), Australian Cyber Security Centre (ACSC), Critical Infrastructure Centre (CIC) and Cyber Security Industry Working Group (CSIWG). It leverages both national and international industry standards, and is largely based on the Electricity Subsector Cybersecurity Capability Maturity Model (ES-C2M2) that was developed in 2012 by the United States Department of Energy (U.S.DOE, 2014).

The framework provides the foundations to assess the current state and maturity of an organisation's cyber security practices in a standardised manner and to make informed decisions about further measures that may need to be implemented.

GreenSync undertook the AESCSF assessment in June 2021. In parallel, the company also evaluated all of its cyber related assets, policies and protections and made revisions where necessary to ensure all appropriate safeguards were in place.

Other cyber security related measures that have been undertaken include the implementation of the appropriate architecture to ensure the entire deX platform is

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protected. We decided to adopt a unified platform-wide approach that enables protective measures to be consolidated, integrated and streamlined across the entire platform. The decision to take this approach was made to facilitate the central management of the entire platform using a broad set of tools and capabilities. The depth and breadth of coverage achieved from implementing security at the platform level enables protection to be embedded across all layers of the platform's architecture. This approach also allows for robust protection to both prevent and mitigate potential threats, which are an ongoing and increasing concern.

The key factors that GreenSync took into consideration and addressed when deciding on our approach to security were:

- Protection of the platform and the infrastructure
- Identification of applications that use the deX API
- Identification of the people and organisations that use the deX and deX products
- Permission management, access-control, and delegation of authority
- Auditability
- Privacy and integrity of API calls
- Maximisation of deX API availability
- Management of API congestion or downtime

The principles of best practise for platform architecture and best practice for build were the basis on which the above items were addressed. deX has been built with security at the centre of every development decision. Secure API access protocols, including transport encryption and bearer token authentication, have been employed and only secure and auditable third party infrastructure is utilised. We have also implemented development processes that ensure the protection of the platform is maintained. This includes making frequent small changes that can be deployed and rolled back quickly if necessary. This approach is also applied to defect fixes and security patches. As part of our business-as-usual (BAU) activities, penetration testing is undertaken on an annual basis. Results are subsequently reviewed and prioritised for resolution.

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# Markets and Regulations

With the rapid growth in DER uptake, regulators and the market more broadly have been increasingly challenged to find the right balance between ensuring ongoing system security and safeguarding value for customers and providing market incentives. As risks to the network have grown in severity and likelihood, the need for regulators to act has escalated. This is most apparent in South Australia where the *Smarter Homes* regulations were introduced in 2020 (refer to the Case Study section of this report for further details). This real-world example is evidence that fair regulation can strike the necessary balance between system security and customer benefit and provide the wider industry with the certainty to warrant further investment. Other States are expected to follow South Australia's approach over the next few years.

## AEMO ESOO Report 2021

The Australian Energy Market Operator (AEMO) released its annual Electricity Statement of Opportunities (ESO) on 31 August 2021. The ESO provides technical and market data for the National Electricity Market (NEM) over a 10-year period to inform the planning and decision-making of market participants, new investors, and jurisdictional bodies. While supply is expected to meet demand for the next five years, the report confirms that critical system risks are increasing due to the accelerated installation of distributed PV. To meet this challenge AEMO recognised it needed the operational tools, specifically solar PV curtailment, outlined in the Energy Security Board's recommendations released the week prior.

