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NSW Electricity Infrastructure Roadmap benefits modelling outcome report

Modelling report for estimating the consumer benefits of the NSW Electricity
Infrastructure Investment Act 2020

May 2024



Acknowledgement of Country

The Department Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Glossary

Cost-Benefit Analysis	CBA
Electricity Infrastructure Investment Act 2020	EII Act or the Act
Energy Corporation of NSW	EnergyCo
Gigawatts	GW
Infrastructure Investment Objectives	IIO
Long-Term Energy Service Agreements	LTESA
Megawatt hours	MWh
National Energy Market	NEM
Net Present Value	NPV
Network Infrastructure Strategy	NIS
New South Wales	NSW
AEMO Services Limited	AEMO Services
NSW Electricity Infrastructure Roadmap	Roadmap
Renewable Energy Zone	REZ
Variable Renewable Energy	VRE
Weighted Average Cost of Capital	WACC

Executive Summary

The NSW Electricity Infrastructure Roadmap (Roadmap) is a plan to deliver reliable, affordable, and clean electricity to NSW households and businesses.

The NSW Consumer Trustee, AEMO Services Limited (AEMO Services), publishes regular Infrastructure Investment Objectives (IIO) reports that inform the Roadmap implementation as required under the *Electricity Infrastructure Investment Act 2020* (the EII Act). The Energy Corporation of NSW (EnergyCo) prepares the Network Infrastructure Strategy (NIS) that coordinates the transmission investment needed in NSW and serves as an input for consideration in the IIO Report. The NIS is a planning document not required under the EII Act but prepared to inform EnergyCo's work as the Infrastructure Planner. Both publications are informed by electricity market modelling activities undertaken by AEMO Services.

In June 2023, the Department of Climate Change Energy Environment and Water (DCCEEW), formerly known as the Office of Energy and Climate Change, published a 'NSW Electricity Infrastructure Roadmap benefits modelling report'. This report detailed a modelling framework to compare No-Roadmap model consumer outcomes with a Roadmap model to estimate net benefits of the EII Act. The modelling framework aims to enable the estimated benefits of the policy to be updated periodically and will inform the policy's evaluation as part of a statutory review in 2025/26.

This report provides the results from the modelling based on the framework outlined in the June 2023 report, with a more detailed explanation of the methodology used to estimate consumer benefits. As noted in the June 2023 report, the No-Roadmap model aligns with the Roadmap model for most inputs and assumptions. This report outlines the changes made to the inputs, assumptions or modelling approach since the draft Roadmap consumer benefits results were published. For a comprehensive list of inputs and assumptions, please refer to the 2023 IIO Report¹.

Summary of final Roadmap benefits modelling findings

This report highlights that the implementation of the EII Act leads to significantly higher renewable energy generation and transmission capacity in the NSW electricity market. Without this additional infrastructure, NSW would become more reliant on high cost fossil fuel generation and imports from other states to meet its energy needs, as well as experiencing elevated reliability risks.

The net benefit of implementing the Roadmap is estimated to be \$25.5 billion (net present value at a 5% discount rate, real \$2022) over the period Financial Year 2022-23 to 2039-2040. This is an

¹ AEMO Services Limited (as the NSW Consumer Trustee), 2023 Infrastructure Investment Objectives Report, December 2023, https://aemoservices.com.au/-/media/services/files/publications/iio-report/2023/2023-iio-report-december_final.pdf?la=en

increase from the \$12.4 billion calculated from the original Roadmap modelling, primarily attributable to larger projected wholesale electricity price benefits that also occur sooner.

Translating the net benefit into the impact on electricity bills, the modelling forecasts that without the Roadmap, NSW residential customers would face bills that are \$156 higher on average per year, while small businesses would face bills that are \$530 higher on average per year. Additionally, the Roadmap is forecast to reduce electricity sector carbon dioxide emissions, and will help to keep the economic opportunities of the transition within NSW.

1 Changes to the method and input assumptions

The approach to modelling Roadmap benefits has been refined since the ‘NSW Electricity Infrastructure Roadmap benefits modelling report’ was published in June 2023². This section outlines the refinements that have occurred in more recent modelling to better reflect the intent of the June 2023 framework, and any inputs or assumptions that have changed since the publication of draft Roadmap consumer benefits results in the draft 2023 IIO Report.

1.1 Technology cost assumptions

All technology cost assumptions, apart from the Weighted Average Cost of Capital (WACC), are aligned between the Roadmap model and the No-Roadmap model. The WACC for projects in NSW is adjusted to reflect the impact of merchant financing without the Roadmap incentives including Long-Term Energy Service Agreements (LTESAs). AEMO Services has revised technology-specific WACCs for their 2023 IIO Report, based on a draft version of new available information informed through a range of evidence including a survey of debt and equity providers. Technology-specific merchant WACCs in the No-Roadmap model have likewise been updated based on assumptions from the same source. A report published by AEMO Services provides an overview of final WACC assumptions developed by the Cambridge Economic Policy Associates Pty Ltd³. This update has resulted in forecast WACC assumptions for generation and storage projects more than doubling under both the Roadmap and No-Roadmap models since the June 2023 report.

