Jemena Electricity Networks (Vic) Ltd

JEN – RIN – Support – Data Visibility and Analytics Program – 20250131

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Abbreviations

Abbreviation	Description
ADMS	Advanced Distribution Management System
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMI	Advanced Metering Infrastructure
APVI	Australian PV Institute
ARENA	Australian Renewable Energy Agency
CAPEX	Capital Expenditure
CECV	Customer Export Curtailment Value
CER	Consumer Energy Resources
CVR	Conservation Voltage Reduction
DAPR	Distribution Annual Planning Report
DER	Distributed Energy Resources
DERMS	Distributed Energy Resource Management System
DMO	Distribution Market Operator
DNSP	Distribution Network Service Provider
DOE DPF	Dynamic Operating Envelope Distribution Power Flow
DPV	Distributed Solar PV
DR	Demand Response
DSO	Distribution System Operator
DSS	Distribution Substation
DVM	Dynamic Voltage Management
EDCOP	(Victorian) Electricity Distribution Code of Practice
ESC	Essential Services Commission
EV	Electric Vehicle
GIS	Geographical Information System
GWh	Giga Watt hour
HV	High Voltage
IASR	Inputs, Assumptions and Scenarios Report
IED	Intelligent Electronic Device (Digital Relay)
IT	Information Technology
JEN	Jemena Electricity Networks (Vic) Ltd
kV	Kilo Volt

Abbreviation	Description
kVA	Kilo Volt - Ampere
LDC	Line Drop Compensation
LiDAR LV	Light Detection and Ranging Low Voltage
MVA	Mega Volt Ampere
MVAr	Mega Volt Ampere Reactive
MW	Mega Watt
MWh	Mega Watt hour
NEM	National Electricity Market
NER	National Electricity Rules
NMS	Network Management System (AMI Itron backend)
NPV	Net Present Value
OLTC	On-Load Tap-Changer
OPEX	Operations and Maintenance Expenditure
OSII	Open Systems International Incorporated
OT	Operational Technology
PQ	Power Quality
PV	Photovoltaic
PVR	Present Value Ratio
SCADA	Supervisory Control and Data Acquisition
SIQ TNSP	Sensor IQ (Itron AMI metering product) Transmission Network Service Provider
TS	Terminal Station
UFLS V2G	Under Frequency Load Shedding Vehicle to Grid (discharging)
VPP	Virtual Power Plant
VRR	Voltage Regulating Relay
VVC	Volt - VAr Control
ZSS	Zone Substation

Overview

This Data Visibility and Analytics (DVA) Strategy forms part of Jemena Electricity Network's (JEN's) CER Integration Strategy (CERIS). It supports JEN's strategic objective of connecting its customers to a renewable energy future, by facilitating the integration of Consumer Energy Resources (CER) into the electricity distribution network and facilitating the electrification of the economy.

The digitisation megatrend has resulted in the proliferation of digital data (e.g. smart meter power quality data) and technologies (e.g. Advanced Distribution Management System (ADMS)). JEN recognises that digital data and analytics could:

- Deliver operational (e.g. detect network faults and incorrect GIS (Geospatial Information Systems) records and safety (e.g. detect broken supply neutral conductors) improvements;
- Facilitate compliance with current and evolving regulatory requirements (e.g. voltage compliance reporting, and data visibility sharing with 3rd parties); and
- Enable JEN to adapt to CER growth with data-driven tools (e.g. CER growth hosting capacity forecast tool) and solutions (e.g. Dynamic Voltage Management (DVM), and DER Management System (DERMS)).

The goals of this DVA program are to:

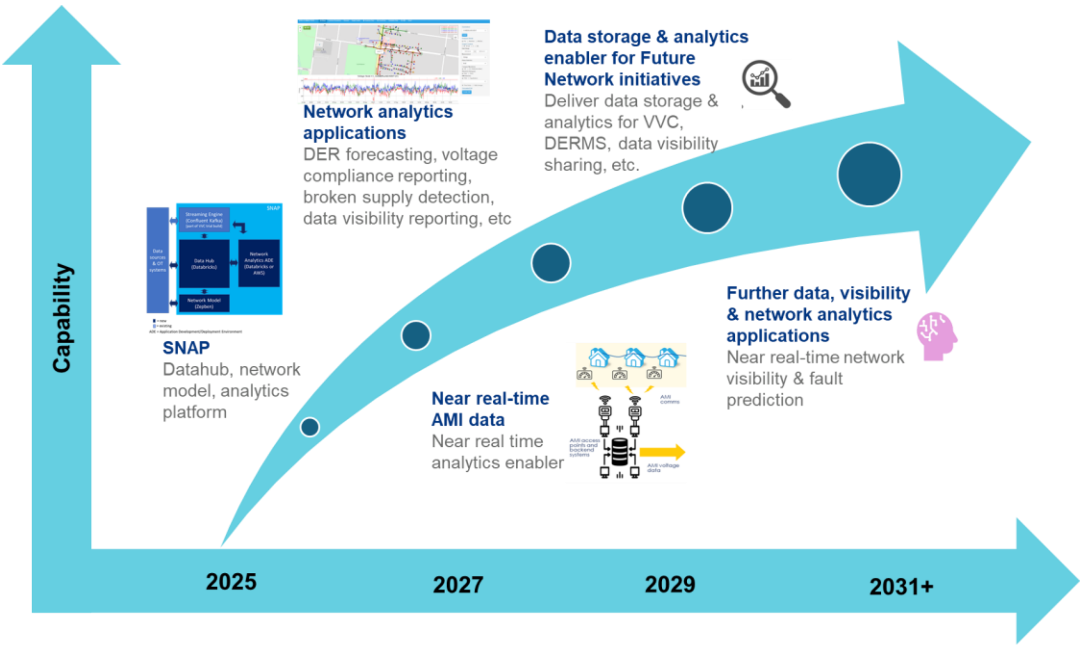
- Increase JEN's ability to use network data and analytics to drive operational and planning improvements;
- Position JEN to manage the energy transition and uncertainties ahead by having a flexible and adaptable data and analytics capability; and
- Build foundation data and analytics capabilities once and then use it to support future network analytics initiatives and avoid duplication of capabilities.

To deliver these goals, the DVA program includes:

- Implementing a Strategic Network Analytics Platform (SNAP) that only needs to be built once to support a number of CERIS and broader initiatives, instead of building siloed platforms for each initiative;
- Enhancing the smart metering infrastructure to deliver near real-time (5 minutes) smart meter power quality data to enable further operational and safety improvements such as near real-time power quality investigations and predictive fault detection; and
- Implementing a program of network analytics applications to improve operational efficiency and effectiveness, improve safety, and respond to emerging customer and regulatory needs over the next 10 years and beyond.

The proposed roadmap for the development of JEN's DVA capabilities to meet its business needs for the next 10 years is illustrated in Figure 1.1-1.

Figure 1.1-1 JEN's Data Visibility and Analytics Roadmap



The program has identified that there is an economic case to invest in a Data Visibility and Analytics solution over the next 10 years, with some investments starting now.

The Data Visibility and Analytics program sets out a least-regrets investment roadmap providing a prudent optimum balance between risk, performance, cost, timing and uncertainty, to meet the identified needs in this strategy.

Table 1-1 presents the net economic value of the Data Visibility and Analytics solution roadmap for various development options for the regulatory control period, spanning 1 July 2026 to 30 June 2031 (next regulatory period).

