Economic Benchmarking Regulatory Information Notice

Basis of Preparation

2020/21

October 2021

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Glossary of terms

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AFW	Application for Work
BOM	Bureau of Meteorology
EBSS	Efficiency Benefit Sharing Scheme
GWh	Gigawatt hours
IRSR	Intra and Inter Regional Settlements Residues
kV	kilovolt
MAR	Maximum Allowable Revenue
MDP	Meter Data Provider
MIC	Market Impact Component
MLF	Marginal Loss Factor
MMS	Market Management System
MVA	Mega volt ampere
MVAr	Megavar
MW	Megawatt
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company Limited
NOS	Network Outage Scheduler
PTRM	Post Tax Revenue Model
RIN	Economic Benchmarking RIN issued by the AER, 28 November 2013
Rules	National Electricity Rules
SCADA	Supervisory Control and Data Acquisition
STPIS	Service Target Performance Incentive Scheme
TAPR	Transmission Annual Planning Report
TNDB	Transmission Network Database
TNI	Transmission Node Identifier

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Sheet: 3.1 Revenue

Table: 3.1.1 Revenue Grouping by chargeable quantity

Variable: ***TREV0101 – From Fixed Customer (Exit Point) Charges***
TREV0102 – From Variable Customer (Exit Point) Charges
TREV0103 – From Fixed Generator (Entry Point) Charges
TREV0104 – From Variable Generator (Entry Point) Charges
TREV0105 – From Fixed Energy Usage Charges (Charge per day basis)
TREV0106 – From Variable Energy Usage charges (Charge per kWh basis)
TREV0107 – From Energy based Common Service and General Charges
TREV0108 – From Fixed Demand based Usage Charges
TREV0109 – From Variable Demand based Usage Charges
TREV0110 – Revenue from other Sources

RIN Requirements

This section has been completed in accordance with chapter 2, section 2.1 of the Benchmarking RIN Instructions and Definitions.

Consistent with the RIN requirements[1], unless stated otherwise all amounts reported reconcile to the Prescribed Transmission Services revenues reported in the Income Statement forming part of Powerlink's Regulatory Financial Statements. In instances where a difference exists an explanation and/or reconciliation has been provided.

Table 3.1.1 has been populated with actual data.

Source

All financial information required to complete this table was sourced from Powerlink's Grid Revenue Billing System.

Methodology and Assumptions

Powerlink has prepared its response using actual information contained in its Grid Revenue Billing System. The system is used to manage billing for all of Powerlink's customers, which include DNSPs and directly connected customers.

Variables	Assumptions / Data Source
TREV0101	***Fixed connection charges*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0102	***Variable connection charges*** – Powerlink does not have any customers with variable connection charges. As permitted under the RIN[2], Powerlink has therefore included a value of zero in these cells.
TREV0103	***Fixed generators connection charges*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0104	***Variable generators connection charges*** – Powerlink does not have any customers with variable generator charges. As permitted under the RIN[3], Powerlink has therefore included a value of zero in these cells.

[1] Australian Energy Regulator (2013a). Economic Benchmarking RIN for Transmission Network Service Providers, Instructions and Definitions, Queensland Electricity Transmission Corporation Limited, p.12.
[2] Australian Energy Regulator (2013a). pp.6, 12.
[3] Australian Energy Regulator (2013a). pp.6, 12.

TREV0105	***Fixed nominated demand charges*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0106	***Variable metered charges*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0107	***General and Common charges*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0108	***Fixed charges from Customers under Maximum Contract Demand agreements*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0109	***Variable charges from Customers under Maximum Contract Demand agreements*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0110	***Revenue from other sources*** – sourced from the following: - Intra and Inter Regional Settlements Residues (IRSRs); - Over/under collections; - AEMO National Transmission Planner (NTP) fee[4]; and - Other Revenue.

From FY2015 there was a change in the accounting treatment of regulated revenues to report them on an 'as billed' basis. Powerlink reports its Maximum Allowed Revenue (MAR) in sheet 3 of the EB RIN template.

Reconciliation

To align reported revenue totals in the EB RIN to Income Statements within Powerlink's Regulatory Financial Statements a reconciliation has been provided below:

2020/21	$
Total Revenue per Regulatory Financial Statements	743,323,377
Under/(Over) collected Revenue	33,649,428
Gross proceeds from sale of assets	3,601,818
Total Revenue reported in RIN	780,574,624

[4] AEMO NTP charges commenced 1 January 2021. NTP charges will be recovered through transmission prices from 2021/22 onwards consistent with the AEMC's Reallocation of national transmission planner costs Rule change. NTP charges will be reported in the annual RIN returns from 2021/22 to align with recovery dates.

Table: 3.1.2 Revenue Grouping by type of connected equipment

Variable: TREV0201 – From Other connected transmission networks
TREV0202 – From Distribution networks
TREV0203 – From Directly connected end-users
TREV0204 – From Generators
TREV0205 – Other revenue

<u>RIN Requirements</u>

This section has been completed in accordance with chapter 2, section 2.1 of the Benchmarking RIN Instructions and Definitions.

Consistent with the RIN requirements[5], unless stated otherwise all amounts reported reconcile to the Prescribed Transmission Services revenues reported in the Income Statement forming part of Powerlink's Regulatory Financial Statements. In instances where a difference exists an explanation and reconciliation has been provided.

Table 3.1.2 has been populated with actual data.

<u>Source</u>

All financial information required to complete this table was sourced from Powerlink's Grid Revenue Billing System.

<u>Methodology and Assumptions</u>

Powerlink has prepared its response using actual information contained in its Grid Revenue Billing System.

Variables	Assumptions / Data Source
TREV0201	***Other connected transmission networks*** – due to the introduction of inter-regional transmission charging from 1 July 2015, the amount reported is the net Modified Load Export Charge (MLEC)[6] as calculated between Queensland and NSW.
TREV0202	***Distribution networks*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0203	***Total revenue from directly connected end users*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0204	***Generators*** – sourced from Powerlink's Grid Revenue Billing System.
TREV0205	***Other Revenue*** – sourced from the following: - Intra and Inter Regional Settlements Residues (IRSRs); - Over/under collections; - AEMO National Transmission Planner (NTP) fee[7]; and - Other Revenue.

[5] Australian Energy Regulator (2013a). p.6.
[6] MLEC is the charge payable by relevant transmission network service providers for use of the Queensland electricity transmission network by adjacent regions.
[7] AEMO NTP charges commenced 1 January 2021. NTP charges will be recovered through transmission prices from 2021/22 onwards consistent with the AEMC's Reallocation of national transmission planner costs Rule change. NTP charges will be reported in the annual RIN returns from 2021/22 to align with recovery dates.

Table: 3.1.3 Revenue (penalties) allowed (deducted) through incentive schemes

Variable: ***TREV0301 – EBSS***
TREV0302 – STPIS
TREV0303 – Other

RIN Requirements

This section has been completed in accordance with chapter 2, section 2.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.1.3 has been populated with actual data.

Source

The EBSS data was obtained from the AER's Final Decision on Powerlink's Transmission Determination 2017/18 to 2021/22 (April 2017).

The STPIS data was obtained from the AER's notification of the approval of Powerlink's performance against the service target performance incentive scheme for each calendar year.

Methodology and assumptions

Variables	Assumptions/Source
TREV0301	***EBSS*** – obtained from the AER Final Decision for Powerlink (April 2017) and uplifted by the AER's CPI escalation method.
TREV0302	***STPIS*** – sourced from the AER's annual notification of Powerlink's approved performance against STPIS. As required under the RIN, figures reflect the year in which the incentive applied to Powerlink's revenues[8].
TREV0303	***Other*** – no other revenue (penalties) allowed (deducted) through incentive schemes to be reported. As permitted under the RIN[9], Powerlink has therefore included a value of zero in these cells consistent with RIN requirements.

[8] Australian Energy Regulator (2013a). p.13.
[9] Australian Energy Regulator (2013a). pp.6, 12.

Sheet: 3.2 Opex

Table: 3.2.1 Opex Categories

Variable:
TOPEX0101 - Field Maintenance - Routine
TOPEX0102 - Field Maintenance - Condition-based
TOPEX0103 - Field Maintenance - Corrective
TOPEX0104 - Maintenance Support
TOPEX0105 - Refurbishment
TOPEX0106 - Insurance Premiums
TOPEX0107 - Self Insurance
TOPEX0108 - Network Operations
TOPEX0109 - Asset Management Support
TOPEX0110 - Corporate Support
TOPEX0111 – AEMC Levy
TOPEX0112 – Project – write-off
TOPEX0113 - Revenue Reset
TOPEX0114 - Debt Management Costs
TOPEX0115 - Grid Support
TOPEX0116 – Net Loss on Disposal of Property, Plant & Equipment

RIN requirements

This section has been completed in accordance with chapter 3, section 3.1 of the Benchmarking RIN Instructions and Definitions.

Consistent with the RIN requirements, unless stated otherwise all amounts reported reconcile to the Prescribed Transmission Services expenditure reported in the Income Statement and/or supporting schedules forming part of Powerlink's Regulatory Financial Statements. In instances where a difference exists an explanation has been provided.

Table 3.2.1 has been populated with actual data.

Source

All financial information was sourced from Powerlink's financial systems and the Regulatory Financial Statements submitted to the AER annually.

Methodology and Assumptions

This table requires a greater level of detail on the Opex activities than that reported in the Regulatory Financial Statements and as such further data from Powerlink's financial systems have been used to populate this table.

Table: 3.2.3 Provisions

Variable: ***TOPEX0301 – The carrying amount at the beginning of the period***
TOPEX0302-0304 – Increases to the provision
TOPEX0305-0307 – Amounts used (that is, incurred and charged against the provision) during the period
TOPEX0308-0310 – Unused amounts reversed during the period
TOPEX0311-0313 – The increase during the period in the discounted amount arising from the passage of time and the effect of any change in the discount rate
TOPEX0314 – The carrying amount at the end of the period

RIN requirements

This section has been completed in accordance with chapter 3, section 3.1 of the Benchmarking RIN Instructions and Definitions.

Consistent with the RIN requirements[10], unless stated otherwise all opening and closing balances reconcile to previously reported amounts. In instances where a difference exists an explanation and reconciliation has been provided.