1.2 Supply chain constraints

Aligned with the final 2023 IIO Report, a National Electricity Market (NEM)-wide supply-chain constraint has been adopted, rather than a NSW-only supply-chain constraint as used in the draft 2023 IIO Report.

The annual build limit for new entrant NEM generation and storage has been set at 4 gigawatts (GW) for all technologies up until 2029-30. From 2030-31 onwards the limit is relaxed and increased

² The Office of Energy and Climate Change, “NSW Electricity Infrastructure Roadmap benefits modelling,” June 2023, https://www.energy.nsw.gov.au/sites/default/files/2023-06/202306_NSW_Electricity_Infrastructure_Roadmap_benefits_modelling_report_v2.PDF

³ AEMO Services Limited, “WACC Assumptions,” May 2024, <https://aemoservices.com.au/support-and-resources>

construction can take place without penalty. Further detail can be found under section 3.3 of the final 2023 IIO Report.

1.3 Fuel costs

Fuel costs are assumed to be independent to the EII Act and therefore are aligned in the Roadmap and no-Roadmap models. This report uses fuel cost assumptions from Australian Energy Market Operator's 2023 Input Assumptions and Scenarios Report rather than the CORE Energy & Resource coal price forecast used in the draft 2023 IIO Report. Further detail can be found under section 5.2 of the Final 2023 IIO Report.

1.4 Renewable Energy Zones (REZ) and intraregional network augmentations

The approach outlined in the June 2023 report stated that transmission projects with an optimal development timing earlier than 2029 would have a delay of two years applied, whereas later projects would have a delay of four years. The justification for these delays is explained in detail in the June 2023 report.

This assumption has been updated in the No-Roadmap model to apply fixed delays of two years to select projects regardless of their optimal timing. This change avoids the risk of project delays changing from two years to four years if their optimal timing changes, and therefore results in the same delays as those in the June 2023 report. Table 1 lists the key intra-regional network augmentations and the delay applied in the No-Roadmap model relative to the optimal timing in the Roadmap (IIO) model.

It is also noted that the Waratah Super Battery (a 'virtual' transmission solution) is excluded from the No-Roadmap model since it is a project specifically conceptualised as a Roadmap-enabled NSW Government response to the anticipated closure of Eraring Power Station.

Table 1: Comparison of REZ and intraregional network augmentation timings between the Roadmap model and the No-Roadmap model

Augmentation	No-Roadmap model delay relative to optimal timing in the IIO ⁴
Hunter Transmission Project	Delayed two years
Humelink	No delay relative to the Roadmap model due to Commonwealth support and development pre-dating Roadmap legislation
Central West Orana REZ	Stage 1: delayed two years Future expansion: delayed four years
Hunter Central Coast REZ	Delayed two years
South West NSW REZ ⁵	Delayed four years
New England REZ	Delayed four years
Waratah Super Battery	Excluded from the No-Roadmap model

1.5 New committed capacity

In the June 2023 report, it was stated that projects that were at least considered ‘anticipated’ as of November 2019 and projects that became committed within the 24 months following November 2019 (i.e. by November 2021) were to be included in the No-Roadmap model. This was based on the assumption that they were likely to be sufficiently advanced to not be materially influenced by the Roadmap legislation.

It was later determined that this approach would be problematic in the initial years of the modelling horizon. New entrant projects typically have lead times (of say ‘X’ years depending on the type of technology), and that means they cannot be built in the first X years of the model. Since the first modelled year in both the Roadmap and No-Roadmap model will continue to move further away from November 2021 in future modelling exercises, the No-Roadmap model would have an artificial and growing shortage of capacity in the first X years of the model under the previous method.

To avoid this, lead times in the No-Roadmap model are now reduced by the difference between the model start date and November 2021. This allows for capacity expansion to occur in the early years of the model. The amount of capacity expansion that is allowed to occur in the No-Roadmap model is then capped to the capacity that, in reality, has been constructed or is committed/anticipated to

⁴ Some of these augmentations may not have any optimal timing at all in the no-Roadmap scenario and may not be built at all (with or without a delay)

⁵ This refers to REZ expansion beyond that already provided by Project Energy Connect, Victoria-NSW interconnector West and Humelink

be constructed. This ensures capacity expansion can occur without exceeding what has occurred in reality under the Roadmap, which would be an unrealistic outcome given the Roadmap's mechanisms.