Table 1-1 –Program Roadmap Economic Evaluation by Options for 2026-2031 Regulatory Period[1]

Economic Evaluation Results	Option 1 - Do Nothing	Option 2 -Project-by-project Data Analytics	Option 3 - SNAP, Near Real-Time Smart Meter Data, and Network Analytics Program'
Total Costs ($M)	36.7	30.0	18.4
Present Value Costs ($M)	29.8	26.7	25.8
Present Value Benefits ($M)	0.0	54.3	75.6
Net Present Value (NPV) ($M)	-	27.6	49.8
Present Value Ratio (PVR)	0	2.0	2.9

The economic analysis of the options suggests that Option 3 – "SNAP, Near Real-time Smart Meter Data, Network Analytics Program" maximises the present value of net benefits, and is therefore the recommended development path.

It is recommended that JEN adopt the strategic roadmap detailed in this Data Visibility and Analytics program.

[1] Direct escalated costs (including overheads), 2024 dollars.

1. Strategic need

1.1 Need for data and analytics

JEN is faced with operating in a rapidly changing energy landscape. Disruptive impacts on distribution networks are triggered by the way electricity networks are used by customers and transition to distributed renewable energy resources, as we know it today.

Customer Energy Resources (CERs) are continuing to increase in numbers and will ultimately become a crucial resource in future to support, manage and utilise within the distribution network. Already JEN has seen strong growth in network-connected, passive distributed solar photovoltaic (DPV) system installations by its customers, and this is likely to continue well into the future. Other emerging, potentially more active CER technology (including customer and community storage, and electric-vehicles), present further challenges and opportunities for network integration of CER and the accelerating pace of electrification.

To adapt and respond to the CER growth, we have proposed a number of CERIS initiatives that require data and analytics:

- In the Voltage and PQ Management program, we have identified the need for a Dynamic Voltage Management (DVM) system. DVM requires data and analytics, including near real-time smart meter power quality data, a data streaming platform to process the power quality data, and analytics for performance monitoring.
- In the Grid Stability program, we have identified the need for a CER Management System (DERMS). DERMS requires data and analytics, including near real-time data, a data streaming platform to compute Dynamic Operating Envelopes (DOEs), data storage, and analytics for performance monitoring.

JEN has currently developed a number of network analytics applications on a digital prototyping (single on-premises) platform. Although these applications (such as broken supply neutral detection and voltage compliance reporting) have delivered operational benefits, the existing prototyping platform is not of commercial grade, is not supported by JEN Digital, and is reaching end-of-life. Jemena currently has a backlog of prioritised analytics applications for development.

JEN also needs the ability to adapt to emerging customer and regulatory needs. For example, providing data and analytics products to 3rd parties as explored through the AER/ Department of Energy, Environment and Climate Action (DEECA) Victorian Network Visibility data trials[2] in Victoria.

As noted by the AER in its Low-voltage network visibility: Summary of neighbourhood battery trials, the trials found that data available to the Neighbourhood Battery Initiative (Victoria) (NBI) was not suitable to their needs. The trial also noted that a balance is needed between additional works by distribution networks to provide data visibility and the extent of costs that are ultimately passed on to consumers.

This DVA program aims to address the above identified needs and existing analytics platform limitations.

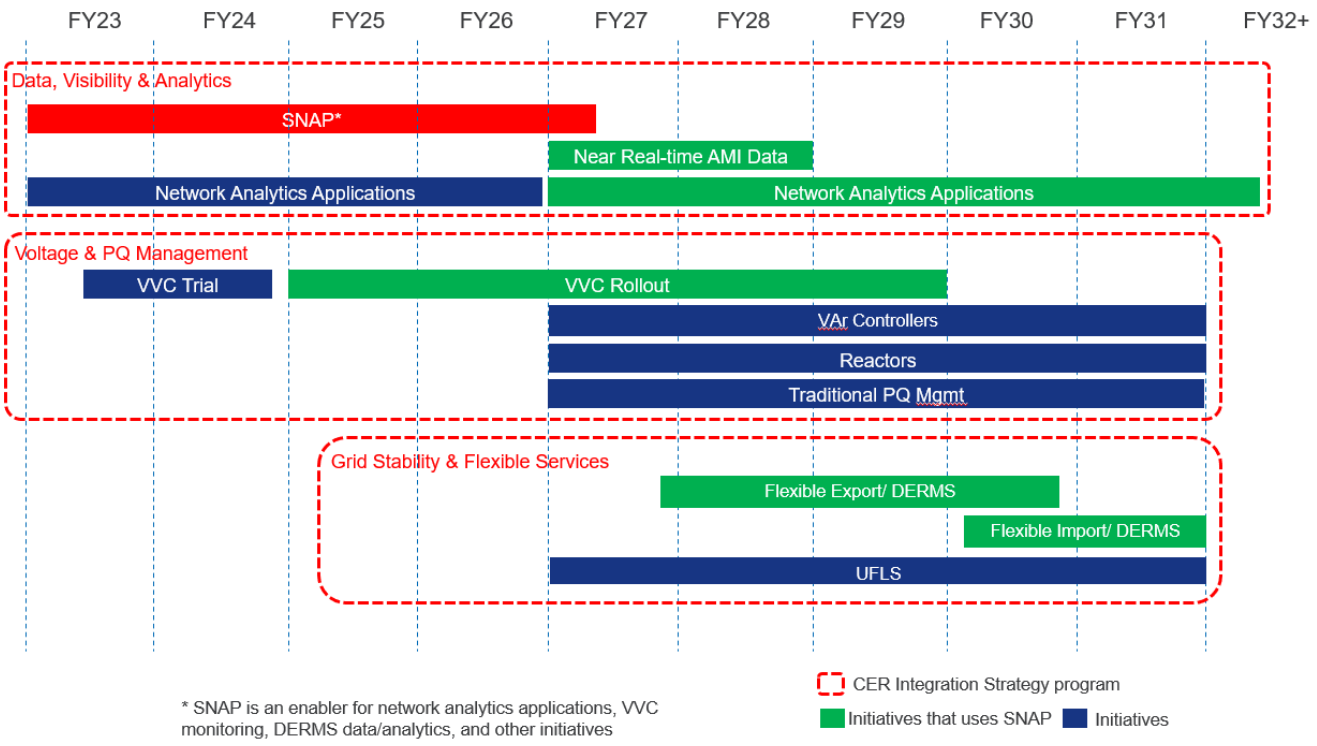
1.2 Alignment with JEN's CER Integration Strategy

JEN's CERIS identified a number of initiatives in the next 5 to 10 years. Many of these initiatives require data and analytics. A key component of this DVA program is a Strategic Network Analytics Platform (SNAP). Our strategic intention is to build SNAP once and then use it to deliver a number of the planned CERIS and other initiatives, as illustrated in the CERIS and other initiatives capability development timeline (Figure 1.2-1) below. This is a more efficient approach than building a data and analytics platform for each initiative.

[2] https://www.aer.gov.au/industry/registers/resources/reviews/network-visibility and AER, Low-voltage network visibility: Summary of neighbourhood battery trials, October 2024.

Figure 1.2-1 below shows that SNAP (in red) in the DVA program is an enabler for a number of initiatives (in green) in JEN's CERIS and other initiatives.

Figure 1.2-1 JEN's CER Integration Strategy & Other Initiatives – Capability Development Timeline



Despite SNAP being an enabler of Grid Stability, Voltage & PQ Management, and Network Assets Digital Twin programs, there is no double-counting of benefits or costs. The enabling capabilities of SNAP are the data and analytics platform used by the other programs. The cost of those programs assumed that a SNAP is available to them.

