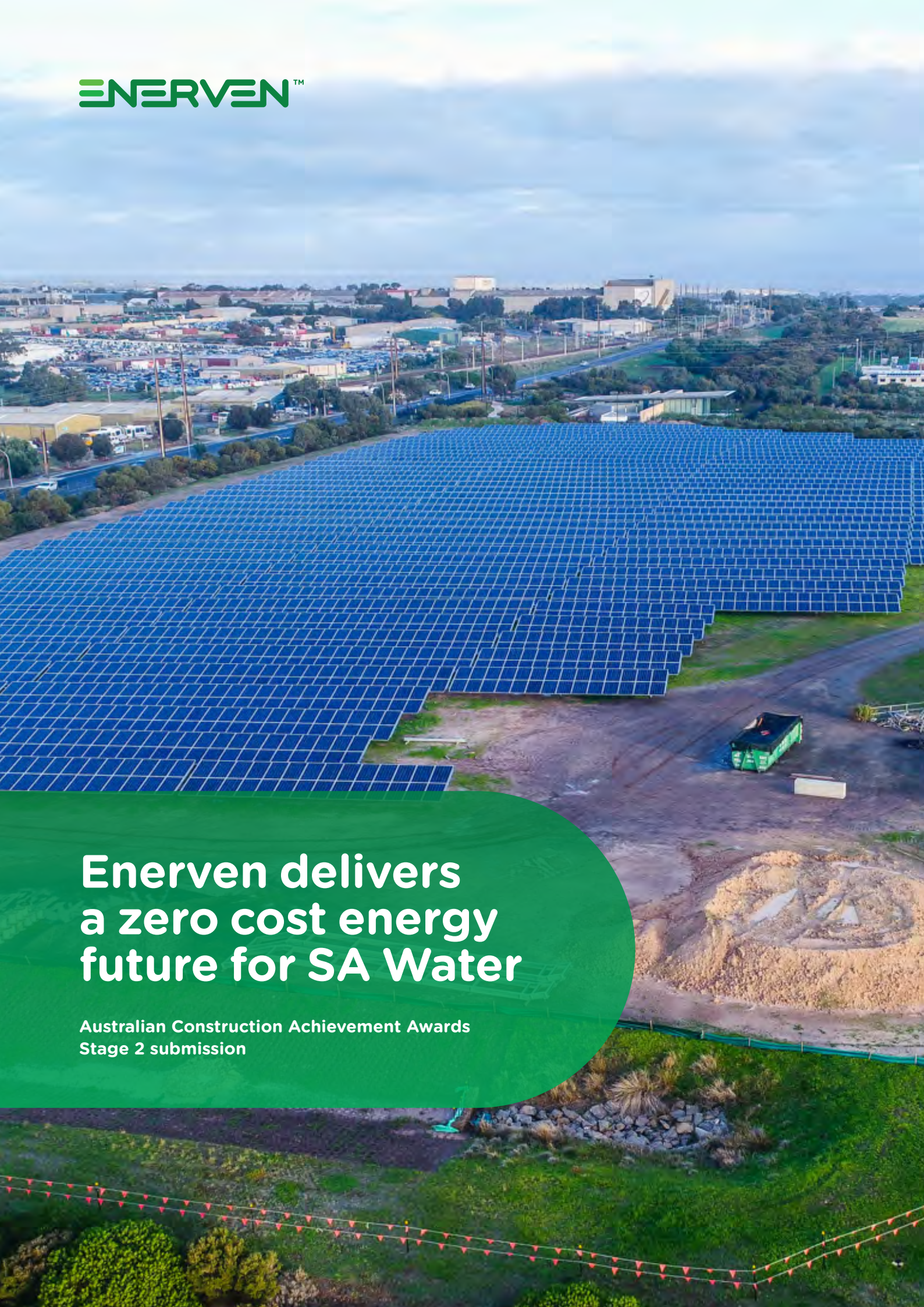

Enerven delivers a zero cost energy future for SA Water

Australian Construction Achievement Awards
Stage 2 submission

We play a pivotal role in South Australia by building & maintaining the infrastructure that keeps the state running.

500+ employees across SA and the NT

Vast experience in renewable & electrical infrastructure

Unrelenting focus on safety & wellbeing of our people

ENERVEN™

Connecting you with tomorrow

Contents

Project Description

In early 2019 Enerven was awarded the contract to deliver the infrastructure to ultimately unlock SA Water's potential to neutralise its energy costs. Enerven is proactive, reliable, experienced, and has a proven track record when it comes to quality, service delivery, safety, and environmental sustainability. We have an unrelenting focus on safety and wellbeing, which underpins everything we do.

SA Water provides world-class water services to over 1.7 million customers across South Australia, including water sourcing, treatment and supply, sewage removal from homes and businesses, and sewage treatment and recycling. It is an immensely energy-intensive industry, with SA Water's 18/19 energy bill exceeding $80 million. SA Water has always had a proactive approach to energy reduction and reducing their environmental footprint. To improve their energy management and reduce energy costs they developed an ambitious program of work that will see the energy they generate and export to the market offset the cost of the electricity they draw from the grid and network charges, to achieve a zero-net outcome. The program was aptly named Zero Cost Energy Future. Sustainably reducing operational expenses, such as electricity, will enable SA Water to keep water service charges as low and stable as possible for their customers.

