Jemena Electricity Networks (Vic) Ltd

IT Investment Brief – Grid Stability and Flexible Services Program

Non-recurrent

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Glossary

AEMO	Australian Energy Market Operator
Augex	Augmentation expenditure
Capex	Capital Expenditure
CER	Consumer Energy Resources
CSIP-AUS	Common Smart Inverter Profile – Australia
Current regulatory period	The period covering 1 July 2021 to 30 June 2026
DEECA	Department of Energy, Environment and Climate Action
DER	Distributed Energy Resources
DERMS	Distributed energy resources management system
DNSP	Distributed Network Service Provider
DOE	Dynamic Operating Envelope
DPV	Distributed Photovoltaics
EV	Electric Vehicle
FLSR	Fault Location and Supply Restoration
ICT	Information and Communications Technology
Jemena	Refers to the parent company of Jemena Electricity Networks
JEN	Jemena Electricity Networks (Vic) Ltd
LV	Low Voltage
NEM	National Electricity Market
NER	National Electricity Rules
Next regulatory period	The period covering 1 July 2026 to 30 June 2031
NSP	Network Service Provider
NPV	Net Present Value
Opex	Operating Expenditure
RYxx	Regulatory year covering the 12 months to 30 June of year 20xx for years in the Next Regulatory Period. For example, RY25 covers 1 July 2024 to 30 June 2025
STPIS	Service Target Performance Incentive Scheme
Totex	Total Expenditure
UFLS	Under-Frequency Load Shedding
V	Volts
VVC	Volt-VAR Control

Grid Stability and Flexible Services Program

Objective and description	This Grid Stability and Flexible Services program articulates the need for Jemena Electricity Networks (Vic) Ltd (JEN) to develop a Distributed Under-Frequency Load Shedding (Distributed UFLS) Scheme and Flexible Services for our customers. These initiatives will strategically respond to the challenges and opportunities associated with increasing Consumer Energy Resources (CER) penetration and the associated influence on power system security and network operating limits.		
Non-recurrent ICT sub-categorisation	☐ Maintaining existing services, functionalities, capability, and/or market benefits	☐ Complying with new/altered regulatory obligations/requirements	☒ New or expanded ICT capability, functions, and services
Background and key drivers	This Grid Stability and Flexible Services Program is one of four programs that will enable JEN to deliver its CER Integration Strategy. JEN has developed its CER Integration Strategy to meet the challenges posed by the rapid transformation of the Australian energy sector as the Australian economy transitions towards a decarbonised net-zero future. JEN's strategic response, set out in its CER Integration Strategy, is to adopt a least-regrets scenario-based investment approach to manage a smooth transition for customers. There are a number of factors driving the need for this investment. **Grid stability challenges** AEMO has forecast that net minimum demand in Victoria will fall below its minimum acceptable operating threshold by late 2024. This poses the following challenges for maintaining power system security: • Supply-Demand Balance – an oversupply of DPV generation that cannot be curtailed or interrupted, leading to a collapse of the power system following the unexpected disconnection of an interconnector; and • UFLS – a scheme that disconnects load to mitigate power system collapse from a sudden drop in system frequency (triggered by a loss-of-generation event), becoming ineffective due to the presence of reverse power flows from DPV. Grid stability applications are required by JEN to support AEMO in addressing both of these emerging power system security needs, to fulfill our power system security regulatory obligations. In the first two weeks of November 2024 alone, AEMO has issued a number of market notices about elevated risk of insufficient demand to maintain a secure operating state in the Victorian region.[1] **A changing energy landscape** JEN is faced with operating in a rapidly changing energy landscape. CER uptake is continuing to increase and will be a crucial resource in the future to support and manage the distribution network and broader energy system. The challenges of managing power system security will be exacerbated as CER uptake continues to increase. Furthermore, low voltage (LV) network planning and operation will become increasingly more important and complex because most CERs are connected to customer premises within our LV networks. With the networks traditionally designed for one-way loads, this change has		

[1] AEMO | Market Notices.

direct and profound implications on our customers' experience with the network and, therefore, on the way JEN manages this part of the network.

Regulatory obligations

Under clause 4.3.4 of the NER, DNSPs must use reasonable endeavours to exercise their rights and obligations in relation to networks so as to cooperate with and assist AEMO in the proper discharge of their power system security responsibilities.