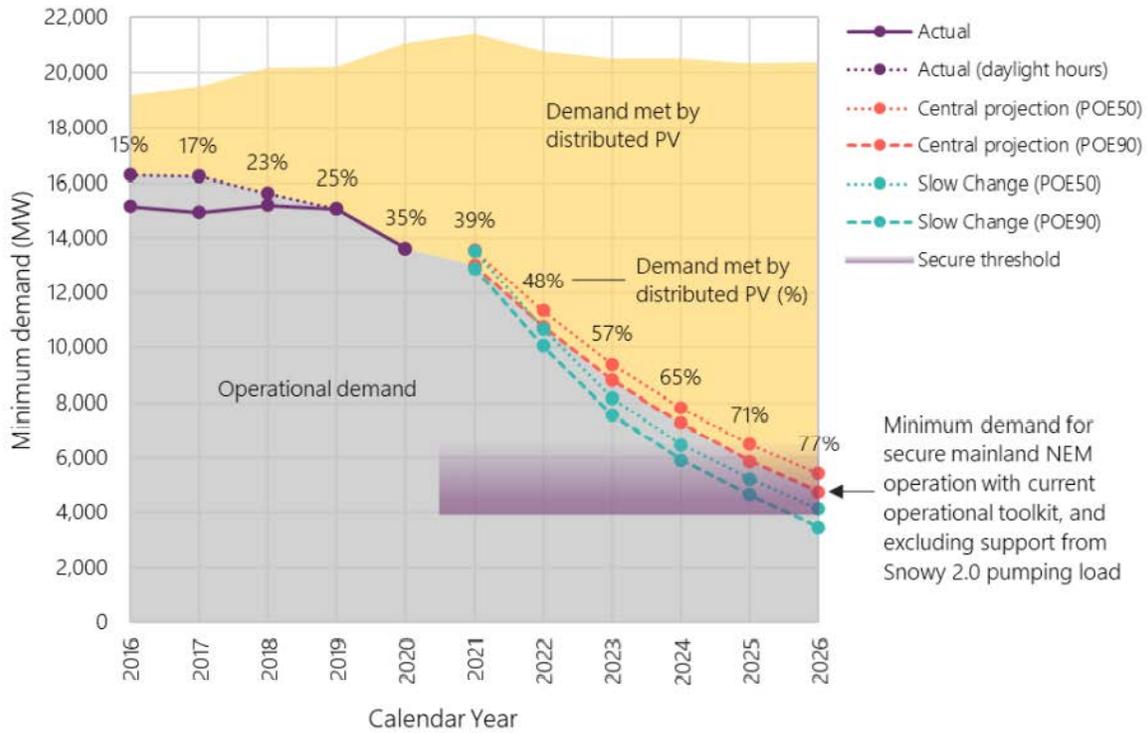
The key insights from the 2021 report included that AEMO forecasts a further 8.9 GW of commercial and residential solar PV to be installed by 2025 in the mainland NEM states. These solar systems alone could supply up to 77% of total electricity demand at times by 2026. As a result, minimum operational demand across the NEM mainland is expected to drop to a record low of 4 - 6 GW by 2025, down from 15 GW in 2019.

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**Figure 2 Minimum demand on the NEM mainland (excluding Tasmania)**



Source: AEMO’s 2021 Electricity Statement of Opportunities

The AEMO ESOO Report highlights the accelerating risk of minimum demand across the NEM. The report validates GreenSync’s strategy to focus near-term on solar PV remote disconnect functionality and commercial partnerships with inverter OEMs.

### Energy Security Board

The Energy Security Board (ESB) Post-2025 Market Design Final Advice to Energy Ministers was released on 26 August 2021. The report set out key recommendations for COAG Ministers to manage Australia’s energy system as both large and small scale, renewable generation enters the system rapidly and in volume. Key to GreenSync is the report’s advice on immediate reforms to support the integration of distributed energy resources and flexible demand.

The Post-2025 Market Design Final Advice urgently recommended that Energy Ministers adopt a jurisdictional Ministerial lever for emergency backstop measures, as an immediate reform to meet the challenge of minimum demand.

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- Use of existing technology and infrastructure, to minimize costs imposed on consumers,
- Where mechanisms to directly curtail small scale solar are considered, we recommend API based solar curtailment through an agent, similar to the SA solution with adaptations to encourage implementations that will align with future initiatives such as two-sided market reforms,
- Include the enrolment of retailers and aggregators to opt-in to the new responsibility for emergency switch-down of solar PV.

The Post-2025 Market Design Final Advice further recommended that Energy Ministers support the DER Implementation Plan. The Plan sequences immediate and initial regulatory, technical and market reforms that address emerging risks and builds capability to deliver benefits to all consumers from high levels of distributed energy resources and new energy services.