Table 3.2 has been populated with actual and estimated data. Estimated data has been disaggregated as described in the *Methodology and Assumptions* section below.

Source

All financial information required to complete this table was sourced from Powerlink's Statutory Financial Statements, Payroll reports and general ledger. In instances where a difference exists an explanation and reconciliation has been provided.

Methodology and assumptions

The methodologies utilised to disaggregate the provision balances between Regulated and Non-Regulated and Opex and Capex are detailed below. In instances where the disaggregation ratio differs from the previous year the opening balance has been amended to reflect the ratio for the current reporting year. This has resulted in instances of the closing balance for the previously reported year differing from the opening balance for the current reporting year. This approach ensures that the movement in the provision balances is preserved for the purposes of the RIN reporting.

Employee Entitlements

Powerlink has utilised the labour time charged to Regulated and Non-Regulated activities to disaggregate the Employee Entitlements provisions between Regulated and Non-Regulated activities. The Regulated provision balances were then apportioned between Opex and Capex based on the labour time charged to Opex and Capex activities.

The opening balance for 2020/21 differs from the closing balance reported in Powerlink's Economic Benchmarking RIN returns for previous years due to the change in the disaggregation ratio discussed previously.

For line items TOPEX0311A & TOPEX0313A "the increase during the period in the discounted amount arising from the passage of time and the effect of any change in the discount rate",

[10] Australian Energy Regulator (2013a). p.18.

Powerlink has used the financial impact of the statutory adjustment as required by Australian Accounting Standards as the basis of reporting.

Others

Other Provisions include the organisation restructure provision and easement compensation provisions for 2020/21 which relates only to Regulated Opex.

Dividends

The provision for Dividends has been allocated between Regulated and Non-Regulated in accordance with the apportionment of Powerlink's fixed asset register.

Sheet: 3.3 Assets (RAB)

Table: 3.3.1 Regulatory Asset Base Values

Variable: ***TRAB0101 – Opening value***
TRAB0102 – Inflation addition
TRAB0103 – Straight line depreciation
TRAB0104 – Regulatory depreciation
TRAB0105 – Actual additions (recognised in RAB)
TRAB0106 – Disposals
TRAB0107 – Closing value for asset value

RIN requirements

This section has been completed in accordance with chapter 4 of the Benchmarking RIN Definitions and Instructions.

Consistent with the RIN requirements[11], unless stated otherwise all amounts reported reconcile to the final Roll Forward Model (RFM) used to establish Powerlink's Regulatory Asset base for each of the relevant regulatory periods and the Regulatory Financial Statements submitted to the AER annually. In instances where a difference exists an explanation and reconciliation has been provided.

Source

Table 3.3.1 has been populated with actual data for additions and proceeds from disposals. Other variables have been populated with information calculated using information from the regulatory financial statements submitted to the AER annually.

Methodology and assumptions

Powerlink has utilised Version 4 of the AER's Roll Forward Model to calculate the Regulatory Asset Base (RAB) for 2020/21.

As per Powerlink's Final Determination for the 2017/18 to 2021/22 regulatory period, the AER will apply forecast real straight line depreciation to calculate Powerlink's RAB over the period. Consistent with this methodology, Powerlink has adopted real forecast depreciation in the calculation of the 2020/21 RAB.

Powerlink has also, in line with the 2017/18 - 2021/22 Final Determination, adjusted 2020/21 capitalisations for movements in provisions.

In re-categorising the substation land assets Powerlink reviewed its land assets and aligned them to the RIN requirements based on actual usage.

[11] Australian Energy Regulator (2013a). p.20.

Table: 3.3.2 Asset value roll forward

Variable: *TRAB0201, 0301, 0401, 0501, 0601 & 0701 – Opening value*
TRAB0202, 0302, 0402, 0502, 0602 & 0702 – Inflation addition
TRAB0203, 0303, 0403, 0503, 0603 & 0703 – Straight line depreciation
TRAB0204, 0304, 0404, 0504, 0604 & 0704 – Regulatory depreciation
TRAB0205, 0305, 0405, 0505, 0605 & 0705 – Actual additions (recognised in RAB)
TRAB0206, 0306, 0406, 0506, 0606 & 0706 – Disposals
TRAB0207, 0307, 0407, 0507, 0607 & 0707– Closing value for asset value

RIN requirements

This section has been completed in accordance with chapter 4 of the Benchmarking RIN Definitions and Instructions.

Table 3.3.2 has been populated with actual data for additions and proceeds from disposals. Other variables have been populated with information calculated using the functionality contained within the AER's RFM.

Source

All information required to complete this table was sourced from a Roll Forward Model (RFM)[12]. Powerlink used the RFM for the period 2012/13 to 2016/17 as a base to create a new model for the regulatory period commencing 2017/18.

Methodology and assumptions

The underlying methodology and resulting financial information used to populate Table 3.3.1 has formed the base to complete Table 3.3.2

Asset categories used by Powerlink differ from those required to complete Table 3.3.2. As such Powerlink has used the following matrix to align to the RIN requirements:

EB RIN template categories	Powerlink's categories	Assumptions
Overhead Transmission Assets	Transmission Lines - Overhead Transmission Lines – Refit	• No assumptions made.
Underground Transmission Assets	Transmission Lines – Underground	• No assumptions made.
Transmission switchyards, substations	Substations Primary Plant Insurance Spares Substations Secondary Systems Land - Substations	• Insurance Spares are classified in the same way as Substations Primary Plant. • Powerlink owned land has been disaggregated into three categories being Substations, Other Purposes and Easements.
Easements	Easements Land - Easements	• Powerlink owned land has been disaggregated into three categories being Substations, Other Purposes and Easements.

[12] See section in relation to Table 3.3.1.

Other Assets with long lives	Commercial Buildings Communications Other Assets Comms - Civil Works Network Switching Centres Land – Other Equity raising costs	• These asset classes have a useful life of more than 10 years. • Equity raising costs are recognised as part of the RAB and are amortised over 43 years. • Powerlink owned land has been disaggregated into three categories being Substations, Other Purposes and Easements.
Other Assets with short lives	Computer Equipment Office Furniture & Miscellaneous Office Machines Vehicles Moveable Plant	• These asset classes have a useful life of less than 10 years.

Table: 3.3.3 Total disaggregated RAB asset values

Variable: ***TRAB0801 – Overhead transmission assets (wires and towers/poles etc)***
TRAB0802 – Underground transmission assets (cables, ducts etc)
TRAB0803 – Substations, switchyards, transformers etc with transmission functions
TRAB0804 – Easements
TRAB0805 – Other assets with long lives (please specify)
TRAB0806 – Other assets with short lives (please specify)

RIN requirements

This section has been completed in accordance with chapter 4 of the Benchmarking RIN Definitions and Instructions.

Table 3.3.3 has been populated with the information from the preceding Tables 3.3.1 and 3.3.2.

Source

This table was completed using an average formula of the Opening and Closing values of each category in Table 3.3.2[13].

[13] Australian Energy Regulator (2013a). p.22.

Table: 3.3.4 Asset Lives

Sub-table: 3.3.4.1Asset lives – estimated service life of new assets

Variable: *TRAB0901 – Overhead transmission assets (wires and towers/poles etc)*
TRAB0902 – Underground transmission assets (cables, ducts etc)
TRAB0903 – Switchyards, substations and transformer assets
TRAB0904 – Other assets with long lives (please specify)
TRAB0905 – Other assets with short lives (please specify)

RIN requirements

This section has been completed in accordance with Chapter 4 of the Benchmarking RIN Definitions and Instructions.

Table 3.3.4.1 has been populated with estimated data.

Source

This table was completed using outputs from the Regulated RFM.

Methodology and assumptions

Consistent with the RIN requirements[14] the weighted average calculation was used and the following assumptions were made:

1) Land and Easements do not have a definite useful life and therefore were excluded from the weighted average calculations.

2) In the weighted average asset life calculation provided in the template Powerlink used the following figures:

EB RIN Requirements	Assumptions
***n* is the number of assets in category j**	Individual asset information is not available within the Regulated RFM, as such Powerlink has substituted the number of asset classes within a category for *n*.
$X_{i,j}$ is the value of asset *i* in category *j*	The Nominal Opening Regulatory Asset Base values calculated from the Regulated RFM were used for $X_{i,j}$.
$EL_{i,j}$ is the expected life of asset *i* in category *j*	The expected useful lives as contained in the Regulatory RFM per asset class were used for $EL_{i,j}$.
RC_j is the sum of the value of all assets in category *j*	No assumptions.

[14] Australian Energy Regulator (2013a). p.22.

Sub-table: 3.3.4.2 Asset lives – estimated residual service life

Variable: ***TRAB1001 – Overhead transmission assets (wires and towers/poles etc)***
TRAB1002 – Underground transmission assets (cables, ducts etc)
TRAB1003 – Switchyards, substations and transformer assets
TRAB1004 – Other assets with long lives (please specify)
TRAB1005 – Other assets with short lives (please specify)

RIN requirements

This section has been completed in accordance with Chapter 4 of the Benchmarking RIN Definitions and Instructions.

Table 3.3.4.2 has been populated with estimated data.

Source

This table was completed using data from Powerlink's Enterprise Resource Planning (ERP) system, SAP, and outputs from the Regulated RFM.

Methodology and assumptions

Estimated residual service life is based on an estimate of the average expended life of each type of asset. This is then subtracted from the corresponding estimated service life of new assets (variables TRAB0901 – TRAB0905) to derive the estimated residual service life.

Why an estimate is required

It is not possible to provide actual data on the residual service life of assets. The actual service life will not be determined until an asset is finally removed from service at the end of its life. While a new asset might be expected to achieve a certain operating life when it is first placed into service, it will be subject to the vagaries of the operating environment in which it is placed and the operating stresses to which it is subjected. The AER has recognised this in the RIN Instructions and Definitions when it has directed Powerlink to report "a current estimation" of the residual service life[15].

How the data was estimated

The method for estimating the average expended life of each type of asset is set out below:

Variables TRAB1001 – TRAB1003
The historical record of the year in which each type of asset was installed was sourced from SAP. A volume weighted average age, based on the count of the number of assets, was then determined for each regulatory year. For example, if there is one substation asset that is one year old, and three assets that are five year old the average age of substation assets is ((1 x 1) + (3 x 5)) / (3 + 1) = 4 years. If the estimated service life of new substation assets is 40 years then the estimated residual life of these substation assets is 40 – 4 = 36 years.

