ICT Infrastructure refresh and cloud migration

UE BUS 7.10 - Cloud infrastructure - Jan2020 - Public

Regulatory proposal 2021–2026

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Contents

1 Overview

Business	United Energy
Title	ICT Infrastructure refresh and cloud migration
Project ID	UE BUS 7.10 - Cloud infrastructure - Jan2020 - Public
Category	ICT capital expenditure and operating expenditure step change - recurrent
Identified need	Over the 2021–2026 regulatory period, we: • need to maintain the technical currency of our ICT infrastructure to ensure we continue to deliver a cost effective, safe, reliable and secure electricity supply, and maintain compliance with regulatory obligations • need to increase our storage capacity to accommodate data growth driven by customer growth and more data intensive approaches to network management and business operations • have an opportunity to migrate some applications to the cloud hosting to deliver benefits to customers.
Recommended option	Option 2—balanced cloud migration and refresh remaining on premise infrastructure
Proposed start date	2021/22
Proposed commission date	2025/26
Supporting documents	1. UE MOD 7.15 - Cloud infrastructure cost - Jan2020 - Public 2. UE MOD 7.16 - Cloud infrastructure risk - Jan2020 - Public 3. UE MOD 12.02 - Quoted services labour rate - Jan2020 - Public 4. UE ATT046 - BDO - Cloud review - Nov2019 - Public 5. UE BUS 7.09 - 5 minute settlement - Jan2020 - Public

Information and communication technology (**ICT**) Infrastructure (i.e. servers, storage and networks) is the foundational capability that supports and enables our core ICT applications to function, including the financial and reporting systems, market systems and network management systems. As the foundational capability which underpins the operation of our ICT systems, it is essential our ICT infrastructure performs reliably without interruption. We therefore need to maintain the health, capacity and suitability of our ICT infrastructure to ensure we continue to operate efficiently, deliver reliable services to customers and be compliant with regulatory obligations.

We currently own and maintain the majority of our ICT infrastructure on-premise. During 2016-2020 regulatory period we have deployed some new applications through cloud-hosting (i.e. ICT infrastructure that is owned and managed by third party vendors and typically paid for on a subscription basis).

As cloud adoption becomes more commonplace and the de facto platform for many application vendors, we have an opportunity to assess whether there is a greater role for cloud hosting to deliver our ICT infrastructure. Cloud hosting has the potential to deliver benefits to customers through lower costs both during 2021-2026 regulatory period and over the longer term.

We reviewed our existing on premise ICT infrastructure and assessed:

- the need to refresh our ICT infrastructure to maintain currency and accommodate data growth over the 2021–2026 regulatory period, including risk monetisation to evaluate the potential cost of failing to maintain our ICT infrastructure
- costs and benefits for migrating from on-premise to cloud hosting over the 2021–2026 regulatory period.

Based on this analysis, we considered a set of options that address the need to refresh our ICT infrastructure and potential for migration to cloud hosting.

Table 1 Summary of options assessed, expenditure and net present value (NPV) of expenditure ($ million, 2021)

Options	Description	Capital expenditure	Incremental operating expenditure	NPV	Risk monetisation
0. Do nothing	Do not refresh or grow existing on-premise infrastructure or migrate to cloud.	0.0	0.0	0.0	222.2
1. On-premise infrastructure refresh	Refresh existing on-premise infrastructure to maintain currency and support growth. Do not migrate existing on premise infrastructure to cloud hosting.	31.9	0.0	29.2	3.9
2. Balanced cloud migration and refresh remaining on-premise infrastructure	Migrate our core ICT infrastructure to cloud hosting. Refresh remaining on-premise infrastructure to maintain currency and support growth.	22.8	4.5	25.0	3.9
3. Aggressive cloud migration and refresh remaining on-premise infrastructure	Migrate our core ICT infrastructure plus 50% of additional infrastructure to cloud hosting. Refresh remaining on-premise infrastructure to maintain currency and support growth.	22.4	6.4	26.5	3.9

Source: United Energy
Note: Options 1 to 3 deliver the same level of infrastructure capabilities with different hosting arrangements. For risk monetisation we have therefore assumed these options will result in the same risk profile, albeit delivered through different hosting approaches.

Based on the options analysis, we propose option 2, a balanced migration to cloud supported by a refresh of remaining on-premise infrastructure. The timing of cloud migration under option 2 is aligned to vendor roadmaps for delivering cloud hosted environments.

This option provides the lowest NPV expenditure to customers during the 2021–2026 regulatory period. Additionally, option 2 provides longer term benefits of cloud hosting, such as easy scalability and adaptability of our ICT environment to changing requirements, meaning customers will only pay for the capacity and services we need.

Option 2 also mitigates the significant risks to our IT systems and business outcomes which would occur if we did not invest in refreshing our infrastructure, as demonstrated by the risk monetisation results.

2 Background

2.1 Our infrastructure capability

ICT infrastructure is at the core of all our ICT capabilities. ICT infrastructure is used to run our business applications which enable us to operate the network to maintain a safe, secure and reliable supply of electricity and meet our corporate and operational compliance obligations.

Our infrastructure supports our other ICT systems, including our network management systems, market systems, financial reporting systems, which enable us to:

- manage the electricity network
- provide meter data to Australian Energy Market Operator (**AEMO**) for market settlement and retailers for billing
- deliver financial management
- conduct asset management
- support the mobile field force that keep customers on supply.

