Australia's Net Zero Transformation:

Treasury Modelling and Analysis: Technical Appendices

September 2025

Contents

Appendix A: Additional outputs

Chart A.1: Projected emissions reductions, by Sector, Baseline Scenario

Mt CO$_2$-e
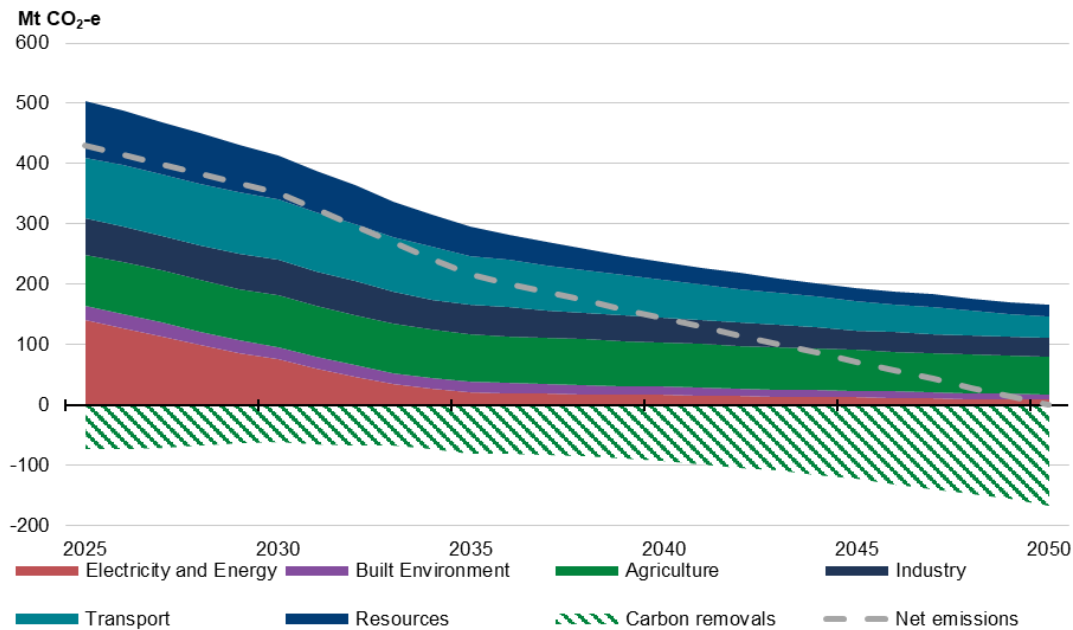
Note: For interpretability, agriculture and land have been split in the above figure. Emissions reductions from land-use change have been incorporated within Carbon Removals. Carbon Removals refer to removing carbon dioxide from the atmosphere and storing it in land-based ecosystems, such as forests and soils.
Source: Treasury modelling.

Chart A.2: Projected emissions reductions, by Sector, Renewable Exports Upside Scenario

Mt CO$_2$-e
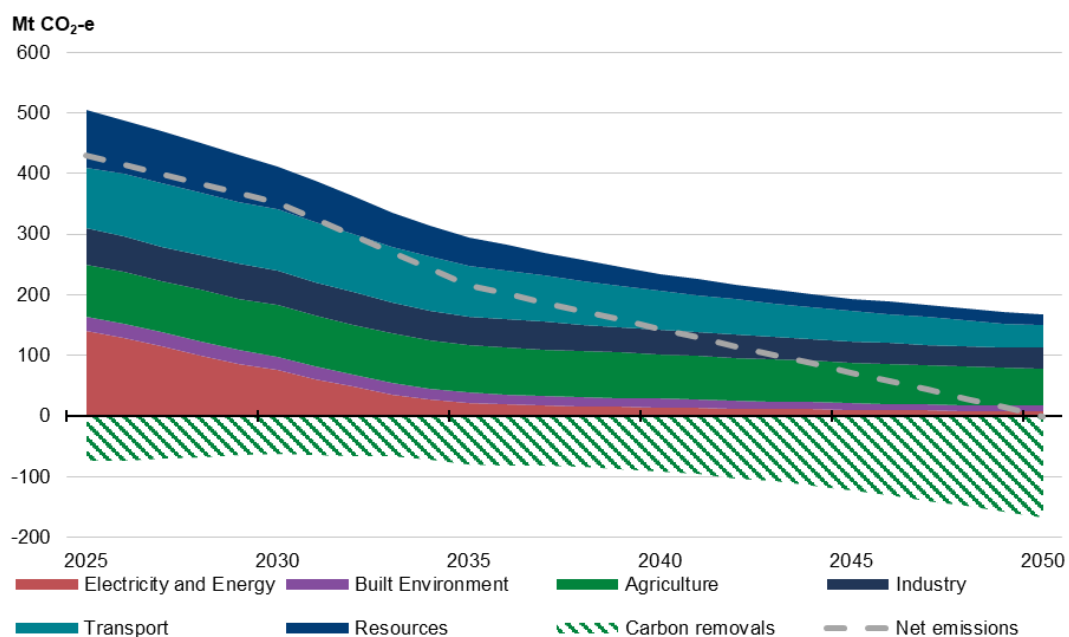
Source: Treasury modelling.

Chart A.3: Projected emissions reductions, by Sector, Disorderly Transition Scenario

Mt CO_2-e

Legend: Electricity and Energy, Built Environment, Agriculture, Industry, Transport, Resources, Carbon removals, Net emissions
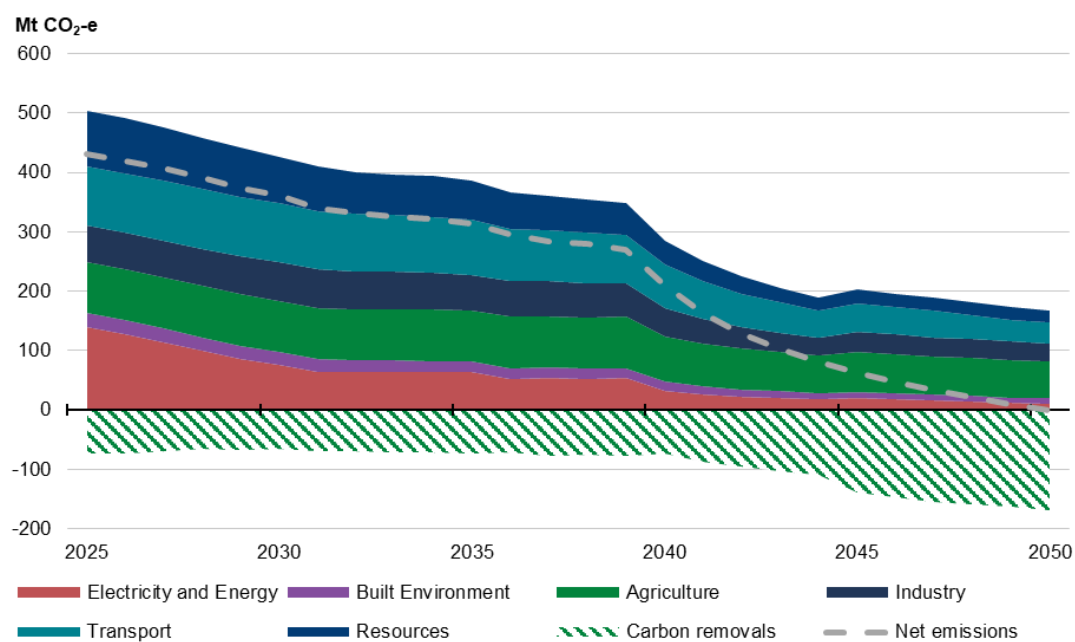
Source: Treasury modelling.

Table A.1: Projected emissions by sector and scenario

Level in 2025	All scenarios	140	61	94	100	24	86	-74	431
Change between 2025 and 2035	Baseline	-119	-12	-46	-19	-6	-7	-6	-215
	Renewable Exports	-119	-13	-47	-17	-6	-7	-6	-215
	Disorderly	-77	0	-28	-8	-5	0	1	-117
Change between 2035 and 2050	Baseline	-12	-17	-29	-46	-8	-17	-87	-216
	Renewable Exports	-13	-13	-28	-47	-9	-17	-89	-216
	Disorderly	-53	-29	-46	-56	-9	-25	-96	-313
Residual level in 2050	Baseline	9	32	19	36	9	62	-167	0
	Renewable Exports	8	34	19	37	9	61	-168	0
	Disorderly	10	31	20	36	9	62	-168	0

Source: Treasury modelling.

Table A.2: Gross value added (GVA) for selected sectors as a share (%) of total, by scenario, 2035 and 2050[1,2,3]

Industry	Historical			Baseline Scenario		Renewable Exports Upside Scenario		Disorderly Transition Scenario	
	1990	2000	2025	2035	2050	2035	2050	2035	2050
Agriculture	4.5	3.4	2.60	2.83	3.67	2.75	3.53	2.76	3.77
Crops and Horticulture			1.10*	1.44	2.17	1.40	2.07	1.43	2.22
Livestock			1.12*	1.04	1.18	1.02	1.13	0.97	1.21
Mining	4.9	4.6	10.40	6.94	4.52	6.67	4.38	7.32	4.74
Coal			2.23*	0.71	0.42	0.65	0.37	0.78	0.45
Iron Ore			3.57*	2.59	1.74	2.50	1.73	2.65	1.83
Gas and LNG			2.53*	1.50	0.43	1.44	0.41	1.69	0.45
Critical Minerals			0.12*	0.41	0.47	0.40	0.44	0.43	0.49
Manufacturing	14.9	12.6	5.79	5.55	5.85	5.59	6.17	5.51	5.88
Iron and Steel			0.15*	0.17	0.20	0.24	0.39	0.15	0.19
Critical Minerals Processing			0.02*	0.03	0.03	0.03	0.03	0.03	0.03
Services	75.7	79.5	81.20	84.68	85.95	84.99	85.93	84.41	85.61
Construction			7.58	7.55	7.61	7.55	7.59	7.54	7.66

1   Values in the table are based off 'current price' estimates.

2   The total value of production in certain sectors can be significantly higher than suggested by the GVA shares, reflecting their high proportion of intermediate inputs.

3   The aggregate 'Agriculture', 'Mining', 'Manufacturing', and 'Services' industries are based on the ABS's Australian and New Zealand Standard Industrial Classification (ANZSIC) (ABS 2013) for comparability against historical data. 'Agriculture' is mapped to Division A, 'Mining' is mapped to Division B, 'Manufacturing' is mapped to Division C, and 'Services' covers Divisions D to S (which includes construction and transport industries).

