HOUSTONKEMP Economists

Memo

To	Stephanie McDougall and Robert Alcaro, Transgrid
From	Ann Whitfield and Tony Chen
Subject	Response to AER draft decision – repex and augex business cases
Date	31 October 2022

This memorandum sets out responses to specific concerns raised by the Australian Energy Regulator (AER) and its consultant EMCa, arising from EMCa's review of business case analysis submitted as part of Transgrid's revenue proposal. These concerns are set out in Attachment 5 of the AER's Draft Decision[1] and in the supporting report provided by EMCa.[2]

The business case analysis relates to both proposed replacement expenditure (repex) and proposed augmentation expenditure (augex).

This memorandum is organised into three sections:

- Section 1 provides a background discussion on the application of terminal values with respect to capital investments in project assessments with a finite analysis period. With this context, it then addresses the specific concerns raised by the AER and EMCa in relation to terminal values and associated matters;
- Section 2 responds to the AER and EMCa's concern relating to varying discount rates across scenarios; and
- Section 3 responds to the AER and EMCa's concern on the weighting applied to the high and low scenarios.

1. Terminal value

Transgrid adopts a 'terminal value' approach to including capital costs in its project business case assessments. The approach involves including in project assessments:

- a negative number for the capital investment of an option as those costs are being incurred, denoting cash outflows incurred; and
- a positive number for the undepreciated value (termed 'terminal value'), which is more accurately described as the residual value of capital assets that is yet to be depreciated.

The sum of the discounted capital investment and discounted terminal value equals the present value of capital cost incurred during the analysis period.

For clarity, this memorandum adopts conventions with regards to the following terms in discussing terminal values:

- Capital investment – relates to cash outflows incurred in building and commissioning capital assets. Capital investments are not expenses in an accounting sense as capital investments swap one asset type (ie cash) for another asset type (capital assets). Capital investments add to the stock of capital assets available to provide a service in economic terms and would typically be found on a balance sheet.

[1] AER, Draft Decision *Transgrid Transmission Determination 2023 to 2028 Attachment 5 Capital expenditure*, September 2022, Section A.2.3.3 part (b).

[2] EMCa, *Review of aspects of Transgrid's Revenue Proposal*, August 2022.

- Capital cost – relates to expenses incurred as a result of using capital assets to provide services. Capital costs are reductions in the stock of capital assets as those assets are used and would typically be found on the profit and loss statement.

The convention avoids the use of 'capital expenditure' or 'capex' in order to avoid conflating the stock (ie capital assets arising from capital investment) and flow of expenses (ie capital costs) incurred by using capital assets.

EMCa raised several concerns relating to how terminal values have been adopted in Transgrid's project assessments:[3]

- importance of being able to substantiate reasonable expectations of future benefits;
- 'option value' considerations needed for scenarios in which there are changes both within and beyond the analysis period which may render the value of an investment redundant beyond a certain time;
- benefits toward the end of the modelled period were negligible for some assessments or at least insufficient to justify the modelled terminal value;
- instances where the full original capital cost of land was assumed as a terminal value; and
- capital cost that is presented effectively net of the terminal value is misleading and under reports the present value (PV) of the actual capital cost of the proposed project. EMCa considered that this also distorts assessment of the payback profile and optimal timing analysis.

We address each of these concerns in turn, after first setting out the rationale for the terminal value approach.

1.1 Rationale for the terminal value approach: matching benefits to costs

The function of adopting a terminal value approach is most accurately and precisely understood as to allow the matching of benefits and costs during the analysis period so that a like-for-like comparison between an option's benefits and costs during that period can be made. The matching of benefits to costs follows the same rationale as the Matching Principle in an accounting context, where revenues are matched to expenses for a particular period so that profits or losses for that period can be understood.

The need for the terminal value approach in project assessments arises from the fact that capital investments result in long lived assets that provide benefits across multiple years, including years outside of an analysis period, while on the other hand, operating costs and market benefits are typically estimated for each year of the analysis period, but not beyond. Consequently, there is a need to match capital costs arising from capital investments in long lived assets with operating costs and benefits that are estimated yearly during the assessment period only.