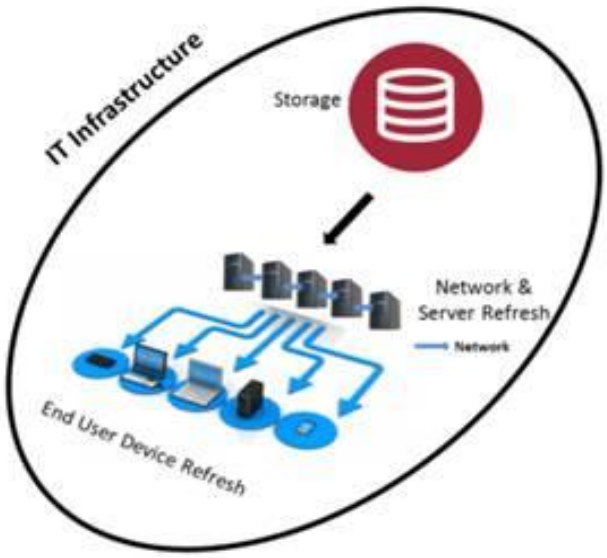
Our ICT infrastructure primarily consists of three component types—servers, network and storage:

- **Servers** - a server is a specialized machine that processes requests and delivers data over a network connection. A server is the central repository of data and various programs which are shared by users in a network. Applications and databases reside on a server. The server provides the processing power. Therefore, servers must be equipped with additional memory and data storage capacity, high processing speed, and other features.
- **Network** - the network provides a way of connecting numerous computers to the servers so that information can be retrieved and processed. As shown in the figure below, networks connect users to servers and servers to storage. Our network connects the entire organisation across multiple sites. It enables us to share files in a secure manner without the need for external media like a USB. The network enables the accomplishment of simple tasks, like printing, through to more complex tasks such as the transfer of significant volumes of meter data.
- **Storage** - data storage is the repository for master and transactional data in relation to our IT enterprise systems. Databases are used to store a structured set of data specific to an application or system. As data is managed as an asset across our organisation, it must be available to retrieve 24 hours a day 7 days a week. Data must be stored in relation to both our production and pre-production environments.

We store production data in order to meet our legal requirements in relation to data retention, for example, meter data must be retained for seven years. Non-compliance with these obligations would result in large fines and potential loss of license which would have negative consequences for customers through service disruption and cost changes. See Appendix A for more information about our data record retention requirements.

The relationship between servers, network and storage is demonstrated in figure 1.

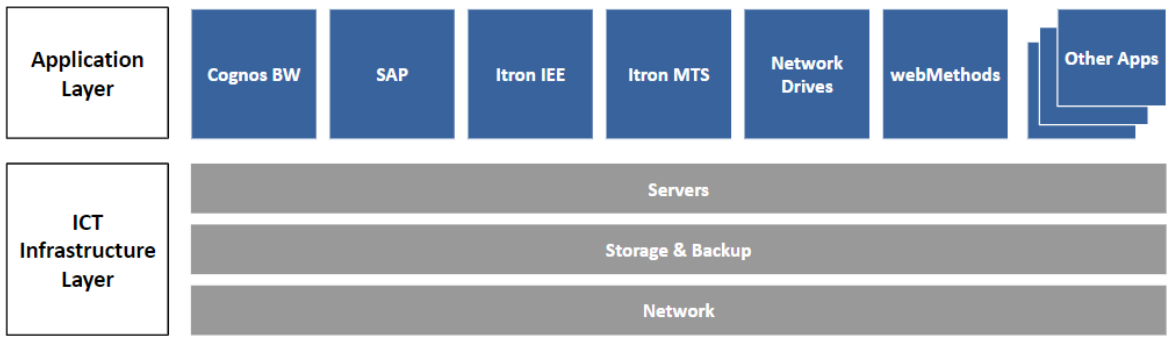
Figure 1 Infrastructure components



Source: United Energy

Figure 2 depicts these key ICT Infrastructure components with our core applications overlayed on top.

Figure 2 Application and infrastructure stack



Source: United Energy

2.2 Infrastructure hosting approaches

There are two broad approaches for hosting the ICT infrastructure required to support our applications:

- on-premise hosting—we own and support the ICT infrastructure required to host our applications
- cloud hosting—cloud providers own and support the ICT infrastructure which hosts our applications.

Currently, we primarily host our infrastructure on-premise in data centres. Until recently, cloud hosting has not been sufficiently mature for us to consider migrating our existing applications and infrastructure from on-premise to cloud-hosting.

During the current period, we have however been deploying many new applications to cloud infrastructure, where we can demonstrate a positive business case that delivers better financial and non-financial outcomes for customers and our network. For example, we recently implemented a new customer self-service project on a

‘public cloud’ in less than a week, which would have taken up to three months if we were delivering it using on-premise infrastructure. A detailed list of our cloud hosted applications can be found in Appendix C.

In the last few years, there has been a visible shift within most industries towards cloud hosted applications and infrastructure. In 2019, cloud spending is expected to grow by 21%[1] in the Asia Pacific market fuelled by an ever increasing number of cloud-based services and offerings. In particular, ‘public cloud’, where infrastructure is shared with other tenants, has become a commoditised solution. The use of cloud-based infrastructure allows organisations to focus on their core business while also obtaining benefits of economies of scale, faster time to market and improved change agility.