[15] Australian Energy Regulator (2013a). p.23.

The specific physical equipment that comprises the count of assets for each variable is:

- TRAB1001 Overhead transmission assets – transmission towers;
- TRAB1002 Underground transmission assets – underground cable sections; and
- TRAB1003 Switchyard, substation and transformer assets – substation switchbays

Variable TRAB1004 – TRAB1005

The individual assets included in these variables are significantly more diverse than the individual assets in the other variables. For this reason a simple count of asset or equipment numbers is not appropriate and an asset value ($'s) weighted average approach has been adopted.

Asset values and an estimated remaining life for the start of the analysis were sourced from the regulated RFM. For each subsequent year the existing assets were rolled forward and 'aged' by one year and any increase in asset value was assumed to have the estimated service life of the corresponding asset type (i.e. variables TRAB0904 – TRAB0905). From this a dollar-weighted average age was determined.

Sheet: 3.4. Operational data

Table: 3.4.1 Energy delivery

Variables: TOPED0101 to TOPED0113 - Energy Grouping by Downstream Connection type

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. At each settlement location for transmission networks (TOPED0101), distribution networks (TOPED0102), directly connected end-users (TOPED0103 to TOPED0112) and pumping and power station auxiliaries (TOPEDO113), customers' energy values are recorded.

Table 3.4.1 has been populated with actual data.

Source

These recordings are stored in Powerlink's metering database as half hour average demands for each connection point, expressed in MW. As required under the Rules:

- Data for TOPED0101 - TOPED0113 has been provided by registered Meter Data Providers (MDPs) [16].

Methodology and assumptions

Numbers provided have been processed from raw meter data and are the sum of half-hour interval energy values recorded for all connection points over the year. This is then divided by one thousand to give a net GWh energy total for each of the variables.

Energy delivered to other connected transmission networks (variable TOPED0101) is calculated as the sum of the absolute value of all energy transfers. That is, gross exported energy plus gross imported energy.

Energy delivered to pumping and Power Station Auxiliaries (variable TOPED0113) is calculated using only connection points whose auxiliary supply is metered separately from its primary generation connection, i.e. excludes connection points where generation and auxiliary supply is measured on the same meter or the auxiliary supply is measured downstream from an already metered connection point.

[16] Australian Energy Market Commission, National Electricity Rules, Version 169, August 2021, clause 7.3.2(d1)).

Table: 3.4.2 Connection points

Variables: TOPCP0101 to TOPCP0111 - Number of entry points at each transmission voltage level

<u>RIN Requirements</u>

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. Further context is provided by reference to chapter 6 of the *Better Regulation Explanatory Statement: Regulatory Information Notices to Collect Information for Economic Benchmarking* ('the Economic Benchmarking Explanatory Statement').

The Economic Benchmarking RIN Instructions and Definitions require that:

> Connection point numbers must be reported as the average of connection point numbers in the relevant Regulatory Year under system normal conditions. The average is calculated as the average of the number of connection points on the first day of the Regulatory Year and on the last day of the Regulatory Year.[17]

The AER has clarified that:

> The purpose of our connection point variables is to provide an indicator of the requirements for transmission services a TNSP has to provide at connection points. These services are a necessary part of maintaining the quality, reliability and security of supply.[18]

For these variables, Table 3.4.2 has been populated with actual data. Powerlink has populated four variables in this table for the following voltage levels:

- TOPCP0102: 330 kV
- TOPCP0103: 275 kV
- TOPCP0105: 132 kV
- TOPCP0106: 110 kV
- TOPCP0108: 33 kV

As permitted under the RIN[19], values of zero have been provided for the following variables as Powerlink does not have any entry points of this voltage:

- TOPCP0101: 500 kV
- TOPCP0104: 220 kV
- TOPCP0107: 66 kV
- TOPCP0109: 22 kV
- TOPCP0110: 11 kV
- TOPCP0111: 6.6 kV

[17] Australian Energy Regulator (2013a). p.24.
[18] Australian Energy Regulator (2013b). Better Regulation Explanatory Statement, Regulatory Information Notices to Collect Information for Economic Benchmarking, November, p.40.
[19] Australian Energy Regulator (2013a). p.6.

Source

For calculating the number of entry points, Powerlink has used AEMO's List of Regional Boundaries and Marginal Loss Factors report that is published for each financial year[20]. This report documents a marginal loss factor (MLF) for each transmission connected generator in the NEM.

Methodology and assumptions

The number of entry points at the end of a regulatory year has been calculated using the number of unique Transmission Node Identifier (TNI) Codes for Queensland transmission connected generators listed in Chapter 1 of AEMO's annual List of Regional Boundaries and Marginal Loss Factors report (MLF Report), with the following exceptions:

- Where separate commercial entities share a single TNI Code, the separate commercial entities are counted as separate entry points. For example, Braemar Power Station, Braemar Stage 2 Power Station and Darling Downs Power Station all share the TNI Code of QBRA but are counted as three entry points.
- Where power station auxiliary load connections have the same TNI Code as the generating units they support, they are counted as a single entry point. For example, Gladstone PS and Gladstone PS Load have the same TNI Code (QGLL) and are counted as only one entry point.
- Generating units not connected to Powerlink assets are not counted – for example, Mackay GT connects to the Ergon 33kV bus and is not counted as an entry point.
- Wivenhoe Pumps are not counted separately from Wivenhoe Generation.
- Where a connection point is yet to be commissioned within the relevant financial year

The number of entry points at a voltage level in a given regulatory year is taken as the average of:

- The number of entry points at that voltage level determined from the AEMO MLF Report for that regulatory year; and
- The number of entry points at that voltage level determined from the AEMO MLF Report for the previous regulatory year.

Variables: TOPCP0201 to TOPCP0212 - Number of exit points at each transmission voltage level

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. Further context is provided by reference to chapter 6 of the Economic Benchmarking Explanatory Statement. Consistent with subsequent instructions issued by the AER, Powerlink has also reported interconnectors as exit points in Table 3.4.2 and not as entry points[21]. Consistent with the AER's approach, prescribed and non-prescribed connection points are included.

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[20] Available at: https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries. Prior to 1 July 2009 this was reported by NEMMCO.

[21] E-mail from AER, EBT RIN – interconnectors and connection point numbers, 12 February 2014.

Consistent with the requirements in relation to entry points, the Economic Benchmarking RIN Instructions and Definitions requires that:

> Connection point numbers must be reported as the average of connection point numbers in the relevant Regulatory Year under system normal conditions. The average is calculated as the average of the number of connection points on the first day of the Regulatory Year and on the last day of the Regulatory Year.[22]

For these variables, Table 3.4.2 has been populated with actual data. Powerlink has populated eight variables in this table for the following voltage levels:

- TOPCP0202: 330 kV
- TOPCP0203: 275 kV
- TOPCP0205: 132 kV
- TOPCP0206: 110 kV
- TOPCP0207: 66 kV
- TOPCP0209: 33 kV
- TOPCP0210: 22 kV
- TOPCP0211: 11 kV.

As permitted under the RIN[23], values of zero have been provided for the following variables as Powerlink does not have any exit points of this voltage:

- TOPCP0201: 500 kV
- TOPCP0204: 220 kV
- TOPCP0208: 44 kV
- TOPCP0212: 6.6 kV

Source

For calculating the number of exit points at the end of a regulatory year Powerlink has used AEMO's annual List of Regional Boundaries and Marginal Loss Factors report, which documents a MLF for each transmission connected load point in the NEM in that regulatory year[24]. As noted above, the AER has stipulated that interconnectors must also be treated as exit points.

Methodology and assumptions

The number of exit points has been calculated as the number of unique TNI Codes for Queensland transmission connected load points listed in Chapter 1 of AEMO's annual List of Regional Boundaries and Marginal Loss Factors report, with the following exceptions:

- Where separate TNI Codes have been created under the one location to facilitate Full Retail Contestability (where that location may have formerly had a single TNI code), this is still counted as a single exit point. For example, in the 2006/07 report the TNI Code for Woolooga 132kV (QWLG) was replaced with Woolooga Energex (QWLG) and Woolooga Ergon Energy (QWLN).
- Wivenhoe Pumps are not counted as an exit point. The Wivenhoe Power Station connection is already counted as an entry point.

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[22] Australian Energy Regulator (2013a). p.24.
[23] Australian Energy Regulator (2013a). p.6.
[24] Available at: https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries. Prior to 1 July 2009 this was reported by NEMMCO.

- The QNI and Terranora interconnectors are included as additional exit points.

The number of exit points at a voltage level in a given regulatory year is taken as the average of:

- The number of exit points at that voltage level determined from the AEMO MLF Report for that regulatory year; and
- The number of exit points at that voltage level determined from the AEMO MLF Report for the previous regulatory year.

Table: 3.4.3 System Demand

Sub-table: 3.4.3.1 Annual system maximum demand characteristics – MW measure

Variable: TOPSD0101 - Transmission system coincident maximum demand (MW)

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. The definition of Transmission System Coincident Maximum Demand set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions has been applied.

For this variable, Table 3.4.3.1 has been populated with actual data.

Source

The variable has been populated with actual information from the same source used for variables in Table 3.4.1 (Energy Delivery).

Methodology and assumptions

The reported value is the build-up of two major components:

- the summation of the actual unadjusted (i.e. not weather normalised) MW demands at Powerlink's downstream connection and supply locations at the time when this summation is greatest; and
- any export at the time of the coincident maximum for each interconnector (consistent with the definition set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions).

Variable: TOPSD0102 - Transmission System coincident weather adjusted maximum demand 10% PoE (MW)

RIN Requirements

This section has been completed in accordance with the definition of Transmission System Coincident Weather Adjusted Maximum Demand 10% POE set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.4.3.1 has been populated with estimated data. While this variable is based on actual data, being the non-weather adjusted maximum demand, it is also materially dependent on judgments and assumptions in developing the methodology for weather adjustment. As a result, Powerlink considers this data to be estimated.

Source

Weather adjusted coincident maximum demand 10% PoE and 50% PoE values are sourced from AEMO using data from its 2021 ESOO. To derive weather adjusted maximum demand at the transmission delivered location, adjustments for auxiliary loads, transmission losses, and embedded operational generators are applied to AEMO's Operational Sent Out weather corrected 10% PoE and 50% PoE demands.