Box 1-1 The need for matching

Suppose there is an option involving capital investment of $50 million that results in a transmission network asset with an asset life of 50 years. Each year, the asset provides $5 million of benefits and incurs $1 million of operating expenses.

The project assessment is performed over an analysis period of 25 years, and a discount rate of 5.5 per cent is used. For simplicity, assume that both capital investment and commissioning occurs at the start of the first year of analysis

[3] EMCa, *Review of aspects of Transgrid's Revenue Proposal*, August 2022, p 36.

Table 1-1 sets out the analysis where nothing is done to match the capital costs with operating expenses and benefits over the 25 year analysis period. In this case, the full capital cost of the asset of $50 million that will be incurred over 50 years is included in the 25 year analysis along with 25 years of opex inputs and 25 years of market benefit inputs.[4] This effectively causes a mismatch between capital costs and opex and benefits in a 25 year analysis period.

Table 1-1 Without matching

$millions, real	PV	Year 1	Year 2 to Year 24	Year 25
Capital cost	(50)	(50)		
Opex	(14)	(1)	(1)	(1)
Benefits	71	5	5	5
NPV	**7**			

Perhaps in more accessible terms, recognising the full $50 million capital investment cash outflow as the capital cost without any approach to matching is analogous to writing off the value of new car after having purchased it from the car dealership, then undertaking a cost benefit assessment assuming the expenditure on the new car is the cost for that period and that the new car should have zero value on the balance sheet (implying that it provides zero future benefits). This analysis would be spurious and illustrates the need for matching.

There are two approaches to match capital costs: the terminal value approach and the annualised cost approach. The two approaches break down capital investments and match capital costs to the analysis period in different ways but will arrive at similar outcomes. We describe each of these approaches below, noting that Transgrid has adopted the terminal value approach in its business cases and RIT-T evaluations, as have other TNSPs and DNSPs.

We note that EMCa has raised concerns with regards to the terminal value approach (which we address in section 1.5 below), but in doing so it is not clear what approach EMCa suggests to ensure capital costs are matched to benefits for the period of analysis. If the annualised cost approach is adopted instead of the terminal value approach, the underlying issues raised by EMCa would still remain. We therefore do not consider it necessary to depart from the terminal value approach and to instead adopt an annualised cost approach in the business cases.

1.1.1 Terminal value approach to matching

The terminal value approach recognises the cash outflows (negative number) of the capital investment but also recognises a residual value (positive number) of the capital asset in the last year of the analysis period. The inclusion of a residual value effectively recognises accumulated depreciation for those years the asset is in commission during the analysis period,[5] and together with discounting (that calculates the time value of money), we arrive at the capital cost appropriate for the analysis period.

Following on from the example in Table 1-1, the terminal value approach recognises the capital investment of $50 million as a cash outflow in Year 1, and also recognises residual value of $25 million in the last year of

[4] It is appropriate to understand the capital investment of $50 million to represent 50 years of capital cost as the asset has an asset life of 50 years. Each year $1 million of the capital investment depreciates (assuming straight line depreciation), which together with the time value of money represents the capital cost of the option in each year of the analysis period.

[5] Capital investment of $50 million less $25 million in residual value equates to $25 million of accumulated depreciation incurred during the 25 year analysis period.

the 25 year analysis period, being the undepreciated portion of the capital asset.[6] Discounting the $50 million capital investment (negative number) and the $25 million residual value (positive number), arrives at $43 million (negative number) in capital costs, which relates to the capital cost incurred during the 25 year analysis period. This is illustrated in Table 1-2, where the present value of the capital cost of $43 million is lower than the $50 million in Table 1-1 because the residual value now properly matches capital costs incurred in the 25 year analysis period to the analysis period.

Table 1-2 Matching using terminal values

$millions, real	PV	Year 1	Year 2 to Year 24	Year 25
Capital cost	(43)	(50)		25
Opex	(14)	(1)	(1)	(1)
Benefits	71	5	5	5
NPV	**14**			

Recognising the residual value and the capital investment would be analogous to recognising a cash outflow when a new car is purchased (ie the capital investment) but also a non-zero new car asset on the balance sheet (residual value) that recognises that the car can provide future benefits.