The Zero Cost Energy Future Program is a global first for a water utility designed to reduce their energy bill across their portfolio of sites and assets. The Program is multifaceted, including development of the optimised control and coordination of energy across sites and active demand management practices. The scope included engineering and delivering 242GWh (Gigawatt Hours) of solar PV and 34MWh (Megawatt Hours) of energy storage across 33 'behind the meter' sites in metropolitan and regional South Australia.

Large solar farms are generally developed and delivered on a single greenfield location, that is fit for purpose with limited complexity. Whereas this project has been delivered across 33 sites necessitating 33 individual solutions, connection agreements, and teams. The challenge was also to deliver the program in 24 months, which considering most Chapter 5 connection agreements take 18 months for a single agreement, facilitating 33 was going to be extremely challenging. The program team had to be creative to deliver this program. The Enerven team has had to engineer solutions specific to each site's unique topography, ground and connection asset condition, and environment. Consequently, they have designed and constructed assets utilising 5 different racking technologies including the largest 5B Maverick system in the world at 14MW. To add to the complexity some structures are less than 80 metres from the ocean, some in remote dry regions and others are in the heart of South Australia's Riverland.

This program has benefited South Australian's and will continue to deliver benefits to the community long after the program is finished.

- 242 GWh capacity
- 33 network sites
- 70 percent of load
- 367,000+ solar panels
- $390M investment
- 250 construction jobs

Project Scope

Site Name	MW/kW PV	Battery Energy Storage System
Adelaide Desalination Plant – Phase 1	12MW PV	12.3MWh BESS
Adelaide Desalination Plant – Phase 2	13.52MW PV	-
Aldinga Wastewater Treatment Plant	1.52MW PV	1.06MWh BESS
Arno Bay Booster Water Pumping Station	100kW PV	-
Caralue Bluff Water Pumping Station	100kW PV	-
Kimba Water Treatment Plant	100kW PV	-
Lock Water Treatment Plant	100kW PV	-
Port Augusta Waste Water Treatment Plant	100kW PV	-
Balhannah Summit Storage Water Filtration Plant	1.11MW PV	0.53MWh BESS
Bolivar Wastewater Treatment Plant	10.73MW PV	4.93MWh BESS
Christies Beach Wastewater Treatment Plant	3.50MW PV	4.32MWh BESS
Hahndorf Wastewater Treatment Plant Reserve	260kW PV	-
Happy Valley Water Treatment Plant	12.83MW PV	8.62MWh BESS
Heathfield Water Treatment Plant	30kW PV	-
Queensbury Water Treatment Plant	30kW PV	-
Mount Pleasant Treatment Plant	40kW PV	-
Lobethal Waste Water Treatment Plant	100kW PV	-
Mallala Pump Station	90kW PV	-
Mannum to Adelation Pipeline Pump Station Number 2	16.85MW PV	-
Mannum to Adelaide Pipeline Pump Station Number 3	16.22MW PV	-
Morgan to Whyalla Pipeline Pump Station Number 1, 2, 3 and 4	25.34MW PV	-
Mount Gambier Depot and Mount Gambier Sewage Pump Station	200kW PV	-
Murray Bridge to Hahndorf Pump Station Number 2	13.02MW PV	-
Myponga Depot and Treatment Plant	790kW PV	35kWh BESS
Onkaparinga Pump Station	440kW PV	350KWh BESS
Port Lincoln Depot	100kW PV	-
Swan Reach to Stockwell Pump Station Number 1 and 2, Swan Reach Water Filtration Plant and Swan Reach Raw Water Pump Station	9.97MW PV	880kWh BESS

Adelaide Desalination Plant – Phase 1

Adelaide Desalination Plant – Phase 1

12MW PV, 12.3MWh BESS

A complex site requiring PV to be installed on fixed racking across 4 geographically diverse areas to accommodate existing constraints of the site. These areas included car parks used during the construction of the desalination plant, undisturbed land adjacent the ocean and areas of non-engineered fill that remained following construction of the desalination plant. Interconnecting works required the installation of a new high voltage overhead line. Due to the scale of the generation capacity, this project required registration of the generating system in the National Electricity Market (NEM).

Adelaide Desalination Plant – Phase 2

13.52MW PV

Connecting to the Adelaide Desalination Plant Phase 1 installation, this large site was installed on land previously owned by the Mobil oil refinery, requiring careful environmental management. Due to the staged nature of the installation, a separate connection and registration in the NEM was required to meet the National Electricity Rules.

Aldinga Wastewater Treatment Plant

1.52MW PV, 1.06MWh BESS

To maximise the production of the site two separate points of connection were utilised for a common fixed tilt array, implemented through a virtual metering arrangement to achieve the target energy production. 12 off 75kW inverters and the BESS were connected to the first connection point, and 5 off 75kW inverters were connected to the second connection, all housed in a containerised inverter/switchroom.

Arno Bay Booster Water Pumping Station, Caralue Bluff Water Pumping Station, Kimba Water Treatment Plant, Lock Water Treatment Plant And Port Augusta Waste Water Treatment Plant

500kW PV

Four separate 100kW ground mount fixed tilt installations at 5 locations delivered as a single project to maximise efficiencies and economies of scale. The remoteness of the sites, all on the Eyre Peninsula in South Australia presented significant logistical and resource challenges that were overcome through detailed planning and execution.

Bolivar Wastewater Treatment Plant

Balhannah Summit Storage Water Filtration Plant

1.11MW PV, 0.53MWh BESS

A fixed tilt PV and BESS installation installed at a remote site to the water filtration plant, due to a lack of available land at the water treatment plant. To offset the plant loads, a virtual metering arrangement was utilised to achieve the net target energy. This project presented significant challenges due to the uneven terrain and unfavourable geotechnical conditions, that were overcome with new and innovative engineering approaches.