In August 2021, AEMO issued a directive to Victorian electricity network service providers (NSPs) to identify and implement measures to restore power system security from the threats caused by increasing levels of uncontrolled DPV within their respective networks[2]. Since then, the DER and System Security Working Group have also been established to address these challenges.

From 25 October 2023, new regulatory obligations took effect to require emergency Backstop capabilities for certain DPV connections.[3] Moreover, from 1 January 2024, each DNSP must have the capability to remotely curtail or interrupt generation by these DPV systems where required by AEMO. The Victorian Government has also imposed similar regulatory obligations.[4]

The regulatory obligations in relation to DPV Backstop capability are conditions of JEN's distribution licence.

Risk management

The Grid Stability and Flexible Services program will help manage the following risks:

- Power system security non-compliance – There are increased risks that JEN may be unable to comply with AEMO directives under the NER regarding the supply-demand balance and standards for minimum levels of load under the control of the UFLS scheme.
- Power system collapse – There may be an increased probability of state-wide blackouts occurring should AEMO be unable to control power system frequency, particularly under critical credible contingencies.
- Customer appliance damage – Should voltage levels increase, for example, due to JEN needing to increase voltage above 258V to trip off DPV as a last resort in an energy emergency to maintain system stability, there will be a risk of damage to customer appliances and safety implications from appliances overheating and insulating deteriorating.
- DER curtailment – Increasing DPV will result in increasing curtailment for both customer exports through fixed export limiting being applied, and gross generation from elevated network voltages, absent of other control mechanisms.
- Load shedding – The reliability of JEN's service delivery to customers may deteriorate. This is because JEN would need to trip reverse power feeders and/or CER as a last resort in an energy emergency to maintain system stability and need to shed load on assets that are overloaded.
- Increased costs – JEN may face increased complaints and claims from customer appliance damage, load shedding, and export limiting. Costs arising from insurance claims and penalties under JEN's service target performance incentive scheme

[2] Refer to Appendix A.
[3] See Victoria Government Gazette, No. S 542, 11 October 2023.
[4] See also DEECA, Victoria's Emergency Backstop Mechanism for rooftop solar, accessed 8 November 2023.

	(STPIS) may not be recoverable where JEN has incurred the costs in breach of the NER. JEN may also incur increased capex costs.
Customer Importance	**Our customers' expectations** Our customers want electricity prices to be affordable. Many of our customers also expect us to operate sustainably and to support decarbonisation and the renewable energy transition. They want us to prioritise network reliability, resilience and power quality.[5] Here are some examples of recommendations that we have received during our customer engagement from 2023 to mid-2024: • The Young people customer voice group wants us to ensure the electricity network is able to handle the shift to 'green' energy and we can help incentivise and drive EV, solar and battery use by customers. • Our small and medium customers expressed strong interest in transitioning to renewable energy sources and the role JEN could play in empowering businesses to achieve their sustainability and energy goals. • Our People's Panel wants JEN to prioritise investing in reliability by assessing, building and maintaining the network to meet changes in operating conditions and withstand network failures. • Network reliability and power quality is a high priority to local councils to ensure stability of community services and critical infrastructure severely impacted by power outages. In response to our Draft Plan released in August 2024, customer respondents reiterated their concerns about affordable prices and their support for network reliability and our future network strategy.[6] **How our proposed program addresses our customers' priority expectations** The program will help address our customers' expectations and priorities, as shown by the benefits that customers can derive from the program, such as improved power system security compliance, maintained supply reliability, DER enablement, and emissions reduction. See the discussion of benefits for the preferred option below. Our preferred option is prudent and efficient. It is the option that generates the highest net present value for our customers over the long term. The program will lead to reduced operating and capital expenditure. By avoiding the need for JEN to apply intentional over-voltages to customers to trip off CER, we can avoid the need for operational expenditure to fund complaints management and equipment damage claims. Adopting Flexible Export Services defers the need for network capital investment in DER enablement and peak demand capacity as it limits the times during the year that worst-case export and import limiting is needed to be applied to manage the network. Doing nothing or delaying the implementation of the Grid Stability and Flexible Services Program will not address our customers' expectations. Below are more details about the risks of doing nothing. On balance, we consider that our proposed program has addressed our customers' priority expectations discussed above.