Moving to a cloud solution results in an application being run in the cloud provider’s data centre and using the provider’s servers, storage and network infrastructure. This can provide a number of benefits, including lower capital expenditure by:

- reducing the amount of physical infrastructure required to run applications (as cloud-based applications are supported by the cloud providers' own infrastructure)
- eliminating the need to refresh infrastructure (as this is done by cloud providers)
- enhancing agility by leveraging the automation capabilities of cloud providers so that we no longer need to coordinate teams to maintain solutions on premise.

Key differences between on-premise and cloud hosting are summarised in table 2.

[1] Forrester Report - Asia Pacific Tech Market Outlook For 2018 to 2019

Table 2 Key difference between on-premise and cloud hosting

Key differences	Cloud hosting	On-premise hosting
Scalability	Easily scalable for changes in capacity requirements with costs reflecting utilised capacity, as follows: • capacity increments can be ordered online and delivered instantly • capacity decreases can be ordered online, with immediate cost reduction.	Scalable in increments with costs reflecting total available capacity rather than utilised capacity. In particular: • capacity increments require the procurement, delivery and installation of new equipment, leading to time delays • capacity decreases result in under-utilised and/or stranded infrastructure.
Adaptability	Easy ability to change or remove service providers as business requirements change. New solution elements can be ordered online and delivered instantly. Rapid set up and turn down of environments (e.g. test environments). Accelerates application deployment which supports delivery of new and evolving products and removes some barriers to innovation.	Less flexibility in adapting to changes in business requirements as requires decommissioning existing applications. New solution elements may require new infrastructure to be procured, delivered and installed, leading to time delays without proper planning.
Exposure to vendor support	Lower exposure to vendor support as it is easy to switch service providers. Allows for single support provider for all ICT infrastructure.	Higher exposure to vendor support as on-premises ICT infrastructure is procured from multiple vendors for the various components.
Reliability risk	Relatively more reliable service as cloud hosting occurs through servers in multiple locations providing more contingency/back up. Cloud hosting also provides quicker disaster recovery (e.g. from natural disasters, power outages, human error and cyberattacks) which reduce the business and customer impact.	Relatively less reliable service as on-premises hosting involves less contingency. Slower disaster recovery leading to higher business and customer impacts. However, this risk can be mitigated through best-practice design and implementation.
Costs	Generally operating expenditure typically paid for on a subscription basis. Can be lower cost as modern cloud patterns are built on simple modularised components leveraging orchestration and automation capabilities. This simplifies the technology environment.	Generally capital expenditure to deploy, refresh and grow. Requires support and maintenance costs.

Source: United Energy, BDO

3 Identified need

ICT Infrastructure is the foundational capability that supports and enables our core business and customer applications. ICT Infrastructure needs to be maintained, refreshed and upgraded periodically (through a structured lifecycle management plan) to ensure that it is able to sustain our operations without interruptions or faults.

Over the 2021–2026 regulatory period, we:

- need to maintain technical currency of our infrastructure to ensure we continue to deliver a cost effective, safe, reliable and secure electricity supply, and maintain compliance with regulatory obligations
- need to increase our storage capacity to accommodate data growth driven by customer growth and more data intensive approaches to network management and business operations
- have an opportunity to migrate some applications to cloud hosting to deliver cost savings and long term benefits to customers.

Each of these is discussed in more detail below.

3.1 Maintaining technical currency

Maintaining ICT infrastructure currency is necessary to ensure we continue to deliver a cost effective, safe, reliable and secure electricity supply for customers while maintaining compliance with our corporate and operational obligations.

The equipment that comprises our ICT infrastructure will reach the end of its useful life (**EOL**) for one or more of the following reasons:

- the cost of maintenance has become inefficient as the equipment ages
- the equipment reaches an age where the manufacturer will no longer provide maintenance. At this point, we are exposed to the risk of system outages to critical ICT systems resulting from equipment failure
- the equipment reaches an age where required component upgrades (e.g., additional disk or memory) are no longer available from the manufacturer
- the equipment can no longer perform its intended role (for example its capacity has been exhausted due to increased business requirements or the requirements of new versions of software)
- the reliability of the equipment has reduced to the point where replacement is the most efficient option to restore stability
- new equipment is released that provides the same (or improved) capability at a lower total cost (for example it is often more cost effective to introduce a new storage device rather than continue to grow an existing device, even though the original device has not yet reached the end of its effective life)
- new technologies emerge that provide the same (or improved) capability at a lower total cost (for example cloud computing).

We assessed our ICT infrastructure against the above criteria to determine which equipment will reach EOL over the 2021–2026 regulatory period. Table 3 provides a summary of our ICT infrastructure that will require currency updates over the 2021–2026 regulatory period. A detailed list of the infrastructure categories and volume breakdowns are set out in Appendix D.