Methodology and assumptions

See AEMO's Electricity Demand Forecasting Methodology Paper[25].

Variable: TOPSD0103 - Transmission System coincident weather adjusted maximum demand 50% PoE (MW)

RIN Requirements

This section has been completed in accordance with the definition of Transmission System Coincident Weather Adjusted Maximum Demand 50% POE set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.4.3.1 has been populated with estimated data. While this variable is based on actual data, being the non-weather adjusted maximum demand, it is also materially dependent on judgments and assumptions in developing the methodology for weather adjustment. As there is no independent means of verifying the correctness or otherwise of historical weather adjustment Powerlink considers this variable will remain as estimated data in the future.

Source

The variable has been populated with information from the same source used for variable TOPSD0102 - Transmission System coincident weather adjusted maximum demand 10% PoE (MW).

Methodology and assumptions

See AEMO's Electricity Demand Forecasting Methodology Paper[25].

Variable: TOPSD0104 - Transmission system non-coincident summated maximum demand (MW)

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. The definition of Transmission System Non-Coincident Summated Maximum Demand set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions has been applied.

For this variable, Table 3.4.3.1 has been populated with actual data.

Source

The variable has been populated with actual information from the same source used for variables in Table 3.4.1 (Energy Delivery).

[25] Available at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2020/electricity-demand-forecasting-methodology/final-stage/electricity-demand-forecasting-methodology.pdf?la=en (accessed 17/08/2021).

Methodology and assumptions

The reported value is the build-up of two major components:

- the summation of the maximum actual unadjusted (i.e. not weather normalised) MW demands at Powerlink's downstream connection and supply locations irrespective of when they occurred in the year. These peaks are reported under system normal conditions (excluding periods affected by outages); and
- the highest export value for each interconnector for each year, irrespective of when they occurred (consistent with the definition set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions).

Variable: TOPSD0105 - Transmission System non-coincident weather adjusted summated maximum demand 10% PoE (MW)

RIN Requirements

This section has been completed in accordance with the definition of Transmission System Non-Coincident Weather Adjusted Maximum Demand 10% PoE set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.4.3.1 has been populated with estimated data. While this variable is based on actual data, being the non-weather adjusted maximum demand, it is also materially dependent on judgments and assumptions in developing the methodology for weather adjustment. As a result, Powerlink considers this data to be estimated.

Source

Non-coincident weather corrected 10% PoE demands for Energex and Ergon connection points have been sourced from Energex and Ergon respectively. The connection points that are non-weather dependant have been populated from the same source used for variables in Table 3.4.1 (Energy Delivery).

Methodology and assumptions

Weather correction is only applicable to DNSP connection points, as the interconnectors, large industrial and rail traction loads which connect directly to Powerlink's network are not materially weather-sensitive.

For the non-coincident weather adjusted summated maximum demand, Powerlink has obtained from each DNSP their calculated temperature corrected values at each connection point, as only the DNSPs have the detailed record of downstream outages and load transfers to robustly perform this calculation.

For 10% PoE results, the statistical calculations were set to calculate the temperature correction corresponding to a 10% probability of exceedance

Variable: TOPSD0106 - Transmission System non-coincident weather adjusted summated maximum demand 50% PoE (MW)

RIN Requirements

This section has been completed in accordance with the definition of Transmission System Non-Coincident Weather Adjusted Maximum Demand 50% PoE set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.4.3.1 has been populated with estimated data. While this variable is based on actual data, being the non-weather adjusted maximum demand, it is also materially dependent on judgments and assumptions in developing the methodology for weather adjustment. As a result, Powerlink considers this data to be estimated.

Source

Non-coincident weather corrected 50% PoE demands for Energex and Ergon connection points have been sourced from Energex and Ergon respectively. The connection points that are non-weather dependant have been populated from the same source used for variables in Table 3.4.1 (Energy Delivery).

Methodology and assumptions

This field was populated as per the variable 'Transmission System non-coincident weather adjusted summated maximum demand 10% PoE (MW)', except using adjusted calculations to calculate the temperature correction corresponding to a 50% probability of exceedance.

Sub-table: 3.4.3.2 Annual system maximum demand characteristics – MVA measure

Variable: TOPSD0201 - Transmission system coincident maximum demand (MVA)

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. The definition of Transmission System Coincident Maximum Demand set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions has been applied.

For this variable, Table 3.4.3.2 has been populated with actual data.

Source

MW and MVAr values were sourced from the same data used for Table 3.4.1 (Energy Delivery) and Sub-table 3.4.3.1 (Annual System Maximum Demand Characteristics – MW measure).

Methodology and assumptions

MVA figures are calculated using MW and MVAr values for each half-hour period for the financial year.

The reported value is a built up of two major components:

- the summation of actual unadjusted (i.e. not weather normalised) MVA demands at Powerlink's downstream connection and supply locations at the time when the summation of the actual unadjusted MW demands is greatest (when variable TOPSD0101 - Transmission system coincident maximum demand, occurs); and

- any export at the time of the coincident maximum demand for each interconnector (consistent with the definition set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions).

Variable: TOPSD0202 - Transmission System coincident weather adjusted maximum demand 10% PoE (MVA)

For this variable, Table 3.4.3.2 has been populated with estimated data due to the reasons given for TOPSD0105. This variable is the summation of the 10% PoE weather adjusted coincident MVA maximum demand at each of Powerlink's downstream connection points. The 10% PoE weather adjusted coincident MVA maximum demand at each connection point is the 10% PoE weather adjusted coincident MW maximum demand divided by the power factor at the time of coincident maximum demand.

Variable: TOPSD0203 - Transmission System coincident weather adjusted maximum demand 50% PoE (MVA)

For this variable, Table 3.4.3.2 has been populated with estimated data due to the reasons given for TOPSD0105. This field was populated as per the variable 'Transmission System coincident weather adjusted maximum demand 10% PoE (MVA)', except using 50% PoE values.

Variable: TOPSD0204 - Transmission system non-coincident summated maximum demand (MVA)

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions. The definition of Transmission System Non-Coincident Summated Maximum Demand set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions has been applied.

For this variable, Table 3.4.3.2 has been populated with actual data.

Source

MVA values were sourced from the same data used to populate variable TOPSD0201 (Transmission System coincident maximum demand MVA).

Methodology and assumptions

The reported value is built up of two major components:

- the sum of actual unadjusted (i.e. not weather normalised) MVA demands at the time of non-coincident MW peaks for each of Powerlink's downstream connection and supply locations. These peaks are reported under system normal conditions (excluding periods affected by outages); and
- the highest export value of each interconnector for each year, irrespective of when they occurred, in MVA (consistent with the definition set out in chapter 9 of the Economic Benchmarking RIN Instructions and Definitions).

Variable: ***TOPSD0205 - Transmission System non-coincident weather adjusted summated maximum demand 10% PoE (MVA)***

For this variable, Table 3.4.3.2 has been populated with estimated data due to the reasons given for TOPSD0105. This variable is the summation of the 10% PoE weather adjusted non-coincident MVA maximum demand at each of Powerlink's downstream connection points. The 10% PoE weather adjusted non-coincident MVA maximum demand at each connection point is the 10% PoE weather adjusted non-coincident MW maximum demand divided by the power factor at the time of non-coincident maximum demand.

Variable: ***TOPSD0206 - Transmission System non-coincident weather adjusted summated maximum demand 50% PoE (MVA)***

For this variable, Table 3.4.3.2 has been populated with estimated data due to the reasons given for TOPSD0105. This field was populated as per the variable 'Transmission System non-coincident weather adjusted maximum demand 10% PoE (MVA)', except using 50% PoE values.

Sub-table: **3.4.3.3 Power factor conversion between MVA and MW**

Variable: ***TOPSD0301 - Average overall network power factor conversion between MVA and MW***

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.4.3.3 has been populated with actual data.

Source

The variable has been populated with actual information from the same source used for variables in Table 3.4.1 (Energy Delivery).

Methodology and assumptions

Powerlink's approach to calculate the power factor, takes account of the phase-angle at each connection point. The power factor is calculated according to the following formula.

$$PF = \frac{\text{MW Coincident Maximum Demand}}{\sqrt{(\text{MW Coincident Maximum Demand})^2 + (\text{MVAr Coincident Maximum Demand})^2}}$$

Where:

- MW Coincident Maximum Demand = a summation of the MW load at each connection point at the time of Transmission System coincident maximum demand. It is calculated in the same manner as TOPSD0101 (Transmission System coincident maximum demand MW), and uses the same data source, but does not exclude interconnector import; and
- MVAr Coincident Maximum Demand = a summation of the MVAr load at each connection point at the time of Transmission System coincident maximum demand. It

is calculated in the same manner as MW Coincident Maximum Demand, and uses the same data source.

Variables: TOPSD0302 to TOPSD0312: Average power factor conversion at each transmission voltage level

RIN Requirements

This section has been completed in accordance with chapter 5, section 5.1 of the Economic Benchmarking RIN Instructions and Definitions.

For these variables, Table 3.4.3.3 has been populated with actual data.

As permitted under the RIN[26], values of zero have been provided for the following variables as Powerlink does not have any lines of this voltage:

- TOPSD0302: 500 kV lines
- TOPSD0305: 220 kV lines
- TOPSD0308: 88 kV lines
- TOPSD0312: 6.6 kV lines

Source

The variable has been populated with actual information from the same source used for variables in Table 3.4.1 (Energy Delivery).

Methodology and assumptions

Each connection point has been assigned its voltage level as seen at its respective settlement location (as per AEMO's annual List of Regional Boundaries and Marginal Loss Factors report). This is the same voltage classification as for variables TOPCP0201 – TOPCP0212. Where a connection point has loads at multiple voltages the connection point has been split to allocate these different voltage loads to their respective voltage level power factor conversions.

As per TOPSD0301, Powerlink's approach to calculate the power factor takes account of the phase-angle at each connection point. The power factor is calculated according to the following formula.

$$PF = \frac{\text{MW for Voltage at Coincident MD}}{\sqrt{(\text{MW for Voltage at Coincident MD})^2 + (\text{MVAr for Voltage at Coincident MD})^2}}$$

Where:

- MW for Voltage at Coincident MD = a summation of the MW load at each connection point of that voltage, at the time of Transmission System coincident maximum demand. It is calculated in the same manner as TOPSD0101 (Transmission System coincident maximum demand MW), and uses the same data source, but does not exclude interconnector import; and

[26] Australian Energy Regulator (2013a). p.6.