While the terminal value has been framed in the project assessments as a conservative estimate of future benefits, as an easy way to interpret what that value means in terms of costs and benefits, it is more precise to understand the terminal value included in Transgrid's project assessments as a residual value that is necessary for the matching and alignment of capital costs to the analysis period, without which the analysis would become spurious.

1.1.2 Annualised cost approach to matching

Matching of the cost of capital investments to benefits can alternatively be achieved using an annualised cost approach, where the capital investments are annualised by taking into account a discount rate, the amount of the capital investment, and the life of the capital asset.[7] The stream of annualised costs will equal the present value of the capital investment if discounted over the whole period of the capital asset's useful life. This approach is adopted by AEMO for its Integrated System Plan (ISP) assessment. Table 1-3 sets out the results from using an annualised cost approach, which is different but comparable to the terminal value approach above.

Table 1-3 Matching using annualised costs

$millions, real	PV	Year 1	Year 2 to Year 24	Year 25
Capital cost	(40)	(3)	(3)	(3)
Opex	(14)	(1)	(1)	(1)
Benefits	71	5	5	5
NPV	**17**			

[6] $50 million less 25 years of depreciation at $1 million per year equals $25 million in residual value.

[7] In Excel, the annualised cost of an investment can be calculated using the PMT() formula.

Continuing with the car analogy, the annualised cost approach is akin to recognising the annual outflows from a car finance lease arrangement, instead of recognising capital investment outflows and residual values.

1.1.3 Terminal value approach versus the annualised cost

The terminal value approach and the annualised cost approach will produce different results due to the way the two approaches treat the capital asset:

- the terminal value approach assumes straight line depreciation in order to arrive at the residual value; in comparison
- the annualised cost approach is more of a financing arrangement that determines the annual payment needed to fund principal and interest repayments.

The main difference between the two approaches is that the terminal value approach recognises the cash outflow related to capital investment at the beginning of the analysis period and is discounted less heavily, while the annualised cost approach spreads out annualised costs evenly over the life of the asset and therefore attracts relatively more discounting.

For all reasonable discount rates,[8] the terminal value approach will generate higher present value capital costs than the annualised cost approach because of the upfront recognition of cash outflow under the terminal value approach. This is illustrated in Figure 1-1 below.

Figure 1-1 Cumulative PV of costs under a 5.5 per cent discount rate

However, it is important to note that differences in present value terms are small (particularly at extreme discount rates), and immaterial to the task of identifying a preferred option (which is undertaken within the context of one approach or the other for all options).

Each approach has advantages and disadvantages. However, from a capital investment perspective where there can be considerable build out and commissioning periods, as is the case with transmission investment, the terminal value approach has an advantage of setting out the build profile (and the cash outflows incurred) in a transparent manner, which can then be discounted. In contrast, the annualised cost approach would have an implicit assumption about the build profile in its present value costs, but this is less transparent.

[8] 'Reasonable discount rates' refers to rates that are commonly seen to represent commercial discount rates. Extremely small discount rates that approach 0 per cent (eg 0.00000001%) or extremely large discount rates approaching 100 per cent will cause the two approaches above to generate equal present value costs, all else being equal.

Notwithstanding the differences, the terminal value approach and the annualised cost approach provide very similar capital cost outcomes. In our example from Table 1-2 and Table 1-3, the present value of capital cost under the terminal value approach is $43 million compared to $40 million for the annualised cost approach (which is only a $3 million difference).[9] These outcomes are similar because both approaches are matching capital costs incurred during the period of the analysis.

The similarities in outcomes implies that EMCa's concerns would not be addressed through adopting an annualised cost approach. We consider that EMCa's concerns around the terminal value may be alleviated by clarifying what capital cost terminal values are (ie residual value) and how they function in NPV cost benefit assessments, as we have set out above.

1.2 Analysis of payback periods can inform when benefits exceed the total capital investment

As detailed above, terminal values (or more precisely, the residual value) included in Transgrid's project assessments are required to match capital costs incurred to operating expenditure and benefits, aligning those costs and benefits with the analysis period. The inclusion of a terminal value does not 'add benefits' to an option.

Attempting to estimate benefits that extend past the analysis period requires forecasting 30 years (or more) into the future with some degree of certainty, in order to inform project assessments. Such a forecasting exercise is difficult and likely to result in inputs that are highly uncertain and of little practical value for project assessments.