* Treasury has estimated historical GVA for relevant sectors using a combination of data sources including the 2022–23 Australian Bureau of Statistics (ABS) Australian National Accounts: Input-Output Tables, and the most recent Department of Industry Science and Resources (DISR) Resources and Energy Quarterly (REQ) export data.

Source: Treasury modelling.

Appendix B: Treasury's modelling framework

Treasury has drawn on an integrated analytical framework to model scenarios that depict a range of potential pathways for Australia to achieve net zero emissions in 2050 (see Chart B.1). Developed largely in-house, this infrastructure integrates:

• Global, economic and technology assumptions

• A domestic whole-of-economy model: Treasury Industry Model (TIM)

• Detailed bottom-up models for key sectors and activities: Electricity Market Model (EMM), Model of Industrial and Resources Abatement (MIRA), and Australian Lifecycle Energy eXpenditure Model (ALEX).

Together, these analytical tools describe how the Australian economy could evolve under different net zero transformation scenarios. This approach provides insights into abatement pathways, an understanding of the key technologies that could support emissions reductions across the economy, and the potential impacts on Australians. It is similar to analytical approaches used in many other climate modelling exercises, both within and external to government.[1]

Chart B.1: Treasury's analytical infrastructure

Global transition pathways
• Use of global climate scenarios from the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6).
• A consistent set of assumptions for global emissions, economic trends and technology assumptions were developed by combining information from key international sources, including IPCC, IEA and Wood Mackenzie, complemented by additional analysis as required.

Australian technology costs, export opportunities and import costs
• Expert analysis from agencies including transport projections and technology costs from DITRDCSA .
• Agriculture sector analysis and land-based sequestration potential from CSIRO, ABARES, DAFF and literature.
• Heavy industry and resources outlook from DISR.
• Technology assumptions informed by CSIRO GenCost, government agencies, and other third-party academic sources.

Treasury whole-of-economy modelling	Treasury sectoral analysis	Treasury household analysis
The Treasury Industry Model (TIM) incorporates detailed global and domestic assumptions, and insights from EMM, MIRA and other sectoral analysis. TIM provides a consistent whole-of-economy narrative for the distribution of changes in emissions and economic activity across sectors.	The Electricity Market Model (EMM) and the Model of Industrial and Resource Abatement (MIRA) provide detailed techno-economic analysis of how cost-effective emissions reductions in electricity generation and for large emitters could be achieved.	The Australian Lifecycle and Energy eXpenditure model (ALEX) incorporates inputs, including from EMM, to look at how household energy-related expenditure and emissions could be affected by consumer choices and other outcomes in the economy.

---

1   For example, CSIRO's Pathways to Net Zero Emissions (2023), Australia's Long-Term Emissions Reduction Plan: Modelling and Analysis (DISER 2021) and Australia's low pollution future: the economics of climate change mitigation (Australian Government 2008).

Global transition pathways

Treasury has developed global transition pathways that combine top-down global temperature targets and climate projections with sector-specific technological and economic insights. This framework ensures the pathways draw on credible evidence and internationally recognised reference points. The global transition pathways are held constant across scenarios. They are not forecasts, and instead represent plausible pathways that if adopted could lead to the required climate outcomes.

The global transition pathways in this report reference the Intergovernmental Panel on Climate Change's (IPCC) Gradual Strengthening Scenario[2] and the International Energy Agency's (IEA) Announced Pledges Scenario,[3] which are consistent with achieving a temperature increase of well below 2°C and corresponding global emissions budgets. These serve as scientific reference points and ensure the Australian transition is consistent with the global effort required to meet established temperature goals.

The IPCC also offers economic narratives that outline potential future development pathways related to different temperature targets, including assumptions related to economic progress, technological advancement, and policy environments. This information informs the feasibility and pace of technological transitions for different sectors, together with information drawn from the IEA, Wood Mackenzie, and government departments.

The IEA's Announced Pledges scenario sets global transition timelines for technologies like renewable energy, energy performance, and fossil fuel reduction, consistent with limiting warming to well below 2°C. The IEA and Wood Mackenzie produce sector-specific benchmarks to model transitions in high emission industries, outlining realistic pathways based on industry-specific challenges and opportunities. Additionally, the IEA provides data on technology readiness levels and cost assumptions, which are used to assess the feasibility of both emerging and mature technologies for national decarbonisation strategies.

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) has contributed global agricultural insights, including transition timelines for livestock and crop demand. These align with the IEA's assumptions and IPCC carbon budget constraints.

To ensure the global assumptions are domestically relevant, historical data and short-term outlook data on commodity export volumes and prices were sourced from the Resources and Energy Quarterly (REQ) published by the Department of Industry, Science and Resources (DISR). By blending these global and local inputs, the framework delivers global decarbonisation pathways that are both scientifically credible and realistic for the Australian economy.

For more information on the global assumptions, see Appendix D: Key assumptions.

---

2   The Gradual Strengthening Scenario assumes that all Nationally Determined Contributions (NDCs) until 2030 are implemented and gradually strengthened moving gradually towards a strong, universal climate policy regime post-2030 (IPCC 2022).

3   The Announced Pledges Scenario assumes that all climate commitments made by governments and industries by the end of August 2023, including NDCs and longer-term net zero targets, will be met in full and on time (IEA 2023).

The Treasury Industry Model

TIM is a domestic whole-of-economy model, which provides an internally consistent economy-wide framework that brings together inputs from a range of sources, including sectoral models, global demand and price assumptions, and changes in the cost and availability of current and emerging low-emissions technology (see Chart B.2). TIM provides insights into the impacts of Australia's net zero transition on economic activity and emissions at an aggregate and sectoral level, accounting for flow-on impacts between sectors and endogenous changes in behaviour throughout the economy.

TIM is a forward-looking, multi-sector dynamic general equilibrium model of the Australian macroeconomy. Further details of the model can be found in Treasury's technical working paper *Modelling Industry Specific Policy with TIM: Treasury's multi-sector dynamic general equilibrium model of the Australian economy* (Carlton et al. 2023).

Chart B.2: Simplified visual representation of TIM

Typical scenario assumptions
(non-exhaustive)

- **Baseline assumptions:** how is the economy expected to change over time under current policy and trends?
- **Global scenario:** what level of abatement ambition does the rest of the world pursue, and how does that change export demand and global prices?
- **Domestic ambition:** what level of emissions reductions does Australia pursue over time?
- **Other assumptions:** includes population and productivity growth, and energy efficiency improvements.

Treasury Industry Model
(simplified)

Government — Expenditure — Consumption — Representative household — Labour

Exports — Aggregate supply — Investment, materials, energy inputs

Imports — Production

Rest of the world — Firms

Emissions — Abatement technology

Outputs
(non-exhaustive)

- How can Australia meet its **emissions** targets? How do emissions change in different industries?
- What is the impact on **macroeconomic aggregates** like GDP, consumption, and investment over time?
- What is the economic impact on **different industries**, including on production, investment, and use of inputs?
- How do Australia's **exports** change?
- What is the impact on **households**, including their wages and consumption?

Inputs
(non-exhaustive)

- Centre of Policy Studies (CoPS) Input-Output database (modified from the 2018-19 ABS Input-Output tables)
- 2018-19 National Greenhouse Gas Inventory (DCCEEW)
- Baseline production for key sectors (DISR, DCCEEW, DITRDCSA, ABARES)
- Global assumptions (DISR, Wood Mackenzie, International Energy Agency, ABARES, and others)
- Abatement technology inputs (MIRA, ABARES, CSIRO, IEA, Wood Mackenzie)
- Land-based sequestration supply curve (ABARES literature review)
- Electricity generation calibration (EMM, AEMO ISP and additional modelling)
- Transport calibration (DITRDCSA, BITRE)
- Household electrification inputs (based on AEMO 2025 GSOO and 2024 WA GSOO)

Since the release of this working paper, a version of TIM has been developed for the purpose of climate and energy modelling. This version of TIM contains additional detail necessary to model a transition to net zero, including:

- An emissions accounting framework.

- New detail on sectors critical to the transition, including hydrogen, critical minerals, and a land-based sequestration sector.

- Production functions that explicitly capture the composition of energy inputs, separate from other intermediate inputs.

- Emissions response functions (ERFs), which are reduced-form representations of detailed analysis on abatement technologies at a sector-specific level.

- Technology bundles to capture substitution between different production technologies in key sectors. This includes substitution between generation technologies in electricity, and between electric vehicles and internal combustion engine vehicles in private transport.

Emissions reduction can be achieved in TIM through several channels, including:

- Improvements in energy efficiency.

- Firms adopting abatement technologies, represented via:

  - Shifts in sector-specific emissions intensities and energy sources over time (where specific technology information is available), partly captured by ERFs.[4]

  - Endogenous shifts away from emissions-intensive production processes and energy sources in response to changes in relative prices.

- The use of land-based sequestration.

- Less production of emissions-intensive goods and services due to declines in global demand, broader economic trends, and domestic policy.

Although TIM is a model of the Australian economy, it can account for a rich set of assumptions about global demand for Australian exports and the cost of imported goods and services, including changes in the global cost of current and emerging low-emissions technologies. TIM has been calibrated to provide a plausible future structure of the Australian economy, taking shifts in the global environment and existing domestic trends and policies into account.

For more information on TIM's inputs and scenario assumptions, see Appendix D: Key assumptions.

The Model of Industrial and Resources Abatement

MIRA provides insights into how large emitters could reduce net emissions through technology and offsets, while factoring in demand shifts from economy-wide modelling.