Bolivar Wastewater Treatment Plant

10.73MW, 4.93MWh BESS

Located at South Australia's largest wastewater treatment facility, this project presented significant challenges in both installation of PV and BESS, as well as complex connection arrangements. As part of the installation, the solar panels were installed across 4 geographically diverse areas accommodating constraints of the site, and the BESS in another separate location, requiring significant interconnecting infrastructure. As there were already multiple sources of existing generation at the site, there were significant challenges that were overcome to integrate the new generation with the existing generation. This required extensive modelling, automation and integration, which was managed with multiple stakeholders including AEMO and Network Service Providers. Overcoming these complexities ensured that the new proposed generation and existing generation at the site met the required generation performance standards.

Christies Beach Wastewater Treatment Plant

Hahndorf Wastewater Treatment Plant Reserve

Christies Beach Wastewater Treatment Plant

3.50MW PV, 4.32MWh BESS

Thorough site investigation determined that this site met the requirements of the low cost 'Peg' east-west racking system. This low cost and high yield system enabled quick installation of the racking system relative to other fixed tilt systems. The peg system was installed at a new site external to the existing wastewater treatment plant, whereby the BESS was installed within the existing plant, requiring interconnecting high voltage infrastructure. In addition, the PV installation was installed adjacent to existing residential properties, requiring sound attenuation solutions for the single central inverter. Existing generation at the site, including another PV 'string inverter' installation presented connection implications. Based on the new generation facility only, registration would not have been required, however due to existing generation on the site registration of the generation facility was required adding complexity to the project.

Hahndorf Wastewater Treatment Plant Reserve

260kW PV

Limited real estate at the site required innovative thinking to find a location to install a solar farm with the size to meet the plant needs. The solution was to install the farm in disused holding ponds, previously a functioning part of the wastewater treatment plant. A fixed tilt racking system was installed directly into the disused holding ponds to minimise the earthworks required and disturbance to potentially contaminated material.

Happy Valley Water Treatment Plant

12.83MW PV, 8.62MWh BESS

This site had the highest public profile on the ZCEF program, due to the requirement to remove a pine tree plantation where the solar farm was to be installed, which in turn presented significant geotechnical challenges for the site. Traditional piled mechanical racking systems were not fit for purpose at the site due to the potential for significant soil movement due to the removal of the pine tree plantation and the underlying black earth and reactive clay soils. In addition, it was a requirement to limit the visibility of the solar farm; conditions of the development process and consultation with nearby residents. The solution involved utilising the 5B deployable racking system, which provided an option to address the geotechnical concerns at the site by installing a new pavement for the panels to be installed on, whilst also allowing the system to be low lying, meeting the requirements of the development approval and alleviating concern of local residents.

This program of work is a world-first, and will certainly generate a legacy for the construction industry.

Adelaide Desalination Plant – Phase 1

Heathfield Water Treatment Plant, Queensbury Water Treatment Plant and Mount Pleasantheat Treatment Plant

100kW PV

Two 30kW and one 40kW roof mount installations at 3 locations. Although relatively small projects on the program, there were still challenges to be overcome regarding generation limits, integration with backup diesel generators, and structural considerations to existing client facilities.

Lobethal Waste Water Treatment Plant

100kW PV

Learnings from the Eyre Peninsula sites were employed at Lobethal, such as trenching profiles, switchboard connection arrangement, stringing details and control and monitoring simplification. Although a challenging project due to severe weather at the time of construction, during the winter in the Adelaide Hills, utilising the learnings from the Eyre peninsula sites allowed for design and construction efficiencies to be realised and enhanced during the latter projects on the program.

Mallala Pump Station

90kW PV

Integration at Mallala required careful planning and co-ordination of shutdowns, and due to the critical nature of the plant, these shutdowns had limited windows at out of hours times. Successful and safe delivery required on clear planning and communication, employing strict lock out tag out processes and procedures to govern outages.

Mannum to Adelation Pipeline Pump Station Number 2

16.85MW PV

Land constraints required significant earthworks to be completed to allow installation of the single axis tracking system technology, the only technology that would enable SA Water to meet their yield requirements at this new site. Close to 18,000 tonnes of material was introduced to fill the site to meet the requirements of the racking technology.

Mannum to Adelaide Pipeline Pump Station Number 3

16.22MW PV

The Mannum to Adelaide Pipeline Pump Station Number 3 is located in and surrounded by undulating and rocky terrain, with no suitable or available land nearby the connection infrastructure for the solar farm. As such, farm land was acquired over 4km away from the pump station. This required installation of over 4km mixed overhead and underground high voltage connection infrastructure. This infrastructure was primarily installed within the existing water pipeline easement, providing challenges in earthing, vibration and maintainability of the new connection assets that required consideration during the engineering and construction phases of the project.

Morgan to Whyalla Pipeline Pump Station Number 3

Morgan to Whyalla Pipeline Pump Station Number 1, 2, 3 and 4

25.34MW PV

The Morgan to Whyalla Pipeline required separate single axis tracking solar farms to be installed at pump stations 1, 2, 3 and 4 with capacities of 6.13MW, 5.87MW, 7.47MW and 5.87MW respectively. All sites required connections to different transmission network substations, also requiring separate connection agreements and separate registrations in the NEM. R2 commissioning with AEMO was completed over a 4-month period for all sites, a significant achievement in Australia for connection of 4 sites under chapter 5 of the National Electricity Rules in this timeframe.