The benefits of SNAP (claimed in this program of relevance to the other programs) is the avoided cost of building and operating a data and analytics platform on a project-by-project basis. The costs of SNAP (in this program) is the cost of building the SNAP platform.

2. Needs Analysis

2.1 Regulatory Obligations

Data and analytics applications that are needed to deliver current and evolving regulatory obligations are listed in Table 2.1 below.

Table 2.1 Network Analytics Applications to Meet Regulatory Obligations

Application	Description	Benefits
High supply impedance (broken supply neutral) detection	Automated detection of broken supply neutral, triggering field crew investigation and repair	Energy Safe Victoria (ESV) Act compliance; replace the 1 in 10 year Neutral Supply Test; customer and field crew safety; avoided costs of [redacted] p.a.
EDCoP voltage compliance	Deliver voltage compliance reports for the ESC to meet EDCoP (Electricity Distribution Code of Practice).	Compliance with ESC requirements; customer safety
Power quality visualisation of LV network	Power quality engineers using the visualisation tool to Investigate quality issues and customer complaints	Compliance with prescribed voltage and PQ limitations in EDCoP; avoided field crew on site investigations of [redacted] p.a.; quicker customer complaint resolution
Phase balancing	Detect phase imbalance and recommend phase balancing	Compliance with prescribed voltage and PQ limitations in EDCoP
Voltage visualisation heatmaps	Over and under voltage heatmaps of zone substation and distribution substation areas	Help the operational team to monitor and manage compliance with prescribed voltage and PQ limitations in EDCoP
Wrong connections detection	Detect customers whose connection on the LV circuit is not correctly recorded on GIS	Avoid planned outage compliance breaches - failure to notify customers of planned outages
DVM performance monitoring	Monitor DVM voltage management performance	Support of the DVM rollout and ongoing operations – contributing to VVC benefits that include EDCoP voltage compliance.
DER LV and HV power flow forecasting	Model LV and HV power flows for forecasted DER growth	To meet emerging regulatory obligations, including Basic Export Limit computation and Dynamic Operating Envelope
Regulatory data access and visualisation	Deliver data access and visualisation as required by regulatory bodies, such as the AER/DEECA Victorian Network Visibility data trials[3]	Comply with regulatory obligations
Broken street neutral detection	Detect broken street neutrals	EDCoP compliance - prescribed voltage and PQ limitations
Network performance dashboard	Dashboard showing voltage and power quality status across the network	Operational support of the electricity network – improve ability to respond faster to voltage and power quality issues for EDCoP compliance
Customer onboarding DER PQ voltage check	Automatically conducting PQ check before onboarding DER (part of new connection tool)	Operational support of the electricity network – support EDCoP voltage and power quality compliance

[3] https://www.aer.gov.au/industry/registers/resources/reviews/network-visibility

Application	Description	Benefits
Proactive identification of impending network electrical failures	Use near real-time PQ data and LV power flow model to detect trends in currents and other measures that could indicate impending faults	Operational support of the electricity network – support EDCoP voltage and power quality compliance; reduce customer faults and improve customer satisfaction; avoid network costs by replacing equipment before failure occurs
DER compliance analytics in near RT	Use near real-time PQ data to determine if DERs comply with dynamic import/export limits (possibility funded via Grid Stability project)	Operational support of the electricity network – support EDCoP voltage and power quality compliance; to meet regulatory requirements for Grid Stability and Dynamic Import/Export Limits

2.2 Enabler for CERIS and other initiatives

The SNAP investment (comprising Stream Processing Engine, Data Hub, Network Model, and Analytics Development Environment) is an enabler for a number of upcoming JEN's CERIS and other initiatives:

- **VVC (Volt-VAr Control)**: VVC uses near real-time (5 min) AMI data as the input signal in the closed-loop control of zone substation transformer tap changes. The VVC solution will require a Stream Processing Engine to manage the processing of the AMI data. We will also require Data Hub for data storage and Analytics Applications to monitor the performance of the VVC solution.
- **DERMS (Distributed Energy Resources Management System) and DOE (Dynamic Operating Envelopes)**: The computation of DOE for DERMS will require a Stream Processing Engine and a Network Model. We will also require Data Storage and Analytics Applications to monitor the performance of a DERMS solution.
- **Network Analytics Applications**: This program includes the development and delivery of network analytics applications to improve operation performance and customer safety and comply with emerging regulatory requirements. Developing and delivering the applications will require SNAP capabilities.
- **Network Assets Digital Twin**: The Digital Twin will involve the storage of new data types such as Classified LiDAR data and high resolution images, and Analytics processing, which can be delivered with SNAP.

2.3 Near real-time analytics

JEN's planned rollout of DVM will enable the capture of near real-time (5 – 15 min delivery) smart meter power quality data for almost 80% of the JEN smart meter population, through the installation of AMI telecommunications Access Points (in addition to the existing ones). This DVA program initiative aims to raise the smart meter power quality data capture in near real-time to over 90% of the JEN smart meter population, by investing in further AMI Access Points. This additional near real-time smart meter power quality data population coverage is a foundational investment that will enable:

- **Operational improvements**: For example, the data enables the detection and prediction of network issues (such as impending transformer overloads), and helps to prioritise remediation works or asset replacements. It could delay or bring forward works.
- **Maintain service levels in the face of increasing climate risk**: For example, the data enables the detection and prediction of impending power quality issues and asset failures by having near real-time visibility of voltage, currents and power factor.
- **Customer satisfaction improvements**: For example, the data enables the early detection of power quality issues so that JEN can resolve the issues before they cause significant customer impacts.

2.4 Risks and opportunities

There are a number of risks that need to be assessed and managed for the do-nothing option. These are described below in the context of DVA.

The inherent DVA risks under the status-quo include:

- JEN analytics currently delivers ongoing avoided cost of [redacted] p.a. to meet Energy Safe Victoria (ESV) Act's 1 in 10-year Neutral Supply Test obligation. Given that the existing network analytics prototype platform is reaching end-of-life, the do-nothing option will result in the need to re-instate the on-site 1 in 10 year Neutral Supply Test for each customer, at a cost of **~[redacted] p.a.**
- JEN analytics currently delivers remote power quality investigations and avoided on-site power quality investigations at a cost of ~$0.75M p.a. Given that the existing network analytics prototype platform is reaching end-of-life, the do-nothing option will result in the ongoing cost of **~[redacted] p.a.**
- JEN analytics currently delivers meter tampering detection for the support of the electricity network. The do-nothing option will result in a loss of the recovered revenue of **~[redacted] p.a.**
- Without SNAP, each CERIS and other JEN initiatives will have to implement data and analytics in a project-by-project basis resulting in cost and time inefficiencies. We estimated that a SNAP approach could save [redacted] in delivery costs and [redacted] **p.a.** in ongoing operational costs, if implemented with the following CERIS and other initiatives: DVM, DERMS, network analytics program, and Network Assets Digital Twin.
- Without near real-time smart meter power quality data, a number of operational improvements and initiatives (e.g. DOE for DERMS) including evolving regulatory compliance could not be delivered. There is a risk that JEN will not be able to meet emerging regulatory compliance requirements in a timely and cost-effective way without near real-time smart meter power quality data.
- New network analytics applications deliver a number of benefits including evolving regulatory compliance, reporting and data visibility, operational improvements, and customer safety. Without the program of network analytics applications these benefits could not be realised. There is a risk that JEN will not be able to meet emerging regulatory compliance requirements in a timely and cost-effective way without the program of network analytics applications.