[5] JEN, 2026-31 Draft Plan, August 2024, chapter 2.
[6] JEN, Feedback on 2026-31 Draft proposal, September 2024.

Key Considerations	In exploring options to address the challenges and risks discussed above, JEN has aimed to develop a solution that: • seeks to achieve power system security compliance with AEMO requirements across JEN's network and then maintain this compliance in an environment of increasing DER penetration • involves identifying and implementing Distributed UFLS capabilities required to address the identified needs of the power system on a least-regrets basis • provides a foundation on which JEN can establish Flexible Services for its customers • optimises the sequence of Grid Stability capability investment to provide the highest net benefit, considering risk, performance, cost, timing and uncertainty • complements and supports other CER integration initiatives and programs • is scalable for the future • ensures total lifecycle costs are minimised for JEN's customers. In addition, we have taken into account the following timing considerations: • DPV Backstop—DEECA has mandated 1 October 2024 as the date when the DPV Backstop capability must be implemented for all new or altered DPV customers. Therefore, this capability is committed and will be deployed in different stages in 2024/25. • Distributed UFLS—AEMO expects system security to be compromised in Victoria for UFLS in 2025. Hence, the capability should be developed starting in 2024. • Flexible Exports – JEN's network limitations associated with DPV are material in its service area now. However, the systems required to support flexible exports (established by the foundational DPV Backstop capability), particularly for the smaller systems, need to be put into place first. Furthermore, deploying JEN's VVC dynamic voltage management system over the next few years will defer the need for flexible export services from 2028 to 2031. • Flexible Imports – JEN expects network limitations associated with EVs to become material in its service area from 2028 to 2031.
Options	JEN has considered five alternatives to deliver the capability articulated above: 1. Do nothing 2. Grid Stability and Flexible Services by 2028-29 without Augex Deferral 3. Grid Stability and Flexible Services by 2028-29 with Augex Deferral 4. Grid Stability and Flexible Services by 2030-31 with Augex Deferral 5. Grid Stability and Flexible Services by 2030-31 without Augex Deferral **Option 1: Do nothing** **Description** No additional capital works are considered under this option. That is, it assumes a business-as-usual or status quo position.

Benefits

- Expenditure levels are maintained

Risks

- Power system security non-compliance – There are increased risks that JEN may be unable to comply with AEMO directives under the NER regarding the supply-demand balance and standards for minimum levels of load under the control of the UFLS scheme. This could affect service delivery to our customers and result in JEN's non-compliance with regulatory obligations, as well as compliance and enforcement consequences.
- Power system collapse – There may be an increased probability of state-wide blackouts occurring should AEMO be unable to control power system frequency, particularly under critical credible contingencies. This may further result in a power system collapse with catastrophic implications for our customer services. Power system collapse (system black) could be minimised by adopting Grid Stability capabilities.
- Load shedding – The reliability of JEN's service delivery to customers may deteriorate, as JEN would need to trip reverse power feeders and/or CER as a last resort in an emergency to maintain system stability. We may also need to shed load on assets that are overloaded, particularly from future EV charging at times of air-conditioning peak demand, absent other control mechanisms, will deteriorate reliability of supply. Deteriorating reliability also has public safety implications for customers and the community; The need for load-shedding could be minimised by adopting Grid Stability capabilities.
- Increased costs – JEN may face increased complaints and claims from customer appliance damage and load shedding. Costs arising from insurance claims and penalties under JEN's service target performance incentive scheme (STPIS) may not be recoverable where JEN has incurred the costs in breach of the NER. JEN may also incur increased capex costs and pass these on to customers on transmission interconnectors and other transmission-based solutions, as alternative ways to address the need.

Option 2: Grid Stability and Flexible Services by 2028-29 without Augex Deferral

Description

Grid Stability applications are established with this option including:

- Foundational Distributed UFLS: This system lays the groundwork for Under-Frequency Load Shedding (UFLS) using distributed resources. It aims to protect the power grid from instability by dynamically shedding loads during frequency disturbances, enhancing grid reliability.
    - Zone substation and distribution feeder dynamically armed Distributed UFLS system: An advanced UFLS system that operates at the zone substation and distribution feeder levels. It dynamically arms and disarms load-shedding mechanisms based on real-time grid conditions, improving response times and grid stability.
- Flexible Exports & Flexible Imports: This system allows for dynamic adjustment of export and import limits for energy resources. It enables more efficient use of grid capacity and improves the integration of renewable energy sources by adapting to changing supply and demand conditions.