2 Consumer costs and benefits

2.1 Methodology for calculating costs and benefits

Consumer costs are calculated for the No-Roadmap model and compared against the Roadmap model to estimate the Roadmap consumer bills impacts. Consumer costs in the No-Roadmap model consist of three categories: wholesale costs, transmission network infrastructure costs, and firming infrastructure costs. For the Roadmap model, costs for transmission, administration, and LTESAs are accounted for in the net benefit calculation. Differences in environmental, distribution network, and retail charges have not been calculated as part of this modelling exercise. Additionally, whilst emissions are included in the overall net benefits calculations, they are not accounted for in consumer bill calculations.

Wholesale costs refer to the cost of generating electricity (which can be volatile), and the financial risk associated with offering fixed prices to consumers. For the purposes of this calculation, we compare only the difference in the electricity generation costs. Spot prices are capped at \$300 per megawatt hour (MWh) to exclude extreme volatility from the calculation as a conservative assumption to measuring wholesale benefits.

Transmission network infrastructure costs refer to the regulated costs associated with maintaining and operating the transmission lines. For the purposes of this calculation, we compare an annualised difference in expected consumer costs for NSW transmission augmentations, inclusive of additional cost categories beyond development and construction, including finance, generator connection, and system strength. This aligns with EnergyCo's 2023 NIS. These costs are assumed to be passed on to consumers using the same methodology in both the Roadmap and No-Roadmap models.

Firming infrastructure costs refer to the subsidy needed to compensate for any unprofitable firming capacity essential to maintain reliability in the No-Roadmap model. This assumes that government intervention in the market would be necessary to continue to meet the reliability standard. This cost is assumed to be recovered from NSW consumers over the life of the project.

Scheme (LTESA) costs: refer to generation and long-duration storage LTESA payments paid to projects that awarded with LTESAs. These are expected to account for a considerable portion of consumer's bills, though help to deliver wholesale electricity price benefits. For the purposes of modelling, these costs are a proxy estimate for a simplified contractual mechanism that does not fully represent the design and use of the LTESA that is emerging from AEMO Services' tender processes.

Other consumer cost categories, including distribution network costs, environmental policy charges, metering, retailer costs and retailer margin, are not considered in the comparison. The Roadmap's net consumer impact is then calculated as the difference between consumer costs in the Roadmap model and the No-Roadmap model.

The difference in consumer costs is divided by NSW operational demand to create a net difference in costs on a dollars per megawatt hour (\$/MWh) basis. This is then converted to bill impacts by multiplying this number by an annual consumption estimate for households (5.9 MWh), and small businesses (20 MWh). These assumptions are aligned with those used for the original 2020 Roadmap forecast modelling⁶.

2.2 Modelling outcomes

The primary driver for changes in modelling outcomes since the draft results is the updated WACC assumptions outlined in Section 1.1. Higher financing costs have resulted in less new Variable Renewable Energy (VRE) capacity being built in NSW in the No-Roadmap model than in the draft results, as capacity is instead built in other states with renewable energy policies.

Figure 1: NSW capacity mix comparison between Roadmap and No-Roadmap modelling projections shows, at a high-level, the modelled NSW capacity mix difference between the Roadmap and No-Roadmap models for VRE and dispatchable generation capacity. In the No-Roadmap model, by the late 2020s, almost 10 GW less VRE is built in NSW in the absence of the Roadmap. Over the same period, 3 GW of dispatchable (firming) capacity additional to the Roadmap model is built in the form of gas peaking power stations and battery storage to maintain reliability. The feasibility of further gas power station capacity, given already relatively tight east-coast gas supply, has not been factored into the modelling. Therefore, the No-Roadmap scenario represents a NSW electricity market with higher levels of uncertainty and therefore higher levels of reliability risk.

These capacity mix differences result in significant changes to forecast dispatch outcomes compared with the Roadmap model, with NSW being more reliant on more expensive fossil fuel generation and imports from other states in the absence of the Roadmap. These differences in dispatch outcomes drive considerable differences in wholesale electricity cost outcomes. Figure 2 presents an annual wholesale electricity cost difference, comparing the original 2020 Roadmap modelling and the updated modelling which forms the basis of the net benefits in this updated report. In addition to the wholesale cost differences being higher overall in the updated modelling, they also occur much earlier than previously projected. This is primarily due to coal power station

⁶ NSW Electricity Infrastructure Roadmap, Building an Energy Superpower Detailed Report, NSW Government, 2020
<https://www.energy.nsw.gov.au/sites/default/files/2022-08/NSW%20Electricity%20Infrastructure%20Roadmap%20-%20Detailed%20Report.pdf>

retirement dates being brought forward relative to the 2020 modelling, differences in fuel price assumptions, and other methodological changes between the two models, including the treatment of network augmentations and the 2020s supply-chain constraint.

