OPTIONS EVALUATION REPORT (OER)

Increase Capacity for Generation in Wagga North Area

OER- N2205 revision 1.0

Ellipse project no(s):
TRIM file: [TRIM No]

Project reason: Economic Efficiency - Network developments to achieve market benefits
Project category: Prescribed - Augmentation-Sub Sys

Approvals

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Change history

Revision	Date	Amendment
1	6 September 2021	Initial issue
2	15 October 2021	Updated for Houston Kemp's comments

Executive summary

An opportunity has been identified to upgrade the 132kV Lines 9R6 and 9R5 supplying Wagga North 132/66kV substation to alleviate potential thermal constraints due to recent renewable generation developments in the Wagga North area. The risk of thermal constraints is likely to increase further as a number of generators are planning to connect in the near future.

There have been recent renewable generation developments in the Wagga North area, with a number of generators planning to connect in this area in the near future. The Bomen Solar Farm (100MW) is currently in service and Wagga North Solar Farm (49MW) is at commissioning stage. Another 320MW of generation is at the committed stage and under development, with plans to commence generation within the next 2 to 9 months.

Studies have shown that with the potential generation development and the existing network configuration, there are scenarios where 9R6 or 9R5 could be loaded beyond their corresponding thermal rating under system normal network conditions with the current level of in-service and committed generation dispatched to their maximum capacities. In all credible scenarios there is expected to be significant economic benefits to the NEM from increasing the generation transfer capacity in the area, with large benefits expected from the advent of the associated renewable energy power generation.

This follows that there are opportunities to realise market benefits through resolving these thermal constraints and lower generation costs in the NEM.

The assessment of the options considered to address the need/opportunity appears in Table 1.

Table 1 - Evaluated options

Option	Description	Direct capital cost ($m)	Network and corporate overheads ($m)	Total capital cost[1] ($m)	Weighted NPV (PV, $m)	Rank
Option A	Restring 9R5 and 9R6 with a modern equivalent of Goat ACSR operating at 85°C	9.9	1.0	10.9	40.4	1
Option B	Restring 9R5 and 9R6 with a high-temperature conductor such as Helsinki ACCC operating at 180°C	11.4	1.2	12.5	38.6	2
Option C	Construct a new double circuit transmission line from Wagga 330 to near Wagga North with Line 991 re-routed	47.6	2.4	49.9	5.0	4
Option D	Construct a new single circuit 132kV transmission line between Wagga North 132/66 kV Substation and Wagga	37.0	1.6	38.6	13.1	3

[1] Total capital cost is the sum of the direct capital cost and network and corporate overheads (total may not add due to rounding). Total capital cost is used in this OER for all analysis.

	330/132 kV Substation					

The Option A has been selected as the preferred option based on the following reasons:

- it delivers the highest net benefits compared to the Base Case under all three (Low/Central/High) scenarios considered;
- the increased transfer capacity to be achieved by implementing Option A (i.e (160MVA)) is adequate to unlock the expected renewable energy and deliver market benefits for the foreseeable future;
- the project is expected to complete in 3 years (the lowest project duration time amongst the Options considered); and
- property acquisition is not required and it is not anticipated at this stage that the project will have a significant environmental impact.

1. Need/Opportunity

An opportunity has been identified to upgrade the supply arrangements to Wagga North area to alleviate potential constraints due to recent renewable generation developments, and to provide transfer capacity for a number of generators planning to connect in the near future. The need for this project is market benefits, though increased economic efficiency associated with lower generation costs in the NEM.

