Western Power
DMIA Report 2022-23

October 2023

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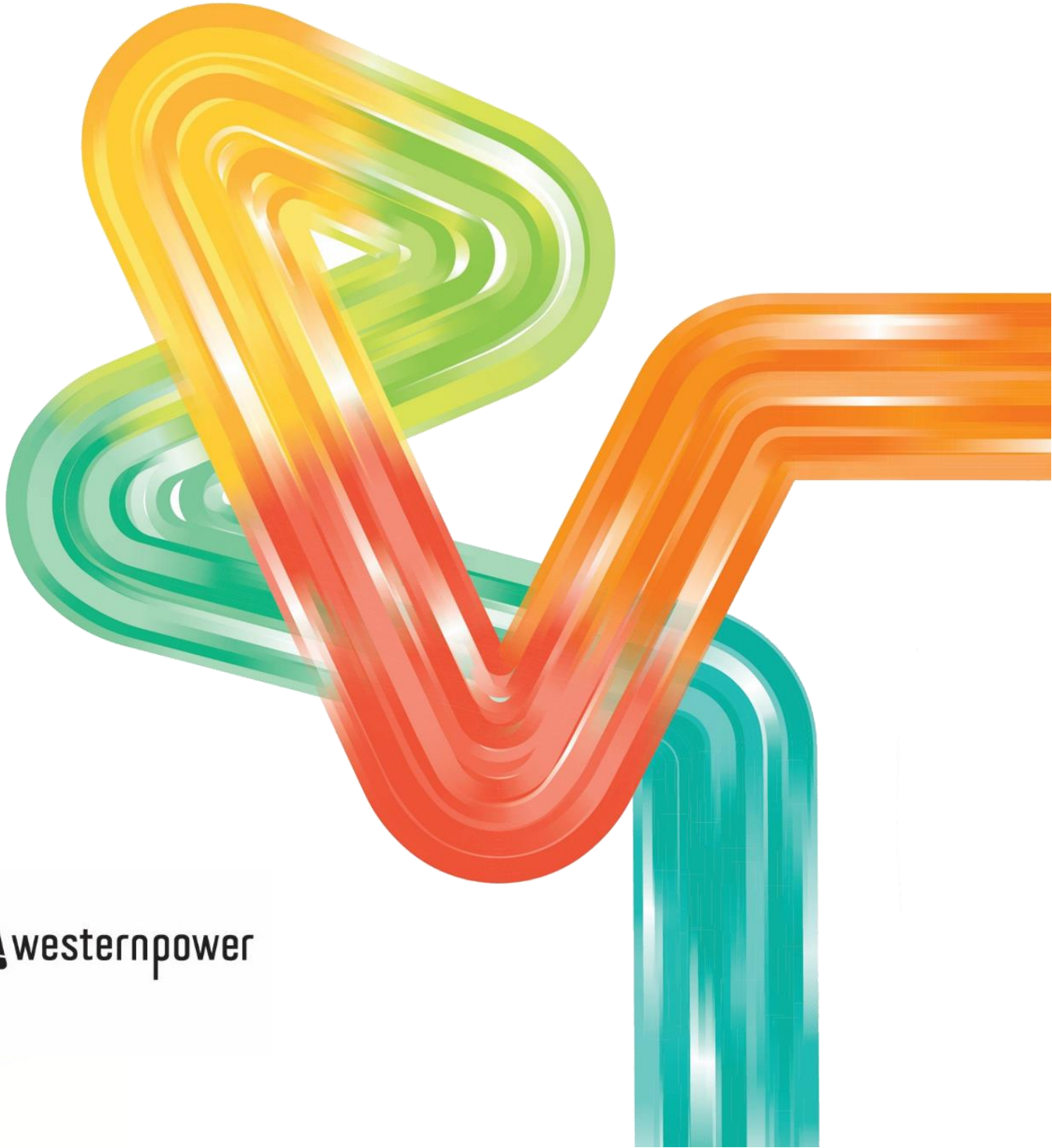

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1. Introduction

1.1 Purpose and Compliance

8. Western Power welcomes the opportunity to provide the first Demand Management Innovation Allowance (DMIA) compliance report to the Economic Regulation Authority (ERA) under clause 6.32(H-J) of the Electricity Networks Access Code 2004, amendments (No. 2), gazetted on 18 September 2020.

9. This report is the first year of the 5th Access Arrangement 2022 to 2027 (AA5) period and has been completed in accordance with the ERA Demand Management Innovation Allowance Guideline 14 September 2021.

10. The DMIA mechanism enables Western Power to invest in research and development projects which have the potential to reduce long-term network costs[1], and is an 'annual ex-ante allowance in the form of a fixed amount of annual revenue at the commencement of each pricing year of an AA period'. It must comply with the ERA DMIA guidelines[2] eligibility and reporting requirements.

11. Pursuant to section 6.32F of the Code, if any amount of the DMIA is not used or not approved by the Authority over the Access Arrangement period, this amount must not be carried over into the subsequent Access Arrangement period or reduce the amount of the demand management innovation allowance for the next Access Arrangement period[3]. The allowance of about $7M over the Access Arrangement period (~$1.4M p.a.) is factored into the prices of the Access Arrangement and represents 0.08% of AA5 target revenue.

12. Projects may include research and development projects undertaken to reduce or shift customer demand to avoid or defer network augmentation or target a reduction in peak demand or broad-based demand. Peak demand continues to be a principal driver of our network augmentation costs. Reducing peak demand will reduce costs for all customers in the long term by avoiding the need for network investment. In recent years, increased two-way power flows, including 'peak reverse power flow', is similarly impacting the network.

13. The purpose of this report is to allow the ERA to:

    a) Assess Western Power's DMIA initiatives undertaken during 2022-23 and entitlement to recover expenditure under the ERA's DMIA mechanism; and

    b) Confirm Western Power's compliance with the annual reporting requirements of the ERA's demand management innovation allowance guideline.