- Phased implementation of dynamic operating envelopes (aligned to 2030.5 C-SIP)
- Customer access to and ability to switch from VPP service providers.

The ESB recommendations are a significant validation of deX's interoperability architecture and GreenSync's strategy to focus near-term on solar PV remote disconnect.

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# Customers, Commercials & Stakeholders

The rapid transition underway here in Australia and across electricity markets internationally continues to validate the multi-sided benefit of the deX platform and the commercial potential to provide value to a range of customer segments. However, commercialising the shared value has required a staged approach aligned with the product roadmap, partnership development, market context and customer readiness. In parallel with our technology development, GreenSync refined and adapted a complementary commercial approach that was responsive to customer needs and lessons from early stage pilots. GreenSync is now in a position to scale the business in parallel with scaling of DER registrations and functionality.

## Achievements

### Australia

In Australia, deX, with the support of ARENA, has been applied in a number of pilots to demonstrate functionality for retailers, DNSPs and the emerging roles of DSO and Distribution Market Operator (DMO). These demonstration projects, such as the DER Integration and Automation project with Evoenergy, have a finite time frame and set of milestones primarily delivered within a professional services agreement. deX is now transitioning from these pilot arrangements to support OEMs meet the *Smarter Homes* remote disconnect requirements in South Australia and further develop their API to enable VPP and emerging compliance requirements including flexible exports. This scaling of services provides the foundations to provide wider commercial value to customers. In turn this allows GreenSync to develop a longer term enterprise or SaaS (Software as a Service) model with customers.

### International

Internationally deX has been recognised as a significant blueprint for transitions of competitive electricity markets to accommodate high penetrations of DER. In the UK, where there is a clear policy driver to develop flexibility markets, GreenSync was part

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of the consortium to successfully deliver UKPN's Advanced Network Management project. In New Zealand the platform was sought out by Wellington Electricity as a unique path to manage EV physical connections while supporting customer value. In Japan, as their market moves to further competition, key players including TEPCo and Mitsubishi Heavy Industries have selected GreenSync to provide specialist advice on flexibility market design and demonstrate platform capability.

## Challenges

### Early Stage Product/Market Fit

The initial concept of deX resonated across the industry and GreenSync secured a range of partners including key retailers, network operators and equipment manufacturers along with support from AEMO and key agencies. However, complexity of technology, policy uncertainty and emergent market status presents a challenge for early commercial success. Careful alignment between long term strategy, software roadmap sequencing and near term commercial needs is critical. Maintaining this requires close collaboration and internal coordination between teams, responsiveness to customer insights and patient investors.

### Technology Partnerships

Fundamental to deX, as a multi sided platform, is the active participation of a range of technology partners. In the early stages of development, however, opportunities to participate were constrained by the ability to align combined technology development with customer readiness and market access. A key example is the potential to utilise VPPs for FCAS response. While technically feasible, the commercial viability beyond demonstration requires confidence in a volume of DER, aggregator participation and durable market access. GreenSync and its OEM partners have recognised that DER market formation and access will continue to grow over time however the focus on asset registration and functionality to meet minimum compliance requirements provide a critical foundation. GreenSync now has existing MOUs and/or integrations with key global Solar PV OEMs representing 95% of the Australian market by volume.

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## **Unexpected Competition**

As deX gained a profile and other industry initiatives were launched, a number of other players emerged with a similar value proposition. GreenSync went from promoting a unique platform that would drive value for many players to defending itself against alternatives. While this is a natural principle of competition following 'first mover', it was a significant risk to consolidating the key partnerships required to catalyse the platform business model.

## **Customer Readiness**

As deX technology evolved, navigating early stage product/market fit, GreenSync realised that customer internal readiness was also a critical factor in commercial adoption. Key processes such as customer registration or retail tariffs that incorporate VPP value need to be in place before a customer can harness the technology. As a result, GreenSync has invested a significant amount of specialist time in supporting partners and customers design systems and processes.