- MVAr for Voltage at Coincident MD = a summation of the MVAr load at each connection point of that voltage, at the time of Transmission System coincident maximum demand. It is calculated in the same manner as MW for Voltage at Coincident MD, and uses the same data source.

Sheet: 3.5 Physical Assets

Table: 3.5.1 Transmission System Capacities

Sub-table: 3.5.1.1 Overhead network length of circuit at each voltage

Variables: TPA0101 to TPA0109

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.1 has been populated with actual data.

As permitted under the RIN, zero values have been provided where the voltage information is not applicable.

Source

Information has been sourced from Powerlink's enterprise resource planning database, SAP. All data was prepared using dates "as-commissioned".

Methodology and assumptions

The voltage used for the variable is the "as constructed" voltage.

The RIN template has been populated with data extracted from Powerlink's enterprise resource planning database, SAP. The extraction is based on a list of all prescribed in-service, above ground, built sections[27] and the "as constructed" voltage associated with each built section. Data extracted for each built section includes voltage and circuit length.

Sub-table: 3.5.1.2 Underground cable circuit length at each voltage

Variables: TPA0201 to TPA0211

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.2 has been populated with actual data.

As permitted under the RIN, zero values have been provided where the voltage information is not applicable.

Source

This data has been sourced from Powerlink's enterprise resource planning database, SAP.

[27] Powerlink uses "built sections" as the basic building block against which transmission line circuit and easement information is recorded. A "built section" is defined as a collection of structures, conductors and easements with common characteristics as listed in SAP.

Methodology and assumptions

The voltage used for the variable is the “as constructed” voltage.

The RIN templates have been populated with data extracted from Powerlink’s enterprise resource planning database, SAP. The extraction is based on a list of all prescribed in-service, underground, built sections[28] and the “as constructed” voltage associated with each built section. Data extracted for each built section includes voltage and circuit length.

Sub-table: 3.5.1.3 Estimated overhead network weighted average MVA capacity by voltage class

Variables: TPA0301 to TPA0312

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.3 has been populated with actual data.

Source

The data is sourced from Powerlink’s enterprise resource planning database, SAP.

Methodology and assumptions

For actual summer normal MVA capacity by voltage data, corresponding ratings data was extracted from the SAP overhead feeder ratings. SAP span length data was used to source the length of the transmission lines in kilometres. For each line the summer weighted MVA was derived by multiplying total circuit kilometres by the limiting summer normal MVA. For each voltage class the sum of the Summer Weighted MVA was divided by the sum of the total circuit kilometres to arrive at the Weighted Average MVA capacity.

Normal summer ratings have been provided in the templates in accordance with section 6.1 of the Benchmarking RIN Instructions and Definitions as Powerlink’s transmission network experiences its maximum demand during summer.

The thermal ratings used are based on the summer normal thermal limits applied to individual lines, which is the maximum that would be permitted under normal operating conditions. Transient and voltage stability limits are managed from a system perspective, rather than on an individual line, with constraint equations applied to different grid sections, consisting of many lines at different voltages, of the system which may introduce limitations on thermal ratings. Substation internal limitations are not considered for overhead transmission lines.

[28] Ibid.

Sub-table: 3.5.1.4 Estimated underground network weighted average MVA capacity by voltage class

Variables: ***TPA0401 to TPA0411***

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.4 has been populated with actual data.

Source

The data is sourced from Powerlink's enterprise resource planning database, SAP.

Methodology and assumptions

For actual MVA capacity by voltage data, corresponding ratings data was extracted from SAP including total circuit kilometres and maximum continuous MVA. For each underground cable the summer weighted MVA was derived by multiplying total circuit kilometres by maximum continuous MVA. For each voltage class the sum of the summer weighted MVA was divided by the sum of the total circuit kilometres to arrive at the weighted average MVA capacity.

SAP records information on system voltage, not rated voltage. Maximum continuous ratings (summer based) have been provided in the templates in accordance with section 6.1 of the Benchmarking RIN Instructions and Definitions, as Powerlink's transmission network experiences its maximum demand during summer.

The thermal ratings used are based on the maximum continuous thermal limits applied to individual underground cables, which is the maximum that would be permitted under normal operating conditions. Transient and voltage stability limits are managed from a system perspective, rather than on an individual cable, with constraint equations applied to different grid sections, consisting of many lines at different voltages, of the system which may introduce limitations on thermal ratings. Substation internal limitations are not considered for underground transmission lines.

Sub-table: 3.5.1.5 Installed transmission system transformer capacity

Variables: ***TPA0501, TPA0502, TPA0503***

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.5 has been populated with estimated data.

Source

The data has been sourced directly from Powerlink's corporate enterprise resource planning database, SAP.

Why an estimate is required

Unlike some other jurisdictions, where the TNSP generally connects directly to the DNSP busbar, the Queensland network has a large number of instances where DNSPs take supply from Powerlink at 132kV or 110kV. The DNSPs then own the 132kV or 110kV feeders that supply the DNSPs remote substation. In other instances an end-user will take supply from a Powerlink 132kV busbar to their own remote substation either via feeders owned by the end-user or by Powerlink owned feeders that provide non-regulated services.

To compensate for this characteristic of the industry in Queensland Powerlink has developed a methodology to reallocate a proportion of the transformer capacity in variable TPA0501 to variables TPA0502 and TPA0503 to reflect the proportion of this upstream capacity that is used to supply DNSPs and other end-users at voltages below 275kV. This methodology has been developed to ensure that there is no double counting of this reallocated capacity with capacity that would already be reported under variable TPA0502 and TPA0503.

How the estimate was produced

A list of Powerlink owned transformer equipment records, associated commissioning and decommissioning dates, and capacity information was extracted for each power transformer from SAP. For each transformer in the list, Powerlink used its high voltage system operating diagrams to identify which variable category was appropriate (consistent with Benchmarking RIN Instruction and Definitions, chapter 9[29]).

The key steps in the methodology to calculate the estimate are:

1. Only applies to substations where there is direct transformation from 275kV or higher to 132kV or lower includes 330/132kV, 275/132kV, 275/110kV, and 275/66kV;
2. Limited to 132kV and lower connections only;
3. Consider multiple bus sections as a single electrical bus when the sections are tied together under system normal conditions;
4. Ignore connections of reactive plant at the busbar;
5. Ignore connections to the transformation back to the higher voltage;
6. Ignore connections to generators;
7. Include connections to transformation to a lower voltage;
8. Include connections to feeders to remote substations;
9. For each included connection categorise it as either Powerlink, DNSP or end-user based on the ownership of the equipment at the remote end of the connection – if Powerlink owns the outgoing feeder but it connects to a DNSP / end-user substation then count as a DNSP /end-user connection respectively;
10. Calculate the proportion of the total number of connections that are categorised as DNSP connections and end-user connections;
11. Multiply the total transformer capacity from 275kV or higher to that busbar by the proportion of DNSP connections and the proportion of end-user connections at that busbar; and
12. These are the capacities that are reallocated from variable TPA0501 to variables TPA0502 and TPA0503 respectively.

[29] Australian Energy Regulator (2013a). p.38.

Variable: TPA0504: Transformer capacity for directly connected end–users owned by the end–user

RIN Requirements

This section has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.5.1.5 has been populated with an estimate.

Source

The data is sourced from Powerlink's high voltage system operating diagrams.

Why an estimate is required

Estimates are provided as historical data on end-user transformer ratings is not required to operate Powerlink's transmission network and has therefore not been collected.

How the estimate has been produced

Ratings data from Powerlink's high voltage system operating diagrams have been used to develop an estimate.

Powerlink considers that this methodology provides its best estimate for end-user transformer capacity.

Where an end-user has already been allocated a proportion of the capacity of Powerlink's upstream transformer capacity (see Variables TPA0501, TPA0502 and TPA0503) no additional capacity is added to this variable.

Variables: TPA0505 and TPA0506

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.5 has been populated with actual data.

Source

The data has been sourced directly from Powerlink's corporate enterprise resource planning database, SAP.

Methodology and assumptions

A list of Powerlink owned transformer equipment records, associated commissioning and decommissioning dates, and capacity information was extracted for each power transformer from SAP. For each transformer in the list, Powerlink used its high voltage system operating diagrams to identify which variable category was appropriate (consistent with Benchmarking RIN Instruction and Definitions, chapter 9[30]).

[30] Australian Energy Regulator (2013a). p.38.

Since the network connection from Millmerran to Middle Ridge was established in 2004, Powerlink's 330/275kV transformers are embedded within the transmission network and are included as part of variable TPA0501, not TPA0505.

Given the large number of SVC transformers on Powerlink's network, a separate SVC transformer variable category has been included in the RIN template to improve granularity as these transformers do not fit well into the other template variable categories provided.

Sub-table: 3.5.1.6 Cold Spare Capacity

Variable: TPA06

RIN requirements

This sub-table has been completed in accordance with chapter 6, section 6.1 of the Benchmarking RIN Instructions and Definitions.

Table 3.5.1.6 has been populated with actual data.

Source

The data has been sourced directly from Powerlink's corporate enterprise resource planning database, SAP.

Methodology and assumptions

A list of Powerlink-owned transformer equipment records, installation status and capacity information was extracted for each power transformer from SAP to identify the transformers kept as cold spares.

Sheet: 3.6 Quality of Service

Table: 3.6.1 Service Component

Sub-table: 3.6.1 Service Parameter 1 – Average Circuit Outage Rate

Variables: *TQS0101 - Lines outage rate - fault*
TQS0102 - Number of Lines fault outages
TQS0103 - Number of defined Lines
TQS0104 - Transformers outage rate - fault
TQS0105 - Number of Transformer fault outages
TQS0106 - Number of defined Transformers
TQS0107 - Reactive plant outage rate - fault
TQS0108 - Number of Reactive plant fault outages
TQS0109 - Number of defined Reactive plant
TQS0110 - Lines outage rate – forced outage
TQS0111 - Number of Lines forced outages
TQS0112 - Transformer outage rate – forced outage
TQS0113 - Number of Transformers forced outages
TQS0114 - Reactive plant outage rate – forced outage
TQS0115 - Number of Reactive plant forced outages

RIN requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012[31] electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[32]

Table 3.6.1 Service Parameter 1 has been populated with actual data for calendar year 2020.