As an alternative, in considering whether benefits exceed the capital investment involved an analysis of the 'payback period' can be undertaken. This involves calculating the present value of capital investments excluding the terminal value and the cumulative present value of operating net benefits (ie gross benefits less operating expenditure) over the assessment period, and identifying when the cumulative present value of operating net benefits exceeds the present value of capital investment. As this calculation excludes the terminal value (and is therefore not dependent on it), the payback period is the time required for the full amount of the capital investment to be 'recovered' through operating net benefits.

If payback is achieved during the analysis period, then the assessment indicates that benefits exceed the total capital investment of an option, regardless of the residual value or its impairment due to changes further into the future (eg stranding or obsolescence risk).[10] Even if payback if not achieved during the assessment period, this assessment can indicate the 'gap' that future benefits would need to fill, which may be less than the terminal value.

Table 1-4 sets out payback periods for the preferred option from a sample of Transgrid's business cases that all have terminal values. Payback timing from this sample are all within the analysis period, indicating that the present value of benefits exceeds the present value of capital investment (including the residual value remaining at the end of the period).

[9] Excluding the terminal value of $25 million in year 25, the PV of capital cost would be $50 million, as set out in Table 1-1.

[10] The only exception is if there could be disbenefits caused by the capital investment incurred *after* the analysis period. However this is unlikely to be a common occurrence.

Table 1-4 Payback periods under the central scenario for a sample of projects

Project	Preferred option	Payback period	Terminal value, PV
OER-1164	Option B	6 years after commissioning	$2.4 million
OER-N2208	Option 1	Year of commissioning	$1 million
OER-N2582	Option B	6 years after commissioning	$2.4 million
OER-N2645	Option 1	4 years after commissioning	$23.2 million
OER-N2497	Option A	3 years after commissioning	$4.8 million

Source: HoustonKemp analysis of business cases provided by Transgrid

1.3 Persistence of benefits at the end of the analysis period

Persistent operating net benefits near the end the analysis period may suggest that benefits will continue into the future past the final year of the analysis period. To a limited degree, persistent operating net benefits can inform whether net benefits arising during the analysis period are likely to be preserved or expanded into the future.

1.4 High terminal values and asset impairment

Some project assessments may exhibit high terminal values reflecting a high proportion of capital investment that remains undepreciated at the end of the analysis period. A high terminal value in and of itself is not inherently an issue since, as discussed earlier, the terminal value functions to allocate the correct amount of capital costs to the analysis period.

However, it is possible that an asset may be impaired in future beyond the assessment period, due to circumstances that result in asset stranding or obsolescence. In this case it may be appropriate to impair the capital asset by reducing the assumed terminal value. The difficulty in reducing the terminal value is determining how much and on what basis that reduction is made, given uncertainties around long range forecasts. To illustrate this difficulty, if the terminal value of $25 million from the example in Table 1-2 (calculated as the undepreciated residual value at the end of the analysis period) is deemed to be too high, then it is unclear what the approach to determining the terminal value should then be.

Forecasts of benefits and costs extending beyond the analysis period could inform the terminal value but introduce more uncertainty as the forecast is extended into the future. Alternatively, the asset lives of capital assets could be shortened, but this would depart from the standard asset lives used in the electricity transmission industry.

In addition to introducing uncertainty, there are also issues of proportionality and materiality in impairing terminal values that would make the assessment less tractable.

While in theory terminal values could be reduced, the practicality of doing so is likely to mean departure from a known and transparent residual value calculation to one that is likely to be less certain, less transparent and potentially more arbitrary. It is not clear that this would materially improve project assessments or maintain proportionality.

A more tractable approach to address concerns of high terminal values or potential impairment of assets is to examine the payback period of the option (as described in section 1.2) and whether there is a gap that is

sufficiently large to be a concern. If payback of the full capital investment occurs during the analysis period or is expected to occur shortly after, then high terminal values or potential impairment of assets is not a material concern given that the full amount of the capital investment will be 'recovered' through net operating benefits, regardless of the assumed terminal value.

1.5 Responses to EMCa concerns relating to terminal value

As noted above, EMCa raised several concerns relating to how terminal values have been adopted in Transgrid's project assessments.[11] We provide a response to each concern below, drawing on the preceding discussion.