Mount Gambier Depot and Mount Gambier Sewage Pump Station

200kW PV

Installed across 2 connection points, ensuring quick turnaround on this project was important, as the project was resourced by construction personnel based in Adelaide. This formed part of the decision to utilise the PEG racking system at this site, minimising time on the site whilst maximising energy generation across the two connection points.

Murray Bridge to Hahndorf Pump Station Number 2

13.02MW PV

To achieve installation of the 13.02MW single axis tracking solar farm at Murray Bridge to Hahndorf Pump Station Number 2, significant upgrades were required to the existing transmission network supply substation, requiring upgrade to the existing pump station connection arrangement, as well as remote end upgrades for the transmission network service provider.

Myponga Depot and Treatment Plant

790kW PV, 35kWh BESS

Significant options analysis was required when developing the best solution for offsetting electricity usage at Myponga Reservoir. Issues with distribution end of line voltage and limiting network augmentation, multiple supply and metering points, as well as significant land grades not suitable for solar farms were all considered in the development. The result was a single connection point, consolidating multiple connection points, fixed tilt racking installed in multiple locations to comply with gradient requirements of the racking, and a BESS installed adjacent to the new connection point, optimising the site for lowest cost for the development, whilst also achieving the best result for offsetting electricity demand at the site.

Swan Reach to Stockwell Pump Station Number 2

Onkaparinga Pump Station

440kW PV, 350KWh BESS

Installation of the Onkaparinga solar farm and batteries overcame challenges due to pre-existing issues in the treatment plant. Issues with existing equipment required a plant shutdown to enter the plant, where multiple shutdowns were required to not only install the new connection infrastructure, but also during the design and engineering phase of the project

Port Lincoln Depot

100kW PV

To achieve the energy yield requirements at the Pt Lincoln Depot, 3 separate buildings were used for installation of the 100kW roof mount system. Co-ordinating the upgrade required detailed structural analysis of each of the buildings, to ensure structural integrity would be maintained, whilst also balancing the requirements to meet 100kW of solar installation. Multiple iterations of design were required, to converge on the final solution that achieved the energy targets whilst avoiding costly structural modifications to existing buildings.

Swan Reach to Stockwell Pump Station Numbers 1 and 2, Swan Reach Water Filtration Plant and Swan Reach Raw Water Pump Station

9.97MW PV, 880kWh BESS

The Swan Reach to Stockwell Pump Station Number 1 required design, construction and commissioning of a 6.3MW solar farm connected to the existing 3.3kV pump station. Site was optimised to stay under 5MW to avoid the requirement for AEMO registration, saving significant time and cost on the project. The Swan Reach to Stockwell Pump Station Number 1 required design, construction and commissioning of a 2.5MW solar farm connected to the existing 3.3kV pump station. This required planning water movement through other pipeline systems to gain required outage durations to successfully complete the project. All sites on the Swan Reach system maintained installed nameplace capacity below 5MW, thus avoiding the requirement of registration of sites in the NEM.

Contract Details

SA Water adopted an alliance contract model for the ZCEF program, adopting a joint governance structure, integrated delivery and leadership team with aligned project objectives. The alliance model created a contractual environment where the contractor (Enerven), in collaboration with the client (SA Water) was able to deliver superior project outcomes by:

- exploring and developing innovative solutions to an uncertain scope, heightened by the ambitious scope of the program
- establishing a joint, and aggressive, project schedule
- managing resourcing constraints in the market depth and breadth
- addressing complex stakeholder engagements
- developing a program and construction method to meet the program objectives on both green and brownfield operational assets

As a result, up to 40 separable portions and sub separable portions were created throughout the program under a comprehensive master framework agreement. Of these separable portions, 18 were established to deliver the 33 sites with the remainder used to execute the centralised procurement strategy, unlocking large cost savings across the program and significantly mitigating supply chain risks.

The master framework agreement also featured a cost-plus contractors fee remuneration model combined with a time, cost (pain/gain) and performance incentive regime which was the driving force behind an attitude to collective success and failure.

The alliance contract model, through the master framework agreement, ultimately provided a foundational basis upon which the client and contractor could work in good faith and share risk and reward in achieving the project outcomes.

The alliance contract model provided a foundational basis where the client and contractor could share risk and reward in achieving the project outcomes.

Outcomes achieved against planned targets for Key Project Parameters

Workplace Health and Safety

Enerven is proactive, reliable, experienced and has a proven track record when it comes to quality, service delivery, safety and environmental sustainability. We have an unrelenting focus on safety and wellbeing, which underpins everything we do. Delivering a program of work across 33 sites is challenging and we have resourced the project with 4 full time safety professionals who support the project delivery teams to manage specific risks associated with the delivery of solar assets at brownfield and greenfield sites both on the ground and on roof tops. We are proud of our performance to date; however, we are not complacent and regularly refresh our direction and expectations to ensure the messages are being received by our people and trusted contractors. Some specific targets and outcomes (to end December 2020) are:

	Target	Actual
Total Recordable Injury Frequency Rate (TRIFR)	<7.5	7.1
Medical Treatment Injuries	<5	2
Near Miss Incidents	<10	3
Hazards Raised (leading)	>150	151

Industry Participation

Enerven has actively engaged with the Office of the Industry Advocate, its subcontractors, and several underrepresented target groups to outperform our industry participation targets. We are very pleased that 3.8% of project hours have been delivered by Aboriginal and Torres Strait Islander People against a target of 2%. Furthermore 90% of all human resources (ex-production of materials) on the project are local to South Australia.

