Jemena Electricity Networks (Vic) Ltd

IT Investment Brief – Digital Twin

Non-recurrent

Jemena
bringing energy to life

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Glossary

BAU	Business as usual
Capex	Capital Expenditure
Current regulatory period	The period covering 1 July 2021 to 30 June 2026
DNSP	Distribution Network Service Provider
ENA	Energy Networks Australia
FNS	Future Network Strategy
FTE	Full time equivalent
GIS	Geospatial Information Systems
HBRA	High Bushfire Risk Areas
ICT	Information and Communications Technology
Jemena	Refers to the parent company of Jemena Electricity Network
JEN	Jemena Electricity Network
LBRA	Low Bushfire Risk Areas
LiDAR	Light Detection and Ranging
Next regulatory period	The period covering 1 July 2026 to 30 June 2031
NPV	Net Present Value
NSP	Network service provider
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
totex	Total Expenditure

Digital Twin

Description and objectives of the program	The purpose of our proposed program is to introduce and embed the use of Light Detection and Ranging (LiDAR), high-resolution aerial photography and a 3d 'digital twin' network model into our operational systems and business processes. This will help us to achieve operational efficiencies and improved customer outcomes in the areas of vegetation management, bushfire risk management, asset maintenance, network planning for augmentation and replacement, network resilience and work delivery.		
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	The Network Assets Digital Twin program supports JEN's strategic objective of connecting our customers to a renewable energy future by introducing new technologies and business processes. A Digital Twin is a virtual replica of our assets, captured via LiDAR and high-resolution images. **Industry best-practice** The use of LiDAR has been common practice in most distribution and transmission networks in Australia and worldwide for many years. Energy Networks Australia (ENA) reported that "using data for more efficient network management allows network service providers (NSPs) to reduce capital and operational expenditure while maintaining a safe and reliable network".[1] This then allows for affordability, reliability and safety benefits for customers." That is, using LiDAR reflects good industry practice employed by a prudent operator. In preparing this business case JEN interviewed representatives from the following Distribution Network Service Providers (DNSP) to ensure that we could benefit from lessons learnt by other DNSPs that utilise LiDAR, to understand what benefits are likely to be achieved and that we appropriately scoped the LiDAR requirements: • Ausgrid: has had a LiDAR and network digitisation program for more than 10 years. • Endeavour Energy: has been using LiDAR capture since 2018, progressively expanding use-cases from vegetation management to asset management and network design. • Essential Energy: has been using LiDAR for more than 10 years, with a rolling program to progressively capture their extensive network. • Powercor, CitiPower, and United Energy: Powercor undertakes regular LiDAR surveys of its own network and those of CitiPower and United Energy using its own fleet of three helicopters with a key focus being vegetation management and bushfire risk management. • Ausnet: have been conducting regular and rolling aerial LiDAR surveys of their distribution network and the transmission network for the last 10 years.		

1 Energy Networks Australia, Data opportunities for smarter networks, October 2020

- SA Power Networks: recently conducted successful trials using LiDAR to survey flood-affected areas in the aftermath of the December 2022 River Murray floods, yielding significant benefits in coordinating and prioritising response and restoration efforts. SA Power Networks is proposing to further embed the use of these technologies in the 2025-30 regulatory period as part of a broader asset management improvement program.

In addition to the above, JEN is aware that Ergon Energy, Energex, Horizon Power and Western Power all have established LiDAR and network digitisation programs, and Tas Networks is currently engaged in a joint project in collaboration with the state government to use LiDAR to map the whole of Tasmania.

Compliance Obligations

The program will deliver a range of operations improvements that promote the efficient operation of the distribution network in the long term with respect to quality, safety and reliability of supply. In addition, it will enhance JEN's capabilities in the detection of vegetation and conductor clearance breaches, leaning poles, and other faults, uplifting the reliability, security, and safety of the distribution system. This supports our compliance with:

- National Electricity Objectives
- National Electricity Rules
- Electrical Safety Act 1998 (Vic)
- Electricity Safety (Bushfire Mitigation) Regulations 2023.