The amount identified as eligible to be claimed under DMIA in this submission is $3.5M and represents the first amount to be included as part of the $7M DMIA allowance for AA5 period. Whilst the amount set for each year is $1.4M, it isn't a cap for each year and can be accumulated up to the value of $7M over the AA5 period.

1 Electricity Network Access Code 2004, clause 6.32G

2 ERA guideline: 3.2: Demand management innovation allowance guideline (erawa.com.au)

3 AA5 Access Arrangement for Western Power Network, section 9.1.3 page 53 :https://www.erawa.com.au/cproot/23203/2/Approved-Access-Arrangement.PDF

2. R&D project

2.1 DMIA project summary

14. Western Power's 2022-23 DMIA has been principally used to develop the virtual multi-organisational distributed energy resources project - Project Symphony "Virtual Power Plant"- as summarised below.

Table 2.1 DMIA expenditure ($M nominal)

Project Symphony spend 2022-23	Actual Capex ($M) – FY23	Actual Opex ($M) – FY23	Funding (ARENA & partners) – FY23	Net DMIA claim – FY23
Business Support Opex - eligible for DMIA	Not claimed	$4.9	$1.4	$3.5

2.2 Project Symphony

15. This section demonstrates how Project Symphony meets the DMIA requirements.

Table 2.2: High level summary

WP Project Numbers:	Comments
Strategy / Activity Description:	Project Symphony – Western Power total
Business case(s):	IAR130063 – approved in September 2021
Investment cost and funding ($M) **From inception to date**	Estimate at completion (EAC): $13.10 opex only over FY19/20-FY23/24 (Business support opex) - ICT Pilot Platform OPEX $5.9M - Symphony PMO Network Monitoring and Test. (OPEX) $7.2M Less, estimated funding of $2.25M (ARENA & partners) Net estimated WP OPEX cost of $10.85M
Investment cost and funding ($M) **From FY23 only**	*Cost & revenue – FY2022-23 only – DMIA claim* OPEX Costs - 4.9M Less funding of $1.4M (ARENA & partners) Net OPEX cost incurred by WP $3.5M
Regulatory Category:	Non-recurring operating expenditure

16. In April 2020 the WA Government published a Distributed Energy Resources (DER) Roadmap for Western Australia, with the ambition to enable "a future where DER is integral to a safe, reliable and efficient electricity system, and where the full capabilities of DER can provide benefits and value to all customers". The roadmap also includes provisions to change policy and regulation, stemming from the inevitable evolution of the energy value chain.

17. It recognised that effective DER integration requires focus on both technical issues (e.g., network and system security and reliability), market issues (e.g., development of appropriate market frameworks to efficiently integrate DER), customer issues and regulatory and policy settings.

18. Project Symphony is an innovative project where customer owned DER, including rooftop solar, battery energy storage and other major appliances such as air conditioning and pool pumps, are orchestrated as a virtual power plant (VPP) to participate in a future energy market and/or provide Network Support Services (peak reduction) and unlock greater economic and environmental benefits for customers and the wider community.

19. Upon completion, Project Symphony will help inform Western Power in developing a functioning DSO capability by 2025, and to scale post 2025, thus enabling the 'business as usual' implementation of demand management solutions into network investment.

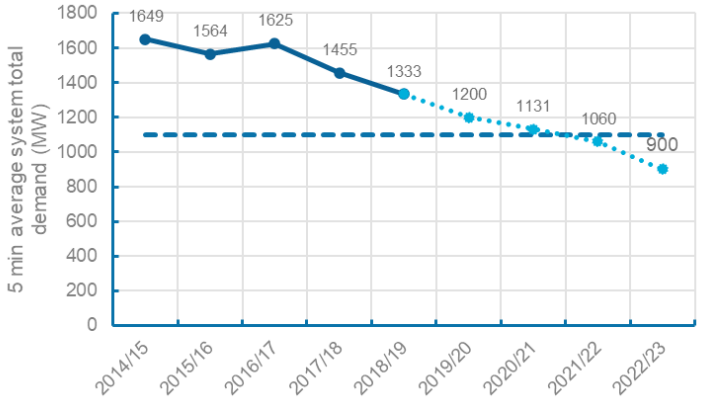
20. The following table provides the information that must be included in this compliance report per DMIA guidelines.

Table 2.2-1: Compliance Reporting Information

Background, nature, and scope of the project: *In this section we provide a summary of need and timing of the project and a summary of the nature and scope of works relevant to the DMIA*	Distributed Energy Resources, or DER are smaller scale devices that can either use, generate or store electricity, and form a part of the local distribution system, serving homes and businesses. DER can include renewable generation such as rooftop solar photovoltaic (PV) systems, energy storage, electric vehicles (EVs), and technology to manage demand, like air-conditioners at a premise. Currently in Western Australia over 1 in 3 households has a solar PV system, contributing significantly to the 2GW of DER capacity available on the Southwest Interconnected System (SWIS) which can serve up to 67% of underlying demand. Whilst customers choosing to install DER are already enjoying the benefits of lower electricity bills, and are contributing to decarbonising the power system, the level of DER comes with challenges for the network and power system. Further, peak demand in areas of the network continues to grow and as experienced over summer 2021 has caused power quality and reliability issues[4]. <u>System Impacts</u> Excess solar power from households and businesses that is being fed unmanaged on to the network pushes the amount of synchronous generation on the power system to increasingly low levels. It also causes reverse power flows that see the physical limits of distribution network infrastructure being reached. According to the 2020 Wholesale Energy Market Electricity Statement of Opportunities, as early as 2023-24, minimum demand is forecast to fall below the 700 MW system security threshold under the expected demand growth scenario. In response to this risk, the state implemented policy requiring new solar PV installations be enabled for the emergency solar management scheme. Additionally, Western Power's System Low demand forecast for Autumn 2019 was 1200MW, declining to 1131MW in 2020, and declining further to 1060MW in 2021, based on a 95% confidence level, as shown in the figure below.