Indicator	Target	Actual (end 11/2020)
Target Group Hours* (% of total hours)	11%	18%

* Target Group includes Apprentices, Trainees, Graduates, Aboriginal and Torres Strait Islander People and People with Barriers to Employment

Cost

The Target Outturn Cost (TOC) process was designed for Enerven to 'pitch' our offer for each of the sites to the Client. This process provided opportunity for efficient Client feedback on scope, risk and cost such that Enerven could flexibly and quickly adjust offers accordingly to meet the agreed requirements and risk apportionment between the two parties. This process has meant that Enerven has been able to deliver a very complex scope of work with comparatively few variations and/or disagreements with our Client. The sequencing of this process provided Enerven an opportunity to spend time visiting the site, developing solutions and concept designs to achieve the challenging energy target requirements and site Operator constraints and provide a price to deliver an often-innovative solution.

Enerven is justifiably proud to deliver this Program within 1% of what we proposed in our tender response in September 2018. During the elapsed time between September 2018 and now, the program scope has evolved significantly, however we have worked closely with our Client to ensure we deliver the requirements of the Program within the Cabinet approved budget.

Stakeholder

Co-locating our teams has fostered a one-team approach to achieving this world-first program. It's allowed efficient conversation and decision-making to remove the risk of unnecessary delays and enabled the businesses to develop a culture of collaboration and work through difficult elements of the Program.

Enerven's broad experience designing and constructing distribution and transmission networks meant we've extensively supported SA Water's complex connection processes across the 33 sites. This has de-risked the project for SA Water and contributed to an excellent working relationship between the 2 businesses. A program of this scale with this many connection agreements has never been attempted before and for SA Water to achieve this scope within 24 months is extraordinary.

The project team

Quality

Enerven has demonstrated its commitment throughout the program by ensuring that all quality objectives, delivery and requirements of the Client and stakeholders are satisfied. Regular reviews were undertaken to ensure the availability of all resources to maintain the "Right First Time" goal. Audits, checks and measures were introduced to manage the risk of trends reoccurring. Issues identified during the auditing process were analysed, recorded and discussed with the team to ensure all trends are highlighted and addressed.

A ZCEF Quality Management System was set up to establish policies, objectives and processes to achieve a successful cost efficient and effective program. Continuously improving and investing in the ZCEF program, whilst developing effective partnering relationships, ensures that we remain proactive and grow the understanding of Quality Assurance Systems.

Environment and Heritage

For the ZCEF Program Enerven initiated: retention of native vegetation under and around the solar arrays; creation of habitat stacks for wildlife; diverting waste from landfill; ensuring the protection of cultural heritage; development of resources for staff and contractors to assist with environmental compliance on site.

On three of the large regional sites containing low growing native vegetation (bushes and shrubs such as saltbush, bluebush, acacia, etc), rather than a grader scraping the area, the vegetation was 'mowed' utilising a specialised flail mower, thereby retaining the rootstock to allow for natural regeneration. This also provided the added benefit of erosion control, dust prevention and allowing native vegetation to outcompete weed species. Additionally, trees removed at sites for associated infrastructure were used to create habitat stacks for wildlife. The stacks were assembled using an excavator with a grab bucket and placing a combination of logs on the ground for reptile habitat and branches pointing up to provide a perch for birds.

Most of the waste generated on site was recyclable material (i.e. paper, cardboard, scrap metal, plastic, wood, etc.), therefore the waste management contractor selected, ensured that the majority of this waste was taken to material recovery facilities and transfer stations. The primary objective for waste entering these facilities is that they go through a process of sorting and retrieving to maximise the recycling and reuse opportunities for all waste materials. As a result, 80.3% of waste has been diverted from landfill. In addition, 65.6% of waste soil generated on site since the project commenced, has been reused, either on site or taken to another location for beneficial reuse, and in accordance with EPA guidelines.

Some SA Water sites contain culturally sensitive areas either adjacent or within the site itself. Bolivar Wastewater Treatment Plant was one example which contained very high-risk sites (i.e. high potential for heritage finds). As such, Enerven staff worked together with Aboriginal monitors and SA Water's heritage and engagement officer for several weeks while civil works were in process. Fortunately, no discoveries were made, and the high-risk heritage areas were left untouched.

Innovation

Being a global first program innovation is a given. Large solar farms are generally developed and delivered on greenfield sites that are fit for purpose with limited complexity. Many of the SA Water projects have been delivered at existing treatment plants and pumping stations with aged infrastructure. Enerven has had to engineer solutions specific to each site's unique topography, ground and connection asset condition, and environment. Consequently, we have designed and constructed assets utilising 5 different racking technologies including the largest 5B Maverick system in the world (14 MW), a 3.5MW PEG system, tracking, fixed-tilt, and rooftop structures. To add to the complexity some structures are less than 80 metres from the ocean, some in remote dry regions and others are in the heart of South Australia's Riverland.

Warehouse storing materials prior to site distribution

Complexity, Difficulty and Optimisation

The Zero Cost Energy Future Program is an incredibly complex project. Most utility-scale solar farms are developed and constructed in a single location, whereas this project has been delivered across 33 sites necessitating 33 individual solutions, connection agreements, and teams. The challenge was also to deliver the program in 24 months, which considering most Chapter 5 connection agreements take 18 months for a single agreement, it was going to be a mammoth task to achieve 33 agreements in this timeframe. The time constraints meant that the team have had to deliver this project in an unconventional manner.