Table 3 Infrastructure components requiring currency updates during 2021-2026 regulatory period

Infrastructure Type	Key system types	Volumes	Importance
Servers	Linux Server SAP HANA VMware host servers Solaris Server AIX Server Windows Server	75 devices[2]	Runs applications and enables operation of the electricity network (e.g. communicating with customers, organising work orders, monitoring network assets and processing solar requests).
Storage	Oracle Exadata Hitachi Data Systems Storage Oracle Storage Hitachi Data Systems Backup Veritas Backup Oracle Tape Backup Library	334 TB[3]	Holds operational and backup data for applications including critical stores of customers' interval meter data. In addition, supports long term retention of data in accordance with legal and compliance requirements.
Network	Cisco Network Routers Cisco Network Switch Firewalls HSM Crypto server Load balancer Wireless Access Point	200 devices	Interconnects all ICT infrastructures to run applications. Ensures ICT security for the ICT environment and the meter network.

Source: United Energy.
Note: see Appendix D for more detail.

3.2 ICT Infrastructure capacity growth

Growth in our infrastructure storage capacity will be required during the 2021–2026 regulatory period due to:

- forecast growth in customer numbers as the Victorian population grows leading to an increased storage requirement for the interval meter data associated with each new customer
- increasing volume of business related data (email, word documents, spreadsheets, etc.)
- increasing utilisation of high quality digital photos of assets within the business to maintain the reliability of the electrical network (for example, power poles)
- increasing utilisation of LIDAR survey data analysis to support bushfire mitigation work.

[2] Does not include counts of VMware virtual machines

[3] Based on 2018 actual storage volumes

Additional storage is needed to handle increased data retention requirements and data backups in line with above data growth.

Table 4 depicts the forecast growth in data storage volumes (excluding backup storage) over the 2021–2026 regulatory period.

Table 4 Forecast growth in data storage

	2021/22	2022/23	2023/24	2024/25	2025/26
Forecast data volume (TB)[4]	373	387	400	413	426

Source: United Energy
Note: the costs to accommodate additional storage to support the five minute settlement rule change are not included in this business case, refer to the five minute settlement business case (UE BUS 7.09).

3.3 Cloud migration

Until recently, cloud hosting has not been sufficiently mature for us to consider migrating our existing applications from on-premise to cloud-hosting. The opportunity to migrate to cloud hosting has arisen for the 2021–2026 regulatory period because:

- application vendors are shifting towards cloud-based solutions within their platform roadmaps
- cloud hosting costs have reduced to economically feasible levels
- cloud hosting capabilities have improved providing greater substitutability for on-premise ICT infrastructure and storage applications
- cloud hosting is becoming more commonplace and better reflects user requirements, approximately 50% of worldwide information and communication technology is currently cloud hosted.[5]

We reviewed the opportunity to migrate our existing on-premise infrastructure applications to cloud hosting over the 2021–2026 regulatory period. As part of this review we considered:

- vendor roadmaps to establish expected availability and suitability of cloud offerings
- forecast capital and operating expenditure for cloud versus on-premise hosting
- relative merits of unquantifiable benefits of cloud versus on-premise hosting.

We identified that migrating our core applications to cloud during 2021–2026 regulatory period would deliver benefits to customers in terms of both direct cost savings in the 2021–2026 regulatory period and longer term cost saving from unquantifiable benefits.

[4] Based on actual storage data usage from 2013 to 2018 forecasted to 2021 based on trends and growth requirements

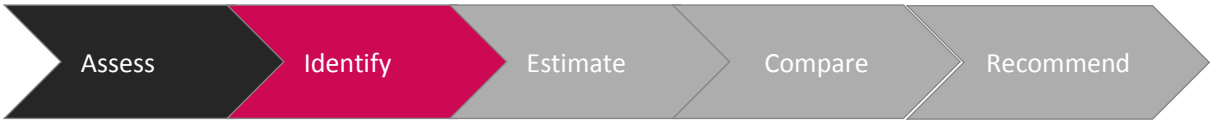
[5] https://www.fastmetrics.com/blog/tech/cloud-computing-trends/ Accessed October 2018.

4 Options analysis

4.1 Approach

We followed a structured approach by how various options could address our ICT Infrastructure requirements over the 2021-2026 regulatory period.

Figure 4 Options analysis approach



- **Assess**—we assessed:
  - the current state of our existing infrastructure to establish when equipment will reach the end of its useful life and require replacement (as shown in table 3)
  - our current infrastructure storage capacity relative to our forecast data retention requirements to determine whether additional storage capacity is required
  - the opportunity to migrate to cloud hosting by reviewing vendor roadmaps and market trends
- **Identify**—we developed four alternative options for refreshing our on-premise infrastructure and migrating to cloud hosting, summarised in table 5.

Table 5 Summary of options

Option	Refresh	Cloud migration
Option 0—do nothing	Do not refresh existing infrastructure.	No cloud migration.
Option 1—refresh on-premise	Refresh existing infrastructure.	No cloud migration.
Option 2—balanced cloud migration	Refresh remaining on-premise infrastructure.	Migrate our core applications to the cloud.
Option 3 —aggressive cloud migration	Refresh remaining on-premise infrastructure.	Migrate our core applications plus 50% of non-core applications to cloud.

Source: United Energy

Estimate—options were costed using a bottom up approach:

- forecast capital expenditure for refreshing on-premises applications based on:
  - forecast volume of equipment reaching end of life and current cost of replacement
  - forecast increase in required storage capacity and current cost of additional storage
  - forecast operating expenditure for migrating applications to cloud hosting based on vendor advice sourced by external advisors BDO
  - forecast operating expenditure savings associated with reduced internal support and maintenance for infrastructure migrated to the cloud.