## **Covid-19 Pandemic**

The Covid-19 pandemic continues to impact both deX and GreenSync more widely. At the outset of the pandemic GreenSync was in the early stages of a capital raising round. This activity immediately stopped as potential investors waited for the subsequent impacts to become apparent. The accompanying funding shortfall required GreenSync to undertake a company-wide review of every aspect of the business, including the strategic direction of deX, to ensure the long term viability of the company was maintained.

The review included assessing personnel requirements and unfortunately we have needed to make redundant ~50% of our staff since the pandemic began. The jobkeeper supplement did enable us to retain some staff for a time.

The pandemic also compelled us to address the way we work and how we could best continue to develop deX under the remote working conditions. Several remote working tools were adopted and we have introduced a "remote first" policy with all staff primarily working from home.

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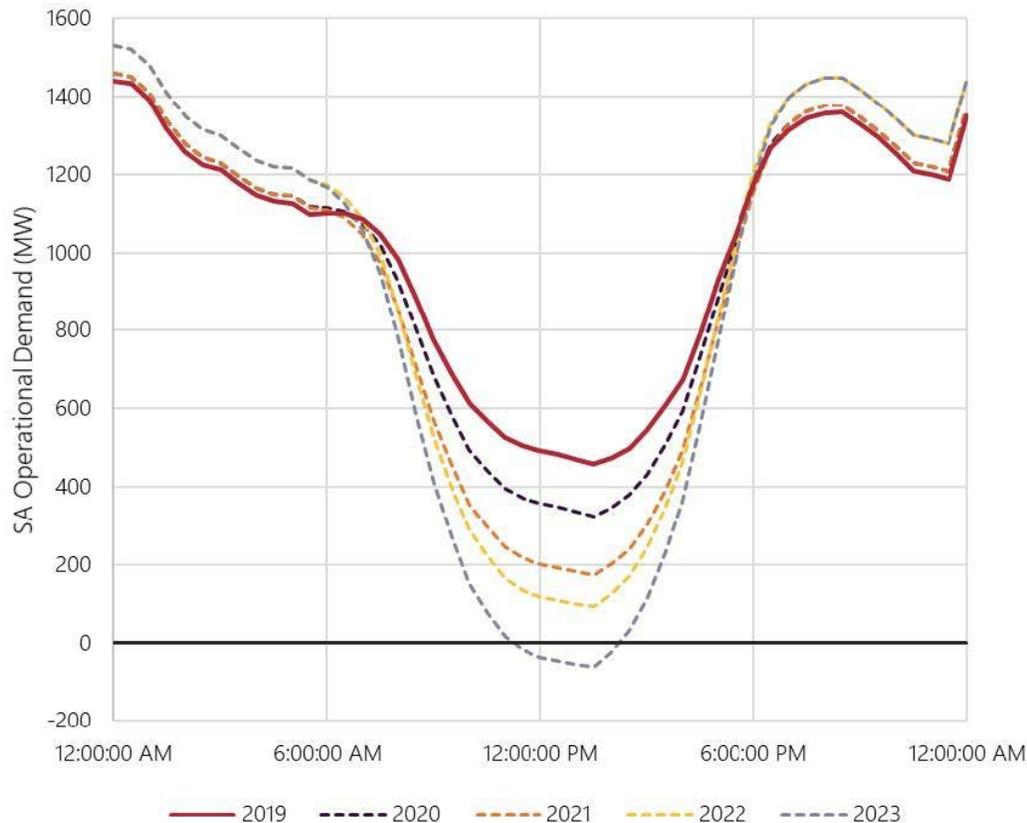
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# Case Study – South Australia

South Australia is at the forefront of the transition to DER with almost 60% of its electricity generation coming from renewables in 2020. Approximately 33% of the State’s dwellings have rooftop PV installed – the highest proportional penetration of all Australian states and territories, and among the highest proportional uptake in the world<sup>3</sup>.

AEMO has forecast minimum demand risks as a result of the increased adoption of solar from 2021/22. In response to this risk, in 2020 the Government of South Australia passed the *Smarter Homes* regulations<sup>4</sup>. These are a series of new technical standards and requirements for smaller generating systems in South Australia.