MIRA is a facility-level model that identifies the most cost-efficient abatement technologies for large emitting facilities and includes the availability and cost of decarbonisation technologies. MIRA is applied to identify emissions reduction pathways for Australia's largest facilities, where the timing and availability of specific abatement technologies has a meaningful impact on Australia's overall potential for direct abatement.
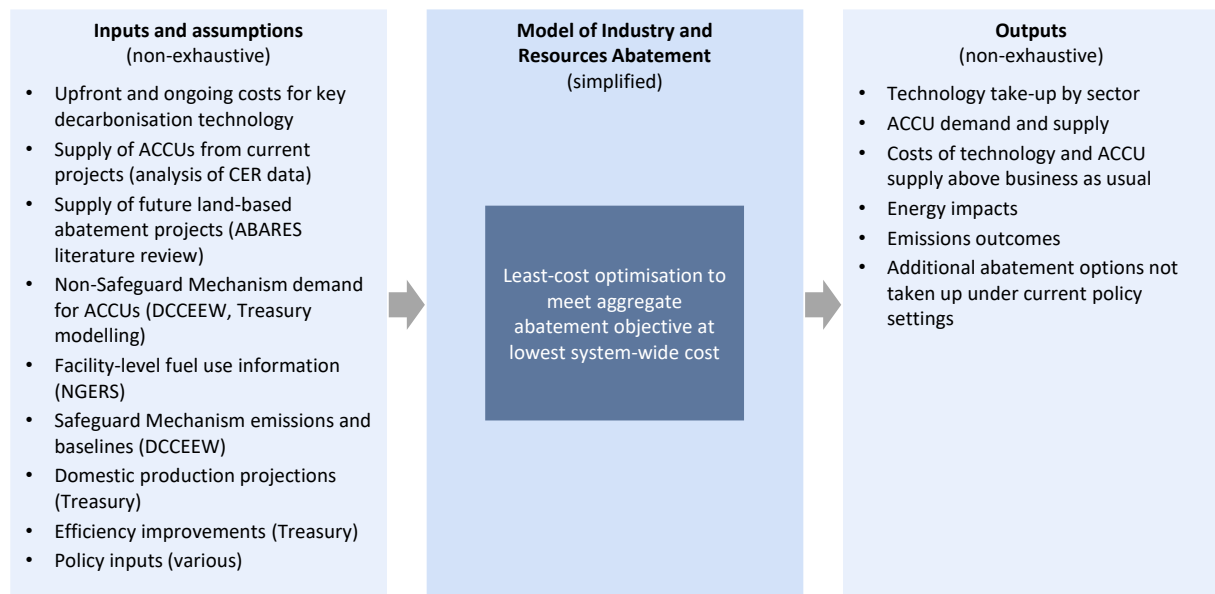
Within the modelling framework, facilities invest in a least-cost set of technologies and purchase carbon credits – Australian Carbon Credit Units (ACCUs) or Safeguard Mechanism Credit (SMCs) – to achieve net emissions reduction targets. Emissions are also affected by ongoing energy performance improvements and projected changes in production.

MIRA draws on facility-level emissions and production information using information on facilities currently covered by the Safeguard Mechanism and provided by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). ACCU supply in MIRA is based on data from the Clean Energy Regulator (CER) and a review of available literature by ABARES.

---

4   ERFs capture the negative relationship between emissions intensities and the marginal abatement incentive. They are smooth functions that reflect information in MIRA on the availability and cost of abatement technology in a way that is compatible with dynamic general equilibrium models like TIM.

MIRA includes assumptions about production projections and detailed information on abatement technologies and costs across covered sectors (see Appendix D: Key assumptions) drawn from a range of external sources, including the global scenarios, Energetics, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), industry and government agencies. Assumptions in MIRA have also been informed by a Technical Advisory Group containing representatives from DISR, DCCEEW, the Department of Agriculture Fisheries and Forestry (DAFF), the CER, and the Climate Change Authority (CCA).

Chart B.3: Overview of MIRA

Inputs and assumptions (non-exhaustive)	Model of Industry and Resources Abatement (simplified)	Outputs (non-exhaustive)
• Upfront and ongoing costs for key decarbonisation technology • Supply of ACCUs from current projects (analysis of CER data) • Supply of future land-based abatement projects (ABARES literature review) • Non-Safeguard Mechanism demand for ACCUs (DCCEEW, Treasury modelling) • Facility-level fuel use information (NGERS) • Safeguard Mechanism emissions and baselines (DCCEEW) • Domestic production projections (Treasury) • Efficiency improvements (Treasury) • Policy inputs (various)	Least-cost optimisation to meet aggregate abatement objective at lowest system-wide cost	• Technology take-up by sector • ACCU demand and supply • Costs of technology and ACCU supply above business as usual • Energy impacts • Emissions outcomes • Additional abatement options not taken up under current policy settings

MIRA provides estimates of the take-up of technology, changes to investment composition and operational costs, ACCU and SMC market outcomes, and emissions reductions. These outputs are also used to calibrate technology take-up, ERFs and ACCU demand in TIM in two stages.
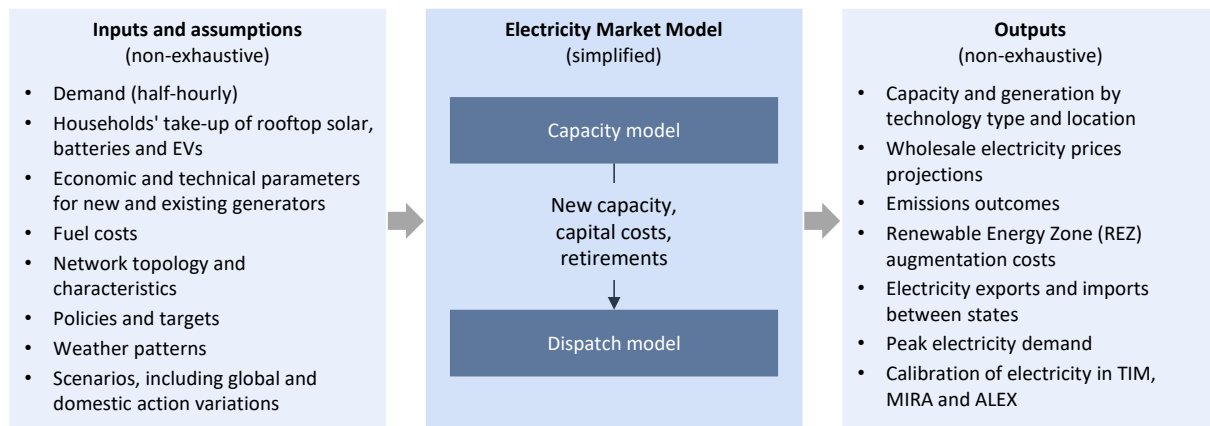
First, MIRA provides a level of technology and ACCU investment and abatement for large emitters to reduce their emissions in line with a 43 per cent emissions reduction by 2030 and net zero emissions by 2050. Second, MIRA technology data are used to calibrate ERFs within TIM across sectors which include large-emitting facilities. These data include technology costs, energy use and emissions intensities (see Chart B.3). This layered approach ensures that technology take-up is not double counted between the two models.

The Electricity Market Model

EMM is designed to analyse energy market outcomes across different scenarios. Assumptions are largely drawn from the Australian Energy Market Operator (AEMO)'s Integrated System Plan (ISP) Step Change scenario, with updates for key policy decisions and market events (AEMO 2024).

EMM is a partial-equilibrium model of the future structure of electricity infrastructure in the National Electricity Market (NEM) – which accounts for 78 per cent of electricity generation in Australia. The model is maintained in partnership between Treasury and DCCEEW and is based on publicly available AEMO models with modified assumptions and scenarios. EMM provides long-term wholesale electricity price projections that are appropriate for use in scenario analysis, but these should not be interpreted as forecasts of price levels.

Chart B.4: Simplified visual representation of EMM

Inputs and assumptions (non-exhaustive)	Electricity Market Model (simplified)	Outputs (non-exhaustive)
• Demand (half-hourly) • Households' take-up of rooftop solar, batteries and EVs • Economic and technical parameters for new and existing generators • Fuel costs • Network topology and characteristics • Policies and targets • Weather patterns • Scenarios, including global and domestic action variations	**Capacity model** New capacity, capital costs, retirements **Dispatch model**	• Capacity and generation by technology type and location • Wholesale electricity prices projections • Emissions outcomes • Renewable Energy Zone (REZ) augmentation costs • Electricity exports and imports between states • Peak electricity demand • Calibration of electricity in TIM, MIRA and ALEX

EMM estimates the least-cost mix of electricity capacity to meet demand subject to policy and real-world constraints, such as interconnector limits and variable patterns of renewable generation. It identifies the optimal combination of new generation, storage and transmission, factoring in existing generators, emissions and real-world constraints. It also identifies dispatch dynamics using highly detailed (half-hourly) patterns for demand and weather, as well as physical constraints to model reliable system outcomes (see Chart B.4).

Electricity market modelling has also been undertaken for Western Australia's Wholesale Electricity Market (WEM) and smaller grids. Detailed modelling of required off-grid industrial and mining operations occurs in MIRA, which also accounts for changes in domestic production. EMM's modelling of the NEM is combined with the remaining grids and off-grid modelling to give an economy-wide picture. This approach ensures consistency across Treasury's modelling infrastructure.
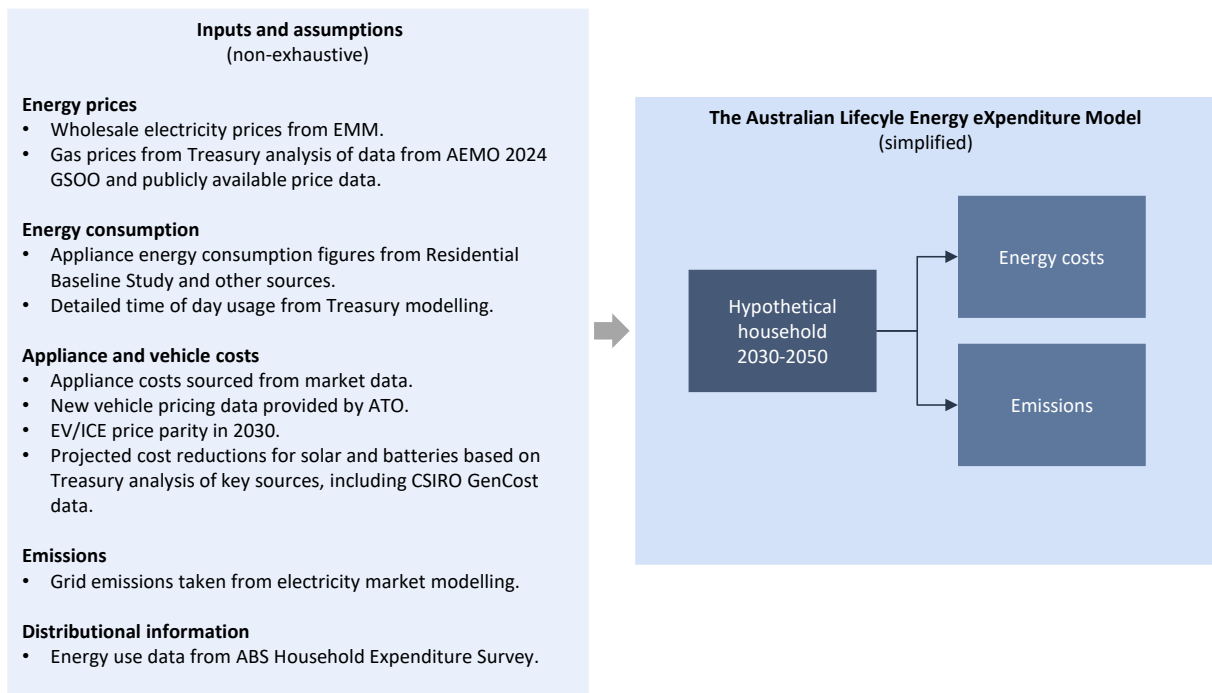
As well as providing insights on its own, model outputs from EMM are used in other Treasury models. Within TIM, for example, a stylised representation of the electricity market is calibrated to the bottom-up electricity modelling. The calibration informs both the generation mix and the level of substitution between electricity generation technologies, based on emissions constraints and technology costs.