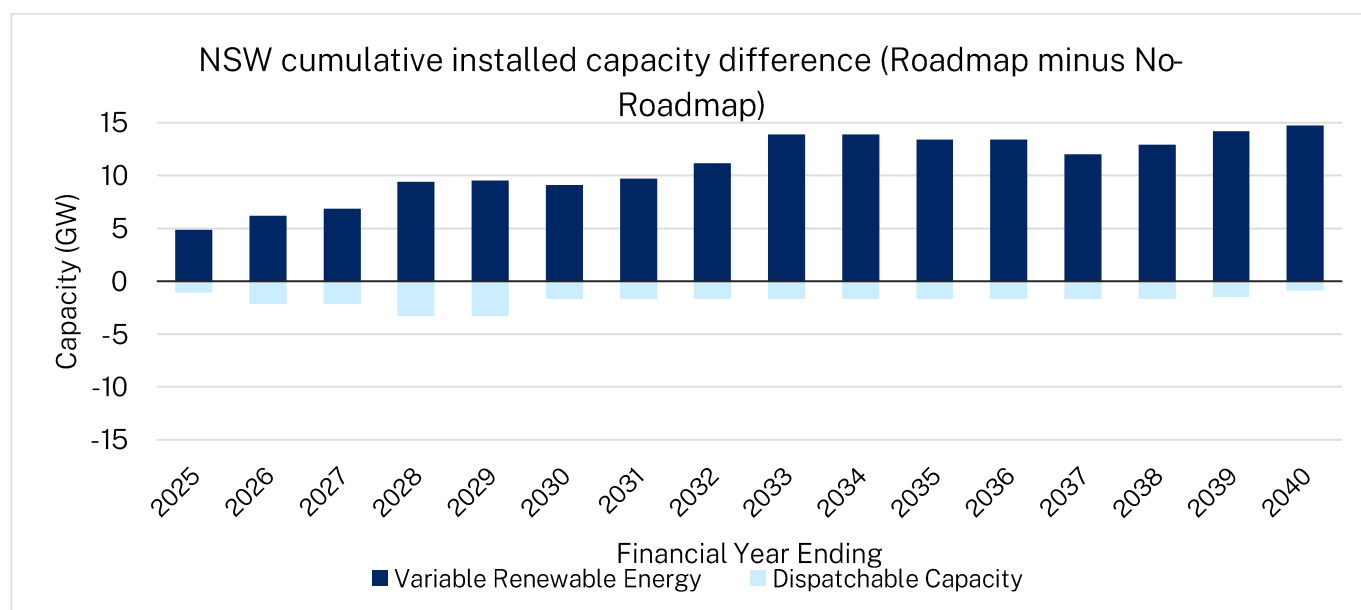


Figure 1: NSW capacity mix comparison between Roadmap and No-Roadmap modelling projections