- Integrated LV DERMS: A low-voltage (LV) Distributed Energy Resource Management System (DERMS) designed for managing DERs at the LV network level. It integrates various DERs to optimise their performance and ensure reliable and efficient operation within the LV distribution network.
- CSIP-AUS DOE capability: This capability within the Common Smart Inverter Profile – Australia (CSIP-AUS) framework pertains to the integration of DERs into the Dynamic Operating Envelopes (DOE) initiatives. It focuses on compliance, coordination, and optimisation of DERs to meet regulatory and operational standards.

Grid Stability and Flexible Services Expenditure ($k, June $2024)[7]

JEN's costs for this option is outlined in the table below.

Initiative	Expenditure type	FY2025/26	FY2026/27	FY2027/28	FY2028/29	FY2029/30	FY2030/31
Grid Stability UFLS	Digital Capex	0	345	706	495	269	148
	Digital Opex	0	0	0	0	0	0
	Network Capex	0	314	710	1,380	1,986	1,103
	Network Opex	0	0	0	0	0	0
Flexible Export Services	Digital Capex	2,443	7,086	4,675	0	0	0
	Digital Opex	0	1,049	1,299	502	502	502
	Network Capex	0	0	0	0	0	0
	Network Opex	0	87	175	175	175	175
Flexible Import Services	Digital Capex	0	0	4,044	6,053	0	0
	Digital Opex	0	0	0	0	0	0
	Network Capex	0	0	0	0	0	0
	Network Opex	0	0	0	0	0	0
Total	**Capex**	**2,443**	**7,745**	**10,135**	**7,928**	**2,255**	**1,250**
	Opex	**0**	**1,136**	**1,474**	**677**	**677**	**677**
	Capex and Opex	**2,443**	**8,881**	**11,609**	**8,605**	**2,932**	**1,927**

7 The dollars presented includes capitalised overheads and escalations.

Benefits

This option allows for the realisation of the following benefits as early as possible:

- Improved compliance – improved power system security compliance by adopting Distributed UFLS (Grid Stability capabilities) to allow AEMO to meet its NER obligations regarding power system security and for JEN to meet its NER obligations regarding directives issued by AEMO to meet those obligations and its minimum levels of load under control of the UFLS scheme.
- Maintain reliability of supply—power system collapse (system black) and the need for load-shedding could be minimised by adopting Grid Stability capabilities. Also, by reducing the magnitude of EV charging at times of maximum demand with the use of Flexible Import Services, the risk of network overload (and therefore forced load shedding to avoid the overload) could be minimised.
- Reduced operational expenditure—By avoiding the need for JEN to apply intentional over voltages to customers to trip off CER and limiting the times during the year that worst-case export and import limiting is needed, we can avoid the need for operational expenditure to fund complaints management and equipment damage claims.
- Reduced capital expenditure—Flexible Export Services defers the need for network investment in DER enablement and peak demand capacity as it limits the times during the year when worst-case export and import limiting must be applied to manage the network.
- DER enablement—the power system could accommodate more CER exports at times other than minimum demand if fixed export limits could be avoided with the use of Flexible Export Services.
- Emissions reduction—If DER enablement can displace centralised fossil fuel generation sources, emissions reductions could be achieved.
- Risk—Mitigates the risks identified in the background and do-nothing option as early as possible.
- We estimate the present value of quantified benefits to be $28.9M.

Risks

- This option has the highest cost.
- Does not include an affordability benefit for our customers as it does not defer our augmentation expenditure.
- The implementation risks for UFLS would be low as JEN is progressively implementing the new requirement over 5 years
- For Flexible Services, JEN is proposing to implement it over three years (2028-2031). By then, the technology would be more mature and adoption by other DNSPs across the NEM would likely open up more competition and availability of the Utility Server and LV DERMS products.

Option 3: Grid Stability and Flexible Services by 2028-29 with Augex Deferral

Description

This option includes Option 2, which reduces the Distribution Substation and LV Augmentation Program by approximately 20%.