4 Independent Review of Christmas 2021 Power Outages Final Report, March 2022.

: System Low history and forecast (in mid-2019)



[Note: The actual 2019 low was 1343.3MW, the actual 2020 low was 1154.6MW and the actual 2021 low was 865.16MW]

In response and as an alternative to costly, customer impacting and frequent interventions by AEMO to maintain system stability, the State Government established the Energy Transformation Taskforce whose vision was to deliver:

- A safe and reliable electricity system where customers can continue to connect DER and where DER supports the system in an efficient way.
- DER capability that offers value throughout the electricity supply chain.
- DER benefits that flow to all customers, both with and without DER.

The taskforce endorsed the DER Roadmap, as the set of actions, action owners and timeframes required to realise this vision.

Network Impacts

The DER uptake is negatively affecting, and with EV growth has the potential to further affect, the economics of network investment. This is because an increase in solar PV generation and peak operating load, is leading to lower, less efficient utilisation of network assets. DER management provides a solution for both the system and network impacts and thus enables supply chain benefits.

The DER Roadmap

The DER Roadmap outlines the requirement for Western Power to continue our development as the Distribution System Operator (DSO). To do this Western Power will need to be able to remotely identify and manage issues at a distribution level.

The DER Roadmap also outlines a future where customer aggregation can manage DER as a way of providing services in the WEM as well as managing day-to-day issues faced in managing the Western Power network including load, thermal and voltage constraints.

The DER Roadmap and supporting changes made to the Electricity Networks Access Code also require that Western Power pursue alternative option services, demonstrating how DER can be harnessed as an alternative to distribution network investments.

The Project Symphony Pilot is one of the key steps in our DSO capability build. Symphony is a pilot project where a mixture of commercial, third party and

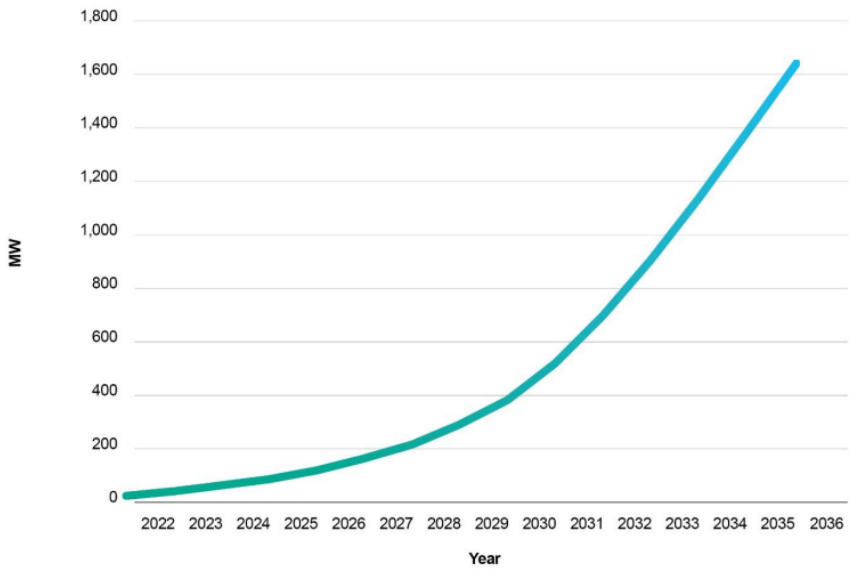
	residential aggregation will be used to meet localised network needs, whilst also providing services to the system and potentially future new market services via the WEM.
Aims and expectations: *In this section we provide the aims and expectations of the project.*	**Project Symphony - DER Orchestration Pilot** Project Symphony's purpose is to address two of the high priority actions in the DER Roadmap: Action 22: DER Orchestration Pilot – technology demonstration - commence a comprehensive Virtual Power Plant (VPP) technology pilot to demonstrate the end-to-end technical capability of DER in the SWIS Action 23: DER Orchestration Pilot – market demonstration - complete a comprehensive VPP market participation pilot that tests the incorporation of aggregated DER into energy markets, including market dispatch and settlement arrangements from the market operator to individual customer. Project Symphony is quantifying the costs and benefits of integrating and orchestrating customer DER assets to more efficiently manage the 'peaks and troughs' of energy demand in the distribution network while enabling broader participation in new energy markets e.g., balancing/capacity market and essential system services i.e., frequency.
Anticipated outcomes: *In this section we provide:* 1. anticipated outcomes if the project proves viable. 2. An estimate of the potential to reduce long-term network costs	*Anticipated outcomes if the project proves viable.* A high proportion of decentralised, unmanaged DER poses a risk to the stability of the WA power network when an excess of local rooftop solar generation greatly exceeds the demand for electricity at certain times of the day. If Symphony proves viable it will orchestrate customer DER to not only overcome the technical challenges to the electricity network but also enable DER participation in future energy markets to unlock greater benefits to customers. This also will drive investment in local services to install DER compliant equipment and control systems and manufacturers who may respond with innovative products. Most importantly, through DER orchestration there is an opportunity to flatten the "duck curve"[5] by shifting demand from evening to midday and thereby improving the utilisation of network assets, enabling decarbonisation of the grid, and potentially providing an economically viable non-network option to network investment. Project Symphony engaged Oakley Greenwood (OGW) consultants to perform modelling of the economic benefits likely available from a full-scale deployment of the technology and processes available from Symphony[6]. The report also found "It is also worth noting that the VPP could result in a significant source of new dispatchable generation in the WEM. As shown in Figure 2 below, based on the economic benefits available, the VPP could result in the addition of over 1,600 MW of dispatchable generation/load by the end of the modelling period. For context, it should be noted that peak demand within the WEM at present is about 4,000 MW and Collie, the largest central generation plant in the WEM is about 340 MW."