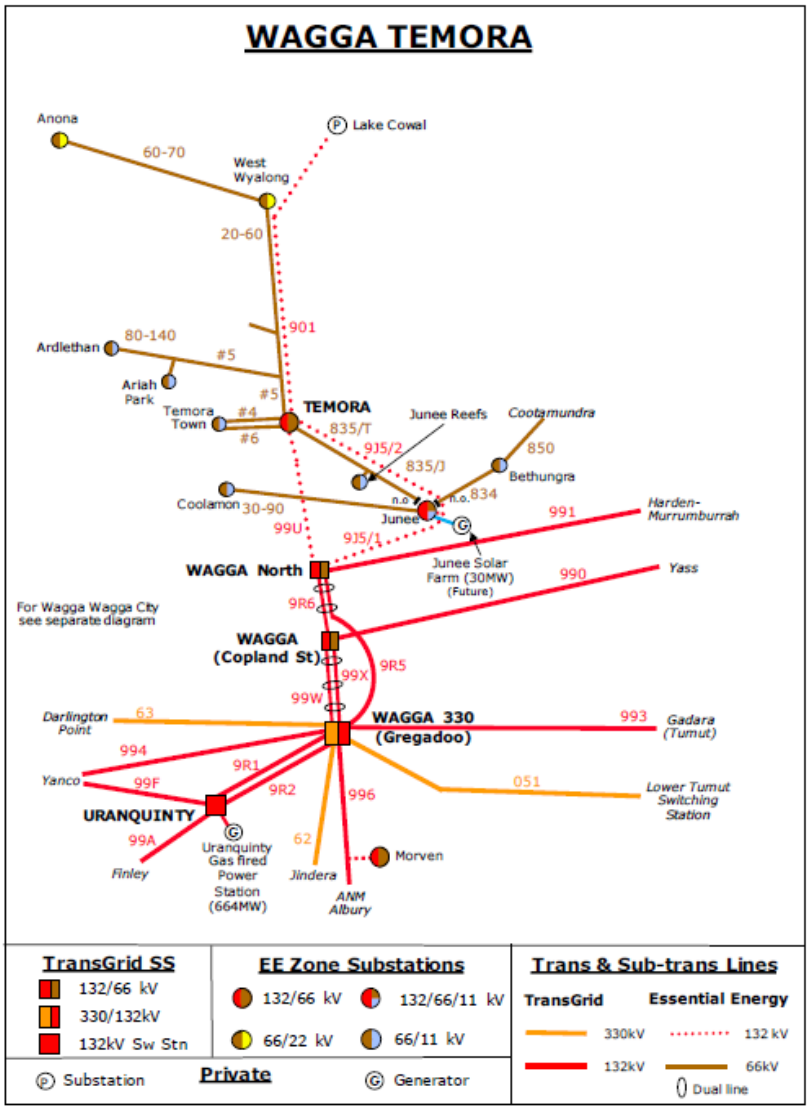

Figure 1: TransGrid and Essential Energy network in Wagga area[2]

Figure 1 illustrates the TransGrid and Essential Energy network in Wagga North area. Wagga North 132/66kV Substation is supplied by 132kV lines 9R5, 9R6 and 991, which are strung with ASCR Panther conductor for a design operating temperature of 85°C. These lines have normal and emergency ratings of 125MVA and 137MVA respectively. The lines 9R5 and 9R6 interconnect Wagga North 132/66kV and Wagga 330/132kV substations, while Line 991 connects to Yass 330/132kV Substation via Murrumburrah. The lengths of the 9R5 and 9R6 lines

[2] Essential Energy – Distribution Annual Planning Report Dec 2020

are approximately 12km and 7.8km respectively. TransGrid provides bulk supply from Wagga North from both the 132kV and 66kV busbars.

There have been recent developments of renewable generation in the Wagga North area, and there are a number of generators planning to connect in this area in the near future. The Bomen Solar Farm (100MW) is currently in service and Wagga North Solar Farm (49MW) is in the commissioning stage. Another 320MW of generation is at the committed stage and under development, with plans to commence generation in the next 2 to 9 months.

Among this committed generation, a total of 270MW is proposed to be connected to Essential Energy's network in the Temora region. This includes Sebastopol Solar Farm (90MW), West Wyalong Solar Farm (90MW), Wyalong Solar Farm (53MW), and Junee Solar Farm (30MW). The total amount of committed generation is expected to result in thermal loading limitations on the 132kV lines connected to Wagga North substation.

Studies have shown that the potential generation development under the existing network configuration, additional generation feeding into Wagga North substation which is not shared evenly among the three lines 9R5, 9R6 and 991. The majority flows to the local load centre at Wagga Wagga, whilst a small percentage flows to Murrumburrah and Yass via line 991. With the current level of in-service and committed generation dispatched to their maximum capacities there are scenarios where 9R6 or 9R5 could be loaded beyond their respective thermal ratings under system normal network conditions.

Figure 2 below illustrates the expected typical daily generation constraint required to manage the loading on the lines, and Figure 3 illustrates the estimated generation to be constrained throughout a year due to system normal overloading in Lines 9R6 and 9R5.

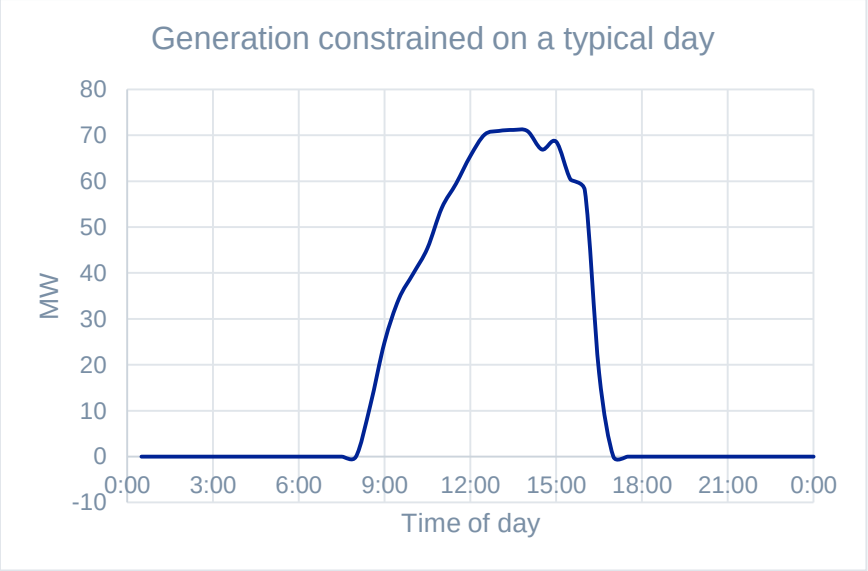

Figure 2: Excess energy to be constrained on a typical day[3]

[3] The amount of constrained energy was estimated based on the projected solar traces and demand forecast data for the Wagga North area. Time of the year used is shoulder period. The projected solar traces of the in-service solar farms have been used to estimate future solar traces of the committed generators located in the same geographical area.