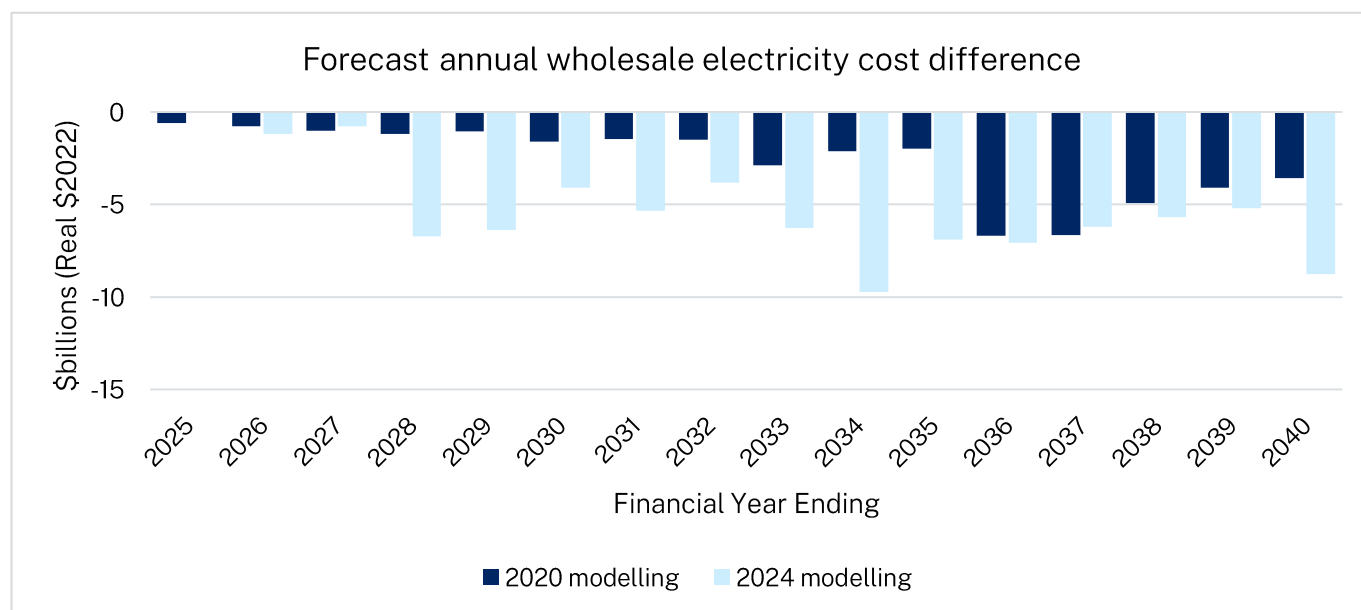


Figure 2: Annual forecast difference in total NSW wholesale electricity costs between Roadmap and No-Roadmap scenario (2020 vs 2024 Roadmap modelling)

As in Table 3 of the previously published Roadmap Benefits Modelling Report, coal power station closure dates in the No-Roadmap model are aligned with the Roadmap model⁷. However, despite this, a lower installed capacity of VRE in NSW leads to higher use of existing coal and gas-fired

⁷ NSW Electricity Infrastructure Roadmap benefits modelling report: A method for estimating the consumer benefits of the NSW Electricity Infrastructure Investment Act 2020, NSW Government, June 2023 https://www.energy.nsw.gov.au/sites/default/files/2023-06/202306_NSW_Electricity_Infrastructure_Roadmap_benefits_modelling_report_v2.PDF

power stations and therefore higher overall emissions. Figure 3 presents an annual projection for Scope 1 emissions from electricity generation, comparing the Roadmap and No-Roadmap scenarios.

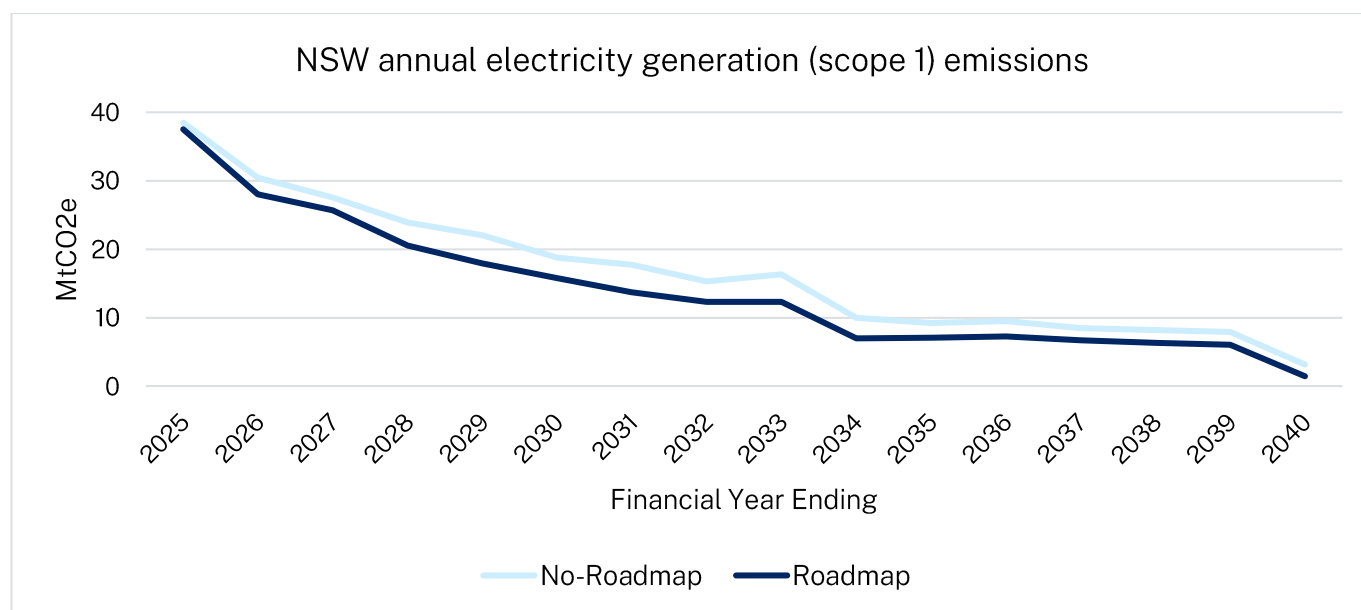


Figure 3: NSW annual electricity generation (Scope 1) emissions comparison between Roadmap and No-Roadmap modelling projections

In December 2023, the *Climate Change (Net Zero Future) Act 2023* commenced, which legislates NSW's target to reduce greenhouse gas emissions by 50% on 2005 levels by 2030, and 70% by 2035, and to achieve net zero greenhouse gas emissions by 2050. Electricity generation represents the single most emitting sector of the NSW economy, and abatement in this sector is critically important to meet the state's emissions reduction targets. Without the Roadmap, other sectors of the economy would be required to increase their abatement efforts, and potentially at a higher cost of abatement than electricity sector emissions.