[5] The duck curve describes the shape of the SWIS daily energy demand profile which is characterised by an evening peak (the head of the duck) and the daytime trough (the belly of the duck). Exacerbation of the duck curve adversely affects the economics of DNSPs as infrastructure must be built to support a few hours per year of peak demand.

[6] The OGW report can be found here: project-symphony-der-services-report.pdf (arena.gov.au)

The forecast increase in battery capacity coupled with the development of DSO capability provides an opportunity for Western Power to contract and manage dispatchable generation for the purpose of providing NSS to manage peak demand in the network.

Figure 2: Total economic potential of VPP-enabled BTM battery capacity (MW) through 2038



Source: OGW analysis

It should include an estimate of the potential to reduce long-term network costs, taking into account any additional costs that may arise in total electricity costs as a result (for example, additional essential services that maybe required).

The findings from the OGW economic modelling are contained in section 1.4 of the report and a summary of the scenarios modelled is reproduced below. It is difficult to accurately apportion the economic benefits to downward pressure on network costs. As the report findings demonstrate the economic benefits may be shared in various ways depending upon the assumptions made about incentive payments by Aggregators to customers and the value sharing between participants, such as AEMO, Aggregators and Western Power.

Aside from the potential to reduce long term network costs, Symphony does provide increased opportunity for customers to increase energy self-sufficiency as the DSO will enable management of DER and this will provide Western Power the means to offer higher generation connection and export limits, which when coupled with battery storage enable customers to reduce their net energy expenditure. This benefit is in addition to the OGW economic analysis as this outcome was not included in the model.

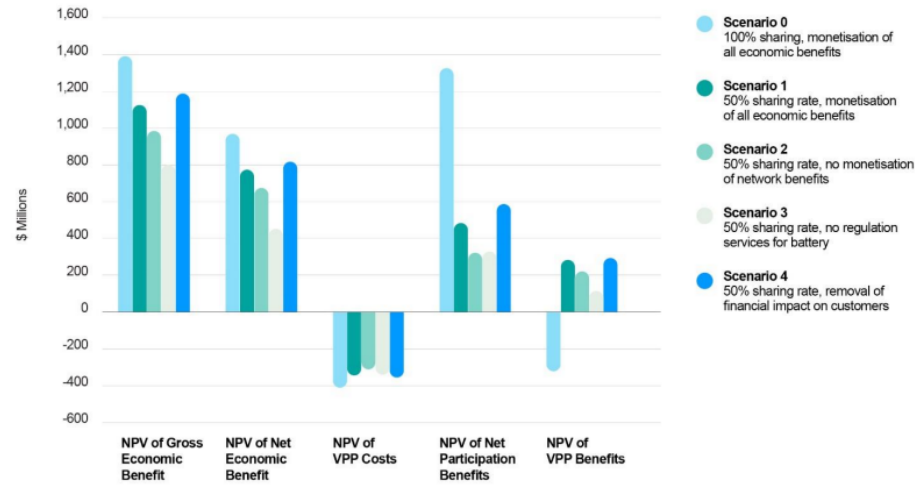
Thus, the report suggests there will be strong economic incentives for customers to invest in battery storage and other forms of demand management (such as load control).

OGW Findings:

All scenarios produce positive gross economic benefits. The maximum economic benefit that is produced in Scenario 0 is significant at just over $1.4b over 15 years in present value terms, based on a weighted cost of capital (WACC) of 4%.

The maximum net economic benefits of $967m over the 15-year forecast time horizon occur in Scenario 0; they fall to just over $776m and $671m under Scenarios 1 and 2, and down to $453m for Scenario 3.

Figure 1: Summary of scenario results



Source: OGW analysis

In relation to the above graph:

The 'Gross Economic Benefit' reflects the total economic benefit calculated under each scenario, in net present value (NPV) terms, excluding any economic cost associated with implementing the VPP.

The 'Net Economic Benefit' reflects the gross economic benefits less the estimated economic costs of implementing the VPP, expressed in NPV terms.

The 'VPP costs' reflects the cost of implementing the VPP, in NPV terms. The 'Net Participant Benefit' is the net benefit that accrues to participants (being the providers of the DER devices which are orchestrated via the VPP) under each of the scenarios, which reflects: (a) the proportion of the economic benefit that is assumed to be passed on to them under that scenario (e.g., the sharing ratio); (b) the upfront costs they are assumed to have to incur in order to participate in the VPP; 7 and (c) except for Scenario 4, the financial (opportunity) cost they face from ceding management of their devices to the VPP operator.

The 'VPP benefits' reflect the benefit to the VPP provider, in NPV terms, taking into account: (a) the proportion of the economic benefit that they are assumed to retain under each scenario (e.g., the sharing ratio); and (b) the cost of implementing the VPP.