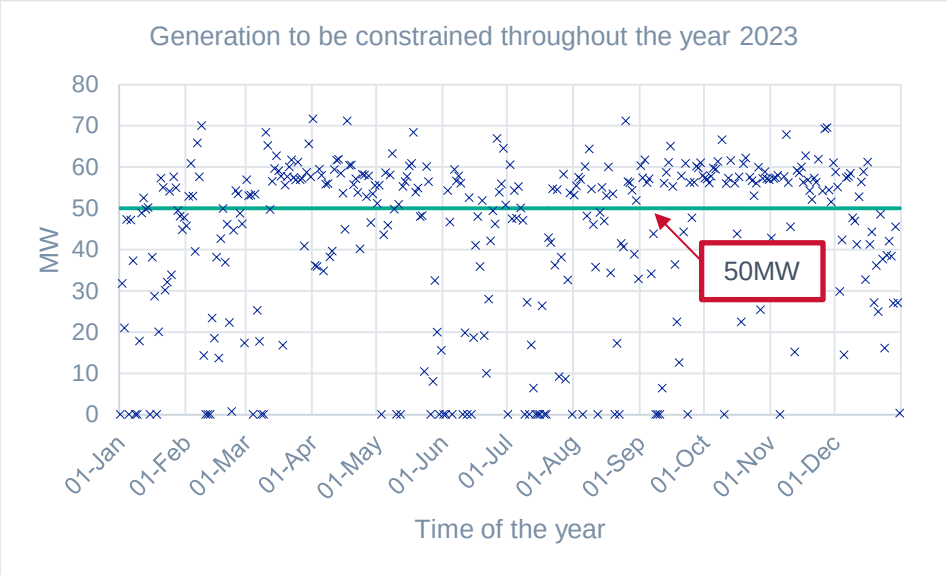

Figure 3: Generation to be constrained in a year

The modelling suggests that for approximately 186 days of the year it will be necessary to constrain at least 50MW of renewable generation in order to ensure the Line 9R6 loading level is maintained below its normal rating. If the network is operated in its present configuration, a significant amount of generation will need to be constrained at times of high output from the solar farms connected to Wagga North and in the Essential Energy network in the Temora region. Hence, the primary risk of not addressing the issue of the thermal limitations identified on Lines 9R5 and 9R6 is the additional market costs incurred in the NEM due to replacement of the low-cost energy with an equivalent amount of conventional fuel-based energy.

In addition to the generation developments in the Wagga North area, Wagga Wagga Special Activation Precinct (SAP), a potential large scale industrial development is expected in the area[4,5]. This development proposed over 40 years is part of an economic and employment hub established to accommodate regionally significant industries and businesses, and is proposed to be supplied from TransGrid's Wagga North 132/66 kV Substation. The associated development includes additional load growth, estimated to be between 148MW and 282MW, and potential solar power generation, estimated between approximately 190MW and 400MW based on different growth scenarios[6].

2. Related needs/opportunities

> N2216 – Increase capacity between Yass and Wagga area
>
> This project investigates the expanding the existing Yass and Wagga Line Overload Schemes (LOLS) to implement a comprehensive unified scheme monitoring all feeders between Yass and Wagga to manage the overloads during N-1 conditions.

> N2208 – Increase capacity at 132kV busbars at Wagga and Yanco Substations, Southern Region

[4] Wagga Wagga SAP: a joint Government Agency initiative led by the Department of Premier and Cabinet and the Department of Planning, Industry and Environment has been announced

[5] Wagga Wagga Special Activation Precinct A.4.1a Structure Plan, July 2020

[6] Final Master Plan - Infrastructure and Service Plan; Wagga Wagga Special Activation Precinct, November 2019

This project involves upgrading the 132kV and 66kV busbars at Wagga 132kV substation and 132kV busbars at Yanco substation. The existing busbars are of galvanised steel pipe which differ from TransGrid's standard of Aluminium tube.

> 000000001180 – Wagga 330kV Secondary Systems replacement

This scope of the project comprises of the complete secondary system renewal (in-situ) combined with a number of primary assets (high voltage CTs, VTs, and CBs) identified under the Asset Replacement program.

3. Options

3.1 Base case

The base case considers a "do nothing" approach, the where existing network infrastructure is maintained and the network is not augmented to account for increased renewable generation.

If the network is operated with the present configuration and as per current operating protocols, a significant amount of energy will need to be constrained at times of high-generation output from the solar farms connected to Wagga North and in Essential Energy's network in the Temora region.