By 2030, the Roadmap scenario projects a 73% reduction in electricity generation emissions compared with 2005 levels, while the No-Roadmap scenario projects a 68% reduction. With the Roadmap in place, the electricity sector is forecast to contribute 53% of the emissions reductions needed to meet the legislated 2030 target. Compared with earlier projections, this is a decrease from a 60% contribution to meeting the 2030 target, driven primarily by higher projected electricity demand, and therefore higher fossil fuel output from the existing coal and gas fleet.

Under the No-Roadmap scenario, this contribution would be just 49%. Compared with earlier projections, this is an increase from a 40% contribution towards the target. This is primarily due to coal power station retirement dates being brought forward in the updated No-Roadmap scenario compared with earlier projections, aligning with the updated coal closure assumptions in the latest Roadmap scenario.

2.3 Consumer benefits

Figure 4 presents an annualised calculation of the net benefits of the Act, including costs and benefits to consumers, and an emissions cost.

Wholesale electricity price reductions are the primary source of forecast benefits from the Roadmap, with smaller benefits arising from lower emissions calculated using the TPG23-08 NSW Government Guide to Cost Benefit Analysis⁸ (CBA), and no firming top-up payments for reliability-driven firming capacity investment as described in Section 2.1.

The No-Roadmap model has lower transmission costs compared to the Roadmap model (since fewer transmission augmentations are built, and later) and no LTESA costs (as these would not exist without the Roadmap).

Translating the net benefit into the impact on electricity bills, the modelling forecasts that without the Roadmap, NSW residential customers would face bills that are \$156 higher on average per year (up from \$130 in the 2020 Roadmap modelling), while small businesses would face bills that are \$530 higher on average per year (up from \$430 in the 2020 Roadmap modelling)⁹.