The amount of the allowance incurred by the Service Provider (SP): 1. *Incurred to date as at the end of that pricing year.* 2. *Incurred in that pricing year.* 3. *Expected to be incurred in total over the duration of the project.*	1. *Incurred to date as at the end of that pricing year*. OPEX Costs incurred from inception to 30/6/23 -$11.6M Less funding of $1.8M (ARENA & partners) Net OPEX cost incurred by WP $9.8M 2. *Incurred in that pricing year – FY2022-23 only – DMIA claim* OPEX Costs - 4.9M Less funding of $1.4M (ARENA & partners) Net OPEX cost incurred by WP $3.5M 3. *Expected to be incurred in total over the duration of the project (FY19/20-FY23/24).* OPEX Costs Est. At Completion (EAC): $13.10M Less estimated funding of $2.25M (ARENA & partners) Net estimated WP OPEX cost of $10.85M

How and why the project meets 'Eligibility Criteria': *In this section we provide details on how and why the project meets the guideline's 6 x eligibility criteria specified in the DMIA guideline*	**#1. Project consists of research and development**: *Demonstrate that the project is for experimental activities whose outcomes cannot be known or determined in advance using current knowledge, information, or experience and that the activities are conducted for the purpose of generating new knowledge:* Given the experimental nature of the project, Project Symphony is partly funded by ARENA.[7] It is a $35.44M project (Across Western Power, AEMO and Synergy) with $8.55M funded by ARENA of which Western Power is to receive $1.92M. The Western Australia Distributed Energy Resources Orchestration Pilot (Project Symphony) is piloting the orchestration of customer-owned distributed energy resources (DER) such as rooftop solar, batteries and major appliances to participate in a future energy market[8]. It will explore and better understand how the innovative (first of a kind) use of DER can provide benefits to customer affordability and network security, reduce emissions, and help strengthen the WA economy and Wholesale Energy Market.[9] The project required each of the partners to invest in development of bespoke platforms and communications systems to implement the Hybrid OPeN model. Western Power chose to implement the Evolve (a collaboration between Zepben and Australian National University) platform to support its DSO function. This product is still in the development phase and required significant investment by Western Power to integrate it with its existing systems, including asset databases, operational systems, metering systems and network monitoring. Western Power, in conjunction with Synergy's technology partner developed a control management gateway to integrate with its Harrisdale Tesla Megapack network battery. The gateway enabled integration between Western Power's SCADA system, as the network operator, and Synergy's dispatch system as the Aggregator. This was the first of its kind in Australia. Western Power also invested into research, in collaboration with the University of Western Australia, into algorithms to support: • Distribution Constraint Optimisation Algorithms (DCOA) to enable flexible allocation of network capacity between individual customers to support a higher utilisation of network capacity (refer Work Package 4.1). • Metrics to measure the efficiency, equity, customer and environmental impact of different capacity allocation methods. • Planned Operating Envelopes as an alternative to provide a more cost-effective method to calculate network capacity and Dynamic Operating Envelopes.

7 Composing a distributed energy symphony in Western Australia's largest energy grid - Australian Renewable Energy Agency (ARENA)

8 Source: Western Australia Distributed Energy Resources Orchestration Pilot (Project Symphony) - Australian Renewable Energy Agency (ARENA)

9 Composing a distributed energy symphony in Western Australia's largest energy grid - Australian Renewable Energy Agency (ARENA)

#2. Project is for demand management:

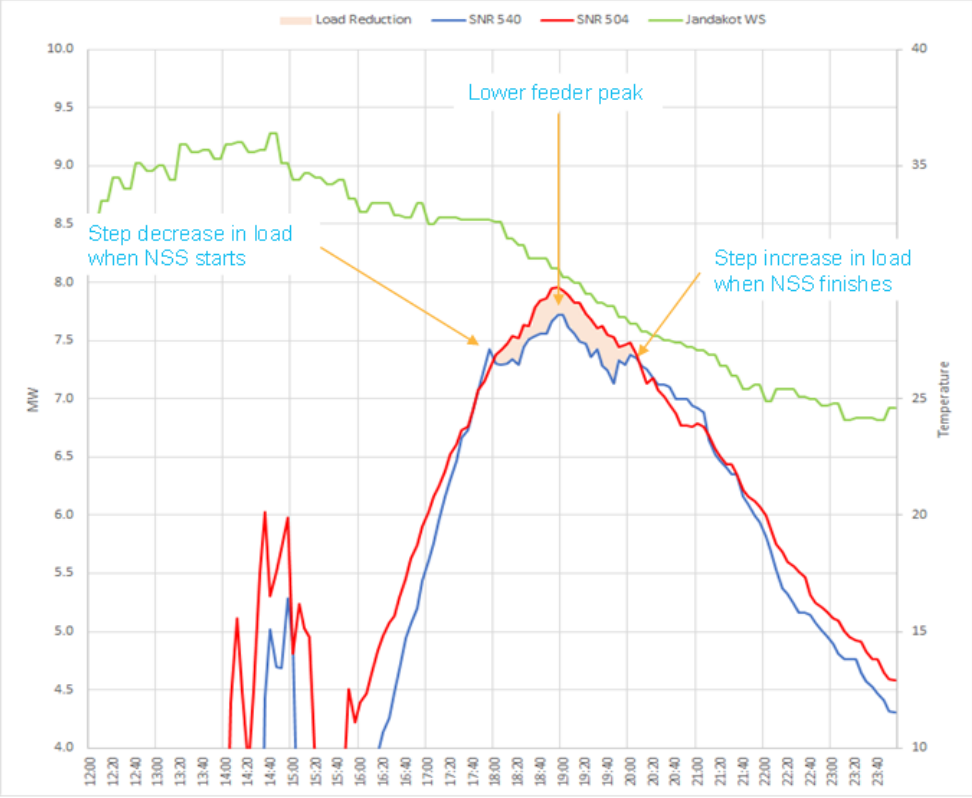
The service provider must provide details of the effect the project, if proved viable, will have on network demand usage patterns:

The project will pilot ways to support the lifting of the "belly of the duck" and "reducing peak demand" by providing customer incentives and market control enabling:

- solar PV to be curtailed during low system demand periods in response to negative WEM pricing.
- batteries to be charged during low system demand periods in response to low WEM pricing and to be discharged during high evening peak periods, under Network Support Service (NSS) contracts to Western Power
- managed loads, such as air-conditioners and in future EVs, to be curtailed during high evening peak periods, under NSS contracts to Western Power