For more information on EMM's inputs and scenario assumptions, see Appendix D: Key assumptions.

The Australian Lifecycle Energy eXpenditure Model

ALEX analyses long-term energy expenditure and emissions of representative households, focusing on their vehicle and household appliance choices. ALEX's outputs are used to demonstrate the potential impact of household investment choices under different scenarios on household energy costs and emissions. This model supplements broader Treasury whole-of-economy analysis through detailed analysis of the impact of consumer choices on energy costs.

Chart B.5: Simplified visual representation of the ALEX Model

Inputs and assumptions
(non-exhaustive)

Energy prices
- Wholesale electricity prices from EMM.
- Gas prices from Treasury analysis of data from AEMO 2024 GSOO and publicly available price data.

Energy consumption
- Appliance energy consumption figures from Residential Baseline Study and other sources.
- Detailed time of day usage from Treasury modelling.

Appliance and vehicle costs
- Appliance costs sourced from market data.
- New vehicle pricing data provided by ATO.
- EV/ICE price parity in 2030.
- Projected cost reductions for solar and batteries based on Treasury analysis of key sources, including CSIRO GenCost data.

Emissions
- Grid emissions taken from electricity market modelling.

Distributional information
- Energy use data from ABS Household Expenditure Survey.

The Australian Lifecyle Energy eXpenditure Model
(simplified)

Hypothetical household 2030-2050 → Energy costs

Hypothetical household 2030-2050 → Emissions

ALEX is a cameo model that estimates expenditure and emissions over a multi-year period for a hypothetical household – it does not provide economy-wide estimates. The model focuses on detailed energy costs for households.

The household in ALEX can purchase electric or gas appliances, choose to install solar panels and home batteries, and purchase either electric vehicles or internal combustion engine vehicles. The model then estimates the capital and financing costs, ongoing energy costs, and emissions for a given period (typically 2030 to 2050).

ALEX draws on information on appliance energy consumption, household consumption behaviour, appliance costs, energy prices and emissions obtained from external sources and internal Treasury modelling. The latter includes EMM and TIM outputs, as well as bespoke internal time of day consumption behaviour modelling (see Chart B.5).

This approach allows for time of energy use to ensure costs are appropriately captured in ALEX – such as solar generation, battery charging and discharging, and EV charging. The model can also explore distributional outcomes such as by state or type of household.

For more information on ALEX's inputs and scenario assumptions, see Appendix D: Key assumptions.

Linking Treasury's modelling infrastructure

Although Treasury's models operate independently, they share a common set of core modelling assumptions and are soft-linked in critical ways (see Chart B.6). This ensures the analysis reflects the strengths of each model, while still providing a consistent and comprehensive economic narrative.

For example, the electricity generation mix from EMM is used to calibrate the electricity generation sector in TIM. As a result, TIM can better reflect the level of investment required across different types of generation under different scenarios, as well as the demand for natural gas and coal by electricity generators.

Chart B.6: Key links within Treasury's modelling infrastructure
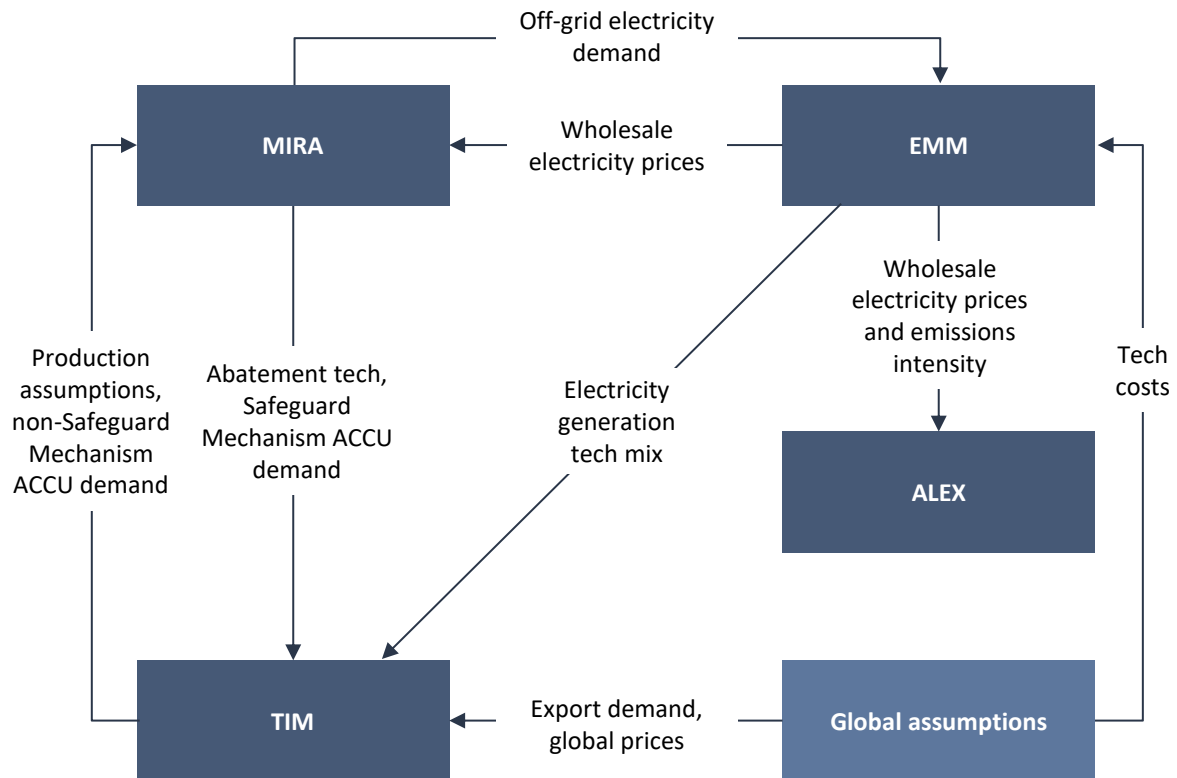
Additionally, TIM's production outputs are used to calibrate sectoral production levels in MIRA, ensuring that the distribution of emissions and abatement opportunities in MIRA is consistent with TIM's whole-of-economy outcomes.

Interpreting the modelling

There are many pathways that the world and Australia could pursue to net zero. Each of these require different sets of information and assumptions, resulting in different modelled outcomes and narratives. For this exercise, significant effort has been devoted to ensuring that the modelling and analysis is based on the best available data sources and assumptions, supported by extensive consultation and peer review.

While the assumptions are intended to represent plausible central estimates, given the uncertainty, a range of alternative assumptions are also plausible. The analysis presented in this report needs to be interpreted within the context of these assumptions and should not be interpreted as government policy. In particular, more caution should be applied in interpreting results further into the future where there is more uncertainty.

Economic modelling and analysis can provide valuable insights into real-world problems. However, models cannot fully replicate the complexity of a modern economy. Nor can they perfectly reflect and predict the behaviours of, and interactions between, an economy's many participants – households, firms and governments. This is particularly the case in net zero transition modelling, which must incorporate emerging sectors and technologies for which there is little real-world data.

Appendix C: Modelling scenarios

Treasury has modelled three scenarios that span a range of potential pathways that Australia could pursue to achieve net zero by 2050. Table C.1 provides a summary of key assumptions underlying, and how they vary across the scenarios. For a narrative-based explanation of the scenarios see Modelling Framework and Scenarios.

Table C.1: Key scenario assumptions

Assumption		Baseline Scenario	Renewable Exports Upside Scenario	Disorderly Transition Scenario
Global climate ambition		Limiting warming to well below 2°C		
Australian abatement	2030 emissions reductions	43% on 2005 levels	43% on 2005 levels	42% on 2005 levels
	2035 emissions reductions	65% on 2005 levels	65% on 2005 levels	49% on 2005 levels
	2050 emissions	Net zero		
	2025–2050 emissions	5205 Mt CO_2-e	5205 Mt CO_2-e	6008 Mt CO_2-e
Investment risk premium		None		Up to 75 basis point increase during the 2030s
Electricity		82% renewable electricity achieved in 2030		
		Broadly aligned with AEMO ISP Step Change	More flexible energy demand, especially export-focussed hydrogen production	Investor uncertainty limits the rollout of renewables
Clean energy industries		Clean energy production in line with the low production scenario in the 2024 *National Hydrogen Strategy*.	Higher clean energy production in line with the base production scenario in the 2024 *National Hydrogen Strategy*.	Delays to the development of hydrogen and green metals industries.
Availability of abatement technology for large emitters		Central technology assumptions		Five years delay to availability of abatement technology
Offsets and credits	Land-based sequestration	As per supply curves		Reduced supply for five years from 2040
	International trading	No Australian participation		

Constructing the modelling scenarios

The modelling scenarios are constructed by sequentially layering inputs and assumptions. The layering begins with applying assumptions that reflect projections of economic activity, energy use and emissions that broadly align with the 'baseline scenario' in *Australia's emissions projections 2024* (DCCEEW 2024a). Average rates of growth in labour productivity, population and participation are underpinned by assumptions consistent with Treasury's long-term projections (see Appendix D: Key

assumptions). Where detailed information is available, underlying domestic demand and production across sectors is benchmarked to existing historical data, projections and forecasts.[5]

Together, the above assumptions determine the starting-point level and distribution of production and emissions across the Australian economy, and therefore the emissions reduction task associated with achieving Australia's net zero commitment.