Grid Stability and Flexible Services Expenditure ($k, June $2024)

Benefits

- This option allows for the realisation of the benefits identified in Option 2
- In addition to those, this option provides an additional affordability benefit as it reduces our other costs for this regulatory period due to the deferred augmentation expenditure
- We estimate the present value of quantified benefits to be $35.6M.

Risks

- This option is the highest cost (same cost as Option 2)
- There is a risk that uptake of DER services could be less than anticipated, which may require us to bring forward our augmentation expenditure, as we would only defer this if it were safe and efficient to do so, which would lower the benefits of this option
- The implementation risks for UFLS would be low as JEN is progressively implementing the new requirement over a 5-year period
- For Flexible Services, JEN is proposing to implement it over a three-year period (2026-2029). By then, the technology would be more mature and adoption by other DNSPs across the NEM would likely open up more competition and availability of the Utility Server and LV DERMS products.

Option 4: Grid Stability and Flexible Services by 2030-31 with Augex Deferral (preferred)

Description

This option is Option 3 deferred by two years.

Grid Stability and Flexible Services Expenditure ($k, June $2024)[8]

JEN's costs for this option is outlined in the table below.

[8] The dollars presented includes capitalised overheads and escalations.

Initiative	Expenditure type	FY2026/27	FY2027/28	FY2028/29	FY2029/30	FY2030/31
Grid Stability UFLS	Digital Capex	345	706	495	269	148
	Digital Opex	0	0	0	0	0
	Network Capex	314	710	1,380	1,986	1,103
	Network Opex	0	0	0	0	0
Flexible Export Services	Digital Capex	0	2,443	7,086	4,675	0
	Digital Opex	0	0	1,049	1,299	502
	Network Capex	0	0	0	0	0
	Network Opex	0	0	87	175	175
Flexible Import Services	Digital Capex	0	0	0	4,044	6,053
	Digital Opex	0	0	0	0	0
	Network Capex	0	0	0	0	0
	Network Opex	0	0	0	0	0
Total	**Capex**	**659**	**3,859**	**8,961**	**10,975**	**7,303**
	Opex	**0**	**0**	**1,136**	**1,474**	**677**
	Capex and Opex	**659**	**3,859**	**10,097**	**12,449**	**7,980**

Benefits

- This option allows for the realisation of the benefits identified in Option 2 (same as Option 3) at a later stage, which reduces the value of these benefits
- In addition to those, this option provides an additional affordability benefit as it reduces our other costs for the next regulatory period due to the deferred augmentation expenditure
- The costs for this project are lower within the next regulatory period, and spread across the following regulatory period to minimise bill impacts for our customers
- We estimate the present value of quantified benefits to be $34.9M.

Risks

- The risks identified in the do-nothing option would remain for an additional two years
- There is a risk that uptake of DER services could be less than anticipated, which may require us to bring forward our augmentation expenditure, as we would only defer this if it were safe and efficient to do so, which would lower the benefits of this option
- The implementation risks for UFLS would be low as JEN is progressively implementing the new requirement over a 5-year period

- For Flexible Services, JEN is proposing to implement it over a three-year period (2028-2031). By then, the technology would be more mature and adoption by other DNSPs across the NEM would likely open up more competition and availability of the Utility Server and LV DERMS products.

Option 5: Grid Stability and Flexible Services by 2030-31 without Augex Deferral

Description

This option is Option 2, deferred by two years.

Grid Stability and Flexible Services Expenditure ($k, June $2024)

Benefits

- This option allows for the realisation of the benefits identified in Option 2 (same as Option 3 and 4); however, at a later stage. This reduces the extent of these benefits
- The costs for this project are lower within the next regulatory period and spread across the following regulatory period to minimise bill impacts for our customers
- We estimate the present value of quantified benefits to be $28.5M

Risks

- The risks identified in the do-nothing option would remain for an additional two years
- The implementation risks for UFLS would be low as JEN is progressively implementing the new requirement over a 5-year period
- For Flexible Services, JEN is proposing to implement it over a three-year period (2028-2031). By then, the technology would be more mature and adoption by other DNSPs across the NEM would likely open up more competition and availability of the Utility Server and LV DERMS products.