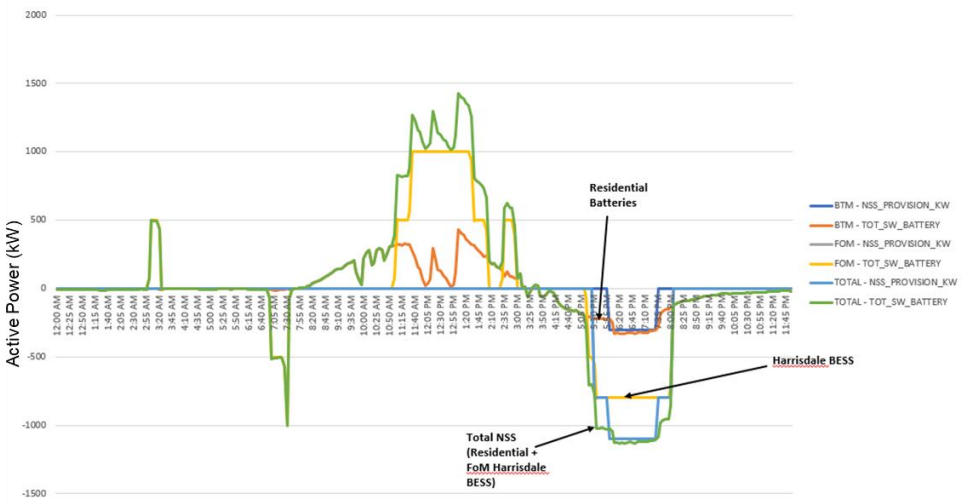
Western Power's Fifth Access Arrangement (AA5) contains substantial network investment, some of which may be deferred using NSS. Other energy market services facilitated by Symphony (such as balancing market trades based upon system demand) are likely to assist reduce demand.

The graph below shows how a NSS can lower feeder peak demand. On 20 January 2023 a 0.3MW NSS (residential BESS only) was provided on SNR 540 (blue line) and is compared to a neighbouring feeder SNR 504 (red line) that has a similar feeder peak demand profile to SNR 540 but has no NSS. This shows an observable stepped change in SNR 540 at start and end times of NSS provision.



The graph below shows how Symphony orchestrated residential batteries and a Western Power owned community battery to 'lift the belly of the duck' (increase daytime load by charging batteries) and flatten its head (lower feeder peak) by a "shaped" NSS deployment in the evening on 21/6/2023. The graph shows the deployment signal sent to the facility containing residential BESS (dark blue line is deployment and orange is actual response) and another containing the Harrisdale BESS installed by Western Power (yellow line is deployment and light blue is response).

The Harrisdale BESS was dispatched at 800kW from 5.30pm to 8pm and residential BESS dispatched at 300kW from 6pm to 7:30pm to achieve a combined 1.1MW of NSS (green line). The benefit of a shaped dispatch is it enables the shape of the peak to be more closely followed and thus leads to more efficient utilisation of storage capacity. In other dispatches the residential and Harrisdale BESS were combined into a single facility for deployment to achieve the same outcome.



#3. Project has the potential, if proved viable, to reduce long term network cost:

The service provider must provide a description and estimation of the costs that can be reduced. Any additional costs that may arise in total electricity costs as a result of the demand management project (for example, effects on power system security, power system reliability or other aspects of the wholesale electricity market) should be taken into account when estimating the reduction in costs.

This project will provide a blueprint for unlocking future efficiencies and cost savings for the state and constituents through the integration of distributed energy resource services. The project initially focuses on the orchestration of customer DER and the provision and validation of services that support the power system network, and access to markets or other arrangements to unlock the value of these services. It will transition into testing of integration between aggregated DER, network management systems and market dispatch systems.

Opportunities are significant due to the direct engagement of key WA electricity market stakeholders (Western Power, Synergy and AEMO), with a commitment by all parties to share learnings, and integrate into broader DER programs including Distributed Energy Integration Programs (DEIP).

As part of its objectives, and once feasibility and viability of the technical solutions have been completed, Project Symphony will estimate the network cost reduction that can be achieved as this is contingent upon multiple factors including the rate of uptake of DER (much of the NSS capacity will be delivered from customer owned batteries), customer participation in VPPs and identification of candidate network investments which are suitable for deferment via an NSS. However, what is known is that targeting demand reduction at the edge of the grid provides benefit upstream through the entire distribution and transmission system. In the AA5 Western Power is approved to invest heavily in network augmentation to cater for decarbonisation and growth. The project has the potential to reduce these costs and transfer some of this investment from capital works to energy market services. This project also provides flexibility for Western Power to manage network risks with incremental investment in NSS until a firm business case for network augmentation is justified.

#4. Project is innovative and not an otherwise efficient and prudent alternative option that a service provider should have provided for in its proposed access arrangement.

The service provider will need to describe and demonstrate that the project is innovative in terms of one or more of the following:

- *is based on new or original concepts, and/or*
- *it involves technology or techniques or concepts that differ from those previously implemented or used by network operators in Australia, and/or*
- *It is focused on customers in a market segment that significantly differs from those previously targeted by implementations of the relevant technology, in relevant geographic or demographic characteristics that are likely to affect demand.*

Project Symphony is an ARENA funded Project (therefore must meet the innovation criteria and not be done elsewhere in Australia), and in their media release on 01/12/2021[10] ARENA stated:

"Project Symphony is a unique pilot where around 500 customers with over 900 DER assets such as rooftop solar, battery storage and major appliances, will be orchestrated as a Virtual Power Plant (VPP). Additional DER assets will be brought online through the involvement of third-party aggregators in a later phase of the project. It will explore and better understand how the innovative use of DER can provide benefits to customer affordability and network security, reduce emissions, and help strengthen the WA economy and Wholesale Energy Market."