Network resilience and operation efficiencies

The digital twin capabilities will allow JEN to improve its network operating efficiencies. This includes by:

- automating parts of the asset inspection process
- uplifting abilities via the use of drones
- eliminate risks associated with the use of the pole cameras
- facilitate information exchange between teams
- improve work planning, prioritisation, scheduling, and delivery for JEN's network capital programs
- avoiding or deferring the need for augmentation or, reducing the cost by enabling works to be targeted more effectively
- assessment of long-term climate and other risks.

Our progress to date

In order to gain a better understanding of LiDAR and high-resolution imagery technology and the potential benefits specifically in the context of the JEN network, we conducted a pilot project in April 2022. This involved LiDAR capture and analysis of 7,084 main spans across two zone substation areas, Sunbury (aerial capture) and Heidelberg (ground-based vehicle capture).

The pilot project confirmed the capability of the solution to provide 3D views of network assets in sufficient detail to accurately allow measurements of distances (for example, vegetation encroachment or conductor clearances) within the 3D LiDAR model. We

	incorporated the learnings from this pilot project in the development of the digital twin program scope of work.
Customer Importance	**Our customers' expectations** Our customers want electricity prices to be affordable. However, they also expect us to: • Prioritise investment in network reliability and network resilience. In addition to our customers' expectations, the Victorian Government is placing several obligations on electricity distribution network providers, including us, to make the network more resilient. • Digitise and automate the network to make it smarter, efficient, more responsive and ready for future energy-related issues. In response to our Draft Plan released in August 2024, customer respondents reiterated their concerns about affordable prices and maintaining network reliability.[2] They also ranked third in importance JEN's initiative on new digital technologies to improve electricity system management and enable new sustainable products and services. **How we've addresses our customers' expectations** Our proposed program is consistent with our customers' expectations about maintaining network reliability and automation as discussed in the capabilities of the proposed solution below. To address the affordability concerns, we are proposing: • to adopt the option which provides the highest benefit to our customers, in net present value terms, over the long term • to implement the program in a staged approach such that we will spread the overall cost over the next and subsequent regulatory periods • to not propose a step change in operating expenditure despite our analysis showing that there is a need for a step change (see section 4.4 of the Program document). We expect this cost to be mostly offset by operational efficiency savings delivered by the program. • to partner with any relevant third party where possible during the implementation phase in order to share costs where this is mutually beneficial and does not compromise the outcomes. Bringing JEN's systems up to industry best practice will deliver process improvements across a broad range of business processes in vegetation management, bushfire risk mitigation, asset maintenance, network design and work delivery – all central to the efficient and effective delivery of the network service to customers. In the long term we expect that the efficiency gains delivered by the program will lead to lower costs for customers and the new capabilities will enhance JEN's ability to model, plan for and mitigate the impacts of extreme weather events, improving network resilience. The program is also expected to deliver more direct and immediate customer benefits, for example in improving the process for new connections or customer-initiated network extensions.
Key Considerations	In exploring options to address the above, JEN has aimed to develop a solution that will enable it to: • manage, maintain and operate its network more efficiently and at a lower cost to customers in future

[2] JEN, Feedback on 2026-31 Draft proposal, September 2024.

- continue to maintain high levels of safety, reliability and regulatory compliance as the network adapts to the changing energy mix
- achieve higher levels of capacity from existing assets
- enhance and streamline the process for new network connections, particularly for commercial and industrial customers such as data centres
- model future scenarios such as the impact of floods or extreme weather events on the network assets, to enhance network resilience in the long term.

Options

JEN has considered four alternatives to deliver the capability articulated above:

(1) Do nothing
(2) Establish LiDAR and network digitisation program with accelerated initial LiDAR survey in LBRA **(preferred)**
(3) Establish LiDAR and network digitisation program with rolling 5-year survey of Low Bushfire Risk Areas (LBRA)
(4) Establish LiDAR and network digitisation program with annual LiDAR surveys in High Bushfire Risk Areas (HBRA) and 3-yearly (33% per annum) LiDAR capture in LBRA.

Option 1: Do nothing

Description

In this option JEN does not proceed with the LiDAR and network digitisation program and continues to rely on existing business processes and tools for vegetation management, asset management, network design and so on until at least 2031. No further trials or other work would be undertaken in this area in the next regulatory period, but JEN could re-assess the potential to introduce these technologies in developing its plans for the following regulatory period.

Benefits

Benefits of this option have been baselined at zero for the purpose of the options comparison.