To ensure we could meet the challenging timeframes, Enerven and SA Water undertook the following:

- Optimisation of an initial 93 site list, down to 33 sites over an 8-month period. This meant site visits to all corners of SA, multiple iterations of concept designs and pricing to feed into SA Water's net present value (NPV) model before sites were 'crossed off the list'. This process also generated the optimal PV and battery size and estimated capital cost for each project and informed program sequencing.
- Recruitment and mobilisation of an Enerven project management office of ~80 people to co-locate with the Client and Owner's Engineer. This required a culture of collaboration to work together to deliver a very challenging goal.
- Standardisation of DC designs and equipment (where possible) such that we could de-risk long procurement lead times and commit to orders prior to detailed design having commenced. Normally procurement is not committed until after detailed design and the generator performance studies (GPS) have been completed. This alone has meant this project is more complex than any solar project of this scale before it.
- Procuring as a program but delivering as 33 individual sites. This has been challenging as quantities were not committed as the site list reduced over time. It further complicated the desire to leverage the purchasing power of a large-scale program when sites are released/committed to individually. This has required the development of very flexible sourcing, logistics and warehousing processes and strong engagement and alignment with our selected OEM and third-party logistics partners. Our engineering team had to work extremely hard at the beginning of the program to ensure the specifications developed did not cause an issue for the connection agreement and generator performance and registration processes that had not necessarily commenced.
- Managing inventory control and outbound logistics to 33 sites across South Australia. Enerven also took on responsibility for sourcing and shipping all materials from our OEM partners in China, Australia, USA, Vietnam, France, Germany, Spain, and Italy. We took our operation a step further on this project though and really harnessed the ethos of this project. This program of work is helping to build a more sustainable future for South Australia and we wanted to make sure our own operations were carried out sustainably. We ensured all trucks are full before going to sites, so we can minimise trips and therefore our carbon footprint, we recycle all packaging from the products, we've worked with local people, and implemented sustainable practices throughout the program
- Scheduling and optimisation of resources/spend in a constantly changing connection and regulatory environment. Enerven's priorities often had to shift as the Client's connection constraints meant that resources needed to be prioritised to other sites making achievement of a 'rhythm' very difficult.
- Development Approval was the responsibility of the Client; however, this was a challenging process noting that many of the assets were constructed in urban areas. Extensive stakeholder consultation was required across many sites, in particular the Happy Valley Water Treatment Plant where nearby residents were actively interested in influencing the 14 MW project.
- Navigating a global pandemic during this project, however, it didn't slow us down. We procured critical equipment early to allow sites to move into construction rapidly while concurrently sites were being analysed for feasibility

Some further complexity included:

- Client standards and requirements were often higher than traditional renewable projects, which necessitated a shift in mentality to ensure we influenced requirements to achieve value for money objectives.
- The specificity of high voltage materials meant that it was very difficult to procure earlier than we would ordinarily be comfortable. This meant we had to 'tranche' our commitments with our OEM partners to ensure manufacturing could commence, with final engineering to often follow some weeks later.
- Integration of the solar and battery assets into live SA Water sites and ensuring we do not disrupt their very important day to day operations of delivering water to South Australians.
- Brownfield sites have very complicated low and high voltage connections which meant specialists were required.
- Managing multiple design contractors with varying levels of experience of the required standards meant we ultimately brought a lot of the design in-house.

Sustainability & Conservation

We have adopted the ethos of this Program and explored ways to make our work more sustainable at every stage. From waste management, to minimising trucks and travel to reduce our carbon footprint, or implementing an 'off-grid' solution by installing a small PV and storage system at Morgan sites 1-4 allowing us to power the site offices. This system could be remobilised to the next site once the previous site had been completed. The program team have looked for opportunities throughout to make the project more sustainable and every stage. The team are really proud the work they have completed will create a more sustainable future for South Australian's.

Leadership and Management of the Project Delivery

A challenging program of work requires a strong and collaborative leadership team who can bring their wider team together to rise to the challenge. Upon award of the ZCEF Program, Enerven, SA Water, and the Owner's Engineer (Aurecon) co-located to ensure a culture of collaboration and trust could be fostered. The joint leadership team believed that a traditional EPC contracting mentality and approach was not going to get the job done on time or as effectively. This 'one-team' approach was often challenging as invariably sensitive discussions were difficult and thus transparency was unavoidable. Despite this, we feel the teams successfully worked in unison and the successful achievement of the Program to date is attributed to their willingness to operate outside of their comfort zones.

While each business had their own company values, to further foster the 'one-team' approach and create a sense of belonging and ownership, a new set of Values were created specifically for this Program. Workshops were undertaken with the leadership team and wider team to capture the core ideals important to delivering this program. The new values needed to continue to inspire and motivate the team throughout the challenging journey ahead. Five separate values were created and launched at an all-team presentation at SA Water Headquarters and posters developed for site offices and the Program head office. Further to this, monthly awards were created to encourage the team to nominate and recognise their peers demonstrating these values. It created a sense of community and provided the opportunity to recognise and reward people for their hard work throughout the program.

This program of work is a world-first, and will certainly generate a legacy for the construction industry. In fact, one of the values created for the program was 'My greatest reward will be telling my family, "I did that"'. Everyone who has worked on this Program can always be proud they worked on a world-first program that will create a more sustainable future for themselves, their families, and South Australia.