  - Forecast labour rate based on a blended external IT labour rate provided by PwC.[6]

- **Compare**—we compared the above options based on NPV cost to customers, risk mitigation and deliverability
- **Recommend**—option two is recommended based on lowest NPV cost to customers and lowest risk to service delivery. This option also meets our customers' expectations that we ensure a safe and reliable service and maintain compliance with our regulatory obligations.

4.2 Options Summary

Table 6 provides a summary of the options assessment.

Table 6 Summary of options, $m June 2021

Options	Description	Capital expenditure	Incremental operating expenditure	NPV	Risk monetisation
0. Do nothing	Do not refresh or grow existing on-premise infrastructure or migrate to cloud.	0.0	0.0	0.0	222.2
1. On-premise infrastructure refresh	Refresh existing on-premise infrastructure to maintain currency and support growth. Do not migrate existing on premise infrastructure to cloud hosting.	31.9	0.0	29.2	3.9
2. Balanced cloud migration and refresh remaining on-premise infrastructure	Migrate our core ICT infrastructure to cloud hosting. Refresh remaining on-premise infrastructure to maintain currency and support growth.	22.8	4.5	25.0	3.9
3. Aggressive cloud migration and refresh remaining on-premise infrastructure	Migrate our core ICT infrastructure plus 50% of additional infrastructure to cloud hosting. Refresh remaining on-premise infrastructure to maintain currency and support growth.	22.4	6.4	26.5	3.9

Source: United Energy
Note: Options 1 to 3 deliver the same level of infrastructure capabilities with different hosting arrangements. For risk monetisation we have therefore assumed these options will result in the same risk profile, albeit delivered through different hosting approaches.

We assume similar competencies and system reliability under an on premise or cloud solutions under options 1 to 3, resulting in the same risk profile.

[6] UE MOD 12.02 - Quoted services labour rate - Jan2020 - Public

4.3 Option 0—do nothing

The 'do nothing' option proposes that we leave the existing infrastructure as-is. This means that we will not:

- upgrade hardware or any supporting software as it reaches the end of its lifecycle
- add additional capacity to support growth
- migrate any existing infrastructure and applications to cloud-hosting.

This option poses the greatest risk to our ability to manage the network to maintain a safe, reliable and compliant network. This is because a failure in our ICT infrastructure would lead to failures in the operation of our core ICT systems and applications including the financial and reporting systems, market systems and network management systems.

Table 7 is a summary of the advantages and disadvantages of this option.

Table 7 Option 0: advantages and disadvantages

Advantages	Disadvantages
No capital expenditure for refreshing or growing our ICT infrastructure	Highest risk of asset failure exposing us to the risk of cyber-attacks, prolonged network outages and non-compliances, due to: • an increasing portion of our equipment aging to the point where spare parts will not be available • an increasing portion of our software aging to the point where security patches no longer available • inability to procure additional infrastructure to cater for growth resulting in capacity shortfalls, leading to business applications no longer functioning.
No incremental operating expenditure for cloud hosting	Inability to deploy new business applications and respond to changing environment, as new applications will be relying on more modern base ICT platform than we will be running.
	Inability to deliver cost savings to customers though: • lower cost of newer technologies • lower cost of cloud-hosting. Inability to deliver longer term unquantified benefits of cloud including greater scalability and adaptability to changing infrastructure needs and reduced exposure to vendors (examples provided under option 1 analysis).

Source: United Energy

4.4 Option 1—on-premise infrastructure refresh

Option 1 proposes refreshing existing on-premises ICT infrastructure and upgrading capacity to accommodate growth. This option involves no migration to cloud hosting for our existing ICT infrastructure.

This option would ensure we maintain our current ICT infrastructure capabilities which support us to continue to deliver a safe, reliable and compliant service for our customers. However customers would not receive the benefits of lower costs in the 2021–2026 regulatory period associated with migrating some applications to cloud

hosting or the longer term unquantified benefits of cloud hosting, such as easier scalability and adaptability and lower vendor exposure.

Table 8 is a summary of the advantages and disadvantages of this option.

Table 8 Option 1: advantages and disadvantages

Advantages	Disadvantages
Ensures our ICT systems continue to support network performance and maintain regulatory compliance, including by: • ensuring we have sufficient infrastructure capacity to accommodate data growth • replacing equipment which has reached end of life to maintain current level of asset failure risk • updating software to ensure current level of cyber security risk is maintained, not increased.	Inability to deliver longer term unquantified benefits of cloud, including: • majority of infrastructure capital costs reflect peak capacity requirements leading to potential under-utilisation • higher cost and longer timeframes to scale or adapt on-premises applications to changing requirements or opportunities to improve our services • higher exposure to vendor support, increasing risk of incurring additional costs • vendor roadmaps may necessitate an accelerated migration to cloud creating a bigger, higher cost change impact than a planned migration.
Current operating models can continue to be used with little or no change.	Higher total cost than other options, including cloud-based option.

Source: United Energy

4.5 Option 2—balanced cloud migration and refresh remaining on premise infrastructure

Under option 2, we propose to migrate our core (based on usage and business criticality) applications to cloud hosting during the 2021–2026 regulatory period. We would also refresh and grow our remaining on premise infrastructure.