Risks

- JEN may not be able to meet its compliance obligations, or the obligations would be met but at a higher cost than the other options
- JEN may not meet its customer expectations to prioritise investment in network reliability and resilience and digitise the network to make it smarter, more responsive, and more efficient.

Option 2: Establish LiDAR and network digitisation program - with annual LiDAR surveys in HBRA and accelerated initial LiDAR survey in LBRA (preferred)

Description

JEN will undertake annual LiDAR surveys in HBRA, complete LiDAR capture of the LBRA in year 2, and undertake 5-yearly (20% per annum) ongoing LiDAR capture in LBRA thereafter.

Direct Escalated Costs

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

$2024 million		RY27	RY28	RY29	RY30	RY31
Capex	Digital	-	-	-	$1.2	$ 4.2
	Asset	-	-	-	-	-

Opex	Digital Nonrecurrent	-	-	-	-	$0.04
	Digital Recurrent Step				$0.1	$0.06
	Asset	-	-	-	-	-
Total					**$1.3**	**$4.3**

Benefits

- Enhanced vegetation management. The automatic detection of vegetation clearance breaches can enhance the quality and increase the efficiency of the assessment activity and reduce the risk of non-compliance to regulated clearance requirements. This use-case is estimated to offer efficiency gains of up to 0.5 FTE in the vegetation assessment process in the first five years.

- Efficiency savings on asset inspection, maintenance planning and project scoping. Access to an accurate 3D model of the distribution network assets will enable process improvements and operational efficiencies in the asset inspection and maintenance planning process. We estimate the potential efficiency gain of up to a 30% reduction in effort for on-site scoping activities and a 20% reduction for maintenance planning activities compared to current practice. We also estimate further efficiencies after five years: 30% reduction in preliminary project scoping effort, 15% reduction in design effort and 25% reduction in survey effort for new projects.

- Improved safety for above ground asset inspections. The program will enable the use of pole-mounted cameras to be phased out from 2028/29, replaced by a process whereby asset inspectors can perform any detailed inspections required by reference to up-to-date imagery from the drone survey. This will eliminate risks associated with the use of the pole cameras, reduce on-site inspection times, and increase the effectiveness of the inspection program.

- FTE savings across network assets and operations group. This will facilitate information exchange between different teams, reducing double-handling of data, improving cross-functional collaboration and reducing errors. While no quantifiable efficiency gains have been assumed in the next regulatory period, the estimated potential long-term opportunity is a saving of 1-1.5 FTE across this group.

- Improved capital work delivery. This program can improve the overall efficiency of work planning, prioritisation, scheduling, and delivery for JEN's network capital programs in numerous ways. JEN estimates a 0.5% efficiency gain compared to current practice within five years of project commencement, rising to 2% over the following five years.

- Potentially unlock significant latent thermal capacity. Early indications are that the program could unlock significant latent thermal capacity in the network, avoiding or deferring the need for augmentation or, reducing the cost by enabling works to be targeted more effectively. Our goal for this use case is to achieve a 5% reduction in network augmentation costs associated with overhead conductor thermal constraints compared to historical levels, within five years of program commencement.

- Other benefits (not quantified). The program will help with assessment of long-term climate and other risks, inform risk mitigation strategies and facilitate more effective coordination of post-incident recovery efforts.

- The program will allow for improved communications with customers seeking to connect to the network, developers seeking to build structures near to the network, landowners with trees close to the network, and other stakeholders interested in current state or future plans for parts of the network. This is consistent with our customers expectation that JEN should provide ongoing service excellence.

- Safety-in-design improvements, by enabling a greater range of potential future hazards or failure modes to be assessed on the desktop during the design process for new connections or other works.
- Long-term reduction in number and duration of customer outages by enhancing per-asset assessment of condition and risk to inform maintenance priorities.
- Automatic correction of errors in GIS.