The key needs for DVA can be summarised into:

- **Strategic data and analytics enabler** – SNAP is a data and analytics enabler, that is more cost effective and efficient if built once for use by multiple CERIS and other JEN initiatives rather than building on a project-by-project basis;
- **Evolving regulatory compliance** – improved ability to comply with evolving compliance reporting, data sharing, and compliance management needs;
- **Operational and customer safety improvement** - Using analytics to automatically detect power quality issues, avoid on-site visits, and for future network planning; and
- **CER management enablement** – provide the analytics platform and data to support CER management capabilities such as DVM and DERMS in the CERIS.

The project implementation risks (which apply to any but the do nothing option) include:

- Electricity network risk – Risk to the electricity network if analytics use cases with operational impact has errors. The mitigation will be to do comprehensive testing prior to release, monitor for errors, and have processes in place to safely recover from errors;
- Electricity network risk – Risk to the electricity network if analytics use cases with operational impact encountered cyber-attacks. The mitigation will be to design the solution with appropriate cyber-security protections in place;
- Delivery risks – Dependency on availability of key resources (SMEs and field resources) is a risk. The mitigation is to have appropriate resourcing contingency and skills development plan in place, and to ensure that the project schedule is aligned with realistic resources availability;

- Delivery risks - Delays due to complexities of implementing new equipment (such as the new Eberle VRR (Voltage Regulating Relay)). The mitigation is to derisk new equipment with lab-based proof-of-concept testing early in the project life-cycle to allow time to fix issues and minimise their impact on the overall project delivery timing.

3. Credible options

3.1 Summary of options

This section discusses how credible options are identified and developed into programs that can address the identified needs. The credible options are considered for their commercial and technical feasibility, deliverability, economic and financial benefits, as well as legal and regulatory implications. Options that do not have sufficient benefits to justify their cost, are not recommended. JEN has identified and considered the following options based on the needs identified in Section 2. These are described in Table 3-1.

Table 3-1: Summary of Options

Description	Advantages/Opportunities	Disadvantages/Risks
Option 1 | JEN to not invest further in a network analytics platform and applications. The existing prototype analytics platform to be decommissioned at end of life (December 2024)	Nil	Risks and opportunities identified in Section 2.4 will not be mitigated and realised respectively.
Option 2 | JEN to justify and implement data and analytics requirements on a project-by-project basis	Allows JEN to meet regulatory compliance and deliver operational improvements identified in Section 2.0. Realise DER enablement benefits of data and analytics. Allows JEN to meet customers' expectations. Our customers' feedback to the Draft Plan has ranked 2 and 3 the following JEN initiatives: – Upgraded systems to keep customers better informed with near real-time information at times they need it the most. – New digital technologies to improve electricity system management and enable new sustainable products and services.	Higher cost, effort and time with separate data and analytics platform implementation for each initiative. I.e. build a new data and analytics platform for each project instead of build once for all projects. This is not a prudent and efficient approach and not consistent with the AER's Better Reset Handbook. Further, this approach ignores our customers' concern about affordability. Less efficient management of project implementation risks.
Option 3 | JEN to invest in a SNAP, near real-time smart meter data, and an analytics program of work.	Allows JEN to meet regulatory compliance and deliver operational improvements. Realise DER enablement benefits of data and analytics. Lowest cost, effort and time with a strategic enabler approach providing long-term benefits. It meets our customers' expectations about systems upgrade and new digital technologies as discussed in option 2 above. More efficient management of project implementation risks.	Higher initial investment.

3.2 Option 1 – ‘Do Nothing’

Under Option 1, no additional capital works are considered that address the identified needs. That is, it assumes the status quo. The 10-year total capital cost of this option is $6.7M.

The unrealised benefits associated with the do-nothing approach are summarised in Table 3-2.

Table 3-2 – Quantification of unrealised value streams for Do-Nothing

Year	Unrealised Regulatory Compliance Benefits ($M) [Neutral Supply Test]	Unrealised Operational Improvements ($M) [PQ investigations, Fraud]
2026	[redacted]	[redacted]
2027	[redacted]	[redacted]
2028	[redacted]	[redacted]
2029	[redacted]	[redacted]
2030	[redacted]	[redacted]
2031	[redacted]	[redacted]
2032	[redacted]	[redacted]
2033	[redacted]	[redacted]
2034	[redacted]	[redacted]
2035	[redacted]	[redacted]
2036	[redacted]	[redacted]
2037	[redacted]	[redacted]
2038	[redacted]	[redacted]
2039	[redacted]	[redacted]
2040	[redacted]	[redacted]
2041	[redacted]	[redacted]
2042	[redacted]	[redacted]
2043	[redacted]	[redacted]
2044	[redacted]	[redacted]
2045	[redacted]	[redacted]
20-Year Present Value Total ($M)	[redacted]	[redacted]

3.3 Option 2 – Project-by-project data analytics

This option requires data and analytics requirements to be built for each CERIS and other initiatives on a project-by-project basis. The CERIS and other initiatives and their data and analytics requirements are outlined in Table 3-3 below:

Table 3-3 Project-by-project Data and Analytics Requirements of CERIS and other JEN initiatives

SNAP Capabilities	VVC	DERMS	Network Analytics Applications	Network Assets Digital Twin
Streaming Engine	Yes	Yes	Yes	
Data Hub (data storage)	Yes	Yes	Yes	Yes
Network Analytics	Yes	Yes	Yes	Yes
Network Model		**Yes**	**Yes**	

The total data and analytics cost of this option over the 2026-2031 regulatory period is $30.0 million (real 2024) as shown in Table 3-4 below.

Table 3-4 Data Visibility and Analytics Expenditure – Option 2

Project by Project	Indicative Year	Cost ($M)
VVC	2027-28	[redacted]
DERMS	2028	[redacted]
Network Analytics Apps	2027-31	[redacted]
Network Assets Digital Twin	2030	[redacted]
Near Real Time AMI data[4]	2027-28	[redacted]
Total Cost for 2026-2031 Regulatory Period	**2026-2031**	**30.0**

4 This is captured under the capital expenditure program for metering and is called ‘access points and relays’.

3.4 Option 3 – SNAP, near real-time smart meter data, network analytics program

This option recognised the on-going need for data and analytics and proposes a strategic platform (SNAP) that is built once and then used to service a number of CERIS and other JEN initiatives; near complete coverage of near real-time data (beyond DVM requirements); and a network analytics program that can deliver analytics applications (for regulatory compliance, operational and safety improvements, and DER enablement) over the next regulatory period.

The total data and analytics cost of this option over the 2026-2031 regulatory period is $20.5 million (real 2024) as shown in Table 3-5. The VVC, DERMS, and Network Assets Digital Twin have zero data visibility and analytics cost in Table 3-5 because their data visibility and analytics capabilities are covered by the SNAP investment cost.

Table 3-5 Data Visibility and Analytics Expenditure – Option 3

Project by Project	Indicative Year	Cost ($M)
SNAP	2026-31	[redacted]
VVC	2027-28	
DERMS	2028	
Network Analytics Apps	2027-31	
Near Real Time AMI Data[5]	2027-28	
Total Cost for 2026-2031 Regulatory Control Period	**2024-2031**	**18.3**

[5] This is captured under the capital expenditure program for metering and is called 'access points and relays'.