The opportunity cost of not mitigating the potential thermal constraints of lines 9R6 and 9R5 is the expected additional cost to the NEM from the equivalent amount of thermal based generation. Figure 4 illustrates the yearly total renewable generation expected to be constrained in Wagga North area. Figure 5 illustrates the NPV of the opportunity cost of the generation constrained at different discount rates for a 25 year period[7,8].

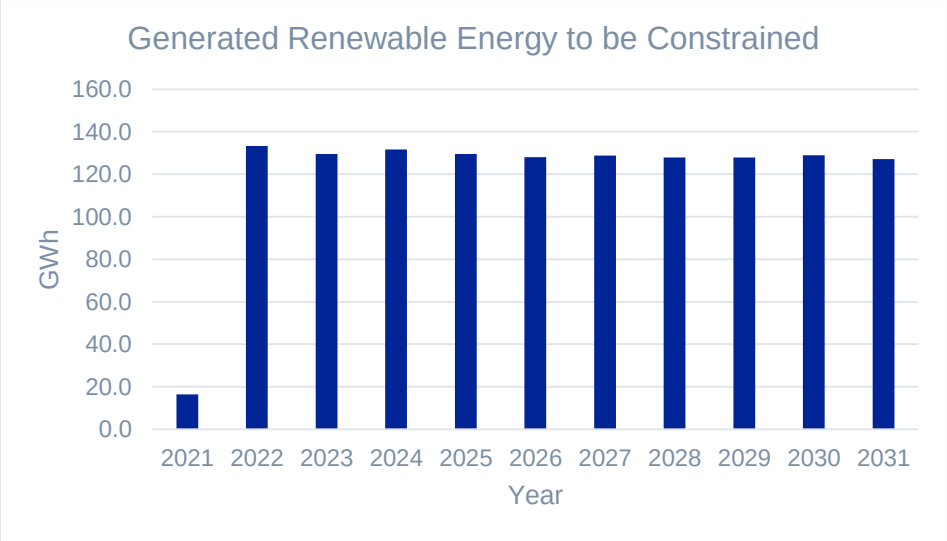

Figure 4: Generated renewable energy to be constrained[9]

[7] Market impact is calculated based on the average Short Run Marginal Cost (SRMC) of all NSW coal-fired generators excluding Liddell $32.04/MWh (which is the average SRMC of Bayswater, Eraring, Mt Piper and Vales Point.)

[8] Excluded Wagga Wagga SAP for the Opportunity Cost estimation as the project is still in early development stage.

[9] Illustrated only for a period of 10 years.

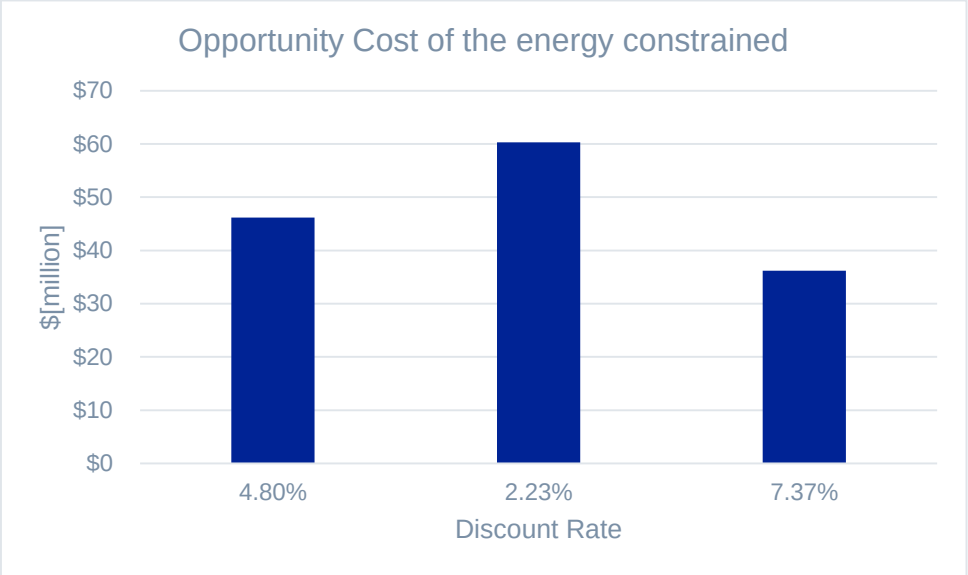

Figure 5: Opportunity cost of the energy constrained

The Wagga Wagga SAP project has been excluded in the main scenario analysis as the project is still in early stage of the development and the information about the potential renewable generation and load growth is not fully confirmed. However, the sensitivity of the opportunity cost to the Wagga Wagga SAP has been examined to investigate the impact of SAP on the potential market benefits. For example for a scenario with 190MW to 400MW renewable generation within Wagga Wagga SAP, the opportunity cost is expected to increase approximately 3 to 5 times compared to the Base Case values indicated in Figure 5.

As above in all credible scenarios, there is expected to be significant economic benefits to the NEM relative to the Base Case, from the investments in options described below, with large benefits expected from the introduction of the increased renewable energy power generation.