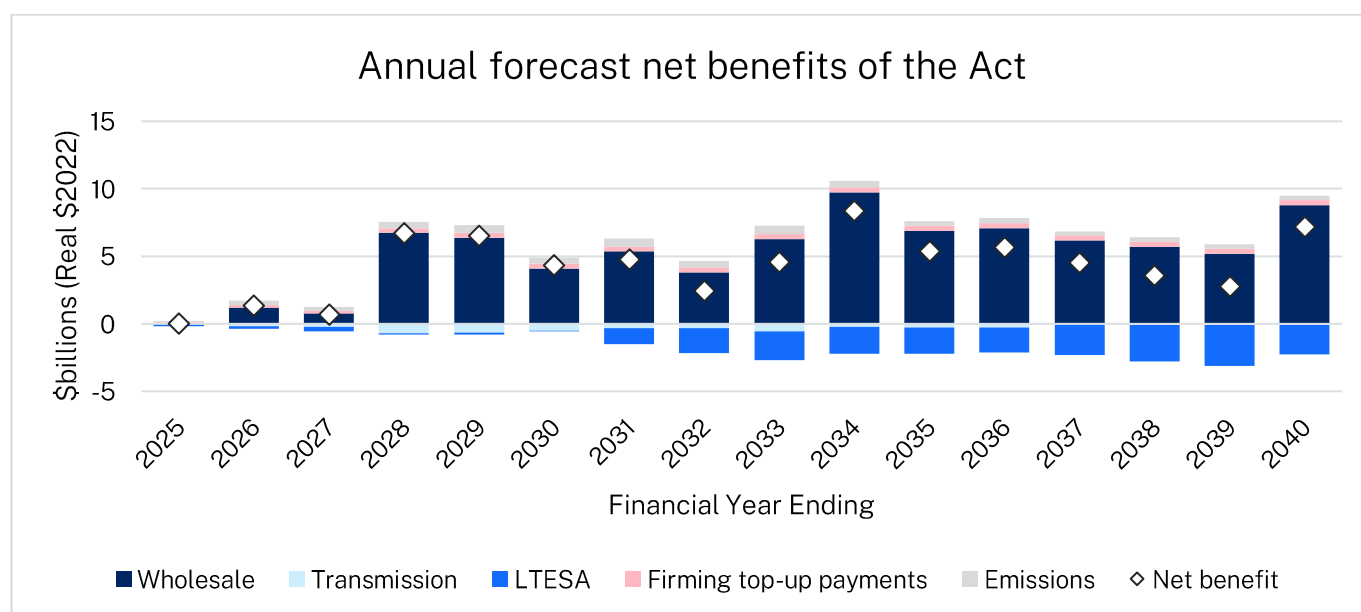


Figure 4: Forecast annual net benefits of the Act

⁸ TPG23-08 NSW Government Guide to Cost-Benefit Analysis, NSW Government, February 2023 https://www.treasury.nsw.gov.au/sites/default/files/2023-04/tpg23-08_nsw-government-guide-to-cost-benefit-analysis_202304.pdf and Technical note to NSW Government Guide to Cost-Benefit Analysis TPG23-08: Carbon value in cost-benefit analysis, NSW Government 2023, https://www.treasury.nsw.gov.au/sites/default/files/2023-03/20230302-technical-note-to-tpg23-08_carbon-value-to-use-for-cost-benefit-analysis.pdf

⁹ Emissions costs are not included in consumer bill calculations.

Figure 5 presents the forecast total net benefits of the Act over the modelling horizon in net present terms, as well as a comparison between the original 2020 Roadmap benefits modelling and updated 2024 modelling.

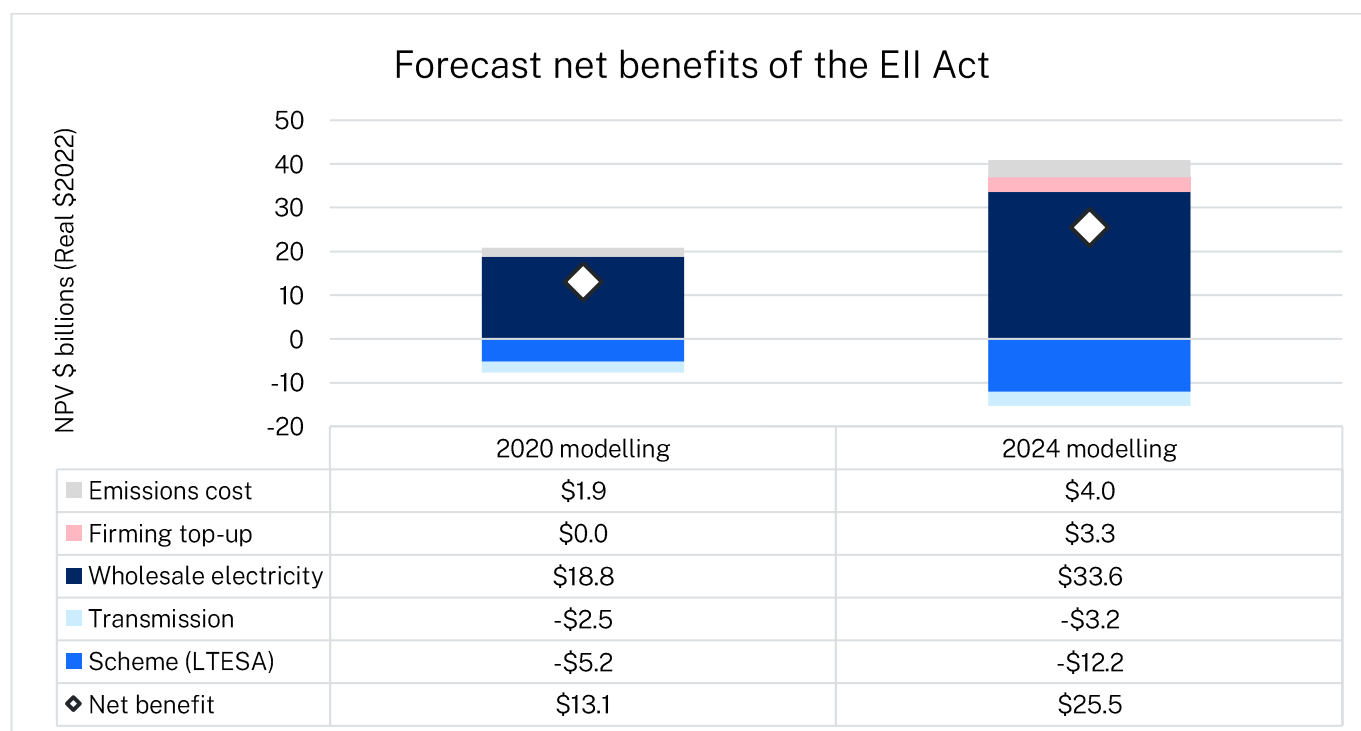


Figure 5: Forecast total net benefits of the Act between Financial Years 2022-2023 and 2039-2040 (net present value, Real \$2022), comparison between 2020 and updated 2024 modelling¹⁰

The net benefit of the Roadmap is calculated to be \$25.5 billion (net present value using a 5% discount rate, real \$2022) over the period Financial Year 2022-23 to 2039-2040. This is an increase from the \$12.4 billion (\$13.1 billion in real \$2022) calculated from the 2020 Roadmap modelling. This increase is primarily because of higher wholesale electricity benefits, as well as benefits now being projected to occur much earlier in the modelling horizon (as in Figure 2), leading to a higher net present value.