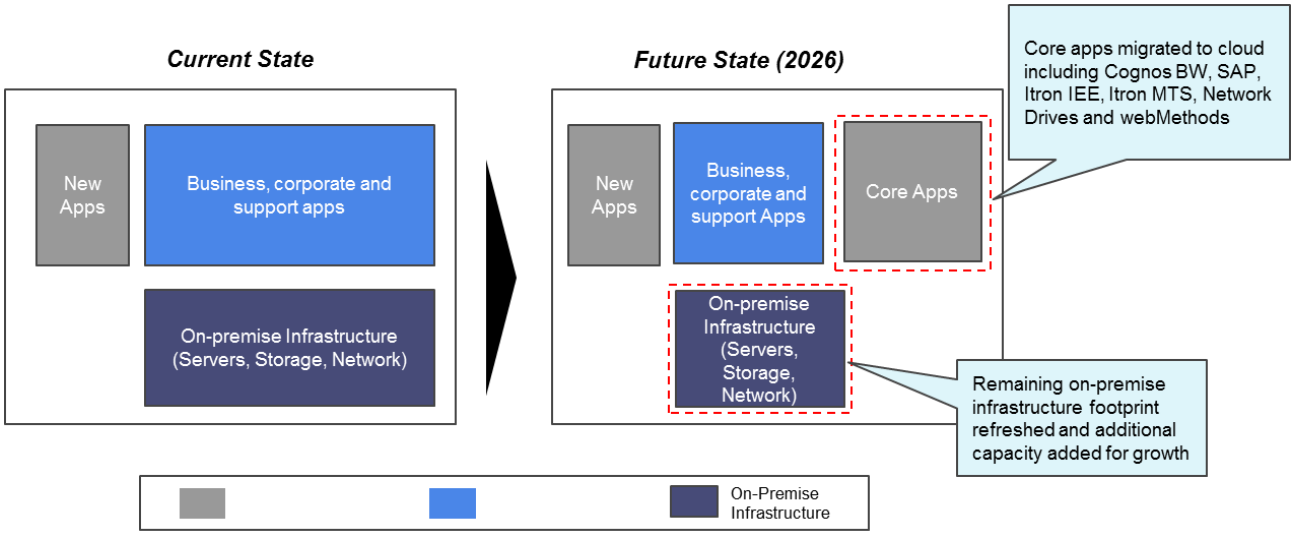
Option 2 is the lowest cost option which ensures our ICT systems continue to support the delivery of a safe, reliable, secure and compliant service for our customers. Option 2 involves:

- reduced capital expenditure associated with refreshing and growing our on-premise infrastructure (when applications move to cloud-hosting, the cloud provider utilises it's own infrastructure to run the applications. This reduces the quantum of infrastructure we require on-premise)
- increased operating expenditure for cloud hosting subscription charges
- reduced operating expenditure through lower datacentre (power, cooling and cabling) costs, hardware and software maintenance costs and labour support costs.

The migration to cloud hosting also delivers additional unquantified benefits such as scalability, adaptability and lower vendor exposure which would lead to longer term cost savings for customers (discussed more in background section).

Figure 3 depicts the current and future states under option 2.

Figure 3 Balanced cloud migration and refresh remaining on-premise infrastructure



Source: United Energy

Table 9 provides details of the ICT infrastructure that would migrate to cloud hosting during the 2021–2026 regulatory period.

Table 9 Cloud migration for core ICT applications under option 2

Infrastructure	Purpose
Cognos/BW	Enterprise-wide business data storage, analytics and reporting (distinct from, but linked to, network analytics and reporting, which primarily resides within Network and Control Centre).
SAP	Business process automation and information software used to manage and integrate important parts of the business, including planning, purchasing, inventory, finance and human resources.
Itron IEE	Central system for the collection, processing, storage, and analysis of meter data.
Itron MTS (Market Transaction System)	Gateway that facilitates delivery and receipt of meter data between our business and key market participants, including Retailers and the market operator (AEMO).
Network drives (user and file shares)	Storage and directory-based organisation of all business documentation.
WebMethods	Middleware layer that bridges and connects the operating system, software components and enterprise applications. Interlinked with and performs a critical role in supporting the Market Transaction System.

Source: United Energy

Table 10 is a summary of the advantages and disadvantages of option 2.

Table 10 Option 2: advantages and disadvantages

Advantages	Disadvantages
Ensures our ICT systems continue to support network performance and maintain regulatory compliance. Lowest total cost option. Involves increased operating expenditure for cloud-hosting, which is offset by reduced capital expenditure for on-premise infrastructure and reduced operating expenditure for datacentre management and software and hardware maintenance and labour support.	Higher organisational change impact and associated risk compared with retaining existing infrastructure and applications on premise (option 1).
Additional unquantified benefits of cloud hosting which will lead to longer term cost savings, including: • costs reflect usage requirements with easier scalability • faster and cheaper adoption of new services • lower exposure to vendor support • lower cost of migrating to cloud compared with a vendor imposed migration.	Unquantified benefits of cloud (including scalability, adaptability and lower exposure to vendors) are not fully realised for ICT infrastructure and applications which remain on premise.
Remaining on-premise infrastructure is refreshed and data growth is accommodated, ensuring we maintain current levels of service delivering including in relation to asset failure and cyber security risks.	