Risks

- JEN is unable to deliver the proposed program. This risk is low as the use-cases have been successfully demonstrated by other DNSPs as well as JEN's trials in 2022.
- JEN will not have the resources to deliver the program given other future digital programs proposed for the next regulatory period. This risk has been mitigated through a top-down review of resource requirements and deliverability across the whole digital portfolio. Our digital technical plan articulates our delivery strategy for our proposed digital projects in the next regulatory period.
- JEN will be unable to embed new processes. This has been mitigated by ensuring an adequately-staffed core team to support the introduction of the technology, supported by dedicated business process change resources as well as a staged implementation approach.
- Risk that reliance on technology leads to an undetected fault. This risk is low as the proposed plan takes a conservative approach where the technology will complement the current practices rather than replace them.
- Risk of incident with aircraft or drone. To mitigate this JEN proposes to engage an experienced third-party to undertake aerial LiDAR surveys and will consider safety record and risk management processes when selecting a provider.

Option 3: Establish LiDAR and network digitisation program - with annual LiDAR surveys in HBRA and rolling 5-year survey of LBRA

Description

JEN will undertake annual LiDAR surveys in HBRA and 5-yearly (20% per annum) LiDAR capture in LBRA. This option includes the same core elements as option 2 but omits the full LiDAR survey of the LBRA in year 2, commencing instead with the rolling 5-year survey program.

Direct Escalated Costs

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

$2024 million		RY27	RY28	RY29	RY30	RY31
Capex	Digital				$1.2	$2.0
	Asset					
Opex	Digital Nonrecurrent					
	Digital Non Recurrent Step					
	Digital Recurrent Step				$0.1	$0.1
	Asset					
Total					**$1.3**	**$2.1**

Benefits

- We will realise the same quantified benefits set out for option 2 although at a lower level given delays in realising the full benefits of the program. Under this option, only 20% of the LBRA is captured each year and so it is not until year six that a 3D model and the associated reports, analytics and design tools would be available for the whole network.
- We estimate the present value of quantified benefits to be $14M at 10 years economic life, compared to $17M for option 2. Our cost-benefit analysis model, submitted together with this investment brief, shows how we have quantified the benefits.
- There is a significant cost reduction from option 2 due to omitting the full LiDAR survey of the LBRA in year 2 and commencing it instead with the rolling 5-year survey program. The cost of LiDAR data capture and classification is directly proportional to the number of network spans surveyed and is a material component of the overall program cost.

Risks

- A disadvantage of this option is that it delays the realisation of many of the intended benefits (discussed in option 2 above), as it is not until year six that a 3D model and the associated reports, analytics, and design tools would be available for the whole network.
- While LBRA are traditionally considered as lower risk areas compared to HBRA, extreme weather events due to climate change are becoming more unpredictable such that LBRAs can also be affected at any time. Commencing the full LiDAR survey at a later date will not mitigate this risk.
- The risks identified for option 2 applies to option 3 as well.

Option 4: Establish LiDAR and network digitisation program - with annual LiDAR surveys in HBRA and 3-yearly LiDAR survey in LBRA

Description

JEN will undertake annual LiDAR surveys in HBRA and 3-yearly (33% per annum) LiDAR capture in LBRA. This option includes the same core elements as option 3 but will use a 3-year rolling cycle to survey LBRA instead of 5-year rolling cycle.

Direct Escalated Costs

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

$2024 million		RY27	RY28	RY29	RY30	RY31
Capex	Digital				$1.2	$2.4
	Asset					
Opex	Digital Nonrecurrent					
	Digital Recurrent Step				$0.1	$0.1
	Asset					
Total					**$1.3**	**$2.5**

Benefits

- We will realise the same quantified benefits set out for option 3 but at faster pace (but delayed compared to option 2). Under option 4, only 33% of the LBRA is captured each year and so it is not until year four that a 3D model and the associated reports, analytics and design tools would be available for the whole network.

- We estimate the present value of quantified benefits to be -$2.3M at 10 years economic life. Our cost-benefit analysis model, submitted together with this investment brief, shows how we have quantified the benefits.
- There is a significant cost reduction from option 2 due to omitting the full LiDAR survey of the LBRA in year 2 and commencing it instead with the rolling 3-year survey program. However, it has higher cost compared to option 3. The cost of LiDAR data capture and classification is directly proportional to the number of network spans surveyed and is a material component of the overall program cost.

Risks

- A disadvantage of this option is that it delays the realisation of many of the intended benefits, as it is not until year four that a 3D model and the associated reports, analytics, and design tools would be available for the whole network.
- While LBRA are traditionally considered as lower risk areas compared to HBRA, extreme weather events due to climate change is becoming more unpredictable such that LBRAs can also be affected at any time. Commencing and completing the full LiDAR survey in year four will not mitigate this risk.
- The risks identified for option 2 applies to option 4 as well.