Following this, a set of global pathway assumptions are applied, consistent with global action that limits temperature increases to well below 2°C, including additional production projections (see Appendix D: Key assumptions).

Finally, a scenario-specific emissions constraint is applied that requires Australia to meet its pre-determined emissions reduction targets. The Baseline and Renewable Exports Upside scenarios are modelled to require 43 per cent emissions reduction by 2030, 65 per cent emissions reduction on 2005 levels to 2035 and net zero in 2050. The Disorderly Transition Scenario is required to achieve net zero in 2050, and interim emissions reduction outcomes (to 2040) are determined by the model.

Where additional emission reduction effort is required, the Treasury Industry Model (TIM) identifies the most cost-effective forms of abatement, at each point in time. The economy-wide marginal abatement incentive reflects the incentive associated with the most expensive abatement options taken up at each point in time.[6] This method of estimating the marginal abatement incentive is a standard feature of many climate modelling exercises, and does not imply the adoption of a carbon pricing policy.

Estimates of the marginal abatement incentive increase over time as the lowest cost abatement options, such as renewable energy in electricity generation, are taken up in the near term and greater emissions reductions are required from harder-to-abate sectors as 2050 approaches (Table C.2). There is also more uncertainty about longer-term estimates because they rely on assumptions about the global context and the availability of cost-effective technology that are more uncertain. Under the Baseline Scenario, the economy-wide marginal abatement incentive in 2050 is $329 in 2024 dollars (Table C.3).

Table C.2: Comparison of estimates of incentives (five-year averages)*

Source	Scenario	2026-30	2031-35	2036-40	2041-45	2046-50
Treasury scenarios	Baseline Scenario	$67/t	$85/t	$126/t	$203/t	$293/t
	Disorderly Transition Scenario	$74/t	$95/t	$121/t	$335/t	$311/t
	Renewable Exports Upside Scenario	$65/t	$84/t	$122/t	$201/t	$294/t
Other scenarios	Infrastructure Australia – Well-below 2°C	$77/t	$113/t	$161/t	$228/t	$328/t

*Treasury marginal abatement incentives are in 2024 dollars. Infrastructure Australia marginal abatement incentive is in 2023 dollars.
Source: Infrastructure Australia 2024

---

5   These sectoral assumptions were developed in consultation with other agencies, including DCCEEW, Department of Industry, Science and Resources (DISR), Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), and Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCSA), and drawing on a range of sources including the International Energy Agency (IEA) and Wood Mackenzie among others.

6   Many sectors will take up lower-cost options and therefore the average cost of abatement in the economy is lower than the economy-wide marginal cost.

Under the Renewable Exports Upside Scenario, Australia's ability to leverage its renewable energy advantages means that the marginal abatement incentive required to meet the emissions constraint is generally a little lower than under the Baseline Scenario over time. By contrast, more significant effort is required to meet net zero under the Disorderly Transition Scenario, particularly once accelerated action commences in 2040, given the constrained availability of land-based sequestration and cost-effective abatement technology. This results in a marginal abatement incentive that is 18 per cent higher on average than under the Baseline Scenario. If Australia was to not set a credible 2035 target or abandon its commitment to net zero by 2050 in the near term, marginal abatement incentives would need to be even higher in the future to achieve net zero by 2050.

Table C.3: Comparison of marginal abatement incentive in 2050

Source	Scenario	Marginal Abatement Incentive*
Treasury	Baseline Scenario	$329/t
Infrastructure Australia	Upper bound	$469/t
	Lower bound	$287/t

*Treasury marginal abatement incentive is in 2024 dollars. Infrastructure Australia marginal abatement incentives are in 2023 dollars.

Appendix D: Key assumptions

Treasury's modelling and analysis has been undertaken using a range of credible data sources and assumptions, supported by extensive consultation and peer review. This section outlines key assumptions applied across the modelled scenarios, categorised for interpretability into: global pathways assumptions, macroeconomic assumptions and abatement assumptions.

Global pathways assumptions

Global transition pathways for key export sectors were developed using the global climate transition framework outlined in Appendix B. As summarised in Table D.1, this includes assumptions about future trajectories for global demand, share of Australian exports, and global prices, drawing on a range of sources including other government products and reputable international sources. The global transformation pathways are the same under all scenarios, so do not drive differences in outcomes across scenarios. International outcomes are inherently uncertain.

Table D.1: Global sectoral assumptions

Sector	Data series	Data source
Agriculture	Global demand (production)	ABARES (GTEM)
	Australian exports	ABARES (GTEM)
	Real global prices	ABARES (GTEM)
Coal	Asia-Pacific demand (production)	IEA WEO 2023
	Australian exports	DISR REQ March 2024, IEA WEO 2023, Treasury
	Real global prices	DISR REQ March 2024, IEA WEO 2023, Treasury
LNG	Global demand (production)	IEA WEO 2023
	Australian exports	DISR Future Gas Strategy
	Real global prices	IEA WEO 2023
Oil	Global demand (production)	IEA WEO 2023
	Australian exports	DISR REQ March 2024, Wood Mackenzie Oil Lens 2025, IEA WEO 2023, Treasury
	Real global prices	DISR REQ March 2024, IEA WEO 2023, Treasury
Critical minerals (Nickel and lithium)	Global demand (production)	IEA Critical Minerals Outlook 2024, Wood Mackenzie Energy Transition Outlook for Nickel 2023, Wood Mackenzie Global Lithium Strategic Planning Outlook Q2 2024, Treasury
	Australian exports	DISR REQ March 2024, Wood Mackenzie Energy Transition Outlook for Nickel 2023, Wood Mackenzie Global Lithium Strategic Planning Outlook Q2 2024, Wood Mackenzie Global Nickel Strategic Planning Outlook Q2 2024, Treasury
	Real global prices	DISR REQ March 2024, IEA WEO 2023, Treasury

Sector	Data series	Data source
Iron Ore	Global demand (production)	Wood Mackenzie Iron Ore Energy Transition Outlook 2024
	Australian exports	DISR REQ March 2024, Global Iron Ore Strategic Planning Outlook – Q1 2024, Treasury
	Real global prices	DISR REQ March 2024, Wood Mackenzie Iron Ore Energy Transition Outlook 2024, Treasury
Iron and Steel	Global demand (production)	Wood Mackenzie Steel Energy Transition Outlook 2024
	Australian exports	DISR REQ March 2024, Wood Mackenzie Steel Energy Transition Outlook 2024, Treasury
	Real global prices	DISR REQ March 2024, Wood Mackenzie Steel Strategic Planning Outlook Q1 2024, Wood Mackenzie Steel Energy Transition Outlook 2024, Treasury
Alumina and Aluminium	Global demand (production)	Wood Mackenzie Aluminium Energy Transition Outlook 2024
	Australian exports	DISR REQ March 2024, Wood Mackenzie Aluminium Energy Transition Outlook 2024, Wood Mackenzie Aluminium Strategic Planning Outlook 2024, Treasury
	Real global prices	DISR REQ March 2024, Wood Mackenzie Aluminium Energy Transition Outlook 2024, Treasury
Ammonia	Global demand (production)	Wood Mackenzie Ammonia Global Supply/Demand Outlook June 2023, IEA WEO 2023, Treasury
	Australian exports	Wood Mackenzie Ammonia Global Supply/Demand Outlook June 2023, Treasury
	Real global prices	Wood Mackenzie Ammonia Global Supply/Demand Outlook June 2023, Wood Mackenzie Global Ammonia Price Outlook 2024, Treasury
Electricity	Capital import costs (solar photovoltaics (PV), wind and batteries)	IEA WEO 2023

Macroeconomic assumptions

The modelling assumes an average annual labour productivity growth rate of 1.2 per cent in the Baseline Scenario, which is consistent with the average labour productivity growth rate in the *2023 Intergenerational Report*.

Average population growth and participation rate assumptions are also aligned with projections in the *2023 Intergenerational Report.* These projections are combined to produce an estimate of potential aggregate hours worked that grows by around 35 per cent between 2025 and 2050, or an annual average rate of 1.2 per cent.

Abatement assumptions

Treasury's modelling shows that continued decarbonisation of Australia's electricity system and improvements in energy efficiency, support emissions reductions in the near-term. Further out, fuel switching and the take-up of new abatement technologies across sectors, the efficient use of gas, and scaling up of carbon removals will also be key actions to support emissions reductions. These findings are underpinned by the abatement assumptions detailed in this section. A combination of broad-based and sector-specific assumptions has been used across scenarios.

Electricity modelling assumptions

The coverage of the electricity sector includes major grids, such as the National Electricity Market (NEM) and Wholesale Electricity Market (WEM), as well as small grids and off-grid generation. All three scenarios assume that the Government's 82 per cent on-grid renewable electricity generation target by 2030 is met, driven by state and territory and Australian Government policies such as the expanded Capacity Investment Scheme (CIS).

Bottom-up modelling of the NEM is undertaken using the Electricity Market Model (EMM) and requires detailed technical and economic assumptions. Key details include:

- The energy transition is assumed to proceed broadly in line with the transition outlined in the Australian Energy Market Operator's (AEMO) *2024 Integrated System Plan* (ISP) Step Change scenario, with assumptions mostly drawn from this scenario.

- Information on the technical and economic parameters of current and potential new generation and transmission is mostly drawn from the 2024 AEMO ISP. These assumptions are updated for Government policy within the Net Zero Plan and market events since release.

- Capital costs for new generation are sourced from 2023–24 GenCost's Global NZE post 2050 scenario (Graham et al. 2024).

- Hydrogen production in the Baseline Scenario is consistent with the *National Hydrogen Strategy –* Low Scenario, with production that is mostly flexible within the month.

- Wholesale gas prices are assumed to be aligned with AEMO's 2024 ISP Progressive Change scenario. Treasury has not modelled gas prices.

- Differences between scenarios is included at Table D.2.

For the WEM, modelling was based on AEMO's WEM Electricity Statement of Opportunities. Assumptions for off-grid industrial and mining operations are drawn from other Treasury modelling inputs. The Model of Industrial and Resources Abatement (MIRA) includes technology options for off-site generation to electrify operations. Growth in off-grid electricity demand to 2050 is also driven by growth in renewable hydrogen production.