3.2 Options evaluated

Option A — Restring 9R5 and 9R6 with a modern equivalent of Goat ACSR operating at 85°C

This option proposed the re-conducting of 9R5 and 9R6 lines with a higher thermal capacity conductor such as Goat ACSR or equivalent. In comparison to the existing ratings of 125MVA/137MVA, re-stringing the lines are expected to achieve normal and contingency ratings minimum of 160MVA and 180MVA respectively.

As per Australian standard sizes of conductor, the conductor selected in this Option is Lime ACSR/GZ. Under this option the total transfer capacity will be increased by 95MW. This increase in the thermal capacity in Lines 9R6 and 9R5 is sufficient to transfer from Wagga North substation the excess renewable generation from currently in-service and committed generators. Under this option, primary terminal connection equipment replacement is not required at Wagga North or at the remote ends of the lines (Wagga 132 and Wagga 330 substations), as the minimum ratings of 1,250A (285.8MVA) are sufficient to align with the expected increased line rating.

The scope of the works under Option A includes:

Line 9R5

- 14.6 km of Lime Conductor Restringing including the insulators and fitting replacements
- 6 Structure Replacements
  - 5 Suspension Structures

- 1 Tension Structure
- Associated Structure Strengthening Required

Line 9R6

- 10.5 km of Lime Conductor restringing including insulators and fitting replacements
- 7 Structure replacements
  - 7 suspension structures
- Associated structure strengthening required

The expected commissioning date for this option is 2024/25.

The expected expenditure profile for this option has been obtained using the TransGrid's Standard Estimating System and summarised in Table 2. The estimates in have an uncertainty of ± 25%.

Table 2: Option A expected expenditure (non-escalated)

	Total Project Base Cost	2022/23	2023/24	2024/25
Estimated Cost-non escalated ($m 2020-21)	10.9	0.1	0.3	10.5

It is estimated that an amount up to $1.0 million is required to progress the project from DG1[10] to DG2, and this is included in the above costs. This is to cover activities such as site assessments, development of concept designs, the commencement of project approvals and early procurement of long lead-time items if required.

It is not anticipated at this stage that the project will have a significant impact on the environment in accordance with Section 111 of the EP&A Act. This will be continually reviewed as the project develops but at this stage, it is anticipated that an assessment in the form of a Summary Environmental Report (SER) will be required.

This project is expected to be completed in an estimated 31 months following the approval of DG1.

Option B — Restring 9R5 and 9R6 with a high-temperature conductor such as Helsinki ACCC operating at 180°C

This Option is similar to Option A with the exception of using a high-temperature conductor, resulting in more than double the existing capacity with minimal need for new structures and whilst maintaining existing easements.

For this option, the high temperature conductor (Z) TACIR/AS 210 m^2 (Lemon/Hawk equivalent) INVAR which has a maximum operating temperature of 180°C has been considered, using TransGrid's standard stringing tensions for the selected conductor.

In comparison to the existing ratings of 125MVA/137MVA, re-stringing the lines under this option should achieve normal and contingency ratings minimum of 160MVA and 180MVA respectively.

The summary of the scope of works under this option:

Line 9R5

[10] DG refers to TransGrid's internal Decision Gate funding process.

- 14.6 km of INVAR conductor restringing including the insulators and fitting replacements
- 6 Structure replacements
  - 5 Suspension Structures
  - 1 Tension Structure
- Associated structure strengthening required

Line 9R6

- 10.5 km of INVAR conductor restringing including the insulators and fitting replacements
- 7 Structure Replacements
  - 7 Suspension Structures
- Associated structure strengthening required

Primary terminal connection equipment replacement is not required at the Wagga North or at remote ends (Wagga 132 and Wagga 330 substations) under this option as the minimum ratings of 1250A (285.8MVA) are sufficient to align with the expected increased line rating.

The proposed conductor replacement works on the transmission line are located within existing easements with the exception of access works.

The expected expenditure profile for this option has been established using the TransGrid's Standard Cost Estimating system and listed in Table 3.

Table 3: Option B expected expenditure (non-escalated)

	Total Project Base Cost	2022/23	2023/24	2024/25
Estimated Cost-non escalated ($m 2020-21)	12.5[11]	0.2	4.5	7.9

The cost estimates provided in Table 3 includes an uncertainty of ± 25%. It is estimated that an amount up to $1.0 million is required to progress the project from DG1 to DG2 and this is included in the above costs. This is to cover activities such as site visits, development of concept design, and commencement of project approvals and early procurement of long lead-time items.

This project is expected to be completed in an estimate 31 months following the approval of DG1.

The expected commissioning date for this option is 2024/25.

Option C — Construct a new double circuit transmission line from Wagga 330 to near Wagga North, and re-route Line 991.

Under this Option a new double-circuit 132kV transmission line is proposed to be built between Wagga North 132/66 kV Substation and Wagga 330/132 kV Substation. The double circuit line consists of a new 132kV line and extension of Line 991 through bypassing its termination at Wagga North and directly connecting it to Wagga

[11] The sum of the yearly costs may not add up to the Total Project Base Cost due to the rounding effect

330/132 kV Substation via one side of the new double circuit-line. Figure 7 shows the schematic diagram of the proposed augmentation.