Western Power would be unable to undertake a project like Symphony as an Access Arrangement investment due to the uncertainty of network benefits and the ability to recruit the other industry participants (Synergy and AEMO), who also needed to commit significant budget for R&D, and without the support of the State Government to make key regulatory reforms in support of the OPeN Hybrid model.

A collaboration between Western Power, Synergy and AEMO, the Project was required to design, procure, develop, implement, and test software based 'platforms' capable of registering, aggregating and orchestrating customer DER to participate in new markets and services – a first of its kind. Identifying and measuring the costs and the benefits (the value) of the Project will be key to understanding the longer-term viability at scale, along with the technical solutions required (note the Project will inform a scalable solution for the SWIS and as such, will not be designed to fully scale).

Whilst there have been some trials in the NEM, notably Project Edge, the isolation of the SWIS and WEM requires the tight and efficient integration of DER at a local, regional and system level to reduce the risk of significant impacts to system security, reliability, and efficiency. The WEM also incorporates a capacity market unlike the National Electricity Market (NEM), and this project will inform policy, market design and regulatory changes required to efficiently integrate DER.

Engagement, recruitment, and participation of primarily residential customers is a first in which their energy assets are utilised as part of a VPP to solve for local

	and system issues associated with peak demand, capacity, and reverse power flow, or 'system low'. System security risks are emerging now as large-scale renewable generation displaces dispatchable thermal generators that currently provide all system security services (e.g., inertia, frequency control, system strength and voltage control). The research jointly between Western Power and UWA on the allocation of capacity via operating envelopes utilising NMI level forecasts was unique and innovative as was the development of a set of metrics to compare capacity allocation methods.
	#5. The service provider must identify all potential sources of funding for the project with an explanation of why it was not able to obtain funding for the project from those sources. *This should include sources such as the Australian Renewable Energy Agency, and federal or state government schemes.* In July 2021, the Minster for Energy approved Western Power to enter into a Commonwealth Funding Agreement with the Australian Renewable Energy Association (ARENA) as part of the Advancing Renewables Program. ARENA has agreed to provide a $8.557M contribution towards the project to offset the total estimated project cost of $35M, that will be shared by the project consortium. As the lead organisation, Western Power is accountable for providing the Program Management Office (PMO) to oversee all Project delivery in accordance with the DER Roadmap, as well as the funding agreement executed with ARENA.

[10] Composing a distributed energy symphony in Western Australia's largest energy grid - Australian Renewable Energy Agency (ARENA)

	#6. The costs were not included in the forecast capital expenditure or operating expenditure approved in the ERA's determination for the Access Arrangement period under which the demand management innovation mechanism applies, or under any other incentive scheme in the Access Arrangement determination. No specific allocation for this investment was included in the AA4 Submission. When the AA4 submission was prepared (in 2016): • the outlook for system lows and their impact was not well understood; and • the DER roadmap work was not available, noting that it had not started, and was only published in April 2020. Project Symphony operating expenses during AA4 were not recovered via the D-Factor mechanism in the AA5 submission. Project Symphony opex investment costs were not included in the AA5 investment forecast in the AA5 submission. Alternative investment options were also not included in the AA5 investment forecasts. Note that the AA5 Capacity Expansion Capex expenditure plan included $6M for DSO implementation post symphony ($1.2M in FY23). AA5 also contained an Opex step change of $4.4M per annum for DSO capability. Neither of those activities are being claimed under this DMIA submission. This DMIA submission only relates to R&D activities within project symphony, beyond the approved Access Arrangement expenditure.

For projects that have not been completed during the year: *In this section we should include* 1. *A summary of project activity to date* 2. *An update on any material changes in that regulatory year* 3. *Any preliminary results* 4. *A summary of planned future activity.*	1. *A summary of project activity to date*. Project Symphony's project scoping and planning, build and integrate, and testing milestones (Milestones 1-3) were completed by the end of June 2023. This included the technical solution designed, built, tested, and deployed to support Symphony pilot. Customer recruitment and DER asset orchestration were demonstrated with the majority of Pilot Test and Learn executions completed by the end of June 2023. Several cycles of Test and Learn reports were completed with Test & Learn execution concluding on 10/07/2023 and the final analysis reporting, findings, and closure reports are to be completed in FY2023-24. *2. An update on any material changes in that regulatory year.* The overall program experienced delays in some milestones but were within the Western Power Investment Governance Framework (IGF) tolerances and agreed with ARENA. Objectives and underlying scope still remain on track to be met. *3. Any preliminary results.* System integration and day to day coordination and inclusion of DER orchestration in the simulated market proved to be possible. Technical feasibility was achieved, and some progress made towards technical and commercial viability. The VPP acted as a scheduled facility with aggregated registration, allowing the addition and removal of connection points. Each connection point within an aggregation was allocated a DOE, representing the available network capacity for each 'registered' connection point. Wholesale market submissions made as price-quantity pairs represent the intended level of injecting into or withdraw from the network for the facility at the relevant point in time. These submissions consider any constraints applied by DOE's and any concurrent NSS delivery, which is prioritised over all other services. Following simulated price creation using a combination of real WEM energy prices and manually simulated energy and contingency reserve raise (CRR) prices, the cleared bids and offers and converted into a dispatch instruction in the form of a dispatch target (for energy) and enablement instruction (for CRR). The target represented the intended injection into and withdraw from the network from the aggregated connection points as provided in submissions and selected based on the wholesale price. The target is inclusive of controlled loads, though performance is assessed based on a tolerance set relative to 5% of the facility injection capacity. The 4 market scenarios were tested, Network Support Service (NSS), Essential System Services (ESS), Constrain to Zero (CTZ) and bi-directional energy trading. <u>NSS</u> Where a NSS was deployed by the DSO, the instruction was included in the dispatch instruction from AEMO. Multiple types of NSS were tested including feeder and distribution transformer targeted NSS, forward NSS (to reduce evening peak demand) and reverse NSS (to reduce daytime peak generation). NSS deployments also combined behind the meter residential batteries and the network Harrisdale Tesla Megapack battery into a single facility.