For clarification, all data reported in the sheet 3.6 templates on the quality of services, except for the sub-section 3.6.3 System losses, relates to calendar year 2020, consistent with the AER's STPIS reporting periods[33]. The sub-section 3.6.3 System losses relates to financial year 2020/21.

Source

Information has been sourced from Powerlink's internal network operating systems. Powerlink collects, records and maintains defined transmission circuit outage data and transmission circuit counts, consistent with the AER's STPIS. The information provided in this RIN has been prepared using the actual dataset upon which Powerlink's annual STPIS report from calendar year 2020 was based.

Actual data for calendar year 2020 has been used to determine fault outage and forced outage rates.

Powerlink's historic transmission element outage data has been used as the source for the number of events per annum.

[31] This is referred to as Version 4 (V4) of the AER's STPIS.
[32] Australian Energy Regulator (2013a). p.29.
[33] Economic Benchmarking RIN STPIS Variables, email from the AER, 6 December 2013.

The total number of elements for each reporting year was determined by averaging the number of elements as at 1 January and 31 December of each reporting year.

For clarification, for calendar year 2020 Powerlink reported on Version 5 of the STPIS.

Methodology and assumptions

The average circuit outage rate data is based on a calendar year measurement period, for consistency with the AER's STPIS reporting years.

The methodology applied is as follows:

- The AER requires that transmission element outage records exclude any outages of elements as per the STPIS Average element outage rate parameter definition exclusions[34].
- Powerlink has assessed each element outage record against the AER's STPIS V4 criteria for a "fault outage" or "forced outage" using the following approach:
  - A "Fault Outage" is:
    - Any element outage that occurs as a result of unexpected automatic operation of switching devices. That is, the element outage did not occur as a result of intentional manual operation of switching devices.
  - A "Forced Outage" is:
    - Any element outage that occurs as a result of intentional manual operation of switching devices based on the requirement to undertake urgent and unplanned corrective activity where less than 24 hours' notice was given to affected customers and/or AEMO. The notification time is determined by:
      - Time between "Actual Element Outage Start Time" and time advised to AEMO and/or time advised to affected customers, as identified in Powerlink's internal network operating systems.
- The total number of elements for each reporting year was determined by averaging the number of elements as at 1 January and 31 December of each reporting year.
- The actual number of *fault* outages per annum and the actual number of element counts were used to calculate the *fault* outage rate for each of the element transmission types – line, transformer and reactive plant.
- The actual number of *forced* outages per annum and the actual number of element counts were used to calculate the *forced* outage rate for each of the element transmission types – line, transformer and reactive plant.

[34] Australian Energy Regulator (2012). Final Decision – Electricity Transmission Network Service Providers Service Target Performance Incentive Scheme, December, p.22. Note – for clarity, given that the AER's STPIS references to 'circuits' actually comprise various 'elements' (eg. lines, transformers and reactive plant), Powerlink has referred to these as 'elements' in this document.

Sub-table: 3.6.1 Service Parameter 2 – Loss of Supply Event Frequency

Variables: TQS0117 - Number of events greater than 0.1 system minutes per annum
TQS0130 - Number of events greater than 0.75 system minutes per annum

RIN requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012 electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[35]

Table 3.6.1 Service Parameter 2 has been populated with actual data for calendar year 2020.

Source

Information has been sourced from Powerlink's internal network operating systems. Powerlink collects, records and maintains defined transmission circuit outage data and transmission circuit counts, consistent with the AER's STPIS. The information provided in this RIN has been prepared using the actual dataset upon which Powerlink's annual STPIS report from calendar year 2020 was based.

Powerlink's historic transmission circuit outage data has been used as the source for the number of events per annum.

For clarification, for calendar year 2020 Powerlink reported on Version 5 of the STPIS.

The loss of supply event records have been used as the source for the megawatt hours (MWh) unsupplied for the loss of supply event and event counts.

Methodology and assumptions

The methodology applied is as follows:

- The AER requires that loss of supply event records exclude any outages of circuits as per the STPIS Loss of supply event frequency parameter definition exclusions[36].
- Each loss of supply event record contains a "System Minutes Lost" value. If the value of "System Minutes Lost" of any loss of supply event exceeds the "x system minute" and/or "y system minute" thresholds, then a count of "1" is added to each applicable threshold, indicating one count for the applicable reportable loss of supply event threshold. Powerlink's historic loss of supply event "Number of Events" data were used to count the number of reportable events for each loss of supply event frequency threshold category that is required by the RIN template.
- The Version 4 STPIS loss of supply event frequency thresholds the AER set for Powerlink are as follows:

  (x) system minutes = 0.10 system minutes

  (y) system minutes = 0.75 system minutes

[35] Australian Energy Regulator (2013a). p.29.
[36] Australian Energy Regulator (2012). p24.

Sub-table: 3.6.1 Service Parameter 3 – Average Outage Duration

Variable: TQS0118 - Average outage duration

RIN requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012 electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[37]

Table 3.6.1 Service Parameter 3 has been populated with actual data for calendar year 2020.

Source

Information has been sourced from Powerlink's internal network operating systems. Powerlink collects, records and maintains defined transmission circuit outage data and transmission circuit counts, consistent with the AER's STPIS. The information provided in this RIN has been prepared using the actual dataset upon which Powerlink's annual STPIS report from calendar year 2020 was based.

Powerlink's historic transmission loss of supply event records have been used as the source for the loss of supply event duration and the number of loss of supply events per annum.

For clarification, for calendar year 2020 Powerlink reported on Version 5 of the STPIS.

Methodology and assumptions

The methodology applied is as follows:

- Powerlink's loss of supply event records exclude any outages of elements as per the AER's STPIS Average outage duration parameter definition exclusions[38].
- The loss of supply event data contains "Supply Outage Duration in minutes" data and the longest duration record for each event was used to sum all reportable loss of supply outage event duration times annually. This record was also used to count the number of all reportable loss of supply outage events annually.
- The annual average outage duration was calculated by dividing the cumulative summation of the loss of supply event duration time for the period by the number of loss of supply events.

[37] Australian Energy Regulator (2013a). p.29.
[38] Australian Energy Regulator (2012). p25.

Sub-table: 3.6.1 Service Parameter 4 – Proper Operation of equipment – Number of failure events

Variable: TQS0119 - Failure of Protection System

RIN requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012 electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[39]

For this variable, Table 3.6.1 Service Parameter 4 has been populated with actual data for calendar year 2020.

Source

Information has been sourced from Powerlink's internal network operations systems. Powerlink analyses the performance of protection systems as part of its analysis of unplanned outage events. The performance of the protection systems is recorded with the associated unplanned outage event data.

The unplanned outage event records provided in response to Table 3.6.1 Service Parameter 1 of the RIN template were used as the source for the protection system failure event counts.

Methodology and assumptions

The methodology applied for the failure of protection and control system data is as follows:

- Any recorded failure/s of a protection or control system in an unplanned outage event record associated with assets that are not providing prescribed transmission services were excluded as per the STPIS Proper operation of equipment parameter definition exclusions[40].
- Any recorded failure/s of a protection or control system in an unplanned outage event record associated with a force majeure event were excluded as per the STPIS Proper operation of equipment parameter definition exclusions[41].
- As part of Powerlink's unplanned outage event analysis and recording process, the operation of systems providing a protection or control function to high voltage plant and equipment is analysed and recorded. This protection and control system operation analysis data was used to identify the protection and control system failure event counts in accordance with the following definition in the AER's December 2012 STPIS Final Decision:
  - … 'protection system failure events' are those events where the relevant protection equipment does not operate for a fault event as designed or where the relevant equipment operates when there is no relevant fault event.[42]

[39] Australian Energy Regulator (2013a). p.29.
[40] Australian Energy Regulator (2012). p26.
[41] Australian Energy Regulator (2012). p26.
[42] Australian Energy Regulator (2012).p.26.

- The unplanned outage event records were used to identify the counts of the number of protection and control system failures for each event.
- Any failure of primary equipment such as circuit breakers to respond to signals sent by protection or control equipment was not counted as a protection system failure event, as per the Failure of protection system parameter exclusions[43].
- The annual number of protection system failure events was calculated by summing the number of protection system failure events for that year identified for the RIN reportable unplanned outage events.

Variable: TQS0120 - Material Failure of the Supervisory Control and Data Acquisition (SCADA) System

RIN requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012 electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[44]

For this variable, Table 3.6.1.4 has been populated with actual data for calendar year 2020.

Source

Powerlink receives the SCADA Minutes Lost report from AEMO on a monthly basis. The number of SCADA failure event counts from the AEMO report has been used as the source for the SCADA system failure event counts.

Methodology and assumptions

Powerlink populated the cell for the 2020 calendar year with data directly from AEMO's SCADA Minutes Lost report.

Variable: TQS0121 - Incorrect Operation Isolation of Primary or Secondary Equipment Data

RIN requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012 electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[45]

For this variable, Table 3.6.1.4 has been populated with actual data for calendar year 2020.

43 Australian Energy Regulator (2012). p27.
44 Australian Energy Regulator (2013a). p.29.
45 Australian Energy Regulator (2013a). p.29.

Source

Data has been sourced from Powerlink's internal network operating systems associated with recording the incidence of incorrect operational isolation. The records include:

- The occurrence of incorrect operational isolation resulting in an unplanned outage of the transmission network; and

- The occurrence of incorrect operational isolation that did *not* result in an unplanned outage of the transmission network.

Methodology and assumptions

The methodology applied for the incorrect operational isolation of primary or secondary equipment data is as follows:

- Powerlink assessed each incorrect operational isolation incident record against the AER's definition below:

  > … 'incorrect operational isolation events' are those events where primary or secondary equipment was not been properly isolated during scheduled or emergency maintenance, irrespective of whether an outage occurred as a result[46].

- Where incorrect operational isolation occurred during primary or secondary isolation sequences, the associated record was included in the count for the number of events.

- The number of incorrect operational isolation events was summated for each year.

[46] Australian Energy Regulator (2012). p.26.