4. Economic evaluation

The key assessment used to compare the merits of the options considered is the present value of the net benefits (NPV) calculated for an unconstrained capex assessment. This represents the present value of the avoided risks, minus the costs. The JEN economic evaluation results and the ability of the options to realise the benefits is presented in Table 4-1, spanning the 2026-2031 regulatory period only.

Table 4-1 – 20-Year NPV of Options ($M, 2024)*[6]

	Option 1 – Do-Nothing	Option 2 - Project-by-project Data Analytics	Option 3 -SNAP, Near Real-time Smart Meter Data, Network Analytics Program
Total Cost	36.7	30.0	18.3
Present Value Cost	29.8	26.7	25.8
Present Value Ratio (PVR)	0.0	2.0	2.9
Net Present Value (NPV)	-	27.6	49.8
Present Value Benefit	0.0	54.3	75.6
Regulatory Compliance – NST	*0.0*	*32.9*	*32.9*
Operational (PQ+Meter)	*0.0*	*21.3*	*21.3*

The economic analysis of the options shows that Option 3 – “SNAP, Near Real-time Smart Meter Data, Network Analytics Program” maximises the present value of net benefits, and is therefore the recommended development path.

[6] This covers cost from 2026 for 20 years. Costs for the prior regulatory period are not included.

4.1 Preferred option

This strategy recommends developing:

- A SNAP that is a foundation capability for delivering data and analytics;
- The extension of JEN's near real-time (5 min) smart meter power quality delivery from almost 80% meter population coverage to over 90%, via the installation of additional AMI telecommunications Access Points to enable emerging near real-time network analytics applications; and
- A network analytics program of works that leverages SNAP, near real-time smart meter power quality data and developing new analytics applications (tools and processes) to deliver the following benefits:
  - evolving regulatory compliance,
  - operational and safety improvements, and
  - CER enablement.

The option that aligns with this strategic approach is Option 3 – "SNAP, Near Real-time Smart Meter Data, Network Analytics Program'. Option 3 delivers maximum benefits at least cost by building data analytics enablers (SNAP and near real-time smart meter data) and developing network analytics applications (network analytics program) to deliver emerging regulatory compliance, operational and customer improvements, and CER enablement benefits. SNAP provides a reusable and extensible data and analytics platform for supporting CERIS and other JEN initiatives into the future.

This option also allows JEN to meet the following customers' expectations at a lower cost.[7]

- Upgraded systems to keep customers better informed with near real-time information at times they need it the most.
- New digital technologies to improve electricity system management and enable new sustainable products and services.

> *'Furthermore, evaluating the cost-effectiveness of various components of the network strategy is important. Balancing investment in new technologies with the need for cost control can help in managing operational expenses and keeping customer bills reasonable.'*

4.2 Optimum Timing

The optimum timing of the deployment of the DVA solution is to start with the SNAP platform, followed by the near real-time smart meter data delivery and the network analytics program.

The optimum timing of the network analytics applications within the network analytics program will be guided by the business priorities of the applications at the implementation time. However, we propose to continually roll out the network analytics applications over the next regulatory period..

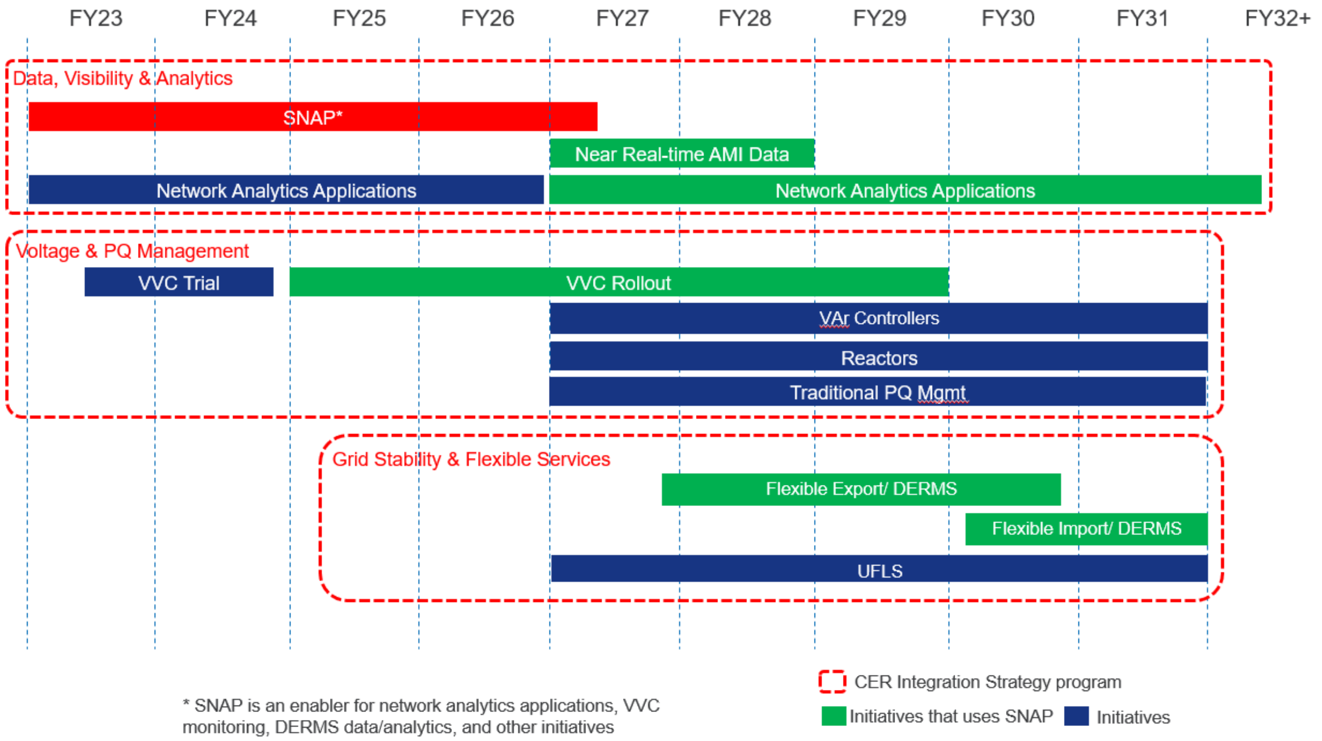
[7] JEN, *Feedback on 2026-31 Draft proposal*, September 2024.

5. Data Visibility and Analytics Solution

5.1 Data Visibility and Analytics solution

The DVA program has three main components: SNAP, Near real-time smart meter power quality data and Network analytics applications. Our proposed capability development timeline for our CERIS programs, including the DVA program is shown below. It shows that that SNAP (in red) in the DVA program is an enabler for a number of initiatives (in green) in JEN's CERIS and other initiatives.

Figure 5.1-1 JEN's CER Integration Strategy & other initiatives – Capability Development Timeline



In the following sections, we describe each component, their costs, benefits and our delivery approach of our DVA program.