The results of NSS deployment tests demonstrated a large number of customer owned batteries, combined with Western Power owned, batteries could be orchestrated to deliver meaningful NSS capacity (>1MW), and this capacity will be further contracted and utilised this coming Summer via Project Encore, the continuation of Symphony. Air-conditioning load control capability which was developed during Symphony will also be tested during Encore.

CTZ

A CTZ command was tested as an alternative form of dispatch target. The command applies a cap (of zero) to connection points or to defined distributed energy resources that are subject to this method of control behind the connection point. CTZ has a similar effect as the NSS in reducing daytime peak generation but is dispatched by the DMO. CTZ tests demonstrated that DER generation could be managed as an alternative tool to mitigate system minimum demand challenges.

ESS-CRR

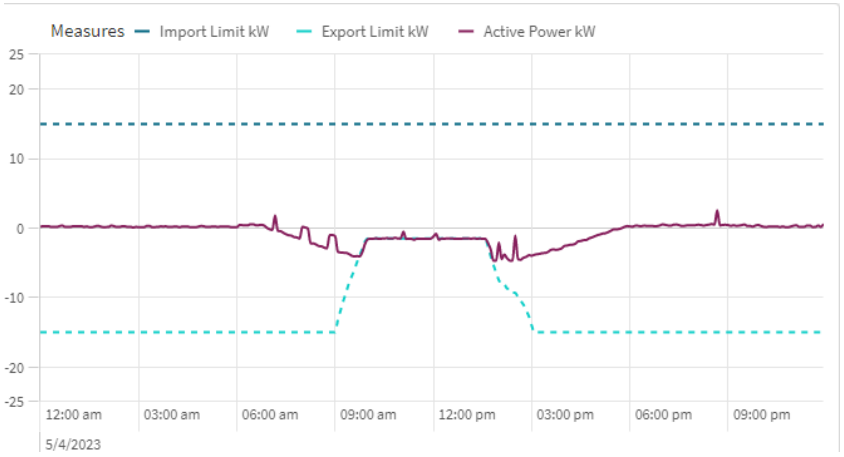
Near time telemetry was provided from the facility representing the measurement of the injection or withdrawal from the aggregated connection points as well as additional data collection for analysis purposes. Where ESS-CRR responses, both simulated and real, were observed, high speed data was recorded using various equipment meeting various specifications and were aggregated together to create a single response from the facility. On site metering provided delayed 5-minute telemetry snapshots of injection and withdrawal. Testing demonstrated a high-speed response to frequency droop could be achieved using both residential batteries and larger network connected batteries.

Bi-directional Energy

Continuous real-time operation and monitoring of the facility demonstrated sufficient potential to expect a future real-time energy service in the timing requirements of the Real Time Market. While there were concerns about the speed of responses to a dispatch instruction provided in real time with a target 5 min in the future, Aggregated DER demonstrated sufficient speed of response, combined with expected future capability to pre-schedule events and only re-send instructions when changes occur.

Dynamic Operating Envelopes (DOE)

Critical to the management of DER under the OpEN hybrid model is the ability for the DSO to publish DOEs and DER to operate within the DOE. This provides a further measure for the DSO to manage peak demand (both import and export) on the network where other measures have been unsuccessful in keeping demand below network limits (such as procurement of NSS to reduce evening demand). Whilst Symphony focused upon testing of hosting capacity (export limits) it did calculate and publish import limits. The below graph shows how the DOE was able to limit the export of a DER during a period of high solar generation. The same approach might be used to manage import limits (e.g., of EV chargers) in future.



Evidence of reports completed can be found at the ARENA website Knowledge Bank - Australian Renewable Energy Agency (ARENA).

A summary of planned future activity.

Planned submission of final Milestone 4 (Project Completion) deliverables to ARENA and closure of Project Symphony:

- WP3.3 Social Science Study
- WP7 DER Participation framework Report
- WP8.3 Cost Benefit Analysis Report
- WP8.2 End of Project Assessment
- WP8.4 Project Closeout Report

For projects that have been completed during the year: *In this section we should include:* 1. *The quantitative results of the project.* 2. *Analysis of the results.* 3. *A description of how the results of the project will inform future demand management projects.* 4. *Any other information available to the SP required to make an informed reader to understand and evaluate the project*.	*The quantitative results of the project.* Not Applicable – Project not yet complete. Due in December 2023. *Analysis of the results.* Not Applicable – Project not yet complete. Due in December 2023. *A description of how the results of the project will inform future demand management projects, including any lessons learnt about what demand management projects or techniques (either generally or in specific circumstances) are unlikely to form technically or economically viable non-network options.* Not Applicable – Project not yet complete. Due in April 2024. *Any other information available to the service provider required to enable an informed reader to understand and evaluate the project*. Completed and published Work Packages (WP) are available on the ARENA website[11] and include: • WP8.1 Vision and Pathway • Project Symphony Lessons Learnt Report 1 • WP1.1 Pilot Area Report • WP2.1 DER Services • WP2.3 DER Service Evaluation • WP3.2 Aggregator Report • WP4.1 Distribution Constraints Optimisation Algorithm Report • WP4.2, 4.3 & 4.4 Combined Platform Functional and Non-Functional Requirements • Project Symphony Lessons Learnt Report 2 • WP5.1, 5.2 & 5.3 Combined Platform (as built) Report for DSO, DMO and Aggregator

[11] Knowledge Bank - Australian Renewable Energy Agency (ARENA)