Quantitative Analysis

The table below summarises the flexible services roadmap economic evaluation by option ($k, June 2024).

Economic Evaluation Results	Option 1 Do Nothing	Option 2 Flexible Services by 2028-29 without Augex Deferral	Option 3 Flexible Services by 2028-29 with Augex Deferral	Option 4 Flexible Services by 2030-31 with Augex Deferral	Option 5 Flexible Services by 2030-31 without Augex Deferral
Present Value Capex	0	21,168	21,168	20,093	20,093
Present Value Opex	0	11,966	11,966	10,723	10,723
Present Value Total Costs	**0**	**33,134**	**33,134**	**30,817**	**30,817**
Present Value Benefits	0	28,929	35,578	34,882	28,525
Net Present Value (NPV)	**0**	**(4,206)**	**2,444**	**4,066**	**(2,292)**

Options Summary

Option 1

The do-nothing option is not recommended as it does not allow JEN to meet its compliance obligations nor meet customer and community service expectations.

Option 2

Option 2 establishes the identified grid stability applications by RY29 but does not include a deferral of our augmentation expenditure. While this option is the most expensive, it provides the least cost pathway to compliance for JEN, as well as providing flexible DER operations for our customers.

Option 3

Option 3 establishes the identified grid stability applications by RY29 and also includes a deferral of our augmentation expenditure. This option allows JEN to comply with our regulatory obligations and provide flexible DER operations for our customers.

Option 4

Option 4 establishes the identified grid stability applications by RY31. This option allows JEN to commence the realisation of benefits within the next period; however, it defers the start in the best interest of customer affordability.

Option 5

Option 5 establishes the identified grid stability applications. This option allows for JEN to commence its flexible services initiative within the period but delays the start in order

	to reduce the costs for our customers within this period. There are no additional benefits for augmentation expenditure deferral under this option.
What We Are Recommending	Option 4 – "Flexible Services by 2030-31 with Augex Deferral" is prudent and efficient and is our preferred option. This option allows us to commence the realisation of benefits within the next period; however, it defers the start in the best interest of customer affordability. This option provides the highest NPV and, therefore, is our recommended option. Options 2, 3 and 4 will all provide a firm foundation for enabling non-network solutions to address future security issues associated with increased penetration of CER and enable us to comply with regulatory obligations, but Option 4 maximises the present value of net benefits for our customers over the long term and is therefore the recommended development path.
Risks of not undertaking the program in the 2026-31 regulatory period	The risks of not implementing the program are high, as outlined in the 'Do nothing option' above. The recent increase in AEMO market notices has already demonstrated the network security risks associated with increased solar export and minimum demand in Victoria. As noted above, AEMO issued a number of market notices in early November 2024 about the elevated risk of insufficient demand to maintain a secure operating state in the Victorian region.[9] Given this, we do not consider waiting for the 2031-36 regulatory period to implement this program as a prudent and responsible approach, given the potentially significant risks. Implementing the program in the next regulatory period will also ensure that we can accommodate more CER consistent with our CER Integration Strategy and the Victorian Government's renewable energy target of 65% and emissions reduction target of 45-50% by 2030.[10]
Cost Estimation	A bottom-up build was used to estimate costs for our preferred option. To verify these costs, we used a proxy approach to previous projects that JEN has successfully completed. Digital estimates for UFLS have been derived using system implementation costs associated with a similar project we recently implemented, FLSR. These costs include internal and external resources required to implement UFLS system capability. Digital estimates for Flexible Services are based on the recently implemented LV-DERMS platform for the Emergency backstop; this is a good proxy as the technology stack is the same. These costs have been derived based on estimates provided by the project team and also the vendor, [redacted] and cover project delivery resources comprising both internal and external resources. Digital opex costs cover ongoing licensing for Flexible Services. Refer to Grid Stability and Flexible Services Program for cost breakdown.
Dependencies on other Investment Briefs	• Data Visibility

[9] AEMO | Market Notices.
[10] Climate action targets (climatechange.vic.gov.au).

Relationship to ICT Capital Forecast	For ICT capital forecast, refer to detailed “Grid Stability and Flexible Services Program” justification paper and “Grid Stability and Flexible Services Program - CBA Model - Flexible Services.xlsb”.