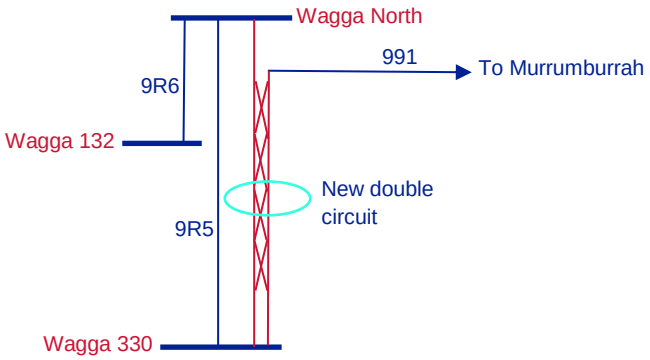

Figure 6: Option C – Conceptual design of the augmentation

The existing 132 kV switch bay at Wagga North currently used for the termination of Line 991 can be used to terminate the proposed new 132kV circuit from Wagga 330/132 kV Substation.

The high-level scope of works include:

a) Construct approx. 14.6km of new double circuit 132kV transmission line from Wagga 330 substation (WG1) to existing Line 991 Structure 613;

b) From Line 991 Structure 613, divert Line 991 to Wagga 330 substation on one side of the new double circuit transmission line;

c) Existing Line 991 Structure 613 to Wagga North (WGN) will then be reused to complete the new feeder from Wagga 330 to Wagga North along the other side of the new double circuit transmission line;

d) 2 off new 132kV switchbays at Wagga 330 substation.

The proposed construction of a new double circuit 132kV transmission line under this option will require the acquisition of new easements. The route alignment for the new double circuit has been selected based on an environmental study carried out for the feasibility study for this option. In addition to the requirements for public consultation as part of the environmental assessment and approval process for this project, the requirement for new easement acquisition and disruption to landowners suggests early consultation with the community will be essential to the success of this Option. Support shall be sought from TransGrid's Landowner and Community Engagement Team during detailed project development.

The expected commissioning date for this option is in 2026/27.

The expected expenditure profile for this option has been obtained from the TransGrid's Standard Cost Estimating System and summarised in the Table 4 below. The estimated costs have an uncertainty of ± 25%.

Table 4 - Option C expected expenditure (non-escalated)

	Total Project Base Cost	2022/23	2023/24	2024/25	2025/26	2026/27
Estimated Cost – non-escalated ($m 2021-22)	49.9	0.4	0.9	3.6	9.3	35.7

It is estimated that an amount up to $5 million is required to progress the project from DG1 to DG2 and this is included in the above costs. This is to cover activities such as site assessments, development of concept design, the commencement of project approvals and early procurement of long lead-time items as required.

This project is expected to be completed in an estimate 58 months following the approval of DG1.

Option D — Construct a new single circuit 132kV transmission line between Wagga North 132/66 kV Substation and Wagga 330/132 kV Substation

Under this option a single 132kV line would be constructed between Wagga North and Wagga 330kV substations. The high level scope of works include:

a) Construct approx. 14.9km of new single circuit 132kV transmission line from Wagga 330 substation (WG1) to Wagga North substation (WGN). The new line will be strung with 1 x Mango ACSR conductors supported by concrete poles;

b) Construct 1 off new 132kV switchbay at Wagga 330 substation;

c) Construct 1 off new 132kV switchbay at Wagga North substation.

The construction of a new single circuit 132kV transmission line under this option will require the acquisition of a new easement. The route alignment for the new 132kV circuit is selected based on the environmental study carried out for the feasibility study for this option. In addition to the requirements for public consultation as part of the environmental assessment and approval process for this project, the requirement for new easement acquisition and disruption to landowners suggests early consultation with the community will be essential to the success of this Option. Support shall be sought from TransGrid's Landowner and Community Engagement Team during detailed project development.

The expected commissioning date for this option is 2026/27.

The expected expenditure profile for this option has been obtained using the TransGrid's Standard Coat Estimating System. The estimates in the Table 5 below have an uncertainty of ± 25%.

Table 5 – Option D expected expenditure (non-escalated)

	Total Project Base Cost	2022/23	2023/24	2024/25	2025/26	2026/27
Estimated Cost – non-escalated ($m 2021-22)	38.6	0.9	1.5	7.3	14.4	14.5

It is estimated that an amount up to $4 million is required to progress the project from DG1 to DG2, and this is included in the above costs. This is to cover activities such as site assessments, development of concept design, the commencement of project approvals and the early procurement of long lead-time items if required.

This project is expected to be completed in an estimate 56 months following the approval of DG1.

3.3 Options considered and not progressed

The Options listed in Table 6 were initially considered but have not been progressed further due to them being assessed as not commercially viable.