Additionally, the 2020 Roadmap modelling utilised a 7% discount rate for net present value calculations. Updated modelling assumes a 5% discount rate, aligned with updated NSW Government CBA Guidelines. The impact of this change alone is estimated to contribute to a \$4.1 billion increase in net benefits between the 2020 and 2024 modelling, as in Figure 6. The net benefits for the other categories presented in the chart have been adjusted taking this into account, showing the change in net benefit, excluding the difference due to a change in discount rate assumptions.

¹⁰ Figures for the 2020 modelling are the difference between the 'BAU Imperfect Foresight Scenario' and 'Roadmap' results as presented in Figure 19 of the NSW Electricity Infrastructure Roadmap, Building an Energy Superpower Detailed Report, inflated to real \$2022.

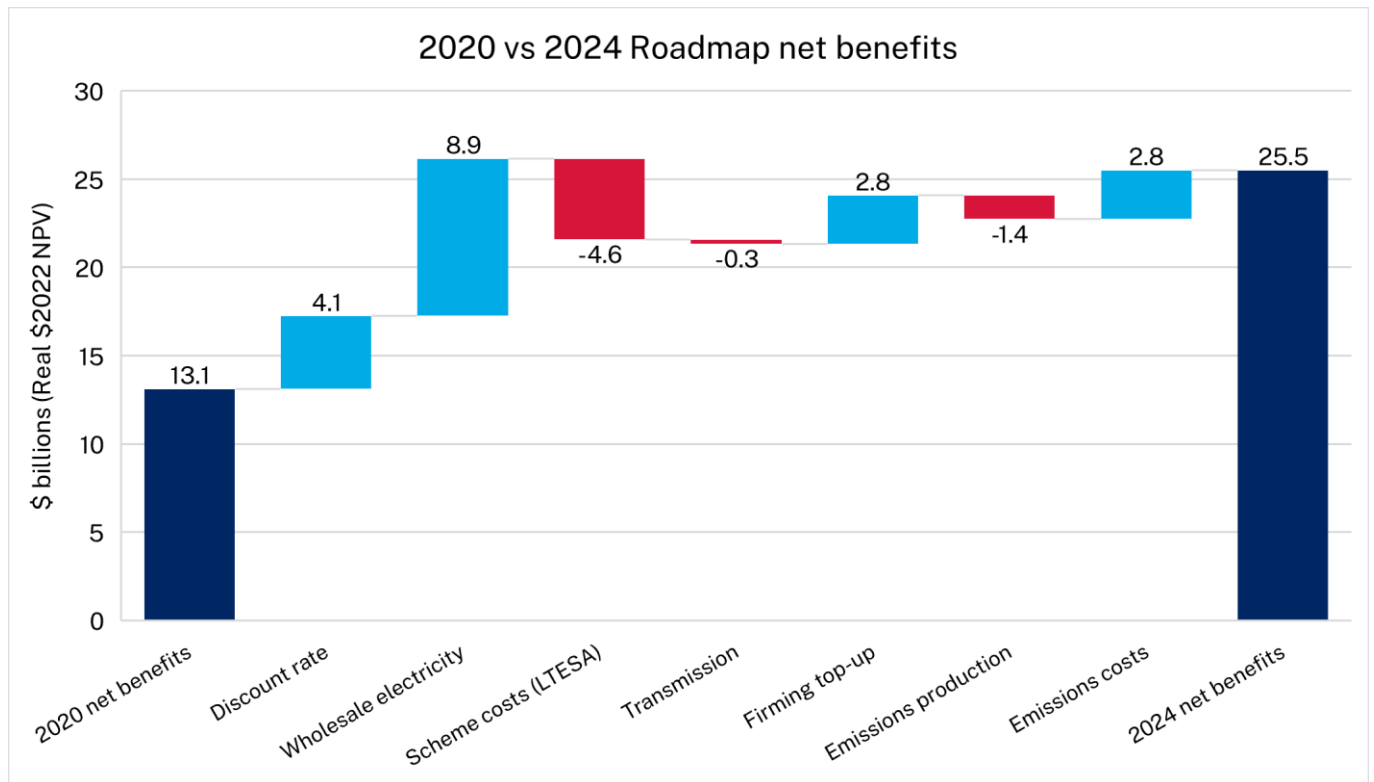


Figure 6: Changes in forecast net benefits of the roadmap (2020 vs 2024 modelling results)