Table 1-5 Responses to EMCa concerns relating to the use of terminal values

EMCa concern	Response
Importance of being able to substantiate reasonable expectations of future benefits	Transgrid's project assessments adopt an analysis period within which costs and benefits are compared. The duration of the analysis period is selected based on considerations of the construction period, and a sufficiently long duration to demonstrate the costs that will be incurred and the benefits that will arise during normal operations, balanced by the inherent uncertainty (and therefore usefulness) in long range forecasts. The terminal value, being the residual value for capital assets, effectively matches costs and benefits for the period of the analysis during which costs and benefits can be more reliability substantiated. The substantiation of the need for future benefits beyond the assessment period can be evaluated by examining the payback period, as discussed in section 1.2. If payback occurs during the analysis period or is expected shortly after, then the full capital investment is recovered regardless of the assumed terminal value and any expectation of future benefits.[12] Even where the payback period is not within the assessment period, this analysis can inform a view of the amount of the 'gap' which future benefit would need to fill to justify the full investment cost, which will not necessarily be the same as the terminal value assumed.
'Option value' consideration is needed for scenarios in which change both within and beyond the analysis period may render the value of an investment redundant beyond a certain time	Option value considerations go to how a project can respond to external developments in the environment the project is expected to operate in. The 'recovery' of capital investments can be assessed by examining payback periods where payback during the analysis period or shortly after indicates that the value of the investment is justified, regardless of the terminal value or future developments beyond the assessment period.
Benefits toward the end of the modelled period were negligible or at least insufficient to justify the modelled terminal value	As described in section 1.1.1, terminal values (or more precisely, the residual value) are required to match costs to benefits within the analysis period. It is more appropriate to consider the payback period to inform whether benefits have exceeded the total capital investment during the analysis period, or how much of a gap remains at the end of the period, rather than focusing on the level of the terminal value.
Instances where the full original capital cost of land was assumed as a terminal value	The value of land does not normally depreciate, and therefore the terminal value equals the capital investment for the land, as the residual value of that land is assumed to be maintained.

[11] EMCa, *Review of aspects of Transgrid's Revenue Proposal*, August 2022, p 36.

[12] Table 1-4 sets out the payback periods for a sample of Transgrid's business cases.

EMCa concern	Response
	Assets that depreciate (eg lines, substations, secondary equipment, etc) will have terminal values that are less than the capital investment amount due to depreciation and their wear and tear as those assets are in commission.
Capital cost that is presented effectively net of the terminal value, is misleading and under reports the PV of the actual capital cost of the proposed project. It also distorts assessment of the payback profile and optimal timing analysis.	As described in section 1.1.1, terminal values are required to match costs to benefits within the analysis period. Alternative approaches can be adopted that do not involve an explicit terminal value: • annualised cost approach, that implicitly will still have a residual value unless the analysis period extends to the full useful life of the asset. • extending the analysis period to the full useful life of the asset, in which case estimation of benefits becomes more uncertain. Both alternatives are still problematic if options involve components with different asset lives. For example, an option involving substations with 30 year lives and lines with 50 year lives assessed over a 50 year analysis period would require terminal values or have implicit residual values for replacement substations.[13] We do not agree that the presentation of capital costs for the assessment period net of terminal values is misleading, or that it distorts the payback assessment. As discussed above, the assessment of the payback period takes into account the total capital investment, and does not net off the terminal value.

2. Varying discount rates across scenarios

Transgrid typically undertakes project assessments based upon a similar rationale to that found in RIT-T cost benefit assessments, in that scenarios are established to account for uncertainties in future states of the world. These scenarios include variations in discount rates.

EMCa considered that 'varying the discount rate along with varying costs and benefits and then weighting the outcome introduces a distortionary impact that effectively masks the impact on economic analysis outcomes of genuine project uncertainties', explaining that discount rates are not 'project related uncertainties'.[14]

We disagree with EMCa's view of varying discount rates in scenarios, as the rationale for the scenarios adopted in the project assessments is to characterise different states of the world that affect outcomes for National Electricity Market (NEM) participants:

- a central scenario that is considered to be most likely to occur in the future given what is known at the time of the project assessment;
- a low benefits scenario that reflects a future state of the world that would give rise to a lower bound level of benefits; and
- a high benefits scenario that reflects a future state of the world that would give rise to an upper bound level of benefits.