AEMO assessment: Effect on South Australia’s operational demand from increasing solar PV generation (19 Nov 2019 & projected)

<sup>3</sup> South Australian Electricity Report 2020, AEMO

<sup>4</sup> [Regulatory Changes for Smarter Homes](#)

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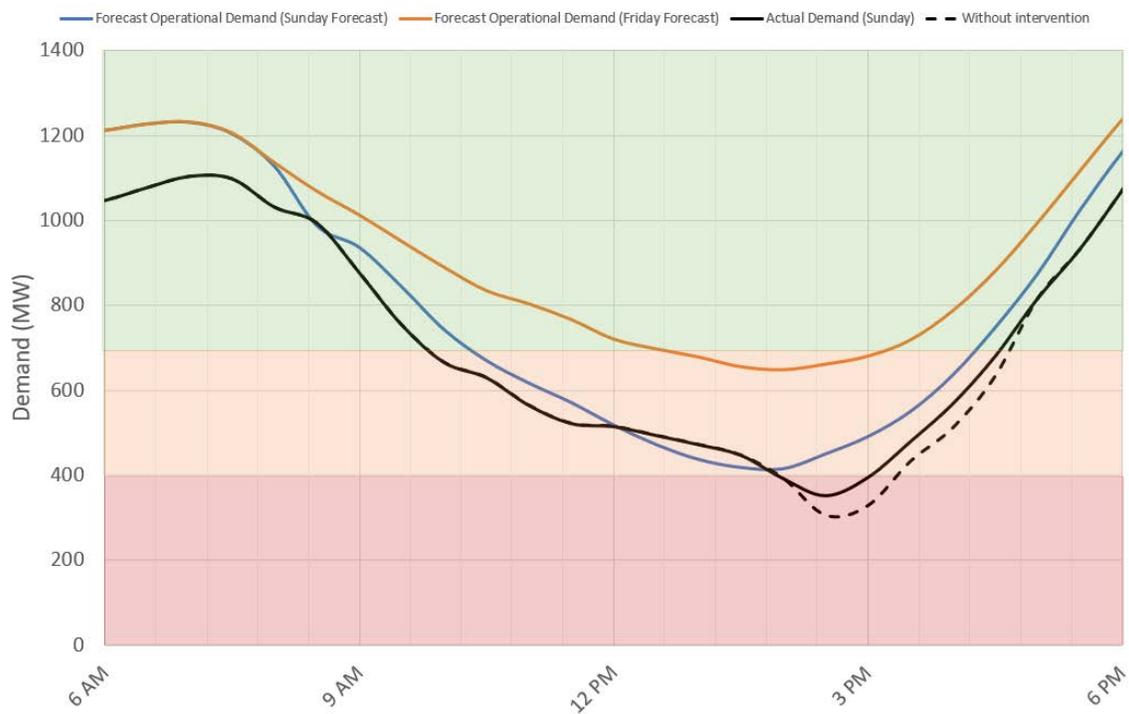


The *Smarter Homes* regulations came into effect on Monday 28 September 2020. The regulations require all customers installing or upgrading solar systems in South Australia to appoint a Relevant Agent who will be responsible for disconnecting and reconnecting the system during State electricity security emergencies.

The specific requirements under this new regulation have seen an increased level of interest in the deX device registration tool and technical integration capabilities. As such, deX is now supporting SA Power Networks (SAPN) and a number of inverter brands to enable advanced communications capabilities and control to meet the new compliance requirements.

### Event time

On Sunday 14 March 2021 demand in South Australia dipped below the minimum secure threshold of 400 MW. A planned outage of one circuit of the Heywood interconnector meant minimum secure demand was 400MW and coincided with demand for the day being ~300MW lower than what had been forecast two days earlier on Friday 12 March 2021.