The combined bottom-up modelling is used to calibrate the electricity sector in the Treasury Industry Model (TIM) to reflect costs in a variable renewable system under the different scenarios.

Table D.2: Key NEM assumption differences from the Baseline Scenario in EMM

Renewable Exports Upside Scenario difference to Baseline Scenario	
Energy Efficiency	Higher, aligned to AEMO 2024 ISP Green Energy Exports scenario
Hydrogen on NEM production	Higher, National Hydrogen Strategy – Base production target Includes seasonal flexibility, 10% of the total flexible component in FY35 rising to 50 per cent of the component is flexible across the year
Industrial flexibility	Includes 15 per cent reduction in industrial winter demand plus 5 per cent annual flexibility
Disorderly Transition Scenario difference to Baseline Scenario	
Energy Efficiency	Lower, aligned to AEMO 2024 ISP Progressive Change scenario
Consumer energy resources & EVs	Lower, aligned to AEMO 2024 ISP Progressive Change growth from 2030 to 2040, returning to AEMO 2024 ISP Step Change assumptions from 2040 to 2050
Hydrogen on NEM production	Lower, reduced from the Baseline Scenario consistent hydrogen production downgrade Less flexible production, around only half the load is flexible within the month
Renewable build restrictions	Restricted to 1.1 GW utility solar and 0.9 GW wind from 2030 to 2040 Renewable Energy Zones (REZ) augmentation costs doubled from 2030 to 2040
Gas prices	Domestic prices marked up by 14 per cent based on percentage differences between AEMO 2024 ISP scenarios
Coal closures	Coal closures between 2030 and 2040 are delayed compared to the Baseline Scenario to align with their currently announced closure dates

Wholesale electricity price projections

EMM produces wholesale price projections for the purpose of comparing scenarios. These projections should not be interpreted as forecasts and focus primarily on longer-term factors relevant to scenarios, particularly technology and input fuel costs. Price projections are not produced for the period 2025 to 2030 given near-term market factors, such as contracting arrangements, are not captured, or required, for scenario comparisons in EMM. The AEMC projects wholesale electricity prices will be around $100/MWh by 2034 (AEMC 2024).

Under the Baseline Scenario, wholesale electricity prices are projected to stabilise around $100/MWh. This is about 10 per cent below the 10-year real historical average. This decline is driven by greater use of firmed renewable electricity and reduced reliance on ageing coal-fired generation. This is consistent with the costs of firmed renewables in 2050 reported by CSIRO's GenCost 2024-25 Report (CSIRO 2025a). It is also consistent with private sector modelling by Endgame Analytics, which projects wholesale electricity spot prices will settle at around $105/MWh over the period from 2035 to 2050.

The change in wholesale electricity prices projected under the Disorderly Transition Scenario, are consistent with analysis of similar Australian energy transition scenarios – for example, Simshauser and Gilmore (2025), Clean Energy Investor Group (2025), and the Clean Energy Council (2025).

Household cameo analysis

Household take-up of electrification and renewable technology will significantly affect their emissions and energy costs. A separate modelling exercise was developed to investigate these impacts given they cannot be easily captured with sufficient detail in whole-of-economy models.

The Australian Lifecycle Energy eXpenditure (ALEX) household cameo model estimates the impact of electrification of durable appliances and renewable technology investments for individual households. These outputs are only used to communicate stand-alone results and are not used as inputs into whole-of-economy modelling. ALEX draws on assumptions and data from internal modelling and external sources (see Table D.3).

Table D.3: Assumptions for household energy cost cameo modelling

Assumption	Source	Further information
Appliances		
Appliance energy consumption data	Residential Baseline Study (RBS) (Energy Consult 2021; Rewiring Australia 2021)	Most appliance energy consumption from sourced from RBS. Rewiring Australia data used to split space heating energy consumption between heating and cooling.
Cooktop consumption data	Alternative Technology Association (2018)	The RBS cooktop energy consumption data were not suitable for use in ALEX due to limited information on induction cooktops.
Appliance capital costs	ACIL Allen (2020), Institute for Energy Economics and Financial Analysis (2024)	Space heating and water heating appliance costs were sourced from a 2020 ACIL Allen's Household Energy Choice in the ACT report, while cooktop costs were sourced from analysis from the Institute for Energy Economics and Financial Analysis.
Time of day consumption patterns	CSIRO's Typical Household Energy Use data and Treasury modelling	Time of day energy use patterns from data for appliances. EVs time of demand is from ISP assumptions.
Vehicles		
Average distance travelled	Motor Vehicle Use Survey (ABS 2018)	12,600km. 2018 data was used instead of 2020, due COVID-19 pandemic disruptions in that year.
Petrol vehicle fuel consumption	Treasury research + BITRE on-road scaling factor	10.4L/100km for sport utility vehicles (SUV).
EV energy consumption	BITRE	0.74MJ/km
Vehicle prices	Treasury research, historical data from VFACTS	$33,500 for an SUV.
EV price parity	Treasury analysis	EVs reach price parity with ICE vehicles by 2030 based on Treasury analysis of historical market prices and trends, and feedback from consultations. This timing is conservative compared to external modelling exercises (Electric Vehicle Council 2023; IEA 2024a).

Assumption	Source	Further information
Solar and batteries		
Solar system size	CSIRO small-scale solar PV projections, 2025 ISP IASR	10.6kW
Solar generation	Treasury analysis, informed by DCCEEW (2024b)	4kWh power generated per 1kW solar PV per day or 15,460kWh per year.
Solar system cost	Treasury analysis, informed by CSIRO 2023-24 GenCost, Global NZE post 2050	$1,030/kW in 2030.
Batteries	Market analysis prices, indexed to GenCost.	$10,670 for a 10kWh battery (including installation) in 2030. Price changes over time indexed to GenCost. Excludes impact of policy support.
Energy prices and other costs		
Electricity prices	Treasury modelling.	Stylised projections based on wholesale price modelling
Gas prices	Treasury analysis based on publicly available price data.	Retail gas price projections for NEM states are based on AEMO methodology outlined in 2024 GSOO. Inputs are sourced from publicly available information including AER and ACIL Allen modelling provided for AEMO ISP. Analysis includes the impact of increasing distribution and network costs from a decline in connections over time that is based on electrification rates from whole of economy modelling. Potential impacts on gas prices arising from the Gas Market Review (DCCEEW 2025) have not been considered.
Petrol prices	Treasury modelling	Current prices based on average market price. Projected based on index from computable general equilibrium modelling framework. Reflects global demand, duties, excises and sales taxes and retail and transportation margins.
Financing costs	Research and market analysis	5.5% interest rate.

Treasury undertook modelling of wholesale electricity prices. The wholesale price projections were used to generate a stylised assessment of retail costs for a typical household. Stylised retail energy costs are estimated for a typical 2–3 person household in this cameo analysis. Cameo analysis of the energy costs for a typical household demonstrates that electrification and purchasing solar PV and batteries can reduce household energy costs by about $4,300 per year. This result is for the Baseline Scenario and accounts for upfront, financing and ongoing costs. Around $2,070 is reduced costs is from lower vehicle costs including avoided petrol costs, and $1,040 is from lower costs from appliances including avoided gas costs. Solar panels and batteries reduce energy costs by $1,200 for the household, and supply around three-quarters of household electricity.

Energy efficiency assumptions

Annual energy efficiency improvements are assumed to be 2.1 per cent in 2025, in line with assumptions in the IEA WEO 2024.[7] Annual increases are assumed to decline linearly to 1 per cent in 2050, reverting to long-run historical averages across the Australian economy. This assumption is applied to all sectors other than the transport, electricity and commercial building sectors, where detailed input data are available.[8] Annual energy efficiency assumptions for each transport mode are supplied by DITRDCSA and BITRE, while annual energy efficiency assumptions in commercial buildings are based on findings from the *2022 Commercial Building Baseline Study* (DCCEEW 2022).

Electrification assumptions

In the built environment sector, the modelling captures electrification within residential buildings, commercial buildings, services, and construction. The pace and scale at which these sectors switch away from fossil fuels is calibrated to align broadly with AEMO's Gas Statement of Opportunities (GSOO) (AEMO 2025).

In the transport sectors, electrification assumptions draw on data inputs from Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCSA) and Bureau of Infrastructure and Transport Research Economics (BITRE). Specifically, data inputs are used to derive energy-use shares for different transport modes, including the use of electricity. For private transport, TIM utilises a technology bundle approach to estimate consumption. This approach captures trade-offs associated with ICE vehicles and EVs, including the cost of capital and investment associated with purchasing new vehicles, fuels, and how those costs change over time. Changes in the relative prices of fuels and capital induce substitution between ICE vehicles and EVs.

In industry and resources sectors, electrification options are captured via detailed information on specific abatement technologies. For further information, see Assumptions for large emitting facilities.

For industries where no explicit assumption is made around electrification technology, the share of electricity in their overall use of energy is assumed to increase by 5 to 15 percentage points to 2050. This range reflects insights drawn from information on different likely electrification opportunities across industries, such as switching to electric motors and pumps in the agricultural sector, or electrifying equipment in the construction sector. These assumptions draw on information from a range of sources, including the National Farmers Federation, Energy Efficiency Council and Australian Energy Council, amongst others.

Technology assumptions

Low-carbon liquid fuel assumptions

Low-carbon liquid fuels (LCLFs) are assumed to reduce the emissions intensity of using diesel and aviation fuel over time. Assumptions about the cost and supply of LCLFs are drawn from CSIRO's *Sustainable Aviation Fuel Roadmap* and *Opportunities* and *Priorities for a Low Carbon Liquid Fuel Industry in Australia* (CSIRO 2025b; O'Sullivan 2025). The reports include analysis of domestic

---

7   Based on Treasury calculations using the IEA World Energy Outlook 2024 Extended Dataset (IEA 2024b).

8   Sectors that transform one form of energy to another (as opposed to using energy as an input in their production process) – for example, the diesel sector transforms oil into diesel – are not assumed to have energy efficiency improvements. In addition, energy use in clean energy industries is covered by separate assumptions.

feedstock availability and production potential, and key insights into the feasibility of developing a local LCLF industry. They suggest that agricultural feedstocks (such as agricultural and sawmill residues, bagasse) could provide a cost-effective source of LCLF in Australia, with limited use of other biogenic feedstocks (such as tallows). The processing and refining of feedstocks into LCLF can occur domestically or be imported.