To characterise these states of the world, it is necessary to vary discount rates to reflect different opportunity costs of employing capital resources in a particular project under each scenario. Not doing so would imply that project outcomes for NEM participants are not affected by differences in funding costs, which is not the

[13] Replacement of substations are needed in this example to maintain network capacity, and replacement substations will still have a residual life of 10 years at the end of the 50 year analysis period.

[14] EMCa, *Review of aspects of Transgrid's Revenue Proposal*, [August 2022], p 36.

case. Consequently, we are of the view that varying discount rates between different scenarios affecting comparisons between long-term, capital-intensive options and short term opex solutions is an appropriate and intentional outcome. It follows that we do not consider varying discount rates have a distortionary effect with respect to genuine project uncertainty and do consider that uncertainty around future discount rates is a relevant part of scenario construction.

More practically, the different discount rates used in each scenario are unlikely to change the weighted scenario rankings and therefore will not affect the identification of the preferred option. This is because:

- the central scenario is weighted more heavily, consistent with it being considered to be more probable; and
- low and high benefit scenarios generally counteract each other in the overall weighted outcome.

It follows that adopting a single discount rate across all scenarios is unlikely to make a material difference to project assessments.

Table 2-1 sets out the assessment for a selection of Transgrid's business cases that illustrates net benefits and rankings under both uniform and varied discount rate assumptions. It shows that adopting a fixed discount rate assumption across all scenarios does not change the identification of the preferred option for these business cases, or materially change the calculation of weighted net benefits.

Table 2-1 Examples of weighted project assessment outcomes adopting fixed and varied discount rates across scenarios

Project	Preferred option	4.8% discount rate across all scenarios		Varied discount rate for each scenario	
		NPV, $millions	**Rank**	**NPV, $millions**	**Rank**
OER-1164	Option B	114	1	121	1
OER-N2208	Option 1	171	1	186	1
OER-N2582	Option B	230	1	263	1
OER-N2645	Option 1	32	1	38	1
OER-N2497	Option A	295	1	334	1

Source: HoustonKemp analysis of business cases provided by Transgrid

The approach of varying discount rates across different scenarios is also adopted across RIT-Ts, undertaken by both Transgrid and other TNSPs, and reflects an established convention. A limited selection of examples of RIT-Ts adopting varied discount rates across scenarios are set out in Table 2-2 below.

Table 2-2 Examples of RIT-Ts with variations in discount rates between scenarios

TNSP	RIT-T project and link	Scenario discount rates
Transgrid	Managing safety and environmental risks on Line 24 (Vales Point - Eraring)	Central: 5.5% Low benefits: 8.7% High benefits: 2.3%
Transgrid	Managing the risk on Line 86 (Tamworth - Armidale)	Central: 5.5% Low benefits: 7.5% High benefits: 2.3%
Transgrid	Maintaining compliance with performance standards applicable to Ingleburn substation secondary systems	Central: 5.5% Low benefits: 8.7% High benefits: 2.3%
Transgrid	Managing safety and environmental risks on Line 21 (Tuggerah - Sydney North)	Central: 5.90% Low benefits: 9.57% High benefits: 2.23%
Transgrid	Managing safety and environmental risks on Line 18 (Kangaroo Valley - Dapto)	Central: 5.90% Low benefits: 9.57% High benefits: 2.23%
Powerlink	Addressing the secondary systems condition risk in the Gladstone South area	Central: 5.90% Low benefits: 3.47% High benefits: 8.33%
ElectraNet	Managing the Risk of Protection Relay Failure	Central: 5.90% Low benefits: 8.95% High benefits: 2.85%
ElectraNet	Managing the Risk of Isolator Failure	Central: 5.90% Low benefits: 8.95% High benefits: 2.85%
ElectraNet	Managing the Risk of Transformer Bushing Failure	Central: 6.00% Low benefits: 8.38% High benefits: 3.62%
AusNet	Maintaining supply reliability in the Shepparton and Goulburn-Murry area	Central: 5.5% Low bound: 2.0% High bound: 7.5%
AusNet	Maintain reliable transmission network services at Sydenham Terminal Station	Central: 5.5% Low bound: 2.0% High bound: 7.5%
AusNet	Maintaining supply reliability in the Cranebourne supply area	Central: 5.5% Low bound: 2.27% Higher bound: 8.73%

2.1 Discount rates adopted for the business cases

A central discount rate of 4.8 per cent was adopted by Transgrid for the business cases. This reflects the discount rate in AEMO's draft 2021 Input and Assumptions Report (IASR),[15] which was the latest available source at the time Transgrid was preparing its business cases. Transgrid has asked us our view on whether it is reasonable to maintain this discount rate assumption.