Enerven have been commended on their industrial relations, seeking external support and advice when required, and complying with all obligations.

Being a world-first program, it's enabled us to upskill our workforce and required them to think innovatively to ensure the program is achieved successfully. Many of the team have been promoted to new roles throughout the Program to further develop and strengthen their skillsets making them assets to our business and the construction industry. The nature of large construction projects often sees resourcing increase to support delivery and contract as the project wraps up. ~80 new employees were hired to help deliver this Program, and their desired skillsets have meant we've been able to redistribute around 80% of the intake into other areas of our business or they have been sought out for other projects.

To ensure a cohesive delivery approach across the Program, the leadership team developed contractor forums which were delivered by the training team prior to works commencing; therefore, expanding the 'one-team' approach to also include our subcontractors. Our training team also worked with SA Water on the training and development needs of their staff as they start to take on the responsibility of the newly constructed solar sites. Their workforce included both electricians and wastewater site operators of varying skills and experience, across 4 different businesses depending on the site. Non-electrical staff needed to be trained on the changes to their sites; electrical staff needed to be trained on the maintenance and design of the new assets. The training program needed to be flexible enough to apply across multiple sites with similar technology but comprehensive enough to address each site's specifics.

The leadership team consisted of Leon Cocchiaro, Ben Birch, Josiah Martin, Will Phillips, and Anthony Malcolm from Enerven, as well as Nicola Murphy and Ben Lewis from SA Water.

Being a world-first program, it's enabled us to upskill our workforce and required them to think innovatively to ensure the program was achieved successfully.

The leadership group implemented a flat organisational structure and the open-plan office ensured they were always visible and available - again, reinforcing the 'one-team' mentality. The leadership group is a young team, but extremely driven with a wealth of experience. The wider team is also relatively young, with several graduate engineers and apprentices working on the program. This Program was extremely challenging, it required new thinking and long hours from the team. It's a testament to the drive of the individuals working on the program and the devotion to deliver a world-first program of work that will benefit the future of South Australians.

The Program was fast-paced and always evolving; the leadership group has effectively developed a collaborative culture and the adaptability required to deliver a global first. It is inspiring to see the pride of individuals and the entire team in delivering such a challenging program of work.

The Leadership Team

Leon Cocchiaro

Program Director

With a wealth of experience from roles spanning 15 years, Leon has successfully managed lump-sum turnkey bids for renewable and thermal energy projects, coordinated green and brown field development opportunities, sourced new development opportunities, and has lead and coordinated Mergers and Acquisitions for green and brownfield development projects across the Australian and EU region. Leon is a committed professional with advanced commercial, financial strategic and technical experience. Throughout his professional life, Leon has developed proven deal flow experience in the energy and large infrastructure industry, and has an exemplary track-record in investment origination, corporate finance, and structuring and negotiations throughout Australia and Europe.

Ben Birch

Commercial Manager

15 years of experience in strategic, transformation and commercial roles, Ben's current position within Enerven as Commercial Manager sees him taking responsibility for positioning the business for the future in the renewables sector. His strong background in financial modelling and contractual management makes him a key advisor in corporate and strategic decisions. Ben's noteworthy skill-set includes, but is not limited to, leading diverse teams, developing and implementing strategies on complex projects, business planning, bid management, corporate governance and change management.

Anthony Malcolm

Engineering Manager

Anthony brings extensive electricity network experience having spent more than 12 years working between ElectraNet, SA Power Networks and Enerven. Anthony's role in the program was to lead a team of specialist engineers who responsible for the optimisation and then developed the detailed designs utilising an extensive pool of internal engineers supported by Contractors to manage the extent of parallel works. Anthony's strengths are technical leadership, high voltage networks and connections, project engineering and safety in design.

Josiah Martin

Program Manager

Josiah brings unique experience in program management, project management and engineering with over 13 years experience with SA Power Networks and Enerven. He has an in-depth understanding of both the technical and strategic objectives of projects and investment strategy in the energy sector. This is demonstrated by delivery of a significant portfolio of projects in electricity generation, transmission and distribution energy infrastructure. Josiah's role of Program Manager on the ZCEF project was responsible for the delivery of the constuction and commissioning for the program. This involved managing a team of Project Managers, Project Engineers, Construction Managers and Construction Supervisors, Commissioning Engineers and Commissioning Supervisors, Trade Skilled Workers, Project Officers and, Project Scedulers. This team planned, managed and excecuted both self performed and subcontracted works across all sites and across all phases of the program, resulting in the successful delivery of the program.

Will Phillips

Corporate Services Manager

With 11 years' experience as an accountant in both private practice and internal positions, William possesses a strong commercial acumen with invaluable onsite operational experience. William's noteworthy skill-set includes, but is not limited to, financial management and analysis, financial modelling, contractor management, supply chain management, tender evaluation and business partnering. William's diverse commercial background has resulted in experience in advisory roles, negotiations, project management and stakeholder engagement across a number of industries and locations across South Australia.

Nicola Murphy

Senior Manager Supply Chain (SA Water)

Nicola is an energetic and delivery focused senior leader with extensive international experience in leading strategic projects and procurement in public and private sectors. Works and leads collaboratively, internally and externally, to drive effective outcomes in complex situations. Having worked for significant periods in retail, financial services and government sectors across the UK and Australia, Nicola combines her broad experience to deliver high performing teams with a focus on outcomes.