Table 6: Options considered but excluded from commercial evaluation

Option	Reason for not progressing
Option E - Install a 120MW/240MWh Battery Energy Storage System (BESS) at Wagga North 132 kV Substation	A preliminary assessment of installing a BESS at Wagga North has revealed that a footprint of approximately 110m x 55m would be necessary. This would require the acquisition of additional property almost the size of the existing Wagga North substation. The indicative cost of the 120MW/240MWh BESS is $120 million, excluding the cost of the additional property and associated plant and substation augmentation works. The expected cost estimate is greater than 12 times higher than the lowest cost option considered. Therefore, this option is not commercially feasible.

4. Evaluation

4.1 Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set assumptions based on current information that is most likely to eventuate (central scenario), a set of assumptions that give rise to a lower bound for net benefits (lower bound scenario), and a set of assumptions that give rise to an upper bound on benefits (higher bound scenario).

Assumptions for each scenario are set out in the Table 7 below.

Table 7: Assumptions made in the scenarios

Parameter	Central scenario	Lower bound scenario	Higher bound scenario
Discount rate	4.8%	7.37%	2.23%
Fuel Cost[12]	100%	70%	130%
Capital cost	100%	125%	75%
Operating expenditure	100%	125%	75%
VCR - AER Latest VCR (escalated)	100%	70%	130%
Scenario weighting	**50%**	**25%**	**25%**

[12] Fuel Cost used for the market benefit calculation is based on the average Short Run Marginal Cost (SRMC) of the NSW Coal-fired Generators excluding Liddell Reference: AEMO's Electricity Statement of Opportunities ESOO 2020.

Since the central scenario represents the most likely scenario to occur, it has been weighted at 50%. The other two scenarios reflect extreme combinations of assumptions designed to stress test the results. Accordingly, these scenarios are weighted at 25%. As this is a market benefit driven Need, the POE50 maximum demand forecasts have been used in all three scenarios in Table 7.

Parameters used in this commercial evaluation:

Table 8: Key parameters used in the commercial evaluation

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2020/21
Base year	The year that dollar value outputs are expressed in real terms	2020/21 dollars
Period of analysis	Number of years included in economic analysis with remaining capital value included as terminal value at the end of the analysis period.	25 years

The capex figures in this OER do not include any real cost escalation.

4.2 Commercial evaluation results

The commercial evaluation of the technically feasible options is set out in Table 2. Details appear in Appendix A.

Table 9 - Commercial evaluation (PV, $ million)

Option	Capital Cost PV	OPEX Cost PV	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Option A	7.9	2.7	36.8	12.6	75.2	40.4	1
Option B	9.3	3.1	35.0	10.5	74.0	38.6	2
Option C	29.5	10.5	0.5	-24.3	43.5	5.0	4
Option D	23.6	8.1	8.8	-15.0	50.0	13.1	3

4.3 Preferred option

All options considered in the evaluation have resulted in positive NPV compared to the Base case for the Central Scenario whilst Options A and B resulted relatively higher NPV compared to the other options in all three scenarios (Central/Low/High) considered. Both Options A and B provide adequate increase in the transfer capacity to alleviate the potential constraints on the expected renewable energy generated in the area and deliver the similar levels of market benefits. However, Option A produces marginally higher NPV than Option B due to the slightly lower capital cost associated with Option A. In addition to the highest NPV, Option A has following benefits compared to the other Options considered:

> Project is expected to complete in 3 years' time (the lowest project duration time amongst the Options considered)

> Property acquisition is not required and it is not anticipated at this stage that the project will have a significant impact on the environment.

Based on the above reasons, Option A is selected as the preferred option.

Given the above assessments, Option A has been selected to upgrade the supply arrangements to Wagga North area to alleviate the potential constraints identified above and to provide adequate transfer capacity to dispatch low-cost solar generation in the area without excessive constraint.

Under this option, the following investments will be undertaken:

> Restring Lines 9R6 and 9R5 using Lime ACSR/GZ conductor.

The scope of works under the preferred option includes:

Line 9R5

- 14.6 km of Lime Conductor Restringing including the insulators and fitting replacements
- 6 Structure Replacements
  - 5 Suspension Structures
  - 1 Tension Structure
- Associated Structure Strengthening Required

Line 9R6

- 10.5 km of Lime Conductor restringing including insulators and fitting replacements
- 7 Structure replacements
  - 7 suspension structures
- Associated structure strengthening required

Capital and Operating Expenditure

The preferred option requires capital expenditure of $10.9 million. For the NPV analysis an annual operating expenditure of 2 per cent of the capital cost has been identified for this option.

The base case requires no additional capital or operating expenditure to current requirements.

Regulatory Investment Test

As the estimated cost of the project is above the Regulatory Investment Test (RIT-T) threshold of $6 million, a RIT-T will be required.

5. Optimal Timing

The test for optimal timing of the preferred option has been undertaken. The approach taken is to identify the optimal commissioning year for the preferred option where net benefits (including avoided costs and safety disproportionality tests) of the preferred option exceeds the annualised costs of the option. The commencement year is determined based on the required project disbursement to the meet the commissioning year based on the OFS.