5.1.1 SNAP

5.1.1.1 Description

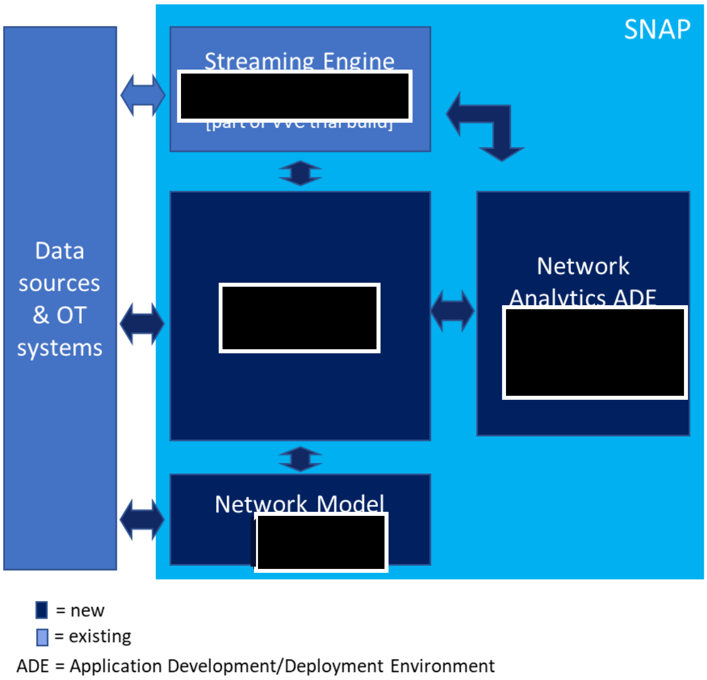
JEN has an existing prototype analytics platform that has reached end-of-life due to a number of shortcomings ,e.g. inability to process near real-time data volumes and capacity (e.g. processor and memory) limitations. The platform also has limited data quality assurance and governance, and limited IT support. To ensure the strategic need of the business (as described in section 1) is met a new network analytics platform is needed.

A key component of the DVA program is the foundation investment in a strategic data and analytics platform, SNAP.

Our strategic intention is to build SNAP once and then use it to deliver a number of CERIS initiatives as shown in the CERIS capability development timeline above. The key components of SNAP are listed below and shown in Figure 5.1-2 below:

- **Streaming Engine**: A near real-time data analytics processing capability to deliver near real-time data processing and events detection. This component is delivered as part of the DVM/VVC (Volt VAr Control) Future Network initiative.
- **Data Hub**: Data storage with a data management layer for data governance, access control, security, performance monitoring, etc.
- **Network Model**: Provides a standardised GIS (Geographical Information Systems) network model that also supports dynamic network states required for emerging analytics applications
- **Network Analytics Application Development Environment (ADE)**: A suite of tools and application development and production environments to enable the development and delivery of network analytics and visualisation applications.

Figure 5.1-2 Key SNAP Components



The SNAP components that need to support other CERIS initiatives are shown in the table below (Table 5-1) below.

Table 5-1 SNAP components required to support other CERIS Initiatives

SNAP capabilities	Initiative examples		
	VVC	DERMS-Full	Network Analytics
Streaming Engine	Yes	Yes	Yes
Data Hub	Yes	Yes	Yes
Network Analytics	Yes	Yes	Yes
Network Model		Yes	Yes

5.1.1.2 Delivery Approach

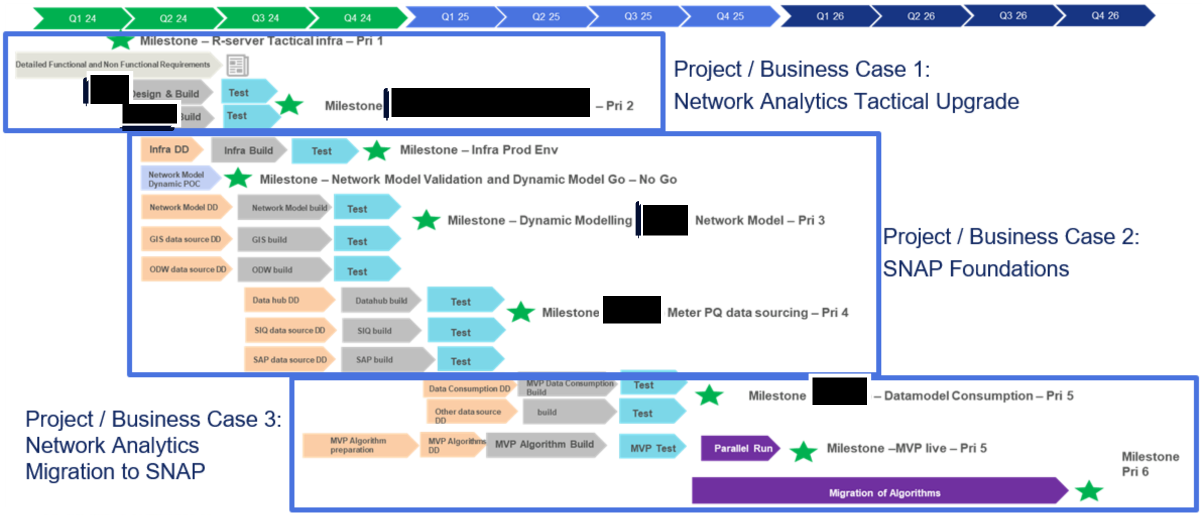
The SNAP is designed with the following design and delivery principles:

- Future Proof Design:
  - Open: Able to build/extend the platform; avoid vendor/product lock in
  - Modular: Able to make use of components independently; reusable
  - Extensible: Able to add future data types, volumes and velocity; adaptable to emerging needs
  - Manageable: Supports data and application security, governance, quality control, etc.
- Cost Efficient:
  - Design for future but only invest in core capabilities initially. Additional investments to be made as needed
  - Cloud-based resources paid on as needs basis
  - Ability to quickly and cost effectively deliver new applications to meet emerging regulatory and operational requirements.
- Pragmatic Staged Delivery:
  - Timing of delivery to meet annual budget limits and resource availability, while also meeting business needs (DERMS, regulatory timelines, etc)
  - Include tactical upgrade to existing analytics platform for transition period
  - Include migration of existing applications to SNAP so that existing platform can be decommissioned at end of SNAP delivery.

The staged delivery is split into 3 distinct projects with the high-level schedule shown in **Error! Reference source not found.** below.

- Project 1: Maintain existing applications by tactically upgrading the existing network analytics platform while SNAP is being built
- Project 2: Build SNAP foundations
- Project 3: Migrate existing applications to SNAP when SNAP is ready

Figure 5.1-3 High Level SNAP Delivery Schedule



The business outcomes and capabilities delivered with this staged delivery approach is summarised in Table 5-2 below.

Table 5-2 SNAP Staged Delivery Outcomes

Indicative Timing*	Business Outcomes	Capabilities Delivered
2024 **Project 1: Network Analytics Tactical Upgrade**	• Able to continue delivering current & new network analytics applications for next 3 years • VVC performance monitoring (on tactically upgraded platform)	• Tactically upgrade existing platform • Network Analytics ADE defined
2025 **Project 2: SNAP Foundations**	• Readiness for supporting network analytics, DERMS & VVC	• Data Hub & Network Model delivered • Network Analytics ADE delivered
2026 **Project 3: Network Analytics Migration to SNAP**	• MVP applications verified on SNAP • Migrate existing applications & VVC monitoring to SNAP • Can build new network analytics applications, DERMS, etc. on SNAP	

MVP = Minimum Viable Product
ADE = Application Development Environment
* There are overlaps in timing between each project

5.1.1.3 Costs

The SNAP staged delivery project cost estimates are summarised in the Table 5-3

Table 5-3 Estimated Cost of SNAP

Opex	[redacted]
SNAP opex – BC1 ongoing + NAP Opex	
SNAP opex - BC 2 one off	
SNAP opex – BC2 ongoing	
SNAP opex- BC 3 - one off	
SNAP opex – BC3 ongoing	
Gross Capex	
SNAP capex – BC1	
SNAP capex – BC2	
SNAP capex – BC3	

5.1.1.4 Benefits

SNAP is a technology enabler. It is a capability that is built once for use by multiple FNS initiatives, as shown above.