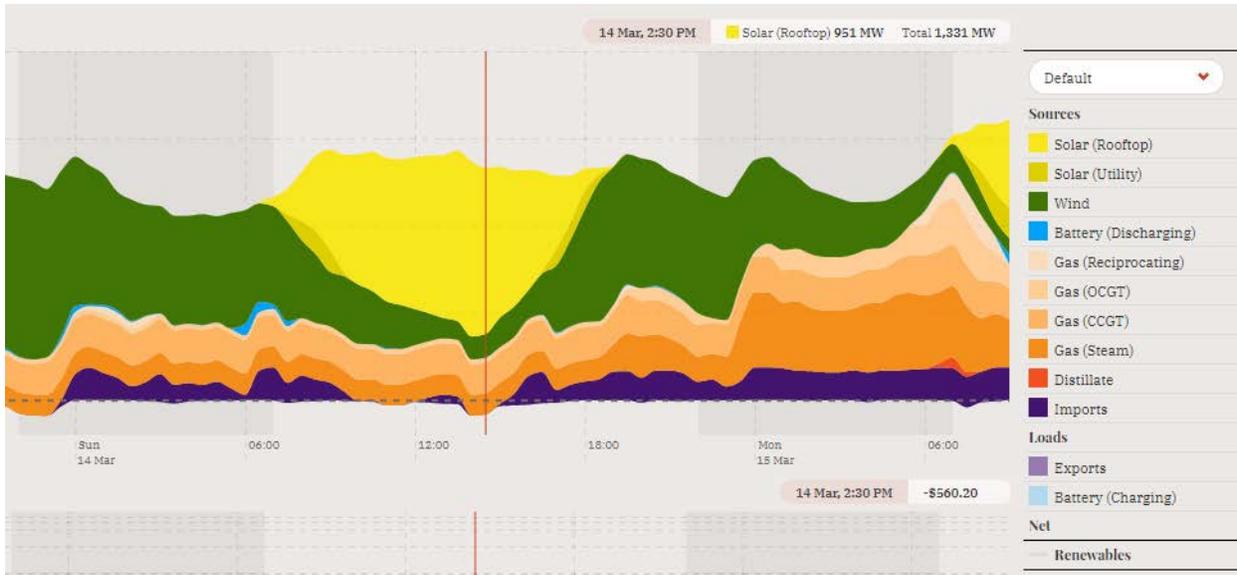


Forecast and actual demand for Sunday 14 March 2021 in South Australia

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Level of Residential PV on Sunday 14 March 2021

At approximately 15:20pm SAPN initiated directions to shed generation to restore demand to a safe level and deX was called on to disconnect its portfolio of solar devices registered under *Smarter Homes*. Disconnection via deX was successfully executed in under five minutes from the time of receiving instructions from SAPN. At approximately 17:25pm SAPN sent a restoration notification and this was also successfully executed in under five minutes from the time of receiving instructions. In summary, the entire deX portfolio successfully participated for the full two hours without issue.

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deX Vision Resources Sites Dispatches Telemetry Network Log out

## Set Dynamic Limit

Dispatch Date \* 21 Dec 2020 Start Time \* 05:01 PM End Time \* 05:06 PM Dispatch Length 30m 1h 12h

NetworkElement ID \* Group A Resources Available \* All

Dispatch Type \* Limit customer export to 0%

SET DYNAMIC LIMIT

The deX Dynamic Limit interface used to initiate remote disconnection and reconnection instructions

Since this event in March 2021 there have been several more extremely low demand days in South Australia. The most recent was on Sunday 26 September 2021 when operational demand dropped to an all time low of 236 MW. As the volume of PV in South Australia continues to grow, the minimum operational demand in the State will continue to fall.

# Program Impacts to Industry

## Industry Vision

The concept of deX was incubated within ARENA's ground breaking A-Lab initiative. Based on the Rocky Mountain Institute's E-Lab model, A-Lab encouraged innovators to bring together partners to ideate and create unique solutions to support the energy sector transition to 100% renewables. A-Lab fostered big ideas and deX was a big idea. The A-Lab program provided facilitation to resolve a problem/solution model and seed funding to develop a proof of concept. GreenSync brought together technology companies including Reposit, retailers including Mojo and network operators United Energy and Evoenergy (formerly ActewAGL). The consortium established the core principles of deX to support network compliance while enabling customer DER to maximise participation in electricity markets.