Source: United Energy

4.6 Option 3—aggressive cloud migration and refresh remaining on premise infrastructure

Under option 3, we would migrate our core applications plus an additional 50% of non-core applications to cloud hosting during the 2021–2026 regulatory period. We would also refresh and grow our remaining on premise infrastructure. Option 3 would also ensure our ICT systems continue to support the delivery of a safe, reliable, secure and compliant service for our customers.

Option 3 is higher cost than option 2 because the incremental increase in operating expenditure for cloud-hosting our non-core applications is greater than the incremental capital and operating expenditure savings from not refreshing and maintaining non-core applications on premise.

Compared with option 2, option 3 would deliver more of the unquantified benefits such as scalability, adaptability and lower vendor exposure because more applications are cloud-hosted. However, migrating more applications to cloud within the 2021-2026 regulatory period increases the change management cost and introduces greater risks during the transition phase.

Table 11 is a summary of the advantages and disadvantages of this option.

Table 11 Option 3: advantages and disadvantages

Advantages	Disadvantages
Ensures our ICT systems continue to support network performance and maintain regulatory compliance. Lower total cost than no cloud migration (option1). Involves increased operating expenditure for cloud-hosting, which is offset by reduced capital expenditure for on-premise infrastructure and reduced operating expenditure for datacentre management and software and hardware maintenance and labour support.	Higher cost than option 2 (balanced cloud migration) as the incremental cost of moving non-core applications to the cloud is greater than the incremental savings.
More and faster realisation of additional unquantified benefits of cloud hosting compared with option 2, which will lead to greater longer term cost savings, including: • costs reflect usage requirements with easier scalability • faster and cheaper adoption of new services • lower exposure to vendor support • lower cost of migrating to cloud compared with a vendor imposed migration.	Higher organisational change impact and associated higher business risk compared to option 2 (balanced cloud-migration).
Remaining on-premise infrastructure is refreshed and data growth is accommodated, ensuring we maintain current levels of service delivering including in relation to asset failure and cyber security risks.	

Source: United Energy

5 Recommendation

We propose option 2, a balanced cloud migration supported by refresh of remaining on-premises infrastructure over the 2021-2026 regulatory period. This option is lowest NPV cost to customers. Option 2 also provides the unquantified benefits of cloud, such as easy scalability and adaptability of our ICT infrastructure to changing requirements and therefore customers only pay for the capacity and services we need.

Option 0 (do nothing) is not recommended due to the extremely high business and customer impact risk profile and lack of strategic business and customer alignment.

Options 1 and 3 both ensure we continue to deliver a safe, reliable and complaint network, however:

- Option 1 (on premise infrastructure refresh) is not recommended because there is an opportunity to migrate our core applications to the cloud and deliver cost savings to customer.
- Option 3 (aggressive cloud migration) is not recommended because the cost savings of migrating non-core applications to the cloud are less than purchase cost of cloud subscriptions. While option 3 would deliver more unquantified cloud benefits, it is also higher risk during the transition phase due to the greater extent of organisational change.

Table 12 Recommended option: expenditure profile ($ million, 2021)

Expenditure forecast	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Capital expenditure	3.9	4.4	2.9	8.4	3.2	22.8
Operating expenditure increment (step change)	0.7	0.7	1.0	1.1	1.1	4.5
NPV expenditure						**25.0**

Source: United Energy Infrastructure-cloud cost model

A Record retention requirements

The retention period for financial records is a minimum of 7 years. This is a requirement of the Corporations Act 2001.

The retention period for employee time and wages records is 7 years, as prescribed by the Fair Work Ombudsman. The various data sets that must be retained as part of these records include the following:

- General information – employer's and employee's name, employer's ABN, employee's commencement date, employment type (i.e. full-time, part-time or casual), and whether the employment is temporary or permanent/ongoing.
- Pay – rate/s p aid to the employee, gross and net amounts paid, details of any deductions from the gross amount, details of any incentive based payments, bonus, loading, penalty rate or other monetary allowance of separately identifiable entitlement paid.
- Hours of work – penalty rates or loadings paid to employees for overtime hours worked, including the number of overtime hours worked by an employee during the day, with the start and finish times for overtime hours, the hours an employee works if the employee is casual or irregular part-time employee who is paid based on time worked, and a copy of the written agreement if an employer and employee have agreed to an averaging of the employee's work hours.
- Leave – details of all leave taken and leave balances/available entitlement. If there is a 'cash out' option, the employer must keep a copy of the agreement to cash out/amount of leave and a record of how much was paid, the amount of leave cashed out and when the payment was made.
- Superannuation contributions – amount paid, pay period, date/s paid, name of super fund, and reason that the employer paid into a particular fund (e.g. a record if the employee's choice of super fund and date/s).
- Individual flexibility agreements – if there is an agreement in place between the employer and employee, a written record/agreement must be retained, including any notice or agreement to terminate the flexibility agreement.
- Guarantee of annual earnings – a copy of the guarantee and the date the guarantee was cancelled (where applicable).
- Ending employment – details of why/how employment was terminated, if notice was provided and how much, and the name of the person who terminated the employment.
- Transfer of business – where there has been a transfer of business, the old employer must provide the new employer with records of any transferring employees (the new employer must ask for the records to be provided within three months of the sale/acquisition/transfer).