5.1.2 Near real-time smart meter power quality data

5.1.2.1 Description

The primary data source for JEN electricity network analytics applications is AMI (Advanced Metering Infrastructure) power quality data that is captured in 5 min intervals. Currently, JEN AMI data is delivered every 4 hours and processed every 24 hours (overnight).

To support emerging DVA applications, including detection and prediction of possible power quality issues, near real-time, 5 min to 15 min, of AMI power quality data is needed.

The ability to receive near real-time AMI power quality data is dependent on the number of AMI Network Communications Access Points (APs) in the mesh network, and the back-end AMI data infrastructure.

Higher levels of APs and back-end data infrastructure investments will provide higher delivery frequency from meters. For example, VVC requires metering data every 5 minutes for approximately 80% of the meters.

Implementation of APs and back-end AMI data infrastructure is dependent on a VVC Rollout that is planned for 2025-27.

Additional APs and back-end AMI data infrastructure investment will likely be required to support near real-time applications. For these applications, metering data collected every 5 minutes for 90-100% of the meters would be needed.

5.1.2.2 Delivery Approach

Our delivery approach is to start by installing APs that will allow metering data to be collected every 5 minutes for almost 80% of the JEN AMI meter population, as defined in the proposed VVC Rollout plans.

When that is completed, additional APs will be installed to provide 5-minute data collection for over 90% of the JEN AMI meter population and support near real time network analytics use cases.

5.1.2.3 Costs

Cost estimates for the additional AMI telecommunications Access Points needed are shown in **Error! Reference source not found.**4 below.

Table 5-4 Cost Estimates for Near Real Time Smart Meter Power Quality Data

Gross Capex	FY23	FY24	FY25	FY26	[redacted]	
Expenditure - RT AMI	-	-	-	-	[redacted]	

5.1.2.4 Benefits

Near real-time AMI data is a foundational investment that will enable:

- **Operational improvements** – For example, the data enables early detection of network issues (such as impending transformer overloads) and helps to prioritise remediation works or asset replacements. It could delay or bring forward remediation works.
- **Maintain service levels in the face of increasing climate risk** – For example, the data enables early detection of power quality issues and asset failures by having near real-time visibility of voltage, currents and power factor.
- **Customer satisfaction improvements** – For example, the data enables the early detection of power quality issues so that JEN can resolve the issues before they cause significant customer impacts.

5.1.3 Network Analytics Program

5.1.3.1 Description

At JEN, network data analytics started in 2018 with the availability of AMI power quality data. Network analytics applications such as the High Supply Neutral Impedance Detection have been implemented in a prototype analytics platform. The applications have delivered operational improvements, cost savings, customer safety and regulatory compliance.

Ongoing development of new network analytics applications will be needed to:

- Manage the uncertainties in energy transition. There is a need to deliver data and produce compliance regulatory reports more efficiently (reporting requirements for DEECA, AEMO, ESC, etc). For example, delivering data for the DEECA/AER Data Trial initiative.
- Support emerging OT capabilities such as VVC (Volt-VAR Control) and DERMS (Distributed Energy Resources Management Systems). For example, network analytics applications are needed to pre-process data for the systems (e.g. compute the $V_{1\%}$ and $V_{99\%}$ values for VVC) and to monitor the performance of the systems.
- Continue to deliver operational improvements through new applications so that network issues such as wrong connections and broken street neutral conductors are more efficiently identified.
- Continue to deliver operational improvements via applications such as DER forecasting power flow model, etc.

To meet these business needs, works to deliver new network analytics applications on the SNAP platform will be carried out. Examples of current network analytics applications (which will need to be updated) and new applications to be developed in the next few years and their benefits are listed in Table 5-5 5 below.

Table 5-5 Indicative Network Analytics Program

Ref	Application	Description	Benefits	Timeframe
1	High supply impedance detection (broken neutral) detection	Automated detection of broken neutral conductors, triggering field crew investigation and repair	Energy Safe Victoria (ESV) Act compliance; replace the 1 in 10-year Neutral Supply Test; Enhanced customer and field crew safety; avoided equipment failure costs of $[redacted] p.a.	2022 (existing)
2	EDCoP voltage compliance	More efficient delivery of voltage compliance reports for the ESC to meet EDCoP (Electricity Distribution Code of Practice)	Compliance with ESC requirements; customer safety	2022 (existing)
3	Power quality visualisation of LV network	More efficient investigation of quality of supply issues and customer complaints using the visualisation tool	Compliance with EDCoP's voltage limits and quality of power supply; avoided field crew on site investigations of $[redacted] p.a.; More efficient customer complaint resolution	2022 (existing)
4	Meter tampering detection	Fraud detection	Operational support of the electricity network Recovered revenue of $[redacted] p.a.	2022 (existing)
5	Meter fault detection	Meter fault detection	Operational support of the electricity network	2022 (existing)
6	Solar reliability report	Automated daily reports on solar reliability. Reports on CER ability to export solar	Customer satisfaction and solar hosting capacity metric	2022 (existing)
7	Phase balancing	Detect phase imbalance and recommend phase balancing	Compliance with EDCoP's voltage limits and quality of power supply	2023 (existing)
8	Voltage visualisation heatmaps	Over and under voltage heatmaps of zone substation and distribution substation areas	Help the operational team to monitor and manage compliance with EDCoP's voltage limits and quality of power supply	2023 (existing)
9	Substation issues and overload detection	Detect substation current overload and other issues	Operational support of the electricity network	2023 (existing)
10	Simulation of new load or solar PV - visualisation	Simulate the impact of new load or solar PV on LV network voltages and currents	Operational support of the electricity network – new connections study	2022 (existing)
11	Wrong connections detection	Detect customers whose connection on the LV circuit is not correctly recorded in GIS	Avoid planned outage compliance breaches - failure to notify customers of planned outages	2024 (new)
12	New connections automation	Provide data needed for new connections assessment	Operational support of the electricity network – determine if a new connection request will cause network issues	2025/26 (new)
13	VVC performance monitoring	Monitor VVC voltage management performance (part of VVC?)	Support the VVC rollout and ongoing operations – contributing to VVC benefits that include EDCoP voltage compliance	2024/26 (new)