Across all scenarios it is assumed that 4.2 billion litres of sustainable aviation fuel and 4.3 billion litres of renewable diesel is used in 2050. In the Disorderly Transition Scenario, the uptake of these fuels is delayed until 2040, but the same volume is used by 2050.

Assumptions for large emitting facilities

Detailed modelling of large emitting facilities has been completed using MIRA (Appendix B) and includes projections of technology take-up by large emitting facilities over time. It is aligned with the Safeguard Mechanism assumptions to 2040, including for trade-exposed facilities. It provides insights out to 2050 about cost-efficient opportunities for facility-level abatement and demand for offsets by applying the principle that large emitters will continue to reduce emissions linearly to 2050. Technology assumptions are drawn from a number of sources, including global scenarios, Energetics, CSIRO, industry and government agencies. The share of technology-driven abatement by sector is detailed in Table D.4 below.

Table D.4: MIRA technology take-up, Baseline Scenario

Sector	Tech summary	Share of technology-driven abatement
Alumina	The alumina sector is assumed to transition from natural gas and coal-based production to renewable hydrogen and electricity-based production in the 2030s.	24
Aluminium	Aluminium production is assumed to take up inert anode technology from 2040.	4
Ammonia	Ammonia production shifts to renewable hydrogen-based production prior to 2030.	8
Aviation	Sustainable aviation fuel is blended with existing fuel consistent with the pathway reflected in whole-of-economy modelling.	7
Cement	The cement sector is assumed to incorporate alternative fuel sources for clinker production prior to 2030, driving moderate levels of onsite abatement. Carbon capture and storage technologies are not cost-effective solutions given projected technology cost and ACCU prices.	3
Mining	Mining facilities continue to adopt cost-effective electrification and onsite renewables technologies this decade. Cost-effective ventilated air methane (VAM) technologies are adopted in the 2030s. Mining facilities switch to battery electric vehicles in the 2030s.	22
LNG and natural gas	Cost-effective carbon capture and storage technologies is assumed to provide abatement throughout this decade. Cost-effective renewables switching and electrification technologies are taken up from 2030.	18
Iron and steel	Natural gas based direct reduced iron-electric arc furnace (DRI-EAF) iron and steel production begins towards the end of this decade, transitioning to hydrogen based DRI-EAF production over the following two decades. Adoption of gas-based DRI technology does not explicitly include use of biomethane and renewable gases.	13

Hydrogen supply chain assumptions

Hydrogen production costs are initially based on the *National Hydrogen Infrastructure Assessment* (DCCEEW 2023). Variation across scenarios is based on changing electricity prices for grid production. Additional delivery and storage costs are assumed based on work from Griffith University (Fletcher et al. 2023a; Fletcher et al. 2023b).

Once produced, 1.1 Mt of renewable hydrogen is used in 2050 to decarbonise existing Australian economic activity across all scenarios based on economic use cases in Treasury modelling. The remaining hydrogen is used to produce green iron and green ammonia for export.

Modelling assumes that 64 kg hydrogen is required for each tonne of green iron produced, roughly the midpoint of possible technical efficiencies (TSI 2025). Consistent with the *National Hydrogen Strategy 2024* (DCCEEW 2024c), 179 kg hydrogen is required for each tonne of green ammonia produced.

Hydrofluorocarbon phase-down assumptions

Hydrofluorocarbons (HFCs) are found in refrigeration and air conditioning, The long-term reduction in emissions from HFCS across all scenarios is aligned with Australia's proposed HFC phase-down (DCCEEW 2021). Under this phase-down, HFC imports are capped at around 2 Mt CO_2-e from 2036 (down from 8 Mt CO_2-e- in 2018).

Agriculture abatement assumptions

For nonfuel related agriculture emissions, the modelling draws on separate emissions response functions (ERFs) for crops and horticulture, and livestock to capture the relationship between emissions intensities and the marginal abatement incentive. The crops and horticulture ERF was provided by ABARES, while the livestock ERF aligns with estimates from CSIRO's 2024 modelling for the CCA's *Sector Pathways* Review (CCA 2024) The ERFs should be interpreted as the potential abatement impacts from a combination of technologies, rather than any one technology.

The ERF for the livestock sector incorporates the effects of different potential abatement technologies including genetic selection, and feed supplements. For the crops sector, the abatement technologies considered include precision agricultural machinery and software, low-till farming, crop rotation, nitrification inhibitors, and slow-release fertilisers. In practice, as new technologies become available, the cost of abatement is likely to change, and uptake rates to increase. This is reflected in adjustments to the parameters of the ERFs over time.

Carbon removals assumptions

Land-based sequestration assumptions

Land-based sequestration refers to processes for removing carbon dioxide from the atmosphere and storing it in land-based ecosystems, such as forests and soils. This can be achieved through a variety of methods including reforestation, afforestation (planting trees on land previously not forested), and improving soil health.

Across all scenarios, land-based sequestration is assumed to be entirely domestically sourced. The supply of and demand for land-based sequestration is then considered in three components. The volume of existing land-based sequestration from total land-use, land-use change, and forestry (LULUCF) to 2040 is calculated to align with the latest estimates of emissions from *Australia's emissions projections 2024* (DCCEEW 2024a). This includes existing LULUCF projects under the ACCU scheme. After 2040, Australia's existing LULUCF net sink is assumed to decline by 3.7 per cent per year. This decline rate is drawn from DCCEEW analysis and reflects natural reductions in sequestration over time as vegetation ages.

The second source of land-based sequestration comes from the additional demand for ACCUs from large emitting facilities covered by the Safeguard Mechanism. This additional demand is estimated in MIRA using a set of land-based carbon sequestration supply curves, supplied by ABARES (see below), that capture the volume of land-based sequestration that land-owners are willing to deliver at different payments per tonne of CO_2 sequestered. The shape of the curves can vary depending on the method of land-based sequestration, reflecting the heterogeneity of take-up and constraints across the methods.

The third component relates to the additional amount of land-based sequestration required for the economy to reach the emissions constraint for a given year – consistent with cost-effective reduction. This additional sequestration could be achieved in a myriad of ways, including through voluntary

purchases of offsets or direct policy. Given the large degree of uncertainty around Australia's sequestration potential, in 2024, ABARES reviewed a wide range of studies that estimated sequestration volumes. Based on this literature review, ABARES, in consultation with DCCEEW and Treasury, supplied four sequestration curves (see Table D.5).

The resource costs of producing land-based sequestration are accounted for within TIM through the diversion of agricultural land to land-based sequestration projects, while labour is drawn from the rest of the economy.

Table D.5: Summary of land-based sequestration supply curves

Sequestration type	Source
Reforestation	Average of existing studies, drawing on results from CSIRO's LUTO 1.0 and GLOBIOM.
Forest Regeneration and Blue Carbon	Roxburgh et al. (2020). Potential future supply of carbon offsets in the land sector in Australia. CSIRO, Australia.
	Nolan et al. (2024) Assessment of economic feasibility of blue carbon projects in Australia. CSIRO, Australia.
Soil Carbon	Roxburgh et al. (2020). Potential future supply of carbon offsets in the land sector in Australia. CSIRO, Australia.
Savanna Fire Management	Roxburgh et al. (2020). Potential future supply of carbon offsets in the land sector in Australia. CSIRO, Australia.

The evidence around the rollout of land-based sequestration continues to be an evolving area of research. Credible estimates of the quantity of land-based sequestration that may be available for a given revenue vary widely. This reflects analytical and data constraints about the carbon sequestration potential of different land types, and uncertainty about the revenue landowners need to repurpose their land. Additionally, the carbon stored in vegetation is at risk of decline or loss due to, for example, droughts and fires, with these risks expected to rise further as a consequence of continued climate change (CSIRO 2024).

Since the initial literature review, there has been further research and model development to better understand the role that land-based sequestration could play in Australia's net zero transition. ABARES is currently developing an in-house model of land-use change (in a similar vein to CSIRO's Land Use Trade Offs (LUTO) model) – the Spatial Agriculture, Forestry and Environment (SAFE).[9]

Carbon dioxide removal technologies assumptions

Novel Carbon Dioxide Removal (CDR) technologies remove CO_2 from the atmosphere, durably store it and create negative emissions. These technologies are currently significantly more expensive than land-based sequestration, mainly due to high capital costs. Costs would have to fall significantly for these technologies to contribute to a cost-effective net zero pathway. Given their high projected costs, novel CDR technologies have not been included as emissions-reduction technologies in the modelled scenarios.

However, there is a wide range of technologies under development that could support future abatement. For example, Direct Air Capture (DAC) technologies separate CO_2 from the atmosphere and store it in either geological, land or ocean reservoirs. CSIRO projects solid absorbent DACs sequestration could potentially be cost competitive in 2050 under its optimistic scenarios (CSIRO unpublished).

---

9   SAFE is a bottom-up spatial model which draws on detail around potential plantings, land value, and planting costs to understand where land-use change may occur.

The modelling does include take-up of lower-cost carbon capture and storage abatement technologies in the LNG and natural gas sector (see Assumptions for large emitting facilities).

Impacts of Australian production on global abatement

In *Box 3.1: Estimating Australia's potential impact on global abatement,* Treasury has considered how Australia's emerging green commodity production could lead to abatement overseas.

The assumptions used for these calculations are outlined in Table D.6. Across all commodities, it is assumed that Australian exports lead to a 100 per cent displacement of the listed end use overseas, illustrating Australia's maximum possible impact in the absence of further information.