We consider that it is reasonable to maintain the central discount rate assumption at 4.8 per cent, rather than updating it to the latest 5.50 per cent assumption in the final 2021 IASR (published in July 2021). The business case scenario analysis and weighted outcome use a range of discount rates in the low benefits and high benefits scenarios, which already accounts for differences around the central 4.8 per cent discount rate assumption.

3. Weighting given to the high and low scenarios

As noted in section 2, the scenarios adopted in Transgrid's project assessments characterise three alternative states of the world, being the central scenario, low benefits scenario and high benefits scenario. The scenarios are constructed so that the upper and lower bounds of net benefits can be considered in order to test the robustness of the project assessment. Typically the central scenario is weighted at 50 per cent, while the low and high benefit scenarios are weighted 25 per cent each, which reflects a view that the central scenario is most likely to occur, while the low and high benefit scenarios are less likely.

EMCa considered that the weights on the low and high benefit scenarios are likely to be too high given that the probability of individual parameters might be 25 per cent already. EMCa supports its view that the weightings cause an unreasonable bias toward the low and high benefit scenarios (particularly the high benefits scenario) using Monte Carlo analysis.[16]

While Monte Carlo analysis can be useful in understanding the distribution of possible outcomes, it naturally focuses on the median or mean outcome. In contrast, Transgrid's project assessments focus on uncertainties in the form of upper and lower bounds (ie the tail ends of the distribution) in order to ensure the result from the project assessment (ie, the identification of the preferred investment option) is robust to a wide range outcomes.

In other words, the low and high benefit scenarios are constructed and weighted in a way so that they inform the robustness of the preferred option, which provides a high degree of assurance that the preferred option is the right option in terms of stakeholder outcomes. The consideration of what is the most likely outcome (which a Monte Carlo analysis can inform) is a secondary concern with respect to understanding uncertainties through analysis of different scenarios.

Finally, as noted in section 2, a lower weighting on low and high benefit scenarios is unlikely to be material in the identification of the preferred option, due to:

- a higher weighting on the central scenario, where options exhibit net benefits; and
- low and high benefit scenarios typically counteracting each other in the weighted outcome, which determines the identification of the preferred option.

Table 3-1 sets out analysis of a selection of projects that illustrates net benefits and rankings under different scenario weightings. It shows that a weighting more focused on the central scenario (ie, 90 per cent weighting for the central scenario and a 5 per cent weighting for each of the low and high scenarios) does

[15] AEMO, *Draft 2021 Inputs, Assumptions and Scenarios Report*, December 2020, p 105.

[16] EMCa, *Review of aspects of Transgrid's Revenue Proposal*, August 2022, p 37.

not change the identification of the preferred option for these project assessments, or materially change the calculation of weighted net benefits.

Table 3-1 Weighted net benefits for a sample of project assessments assuming different scenario weightings

Project	5% weighting for low and high benefit scenarios		25% weighting for low and high benefit scenario	
	NPV, $millions	**Rank**	**NPV, $millions**	**Rank**
OER-1164	115	1	121	1
OER-N2208	174	1	186	1
OER-N2582	113	1	125	1
OER-N2645	34	1	38	1
OER-N2497	302	1	334	1

Source: HoustonKemp analysis of business cases provided by Transgrid

The high, central and low scenarios approach to project assessments has been adopted across several RIT-Ts (notably those for which wholesale market benefits are not a key driver of project benefits).

Notwithstanding the approach to date, Transgrid has recently been discussing its scenario approach, and has agreed to adopt default weightings of 5:90:5 across high, central and low scenarios for non-ISP RIT-Ts going forward.