Ref	Application	Description	Benefits	Timeframe
14	DER LV and HV power flow forecasting	Model LV and HV power flows for forecasted DER growth	To meet emerging regulatory obligations, including Basic Export Limit computation and Dynamic Operating Envelope	2024 (new - basic); 2026 (enhance)
15	Regulatory data access and visualisation	Deliver data and visualisation as required by regulatory bodies, such as the AER/DEECA Network Visibility trial	Comply with regulatory obligations	2024 onwards
16	Broken street neutral detection	Detect broken street neutrals	Avoided asset failure costs Customer safety EDCoP compliance - voltage limits and quality of power supply; (In 2018, a circuit neutral fault resulted in customer claims >$400K and negative press)	2024 (new)
17	DOE forecasting	Forecast DOE 24 hours ahead, based on power flow estimates and network constraints. (streaming engine and analytics) (cost of this use case is funded from Grid Stability project)	Support the “Grid Stability” DERMS regulatory compliance project	2025 (new)
18	HV capacitance model/ visualisation	Develop HV capacitance model and visualisation of it	Operational support of the electricity network – help the Planning Team	2025 (new)
19	Network performance dashboard	Dashboard showing voltage and power quality status across the network	Operational support of the electricity network – improve ability to more efficiently respond to voltage and power quality issues for EDCoP compliance	2025-26 (new)
20	Simulate add/transfer of load on DSS	Enable simulations of add/transfer of load on Distribution Substations on network visualisation tool for network planners and designers	Operational support of the electricity network – capability enhancement, reduce manual effort	2026 (new)
21	Simulate rewire of street / parallel	Enable simulations of rewire of street, including parallels, for network planners and designers	Operational support of the electricity network – capability enhancement, reduce manual effort	2026 (new)
22	Simulate flexible vs fixed export limits	Enable simulations of customer cost impact of flexible vs fixed export limits, to inform customers	Educate customers on impact (such as cost) of emerging market/regulatory mechanisms such as flexible import/export	2027 (new)
23	Customer onboarding DER PQ voltage check	Automatically conducting PQ check before onboarding DER (Part of new connection tool)	Operational support of the electricity network – deliver more efficient assessment of EDCoP voltage and power quality compliance	2027 (new)
24	Proactive identification of impending network electrical failures	Use near RT PQ data and LV power flow model to detect trends in currents and other measures that could indicate impending faults	Operational support of the electricity network – deliver more efficient assessment of EDCoP voltage and power quality compliance; reduce customer faults and improve customer satisfaction; avoid network costs by replacing equipment before failure occurs ($ benefits TBD)	2027 (new)

Ref	Application	Description	Benefits	Timeframe
25	Proactive identification of customer initiated or network related abnormalities	Use near RT PQ data and LV power flow model to detect abnormal network usage conditions	Operational support of the electricity network – trigger field and other investigations more efficiently on detection of abnormal network usage conditions	2027 (new)
26	DOE in near real time	Use near RT PQ data to determine near RT (e.g. 5 min) available import/export capacity and DOE for individual customers with DERs. (cost of this use case is funded from Grid Stability project)	To meet regulatory requirements for Grid Stability and Dynamic Import/Export Limits	2028 (new)
27	DER compliance analytics in near RT	Use near RT PQ data to determine if DERs comply with dynamic import/export limits (possibility funded via Grid Stability project)	Operational support of the electricity network – deliver EDCoP voltage and power quality compliance. To meet regulatory requirements for Grid Stability and Dynamic Import/Export Limits	2028 (new)
28	Near RT PQ data for field force (Electrical Digital Twin)	Deliver near RT PQ data for the field force and Control Room to have visibility of the electrical network for finding faults, monitoring conditions, etc Also incorporate dynamic switch states to form an electrical digital twin of network To be provided on mobile device for field force	Operational support of the electricity network – real time visibility of the electrical network	2029 (new)
29	Near RT network performance dashboard	Deliver near RT network performance dashboard that shows the current state of voltages, operating remote control switches, operating capacity of LV network elements, etc	Operational support of the electricity network – real time visibility of the performance metrics of the electrical network	2029 (new)
30	Reliability data validation automation	Automated validation of OMS outage data against other reports	Reduce by 2 weeks per month of manual effort required for RIN and monthly reliability reporting; more accurate STPIS reporting	2024 (new)

5.1.3.2 Delivery Approach

Our delivery approach follows the following principles:

- Prioritise applications based on business and customer benefits;
- Leverage SNAP investment and near real-time AMI power quality data;
- Adapt to evolving business needs through an internal agile team (Network Reliability and Intelligence Team working with Digital Analytics Team) that can scale with contractors where needed;

- Ability to take hybrid approach of building internal applications as well as vendor applications where it makes economic, strategic and/or competitive sense; and
- Develop expertise and retain IP (intellectual property) in internal teams where practical.

5.1.3.3 Costs

Cost estimates for the Network Analytics Program are shown in Table 5-6 below.

Table 5-6 Cost estimates for Network Analytics Program

Opex	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31
Network Analytics Program Opex	[redacted]								

5.1.3.4 Benefits

Built on the SNAP and near real-time AMI foundational investments, Network Analytics Applications could deliver benefits in the areas of:

- **Operational improvements**: such as replacing on-site power quality investigations with remote power quality visualisation tools, meter tempering detection, network planning tools;
- **Regulatory compliance**: ability to deliver evolving reporting requirements such as data development for the DEECA/AER Data Trial;
- **Maintain service levels in the face of increasing climate risk**: such as the prediction of impending power quality issues and asset failures by detecting near real-time trends in voltage, currents and other measurements;
- **Network data improvements**: applications to improve network data such as wrong GIS (Geospatial Information System) records detection and phase colour detection;
- **Customer safety improvements**: such as the detection of broken supply neutrals (high impedance detection);
- **Customer satisfaction improvements**: generate metrics that could impact customer satisfaction and help to prioritise network remediation works. For example, generate an index on solar export restrictions to prioritise LV remediation works.

5.2 DVA investment costs

Error! Reference source not found.9 lists the expenditures for the Data Visibility and Analytics Program to s upport this roadmap.

Table 5-7 – Data Visibility and Analytics Program Expenditure – Preferred Option 3

Data Visibility and Analytics Program	Indicative Year	Cost ($M)
SNAP	2026-31	[redacted]
VVC	2027-28	
DERMS	2028	
Network Analytics Apps	2027-31	
Mechanical Digital Twin	2030	
Near Real Time AMI data[8]	2027-28	
Total Cost for 2026-2031 Regulatory Control Period	**2026-2031**	

8 This is captured under the capital expenditure program for metering and is called ‘access points and relays’.

6. Findings and recommendation

This DVA program is required to support the other FNS initiatives. This can be achieved by building data analytics enablers (SNAP and near real-time smart meter data) and developing network analytics applications to deliver emerging regulatory compliance, operational and customer improvements, and DER enablement benefits. The needs can be best met by Option 3 which builds the enablers (SNAP, near real-time smart meter data) and delivers a network analytics program of works.

The DVA program has identified that there is an economic and strategic case to invest in a DVA solution over the next 10 years.

The DVA solution sets out a least-regrets investment roadmap providing a prudent optimum balance between risk, performance, cost, timing and uncertainty, to meet the identified needs in this program.

Table 6-1 presents the net economic value of the DVA solution roadmap for the next regulatory period, spanning 2026 to 2031.

Table 6-1 – Program Roadmap Economic Evaluation by Option for 2026-2031 Regulatory Period

Economic Evaluation Results	Option 1 - Do Nothing	Option 2 -Project-by-Project Data Analytics	Option 3 -SNAP, Near Real-time Smart Meter Data, Network Analytics Program
Total Capital Costs[9] ($M)	36.7	29.5	18.4
Present Value Costs[10] ($M)	29.8	26.7	25.8
Present Value Benefits ($M)	0	54.3	75.6
Net Present Value (NPV) ($M)	**-**	**27.6**	**49.8**
Present Value Ratio (PVR)	0	2.0	2.9

The economic analysis of the options shows that Option 3 – “SNAP, Near Real-time Smart Meter Data, Network Analytics Program” maximises the present value of net benefits, and is therefore the recommended development path.

7. References

- JEN Consumer Energy Resources Integration Strategy (CER Integration Strategy), 2024
- Victorian Electricity Distribution Code of Practice (EDCOP), Essential Services Commission, May 2023