Table D.6: Assumptions and sources for global abatement impact of Australian exports

Commodity	Abatement impact	Production displaced	Notes	Sources
Green iron	-1.6 t CO_2-e / t Iron	Conventional blast furnace ironmaking	Assumes displaces ironmaking in blast furnaces, using emissions benchmarks from Japan and South Korea. Green iron is an input into steel production using electric arc furnaces.	DISR assumption
Green ammonia	-1.6 t CO_2-e / t Ammonia	Grey ammonia Coal use in coal-fired power stations Bunker fuel in shipping.	Global emissions impact is averaged over these three prospective uses cases.	DISR assumption, DCCEEW (2024d), BloombergNEF (2024a), Valera-Medina et al. (2018)
Lithium	-99.0 t CO_2-e / t LCE	Internal combustion engine vehicle use. Gas peaking generation.	Abatement from lithium in EVs is based on the emissions difference between an average ICE vehicle and an average EV.	Data for lithium abatement sourced from BloombergNEF (2024b), BloombergNEF (2024c), Cantor et al. (2024), Treasury analysis
			Grid-scale batteries displace gas generation, cycling once per day using renewable energy, with standard energy losses. Only the value-added contribution of Australian lithium to the final price of the battery is counted as Australia's contribution to global abatement (around 8 per cent).	Treasury analysis

Glossary

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACCU	Australian Carbon Credit Units
ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEMO ISP	Australian Energy Market Operator Integrated System Plan
ALEX	Australian Lifecycle Energy eXpenditure Model
ANZSIC	Australian and New Zealand Standard Industrial Classification
AR6	Sixth Assessment Report
ATO	Australian Taxation Office
BITRE	Bureau of Infrastructure and Transport Research Economics
BNEF	Bloomberg New Energy Finance
CCA	Climate Change Authority
CDR	Carbon Dioxide Removal
CER	Clean Energy Regulator
CIS	Capacity Investment Scheme
CO2	Carbon Dioxide
CO2-e	Carbon Dioxide Equivalent
CoPS	Centre of Policy Studies
CPI	Consumer Price Index
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAC	Direct Air Capture
DAFF	Department of Agriculture Fisheries and Forestry
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DISER	Department of Industry, Science, Energy and Resources
DISR	Department of Industry, Science and Resources
DITRDCSA	Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts
DRI-EAF	Direct Reduced Iron Electric Arc Furnace
EMM	Electricity Market Model
ERF	Emissions Response Function
EV	Electric Vehicle
GLOBIOM	Global Biosphere Management Model
GSOO	Gas Statement of Opportunities
GTEM	Global Trade and Environment Model
GVA	Gross Value Added
HFC	Hydrofluorocarbons
IASR	Inputs, Assumptions and Scenarios Report
ICE	Internal Combustion Engine
IEA	International Energy Agency
IEA WEO	International Energy Agency World Energy Outlook

IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
km	Kilometre
kW	Kilowatt
kWh	Kilowatt-hour
LCLF	Low Carbon Liquid Fuel
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land Use Change, and Forestry
LUTO	Land Use Trade Offs
MIRA	Model of Industrial and Resources Abatement
MJ	Megajoule
Mt	Megatonne
MWh	Megawatt-hour
NDC	Nationally Determined Contribution
NEM	National Electricity Market
NGERS	National Greenhouse and Energy Reporting Scheme
NZE	Net Zero Emissions
PV	Photovoltaic
RBS	Residential Baseline Study
REQ	Resources and Energy Quarterly
REZ	Renewable Energy Zone
SAFE	Spatial Agriculture, Forestry and Environment
SMC	Safeguard Mechanism Credit
SUV	Sports Utility Vehicle
t	Tonne
TIM	Treasury Industry Model
VAM	Ventilated Air Methane
WEM	Wholesale Electricity Market

References

ABS (Australian Bureau of Statistics) (2013) *The detailed classification: Australian and New Zealand Standard Industrial Classification (ANZSIC)* , ABS Website, accessed 12 September 2025.

ABS (2018) *Survey of Motor Vehicle Use, Australia* [data set], ABS Website, accessed 12 September 2025.

ACIL Allen (2020) *Household energy choice in the ACT* [PDF]*,* ACIL Allen, accessed 12 September 2025.

AEMC (Australian Energy Market Commission) (2024) *Residential Electricity Price Trends 2024*, AEMC, accessed 12 September 2025.

AEMO (Australian Energy Market Operator) (2024) *Integrated System Plan (ISP)*, AEMO, accessed 12 September 2025.

AEMO (2025) *Gas Statement of Opportunities*, AEMO, accessed 12 September 2025.

Alternative Technology Association (2018) *Household Fuel Choice in the NEM 2018* [PDF], Alternative Technology Association, accessed 12 September 2025.

Australian Government (2008) *Australia's low pollution future: The economics of climate change mitigation* [PDF], Australian Government, accessed 12 September 2025.

BloombergNEF (Bloomberg New Energy Finance) (2024a) *Ammonia no magic bullet to cut Asia's power emissions,* BloombergNEF, accessed 12 September 2025.

BloombergNEF (2024b) *2024 Lithium-ion battery price survey,* BloombergNEF, accessed 12 September 2025.

BloombergNEF (2024c) *Lithium-ion batteries: State of the industry 2024,* BloombergNEF, accessed 12 September 2025.

Cantor C and Soulopoulos N (2024) *The lifecycle emissions of electric vehicles,* BloombergNEF, accessed 12 September 2025.

Carlton F, Gustafsson L, Hinson M, Jaensch J, Kouparitsas M, Peat N, Quach K, Wende S and Womack P (2023) *Modelling Industry Specific Policy with TIM: Treasury's multi-sector dynamic general equilibrium model of the Australian economy,* Treasury, accessed 12 September 2025.

CCA (Climate Change Authority) (2024) *Sector Pathways Review*, CCA, accessed 12 September 2025.

Clean Energy Council (2025) *The Impact of a Delayed Transition on Consumer Electricity Bills* [PDF], Jacobs, accessed 12 September 2025.

Clean Energy Investor Group (2025) *The cost of no renewables: The unaffordable alternative* [PDF], Clean Energy Investor Group, accessed 12 September 2025.

CSIRO (Commonwealth Scientific and Industrial Research Organisation) (2023) *Pathways to Net Zero Emissions – Integrated Environmental Economic Modelling*, CSIRO, accessed 12 September 2025.

CSIRO (2024) *Australia's carbon sequestration potential*, CSIRO accessed 12 September 2025.

CSIRO (2025a) *GenCost: cost of building Australia's future electricity needs*, CSIRO, accessed 12 September 2025.

CSIRO (2025b) *Sustainable Aviation Fuel Roadmap,* CSIRO, accessed 12 September 2025.

CSIRO (unpublished) Australian Carbon Dioxide Removal Roadmap, CSIRO, Australia

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2021) *Hydrofluorocarbon (HFC) phase-down*, DCCEEW, accessed 12 September 2025.

DCCEEW (2022) *Commercial Building Baseline Study,* DCCEEW, 12 September 2025.

DCCEEW (2023) *National Hydrogen Infrastructure Assessment*, DCCEEW, 12 September 2025.

DCCEEW (2024a) *Australia's emissions projections 2024,* DCCEEW, accessed 12 September 2025.

DCCEEW (2024b) *Solar Panels*, DCCEEW Website, accessed 12 September 2025.

DCCEEW (2024c) *National Hydrogen Strategy 2024,* DCCEEW, accessed 12 September 2025.

DCCEEW (2024d) *National greenhouse accounts factors*, DCCEEW, accessed 12 September 2025.

DCCEEW (2025) *Gas Market Review Consultation*, DCCEEW, accessed 12 September 2025.

DISER (Department of Industry, Science, Energy and Resources) (2021) *Australia's Long-Term Emissions Reduction Plan: Modelling and Analysis*, Australian Government, accessed 12 September 2025.

Electric Vehicle Council (2023) *Raising standards, cutting costs: How an effective new vehicle efficiency standard can reduce vehicle emissions and save consumers money* [PDF], Electric Vehicle Council, accessed 12 September 2025.

Energy Consult (2021) *2021 Residential Baseline Study for Australia and New Zealand for 2000 to 2040*, Energy Consult, accessed 12 September 2025.

Fletcher A, Nguyen H, Salmon N, Spencer N, Wild P and Bañares-Alcántara R (2023a) *Queensland green ammonia value chain: Decarbonising hard-to-abate sectors and the NEM-Main report* [PDF], Griffith University, 12 September 2025.

Fletcher A, Nguyen H, Salmon N, Spencer N, Wild P and Bañares-Alcántara R (2023b) *Queensland green ammonia value chain: Decarbonising hard-to-abate sectors and the NEM–Information sheets* [PDF], Griffith University, 12 September 2025.

Graham P, Hayward J and Foster J (2024) *GenCost 2023-24: Final report*, CSIRO, accessed 12 September 2025.

IEA (International Energy Agency) (2023) *World Energy Outlook 2023 Methodology*, IEA, accessed 12 September 2025.

IEA (2024a) *Global EV Outlook 2024,* IEA, accessed 12 September 2025.

IEA (2024b) *World Energy Outlook 2024 Extended Dataset* [data set], IEA, accessed 12 September 2025.

Infrastructure Australia (2024) *Valuing emissions for economic analysis: Guidance note*, Infrastructure Australia, accessed 12 September 2025.

Institute for Energy Economics and Financial Analysis (IEEFA) (2024) *Appendix A: Modelling the phase-out of gas appliances* [PDF], IEEFA, accessed 12 September 2025.

IPCC (Intergovernmental Panel on Climate Change) (2022) *Sixth Assessment Report. Working Group III: Mitigation of Climate Change*, IPCC, accessed 12 September 2025.

Nolan M, Rochester W, Slawinski D, Branson P, Marcos Martinez R, Navarro Garcia J, Kenna E, Hardiman L, Steven A and Vanderklift M (2024) *Assessment of the economic feasibility of blue carbon projects in Australia*, CSIRO, accessed 12 September 2025.

O'Sullivan CA, Mishra A, Mueller S, Nadeem H, Flentje W (2025) *Opportunities and Priorities for a Low Carbon Liquid Fuel Industry in Australia*, CSIRO, accessed 12 September 2025.

Rewiring Australia (2021) *Savings in the Suburbs*, Rewiring Australia, accessed 12 September 2025.

Roxburgh S, England J, Evans D, Nolan M, Opie K, Paul K, Reeson A, Cook G and Thomas D (2020) *Potential future supply of carbon offsets in the land sector in Australia*, CSIRO, accessed 12 September 2025

Simshauser P and Gilmore J (2025) *The Counterfactual Scenario: are renewables cheaper?* [PDF], Griffith University, accessed 12 September 2025.

TSI (The Superpower Institute) (2025) *Model Methodology: A Green Iron Plan for Australia*, TSI, accessed 12 September 2025.

Valera-Medina A, Xiao H, Owen-Jones M, David WIF, Bowen PJ (2018) 'Ammonia for power', *Progress in Energy and Combustion Science,* 69(1):63–201, doi:10.1016/j.pecs.2018.07.001.