The results of optimal timing analysis are:

> Optimal commissioning year: 2024/25

> Commissioning year annual benefit: $2.1 million
> Annualised cost: $620,000

Based on the optimal timing, the project is expected to have substantial expenditure in the 2023-2028 Regulatory Period. Further, the project needs to commence in the last year of 2018-2023 Regulatory Period.

6. Recommendation

The final preferred option will be determined through the RIT-T process based on detailed network analysis, market modelling, technical and economic feasibility. However, based on the option evaluations in this report, it is recommended the preferred network option is:

Option A – Restring 9R5 and 9R6 with a modern equivalent of Goat ACSR operating at 85°C.

Under this Option the selected conductor to re-conductor the Lines 9R6 and 9R5 is Lime ACSR/GZ.

It is therefore recommended that the project be approved to proceed to a RIT-T assessment, with a view to the preferred option being implemented by 2024/25.

Based on the options listed in Table 9, it is expected that this project would incur a total capital cost of approximately $10.9 million in non-escalated 2020/21 dollars.

This option requires up to $1.0 million of capex to progress the project to Decision Gate 2 (DG2) which is included in the above project cost.

Appendix A – Option Summaries

Table 10: Summary of the Option A

Project Description	**Increase Capacity for Generation in Wagga North Area**		
Option Description	Option A – Restring 9R5 and 9R6 with a modern equivalent of Goat ACSR operating at 85°C		
Project Summary			
Option Rank	1	Investment Assessment Period	25
Asset Life	45	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	36.8	Annualised CAPEX ($m)	0.6
NPV @ Lower Bound Scenario (PV, $m)	12.6	Network Safety Risk Reduction ($m)	N/A
NPV @ Higher Bound Scenario (PV, $m)	75.2	ALARP	N/A
NPV Weighted (PV, $m)	40.4	Optimal Timing	2024/25
Cost			
Direct Capex ($m)	9.9	Network and Corporate Overheads ($m)	1.0
Total Capex ($m)	10.9	Cost Capex (PV,$m)	7.9
Terminal Value ($m)	4.9	Terminal Value (PV,$m)	1.6

Table 11: Summary of the Option B - Restring 9R5 and 9R6 with a high-temperature conductor

Project Description	**Increase Capacity for Generation in Wagga North Area**		
Option Description	Option B – Restring 9R5 and 9R6 with a high temperature conductor		
Project Summary			
Option Rank	2	Investment Assessment Period	25
Asset Life	45	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	35.0	Annualised CAPEX ($m)	0.7
NPV @ Lower Bound Scenario (PV, $m)	10.5	Network Safety Risk Reduction ($m)	N/A
NPV @ Higher Bound Scenario (PV, $m)	74.0	ALARP	N/A
NPV Weighted (PV, $m)	38.6	Optimal Timing	2024/25
Cost			
Direct Capex ($m)	11.4	Network and Corporate Overheads ($m)	1.2
Total Capex ($m)	12.5	Cost Capex (PV,$m)	9.3
Terminal Value ($m)	5.6	Terminal Value (PV,$m)	1.8

Table 12: Summary of the Option C - Construct a new double circuit transmission line from Wagga 330 to near Wagga North, and re-route Line 991.

Project Description	**Increase Capacity for Generation in Wagga North Area**		
Option Description	Option C – Construct a new double circuit transmission line from Wagga 330 to near Wagga North, and re-route Line 991.		
Project Summary			
Option Rank	4	Investment Assessment Period	25
Asset Life	45	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	0.5	Annualised CAPEX ($m)	2.5
NPV @ Lower Bound Scenario (PV, $m)	-24.3	Network Safety Risk Reduction ($m)	N/A
NPV @ Higher Bound Scenario (PV, $m)	43.5	ALARP	N/A
NPV Weighted (PV, $m)	5.0	Optimal Timing	2026/27
Cost			
Direct Capex ($m)	47.6	Network and Corporate Overheads ($m)	2.4
Total Capex ($m)	49.9	Cost Capex (PV,$m)	29.5
Terminal Value ($m)	33.3	Terminal Value (PV,$m)	10.8

Table 13: Summary of Option D - Construct a new single circuit 132kV transmission line between Wagga North 132/66 kV Substation and Wagga 330/132 kV Substation

Project Description	**Increase Capacity for Generation in Wagga North Area**		
Option Description	Option D – Construct a new single circuit 132kV transmission line between Wagga North 132/66 kV Substation and Wagga 330/132 kV Substation		
Project Summary			
Option Rank	3	Investment Assessment Period	25
Asset Life	45	NPV Year	2021
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	8.8	Annualised CAPEX ($m)	2.0
NPV @ Lower Bound Scenario (PV, $m)	-15.0	Network Safety Risk Reduction ($m)	N/A
NPV @ Higher Bound Scenario (PV, $m)	50.0	ALARP	N/A
NPV Weighted (PV, $m)	13.1	Optimal Timing	2026/27
Cost			
Direct Capex ($m)	37.0	Network and Corporate Overheads ($m)	1.6
Total Capex ($m)	38.6	Cost Capex (PV,$m)	23.6
Terminal Value ($m)	25.7	Terminal Value (PV,$m)	8.3