Table: 3.6.2 Market Impact Component

Variable: TQS02 - Market Impact Parameter

RIN requirements

This section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. Section 7.1 states that:

> Quality of services must be reported in accordance with the definitions specified in the December 2012 electricity transmission network service providers service target performance incentive scheme (STPIS) documents.[47]

Table 3.6.2 has been populated with actual data for calendar year 2020.

Source

For clarification, for calendar year 2020 Powerlink reported on Version 5 of the STPIS.

Data that was prepared and verified as part of the Powerlink's annual STPIS reports to the AER for the Market Impact Component (MIC) of the STPIS, forms the basis of the data for this RIN.

Historic network constraint equation records have been sourced from AEMO's Market Management System (MMS).

The historic network constraint equation records have been used as the source for the MIC data.

Methodology and assumptions

The methodology applied is as follows:

- The AER requires that MIC performance records exclude any events, consistent with the Version 4 STPIS MIC definition exclusions and the AER's Scenario Reference Guide[48] document.
- The historic network constraint equation records from AEMO were reviewed in conjunction with AEMO's Network Outage Scheduler (NOS); Market Notices published by AEMO and Powerlink's internal network operating systems.
- This dataset was assessed against the Version 4 STPIS MIC exclusion criteria to prepare the market impact parameter value that is required by the RIN template.

2020/21 Explanatory Note:

Powerlink's 2020/21 Economic Benchmarking RIN Return reports MIC information consistent with its 2020 annual STPIS report, which was based on AEMO's Marginal Cost Constraint (MCC) data provided to Powerlink on 15 January 2021.

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[47] Australian Energy Regulator (2013a). p.29.
[48] AER Scenario Reference Guide, email from the AER, 13 December 2013.

Subsequent to provision of the initial MCC data:

- the AER advised Powerlink on 21 January 2021 that AEMO had made manual updates to its MCC data. These changes added new reportable events to Powerlink's 2020 MIC information, but had no financial impact on the 2020 STPIS result; and
- Powerlink confirmed an agreed approach with the AER on 11 August 2021 on how to treat duplicate network constraint DI counts. This issue affected 2019 and 2020 MCC data.

Calendar year 2015 data

In its Draft Decision for Powerlink's 2018-22 regulatory period[49], the AER determined that the 38 counts in 2015 relating to a Powerlink initiated planned network outage, associated with multiple generators should be excluded as the constraints were related to AEMO directions to generators. Consistent with this advice, Powerlink's calendar year 2015 data excludes the 38 MIC counts.

For clarification, the revised figure is provided below.

MIC	2015
Previous	66 DIs
Revised	28 DIs
Change	38 DIs

Powerlink's 2023-27 Revised Revenue Proposal Reset RIN return, which we expect to publish in December 2021, will incorporate these changes for 2015, 2019 and 2020.

Powerlink and other TNSPs[50] consider the AER should review the 2015 STPIS (Version 5) as a matter of urgency. Our recent MIC results for 2019 and 2020 reflect extensive changes in the energy market since the scheme was established. The current STPIS does not appropriately recognise these significant changes in the operating environment.

Powerlink also considers the current arrangements do not promote the long-term interests of customers and are inconsistent with the underlying principle of incentive schemes established under the Rules to provide genuine financial incentives for networks to improve market performance.

[49] AER – Draft decision for 2017-2022 Powerlink determination – Attachment 11 STPIS, Australian Energy Regulator, p.11-13.
[50] Refer to Powerlink's Revenue Proposal, Appendix 15.02 – Energy Networks Australia STPIS Review Letter, published on the AER's website

Table: 3.6.3 System losses

Variable: TQS03 - System losses

RIN Requirements

This sub-section has been completed in accordance with chapter 7, section 7.1 of the Economic Benchmarking RIN Instructions and Definitions. This requires system losses to be calculated as:[51]

$$\frac{(Electricity\ inflows - electricity\ outflows) \times 100}{electricity\ inflows}$$

Electricity inflows is the total electricity inflow into Powerlink's transmission network including from generation, other connected TNSPs at the connection point, and connected DNSPs as measured by revenue meters.

Electricity outflows is the total electricity outflow into the networks of connected distribution network service providers, other transmission networks and directly connected end-users as measured by revenue meters.[52]

Table 3.6.3 has been populated with actual data for financial year 2020/21.

Source

The data for electricity inflows has been built up from three calculable components:

1. 'the total electricity inflow into Powerlink's transmission network including from generation .... and connected DNSPs';
2. 'other connected TNSPs at the connection point'; and
3. 'Pumping and power station auxiliaries'.

The first component comprises all transmission connected scheduled, semi-scheduled and non-scheduled generators, as well as any metered inflow from connected DNSPs and directly connected end users[53]. The second component is the gross import component of variable TOPED0101. This represents the total electricity inflows from non-Queensland based sources of energy. The third component comprises Wivenhoe Pump units 1 and 2, as well as metered remote auxiliary loads associated with AEMO registered generators.

The addition of the first and second components and subtraction of the third component represents the total electricity inflows into Powerlink's transmission network.

The data for electricity outflows has been built up from two calculable components:

1. 'the total electricity outflow into the networks of connected distribution network service providers' as well as 'and directly connected end-users'; and

[51] Australian Energy Regulator (2013a). p.30.
[52] Australian Energy Regulator (2013a). p.30.
[53] In previous Economic Benchmarking RIN Returns, Powerlink counted metered inflow from DNSPs and directly connected end users as negative outflow. The change to count inflow from connected DNSPs and directly connected end users separately results in a marginal reduction in the system loss percentage, as it increases the denominator in the calculation. Compared to the previous methodology, Powerlink's system loss percentage was 0.03 percentage points lower on average over the past six years (2014/15 to 2019/20) under the new methodology.

2. ‘other connected TNSPs at the connection point’.

The first component comprises all outflows from connected DNSPs as well as directly connected end users.

The second component is the gross export component of variable TOPED0101. This represents the total electricity outflows to non-Queensland based consumers of energy.

The addition of the first and second components represents the total electricity outflows to Queensland based consumers of energy.

Numbers provided are the sum of half-hour interval energy values recorded over the year from raw meter data (in kWh) divided by one million to give a GWh energy total for each component.

Data Correction

Data errors were identified and corrected in the classification of the source data for system losses data for the 2014/15 to 2019/20 years.

The revised figures are provided below and in the template.

System losses	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21*
Previous	2.85%	2.76%	2.52%	2.58%	2.56%	2.58%	-
Revised	2.82%	2.74%	2.49%	2.56%	2.53%	2.53%	2.23%
Change	(0.03%)	(0.02%)	(0.02%)**	(0.02%)	(0.03%)	(0.04%)**	-

*While not a data correction, for completeness the values for the 2020/21 year is also provided.

**Numbers may not add due to rounding.

<u>Methodology and assumptions</u>

Losses have been calculated in accordance with the formula set out in chapter 7 of the Benchmarking RIN Instructions and Definitions.

Sheet: 3.7 Operating Environment Factors

Table: 3.7.1 Terrain Factors

Variable TEF0101 - Total number of vegetation maintenance spans

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.1 has been populated with estimated data.

Source

The data has been sourced from Powerlink's enterprise resource management system, SAP.

Why an estimate is required

Powerlink manages its easements by individual span based on condition. While Powerlink's systems and delivery transition to span management, judgment has been applied in interpreting the work order information to develop an estimate of the number of vegetation maintenance spans in some instances.

How the estimate has been produced

A list of work orders relating to vegetation maintenance was retrieved from SAP. Each work order was inspected to determine relevance according to chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions. Where a specific ground span has not been specified, an estimate of the spans affected by the work order was made based on the description of the maintenance activity and the costs booked against it. Where more than one maintenance activity occurred on a span, the duplicates are removed so that each maintenance span was only counted once.

Variable TEF0102 - Average vegetation maintenance span cycle

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.1 has been populated with estimated data.

Why an estimate is required

Powerlink manages its easements by individual span based on condition. While Powerlink's systems and delivery transition, an estimate is required in some instances. This estimate used vegetation span data which required judgment in interpreting work order information.

How the estimate has been produced

An estimate of the average frequency of cutting cycles is based on Powerlink's asset management policy cycle time weighted by the number of vegetation maintenance spans.

2021/21 Explanatory Note: The average vegetation maintenance span cycle has increased following a review of risk factors.

Variable TEF0103 Average number of trees per vegetation maintenance span

Why an estimate is required

An estimate is required as Powerlink's vegetation management largely occurs as corridor maintenance. Such maintenance does not include individual tree counts, but vegetation densities and height data have improved, including some initial LiDAR and spatial survey results.

Powerlink considers that its best source of data to estimate this variable is its internal land management inspections data and LiDAR and spatial survey results.

How the estimate has been produced

The following methodology was applied to estimate the average number of trees from Powerlink's internal land inspection data for spans where maintenance has been performed and inspection data is available:

1. Identified spans with a height category of 4 or greater, which represents an average height of vegetation in the span of 3-5m. This is reasonably consistent with the AER's definition of a tree.
2. From this set of spans, use the density rating to assign a proportion of the span covered with 100% vegetation of interest. Powerlink uses a density category of 5, to represent 50% coverage.
3. Assume 1600 stems per hectare for 100% coverage. A stocking of 1600 stems per hectare equates to a nominal "tree" spacing of 2 metres x 3 metres.

   For example, if a span has an area of 2 hectares, a height category of 4 or greater and a density category of 5 – the span is estimated to contain 1600 stems. This number was confirmed with a small number of established plots. Using this hypothesis, Powerlink used inspection data recorded in SAP to produce an average for the network.

The methodology assumes that:

- the density category allocated to a span aligns with the number of stems per hectare; and
- the number of stems is scalable up to the area of the span and can be averaged over the state.

Powerlink considers that this methodology provides its best estimate of the average number of trees per vegetation maintenance span. The estimated number of trees continues to improve as additional data becomes available, which links to notifications and work orders.

2020/21 Explanatory Note: The average number of trees per span reduced due to lower densities of vegetation in the spans maintained and reductions in the span widths.

Variable TEF0104 - Average number of defects per vegetation maintenance span

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.1 has been populated with estimated data.

Source

The data has been sourced from Powerlink's enterprise resource management system, SAP.