Quantitative Analysis

The table below summarises the quantitative differences between the analysed options.

	Capex ($2024M)		Opex ($2024M)		Totex ($2024M)		NPV
	Asset	Digital	Asset	Digital	Asset	Digital	
Option 1	-	-	-	-	-	-	-
Option 2	-	$5.4	-	$0.2	-	$5.6	$1.7
Option 3	-	$3.3	-	$0.1	-	$3.4	$1.1
Option 4	-	$3.6	-	$0.1	-	$3.7	($1.5)

Options Summary

Option 1

JEN does not consider the do-nothing option credible. JEN recognises that its lack of capability in this area and inability to take advantage of the benefits of these established technologies now falls significantly behind good industry practice in the sector and should be addressed.

Option 2

This option allows Jemena to achieve operational efficiencies and improved customer outcomes in the areas of vegetation management, bushfire risk management, asset maintenance, network planning for augmentation and replacement, network resilience and work delivery. This option allows us to develop this capability earlier, therefore realising benefits for our network and customers sooner.

Option 3

Option 3 has significantly lower cost compared to option 2 but this is at the expense of delayed realisation of some benefits related to LBRA LiDAR survey. JEN does not support delaying the full survey of LBRA given increasing unpredictability of extreme weather events.

	Option 4 Option 4 has significantly lower cost compared to option 2 and higher cost compared to option 3. Option 4 also allows JEN to achieve operational efficiencies and improved customer but at lower level compared to options 2 and 3 (over a ten-year period). This has resulted in a net present value much lower than for options 2 and 3. Similar to our view on option 3, JEN does not support delaying the full survey of LBRA given unpredictability of extreme weather events.
What We Are Recommending	Option 2 is our preferred as it has the highest forecast NPV of the options considered. It also reflects best industry practice. This option will enable us to have a complete 3D model (and the associated reports, analytics and design tools) of the network by year 2 of the program implementation. This will enable us to use the collected information to start developing our plans in relation to, for example, vegetation management, asset inspections and other uses, early on.
Risks of not undertaking the program in the 2026-31 regulatory period	While we are aiming to start the program in the next regulatory period, we are also mindful of our customers' concerns about affordability, hence our proposed approach to implement the project across two regulatory periods. The capability development phase will run over four years commencing in the 2029-30 regulatory year, with a transition to Business As Usual (BAU) operations thereafter.
Cost Estimation	A bottom-up build was used to estimate costs for our preferred option, the details of which are below. Based on our experience gained with the pilot project conducted in 2022 (outlined in the Background section above), we have further built on our understanding of costs involved with the engagement of consulting firm, 'Energy Horizons' who have applied their expertise in determining forecast costs. A 'bottom-up' build of costs includes capex associated with Jemena staff, LiDAR capture and photographic surveys provided by a third party, analysis and integration with JEN systems. Opex includes costs associated with external data storage of aerial photography.

			Total direct (2024$M)	Effort (days)	Comment
Digital	Capex	Internal labour	$1.8		Planning & project design, Jemena staff costs
		Contract labour	$3.4		LiDAR capture & classification
		Internal hardware			
		Internal software			
		External labour			
		External hardware			
		External software	$0.2		Software, analytics & data storage
		Subtotal	***$5.4***		
	Opex	Internal labour			
		Contract labour			
		Internal hardware			
		Internal software			

			External labour			
			External hardware			
			External software	$0.2		Software, analytics & data storage, recurring costs in future years
			Subtotal	***$0.2***		
	Network	Capex	Internal labour			
			Contract labour			
			Subcontract			
			Plant and Equipment			
			Subtotal			
		Opex	Internal labour			
			Contract labour			
			Subcontract			
			Plant and Equipment			
			Subtotal			
	Total	**Capex**		***$5.4***		
		Opex		***$0.2***		
Dependencies on other Investment Briefs	Not applicable					
Relationship to ICT Capital Forecast	For ICT capital forecast, refer to detailed “Network Assets Digital Twin Program” justification paper and “Network Assets Digital Twin Program - CBA Model.xlsb”.					