Following the successful development of a demonstration platform and widespread industry support GreenSync launched the deX initiative at an industry event in Melbourne in August 2017 with AEMO's then CEO Audrey Zibelman. The event brought together representatives from key organisations across the energy sector to recognise the initiative and celebrate its ambition. In March 2018 GreenSync released the deX Whitepaper outlining the key context and trends that underpin the rationale for deX, the three product layers, universal key benefits and the product roadmap.

## Industry Collaboration

The deX partner program formally brought together over 100 organisations agreeing to collaborate on the development of concepts and opportunities to trial the technology. GreenSync has hosted a 'Green Room' series of industry events and workshops in key topics including electric vehicle integration, DER marketplace development and dynamic connection agreements. The events combined keynote speakers with active audience participation to explore ideas, opportunities and barriers.

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## **DER Integration Architecture**

GreenSync published a detailed 'Reference Model' to set out the architecture of the deX platform and interaction with key industry platforms. These include Advanced Distribution Management Systems (ADMS) for distribution system operators, and Market Management Systems (MMS) and Energy Management Systems (EMS) for transmission system and energy market operators. In addition, aligning interfaces to distributed energy resources management systems (DERMS) and VPP platforms to coordinate the device. The Reference Model was shared both here in Australia with AEMO, ARENA and the Distributed Energy Integration Program (DEIP) and key network operators and industry consultants. In addition the Reference Model was utilised by TEPCo and UKPN to inform flexibility market design. The architecture aligns with the 'Hybrid Model established by the AEMO/Energy Networks Australia (ENA) Open Energy Networks and the framework for the current AEMO Project Edge and Symphony pilots.

## **Policy and Standards Development**

GreenSync has actively contributed to a range of industry policy and standards forums to advance DER integration. GreenSync has developed key industry papers, notably the widely received 'Navigating Standards and Frameworks for DER' (November 2019) and the 'deX Discussion Paper - Dynamic Connection Agreements' (September 2019). GreenSync co-authored the 'Distributed Energy Resources (DER) Visibility and Monitoring Best Practice Guide' with Solar Analytics on behalf of key DER OEMs and technology providers. In addition GreenSync has contributed submissions to a range of industry consultation processes and participated actively and generously in key forums to develop policy, standards and programs to support DER integration.

## **Pilots and Trials**

GreenSync has both initiated and participated in a number of pilots and trials leveraging both the technology platform and associated domain knowledge. This has had a positive impact both directly with customers and partners as well as indirectly with the wider industry. Each pilot has been a feature of ARENA knowledge

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sharing activities and presented in a range of forums, reports and conferences here in Australia and internationally.

## **Scaling**

Today, the deX platform is graduating from its early stage development phase and being applied in production as part of real-world critical infrastructure. As outlined above, deX is being deployed at scale to provide critical emergency backstop to manage minimum demand in South Australia. GreenSync is now working with partners to support its application in other jurisdictions to ensure we can meet the near term need to manage through minimum demand, and continue the transition to 100% renewables at scale that maintains grid stability and unlocks functionality to maximise customer benefits and minimise cost.

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## Next steps for deX

In 2016 GreenSync came together with partners with a vision for a digital platform that would enable electricity grids to support more renewables and manage the forecast increase in rooftop solar, electric vehicles and other DER while also helping consumers to get more value from their DER. Over the course of the deX Program the DER landscape both in Australia and around the world has dramatically changed. The exponential growth in DER has exceeded many people's expectations and accelerated the need to address the accompanying network challenges.

These circumstances have validated the vision for deX and its ability to deliver on that vision has now been proven. deX will next focus on enhancing and scaling the functionality delivered to date so that hundreds of thousands, and ultimately millions, of DER can be coordinated via the platform. To realise this potential, GreenSync will continue to focus on partnering with major DER OEMs to support interoperability, enabling imminent grid connection requirements and unlocking the potential for flexibility services as markets form over the coming years.

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