B Risk monetisation framework

Table 13 Risk monetisation framework

Risk category	Risk type	Description of risk
IT Risks	Outage	Outages may be caused due to poor infrastructure currency and insufficient infrastructure resource capacity (e.g. server memory). Outage resolution may be prolonged due to unavailability of appropriate technical resources (e.g. vendor support) or available replacement hardware through not refreshing software after it reaches end of life. Investing under our preferred option will ensure sufficient memory and continued compatibility with existing market products.
	System sustainability	If systems are not refreshed, they will not be compatible with associated market products when reaching End of Life, such as security patches. Ensuring continued access to patches through refreshes would reduce vulnerabilities to cyber security attacks. In addition, refreshing would ensure we do not incur additional costs from maintaining inefficient, unconsolidated systems.
	Suitability	Legacy, unmaintained systems are more prone to failures, data loss and security breaches. This can affect VPN and UE's ability to meet regulatory and compliance requirements such as customer management, financial and market reporting obligations (e.g. submission of accurate market performance data)
Business Risks	Reliability impact	As infrastructure and cloud supports all major applications, an incident would result in system failures across the applications sitting on top of the infrastructure including Market Systems, SAP and Network Management as occurred with the 'SuperCluster' issue at United Energy in 2018 (refer to United Energy System and Sustainability review for further information). Investment in our preferred option would ensure continued low levels of incidents.
	Compliance risk	
	Bushfire risk	
	Safety risk	

Source: United Energy Risk monetisation framework

C Current cloud deployments

Table 14 Cloud deployments

Function	Product
SMO	ServiceNow
Collaboration	Office365
Finance	CBA CommBiz
Demand response	Bidgley is not FIRB compliant and working on a project to replace it
Web	UE Outage Channels (AWS) – in build
Web	UE External Corporate Website (Azure)
Finance	Blackline
Risk	Protecht
Finance	ADP
Finance	ATO Business Portal
Finance	CORPORATE ONLINE
	GRC Manager
Market	MSATS Production (Legacy)
	Reval
SMS	Whispir (SMS)
	Adobe Sign
Web	AWS SNS (SMS)
Risk	Copperleaf
Test Automation	HP ALM
Vegetation Management	FMC Cloud
Living Values	Redii (Red Balloon)
Content publication	Airwatch
Finance	PwC Purchase to Pay

Source: United Energy

D ICT infrastructure current state

ICT Infrastructure primarily comprises of storage, server and network. The devices involved in each of these three types of infrastructure are described in more detail below.

Storage

There are a variety of storage and data backup devices utilised by us to support business applications. These include:

Table 15 Storage footprint

Device	Purpose	Application	Application Purpose
Oracle Exadata	Used to host production, DR and non-production Oracle databases for critical applications.	Itron IEE	Interval meter data[7]
		Itron MTS	Market gateway
		SAP ERP	Finance, HR8, asset management
Hitachi Data Systems & Oracle Storage	Used to store all other production, DR and non-production business application data.	Outlook	Email data
		Network drives	Data required to be shared amongst business users
		Business application servers	Storage for business applications
		Virtual server fleet	Further business application storage
Hitachi Data Systems and Veritas backup storage	provides 30 days of on line backups for all United Energy data.		
Oracle tape backup library	provides 7 years of off-site backups for all data.		

Source: United Energy

It is our design standard that storage used for Disaster Recovery purposes is configured with the same performance as production storage. This is to ensure that the disaster recovery solution can be relied on when required.

A recent example at United Energy illustrated the importance of this design principle. A major outage occurred at the primary data centre, but we were unable to utilise the disaster recovery site as the storage at that site was lower performance than at the primary site, and we lacked confidence that the disaster recovery infrastructure would support the full production workload.

[7] Meter data must be maintained for 7 years.

[8] Financial records and employee time and wages records must be maintained for a minimum of 7 years. Refer Appendix B.

The proposed cloud and infrastructure submission aligns with our design standard whereby the production and DR storage is the same configuration and performance.

Server

We utilise more over 75 server devices to run critical business applications. The main categories and volume breakdowns are set out in table 16.

Table 16 Server Device Volumes

Category	Volumes	Description
Linux Server	6	Servers for applications that must run Linux on a dedicated server.
SAP HANA	2	High performance analytics and reporting platform
VMware host servers	28	Servers that run VMware (a tool which allows a physical server to run multiple “virtual” servers).
Solaris Server	12	Servers that runs multiple Solaris virtual servers.
AIX Server	4	Servers that run AIX.
Windows Server	24	Servers for applications that must run Windows on a dedicated server.

Source: United Energy

Network

We utilise nearly 500 network devices to run critical business applications. The main categories and volume breakdown are set out in table 17.

Table 17 Network device volumes

Category	Volumes	Description
Firewall	10	Firewalls separate the network into discrete security zones.
HSM Crypto server	4	Devices that securely store security certificates for the meter network.
Load balancer	4	Devices that distribute traffic across multiple devices.
Network Router	26	Devices that direct traffic between locations.
Network Switch	120	Device that connects users, telephones, printers, servers and other devices.
Wireless Access Point	40	Devices that provide wireless connectivity to end user devices.

Source: United Energy