Why an estimate is required

Powerlink manages its easements by individual span based on condition. While Powerlink's systems and delivery transition, an estimate is required in some instances. This estimate of the average number of defects per vegetation maintenance span used vegetation span data and defect notification information, which required judgement in interpreting the work order and notification information.

How the estimate has been produced

A list of defect notifications was retrieved from SAP with defect codes for "risk 4" and "risk 5". Each notification was inspected to determine relevance according to chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions. The total number of defects was divided by the total number of vegetation maintenance spans as determined in TEF0101.

2020/21 Explanatory Note: Vegetation-related defects remain low, which result from a program to address identified defects.

Variable TEF0105 - Tropical proportion

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.1 has been populated with estimated data.

Source

The data has been sourced from the Australian Bureau of Meteorology Australian Climatic Zones map. Vegetation spans have been sourced from variable TEF0101.

Methodology and assumptions

Powerlink's prescribed transmission network was overlayed geospatially onto the Australian Bureau of Meteorology Climatic Zones Map, based on temperature and humidity. This allowed Powerlink to develop a count of vegetation maintenance spans that fall within the Hot Humid Summer and Warm Humid Summer regions, consistent with the instructions for Tropical Spans in the Benchmarking RIN Instructions and Definitions[54].

[54] Australian Energy Regulator (2013a). p.32.

Why an estimate is required

Variable TEF0101 is used as an input to this calculation. As it is an estimate, the output for this variable is also an estimate.

Powerlink records for vegetation management are booked against spans, but some estimates are required.

How the estimate has been produced

Powerlink's prescribed transmission network, including vegetation maintenance spans, was overlaid with the Australian Bureau of Meteorology's Australian Climatic Zones map.

Variable TEF0106 - Standard vehicle access

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.1 has been populated with estimated data.

Source

The data is sourced from Powerlink's geospatial information system.

Why an estimate is required

Powerlink's systems apply a standard of access to most transmission line structures by 4WD in dry weather. Therefore, no internal data is available on accessibility to assets by 2WD vehicles.

How the estimate has been produced

Estimates been derived by estimating prescribed built section spans from commissioning dates and overlaid with road information from Powerlink's geospatial information system.

Methodology and assumptions

Powerlink applied the following methodology:

- Powerlink's approach was underpinned by Queensland road network data from the Queensland Department of Environment and Resource Management (DERM), which was publicly available[55].
- Using its geospatial information system, Powerlink determined what parts of the road network could be considered 2WD accessible, based on whether it was classified as a highway, motorway, main road, secondary road or named local road.
- It was then necessary to determine proximity from these roads to the infrastructure. Spans that were more than 100 metres from the roads identified above were considered not accessible (i.e. not in a reasonable walking distance or for carrying equipment, etc).

[55] DERM, QLD_RD_Polyline v.6.1.3.

Variable TEF0107 - Altitude

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.1 has been populated with actual data.

Source

Data has been sourced from Geoscience Australia and Powerlink's geospatial information system.

Methodology and assumptions

Powerlink applied the following methodology:

- Geoscience Australia produces a robust 1 second Digital Elevation Map (DEM)[56]. It records elevation in areas (or cells) of $30m^2$. Powerlink considers that a more appropriate estimate can be obtained by dividing each $30m^2$ cell further into $10m^2$ cells (i.e. there are nine $10m^2$ cells in each $30m^2$ cell).
- Powerlink developed an approach to effectively interpolate between adjacent $30m^2$ cells, providing altitude estimates for each of the $10m^2$ areas within each of the DEM's $30m^2$ cells.
- The contour of an area is relevant to planning the location of network infrastructure. Therefore, Powerlink developed appropriate contour representations, consistent with the RIN definition of Altitude[57].
- The contour map was also cross-checked against a 10 metre contour map produced by DERM, which showed that Powerlink's map was fit-for-purpose.
- Using data from Powerlink's geospatial information system, Powerlink's prescribed transmission network was overlaid to all cells with terrain contours of 600 metres or greater. The result is the combined length of spans across these cells.

Variable TEF0108 - Bushfire Risk

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions. The data was based on State government bushfire hazard mapping (updated in 2016) and identified vegetation maintenance spans within the high bushfire hazard areas.

For this variable, Table 3.7.1 has been populated with estimated data.

[56] http://www.ga.gov.au/topographic-mapping/digital-elevation-data.html
[57] Australian Energy Regulator (2013a). p.38.

Source

The bushfire hazard mapping was sourced from the Department of Natural Resources and Mines QSpatial Catalogue (December 2016) and is consistent with previous reporting.

Methodology and assumptions

Powerlink applied the following approach:

- The number of vegetation maintenance spans in high fire bushfire risk areas was identified from a count of spans which directly interact with DCS's Potential Bushfire Risk dataset.
- Each span was filtered by the highest fire risk and then subsequently filtered until all spans directly interacted with their highest potential fire risk category.
- The identified maintenance spans are those from TEF0101 for each regulatory year.

Why an estimate is required

Variable TEF0101 is used as an input to this calculation. As it is an estimate, the output for this variable is also an estimate.

Powerlink records for vegetation management are booked against spans, but some estimates are required.

How the estimate has been produced

Powerlink's prescribed transmission network was overlaid with the DCS's Potential Bushfire Risk dataset. Each vegetation maintenance span was filtered by the highest fire risk and then subsequently filtered until all spans directly interacted with their highest potential fire risk category. The identified vegetation maintenance spans are those from TEF0101.

2020/21 Explanatory Note: Based on assessed risk factors, bushfire risk spans were maintained at a slightly higher rate (6%) than the State average (2% increase).

Table: 3.7.2 Network characteristics

Variable TEF0201 - Route line length

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.2 has been populated with actual data.

Source

This data has been sourced from Powerlink's enterprise resource planning database, SAP. The data is based upon assets "as-commissioned".

Methodology and assumptions

The variable is populated with data extracted from Powerlink's enterprise resource planning database, SAP. The extraction is based on a list of regulated built sections.[58] The variable has been calculated as the sum of route kilometres across all voltage levels.

Variable TEF0202 - Variability of dispatch

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.2 has been populated with actual data.

Source

This data has been compiled from:

- Powerlink's metering database for historical sent out energy from transmission connected generation sources metered at the transmission network connection point;
- Powerlink's data historian[59] of SCADA telemetered data for historical sent out energy from distribution connected generation sources;
- AEMO's NEM Generation Information publication for historical generator scheduled status, technology type, capacity and end date;[60]
- Powerlink's metering database for historical transmission connected generator start and end dates; and
- Powerlink's data historian system of SCADA telemetered data for historical distribution connected generator start and end dates.

[58] Powerlink uses "built sections" as the basic building block against which transmission line circuit and easement information is recorded. A "built section" is defined as a collection of structures, conductors and easements with common characteristics as listed in SAP.
[59] Powerlink's data historian is a time-series database designed to efficiently collect and store data.
[60] Refer AEMO Generation Information, NEM Generation information publications, accessed November 2020.

Methodology and assumptions

In previous Economic Benchmarking RIN Returns, Powerlink has reported Variability of Dispatch as the total sum of non-thermal generation capacity divided by the total sum of all generation capacity connected to the transmission system. For its January 2021 Reset RIN return and annual Economic Benchmarking RIN Returns from 2020/21, Powerlink has amended its methodology to align with the AER's definition of "Proportion of energy dispatch from non-thermal generators".[61]

Variability of Dispatch % - Energy methodology and assumptions

For historical data, interconnector energy inflows and storage plant (large-scale batteries, pumped hydro, and Virtual Power Plant batteries) have not been included as the dependant generation technology cannot be determined.

Historical energy has been compiled by aggregating all 30-minute energy intervals for scheduled and semi-scheduled transmission connected and embedded generators (operational generators) by thermal and non-thermal fuel types for each financial year. The fuel types classified as thermal include black coal, Combined Cycle Gas Turbine (CCGT) and Open Cycle Gas Turbine (OCGT). The fuel types classified as non-thermal include hydro, wind, and solar PV.

To derive the proportion of dispatch from non-thermal generators for energy, the total sum of non-thermal generation is divided by the total sum of both thermal and non-thermal generation.

Variable TEF0203 - Concentrated load distance

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.2 has been populated with actual data.

Source

Data for route line length has been obtained from the same source as variable TEF0201 – Route Line Length. Data on sizes of generation and load has been obtained from Powerlink's Transmission Annual Planning Report 2020 (TAPR 2020).

Generation and load connection points were taken from the source data used to determine variables TOPCP0101 – TOPCP0111 (Number of entry points at each transmission voltage level) and TOPCP0201 – TOPCP0212 (Number of exit points at each transmission voltage level) respectively.

Methodology and assumptions

This variable is defined as the:

> Greatest distance (Route Line Length) from node having at least 30 per cent of generation capacity to node having at least 30 per cent of load, where a node is a connection point from a generation source or location to the (transmission) network at

[61] Section 9, Economic Benchmarking RIN for Transmission Network Service Providers Instructions and Definitions, Australian Energy Regulator, November 2013, p. 39.

> source end and a connection point to a load or distribution system at the destination end.
>
> Where there is no concentrated source or load above 30 per cent, respond relative to the largest concentrated source and load and indicate the generation and load magnitudes.[62]

From the generation capacities in Table 6.1 of TAPR 2020, there is no concentrated generation source greater than 30% of the total. The largest concentrated source is Stanwell Power Station, as the Gladstone Power Station capacity is distributed across two different connection points.

From Tables A.1 to A.18 of Appendix A of TAPR 2020, there is no concentrated load greater than 30% of the total. The largest concentrated load is South Pine 110kV. The Boyne Island aluminium smelter load, while slightly larger in total, is distributed across two different connection points.

Having established the source and load nodes, the shortest transmission line circuit length between the two points was identified as Stanwell – Calvale – Halys – Tarong – South Pine.

Variable TEF0204 Total number of spans

RIN requirements

This section has been completed in accordance with chapter 8, section 8.1 of the Benchmarking RIN Instructions and Definitions.

For this variable, Table 3.7.2 has been populated with actual data.

Source

Powerlink's corporate enterprise resource planning database, SAP.

Methodology and assumptions

The RIN template has been populated with data extracted from SAP. The extraction is based on a list of regulated active ground spans.

[62] Australian Energy Regulator (2013a). p.38.

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