Ben Lewis

Program Manager (SA Water)

Ben has extensive team, program and project management experience gained over a 19-year career across a range of civil and utility based disciplines. Ben has strong project delivery and operational management experience working with large contracting companies within Victoria and South Australia. He has a strong understanding of tender development, estimating, submission preparation and construction delivery across Gas, Water and Civil infrastructure projects and programs of work. Most recently Ben has been fulfilling the role as Program Manager for the $400M Renewable Energy, Zero Cost Energy Future Program of works for SA Water. During his time on the project he has gained significant exposure to Automation and Control Systems for renewable energy generation, Integration with Brownfield facilities, design development and review, Network Service Provider connection complexities and complex stakeholder negotiations.

Technical Paper

With SA Water's 2019/20 energy bill exceeding $86M and consuming over 580GWh they embarked on an ambitious plan to invest in technology and aiming to neutralise their energy costs. SA Water's vision was for behind the meter installations sized to offset site loads across initially 93 selected sites. Following Enerven's engagement, preliminary investigations and concept designs were undertaken to optimise generation outcomes against the lowest possible cost. The result was some 242-gigawatt hours (GWh) of solar generation and 34 megawatt hours (MWh) of energy storage deployed across 33 sites.

The program is a global first for a water utility designed to sustainably reduce their energy bill across their portfolio of sites and assets. The Program is multifaceted, including development, optimised control and coordination of energy using active demand management practices.

SA Water's Zero Cost Energy Future program is made up of several initiatives, including energy market optimisation in later stages. Enerven as SA Water's EPC partner delivered the PV and Energy Storage infrastructure to support SA Water's goal of a zero-cost energy future. The PV and Energy Storage infrastructure was the first initiative and the basis of future energy initiatives.

Two of the biggest constraints driving the site feasibility are, access to land, and access to a suitably sized connection point to the local electricity network. The nature of SA Water's network presented a unique opportunity as they already have so many sites with existing network connections and many of the larger sites are in arid or semi-arid areas with a limited population density meaning land acquisition was relatively smooth.

Traditionally, the solar market has consisted of large-scale solar farms exceeding 100MW or small residential systems of only a few kilowatts. Small grid-scale generator connections, particularly those only marginally exceeding 5MW have seen network studies and connection costs as well as registration timeframes prohibitive to development.

A joint effort to analyse the program's economics lead to SA Water determining behind the meter installations, with the additional network usage cost saving, which are outside the reach of conventional utility-scale developments, was viable and were enough to overcome the typical economic constraints present in traditional small grid-scale generation projects. This is largely due to their existing infrastructure and the deferable nature of SA Water's major pumping load which was rescheduled to align with peak solar generation. The result is generation sizes connected to the network ranged from 30kW to 16MW.

The economics of the program was further supported by ensuring access to additional revenue streams including not only the energy market but Frequency Control Ancillary Services (FCAS) Contingency, FCAS Regulation and even being ready for a future Fast Frequency Response (FFR) market as per ESCOSA requirements. The challenge was also to deliver the program in the 24 months, which considering most Chapter 5 under the National Electricity Rules connection agreements take 18 months for a single agreement, facilitating what ended up being 33 sites, 13 with NEM registration was going to be extremely challenging.

These ambitious timeframes required a different approach. Typically for utility scale projects grid studies are completed prior to financial close. With this program funded unlike other typical generation projects there was no such limitation. As a result, detailed design and construction phases were able to commence prior to grid studies or network connection being finalised. As a result, without waiting for grid studies or network connection details design and construction could proceed.

To support this aggressive approach Enerven, as SA Water's EPC partner, utilised its extensive network experience to predict network connections and proceeded to design, procure, and construct while maintaining flexibility for changes to connection requirements throughout the process.

The Zero Cost Energy Future program resulted in a total of 140MW, 242 GWh of solar generation and 17MW, 34 MWh of energy storage across 33 sites. What was originally 93 sites was refined down to 33 during the site investigation and optimisations stage without materially impacting the total program generation targets.

Working behind the meter brings the large and obvious challenges of brownfield integration. This together with demanding geotechnical and environmental conditions including contaminated soils, coastal corrosive areas, rock refusals and sloping land required a flexible approach to technology solutions, an adaptable team and collaborative partnership with SA Water.

With a strong background in large-scale electrical infrastructure projects, and experience in delivering mid-sized solar projects, Enerven could bring together the required engineering, procurement, logistics and construction resources necessary for a program of this scale and complexity.

Early bulk procurement of critical equipment allowed sites to move rapidly into construction whilst others were continued through feasibility stage. The volume of sites allowed large cost items such as inverters and panels to be redeployed with size and generation targets adjusted to meet overall program goals. The range of site conditions called for a range of technical solutions We used four different racking technologies including fixed tilt, single-axis tracking and high-density solutions 5B and PEG® to suit unique constraints of each project site.

Enerven's core values include a focus on community, and this program has enabled us to generate approximately 250 local jobs during construction and exceed our targets, achieving nearly 4% of program hours by people that identify as Aboriginal or Torres Strait Islander, which is something that we are incredibly proud of.

The adopted approach expedited generation outcomes well beyond what would be achievable in the traditional delivery model. Although the initial ambitious target of being zero cost by 2020 was not achieved it was an incredible outcome and Australian first to connect the 13 NEM registered sites by what is predicted to be the end of 2022 including significantly undertaking R2 testing of 4 sites in the 4 months until the end of quarter 1 2021. Enerven expects this delivery methodology and learning outcomes from this program will be utilised by other utilities and organisations that have significant loads particularly if they have access to existing network connections.

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