**Australia**

## Key reference documents

* [Australia’s long-term emissions reduction plan](https://www.dcceew.gov.au/sites/default/files/documents/australias-long-term-emissions-reduction-plan.pdf)
  + Published by the previous government so likely to be evolution to this plan.
* [Technology investment roadmap](https://www.dcceew.gov.au/climate-change/publications/technology-investment-roadmap)
* [APERC Overview](https://aperc.or.jp/file/2023/9/1/APEC_Energy_Overview_2023.pdf) – Australia chapter
* [Gas Statement of Opportunities](https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2023/2023-gas-statement-of-opportunities.pdf?la=en&hash=10261137C785EA7B5A7E0E417A96B700)
* [Electricity Statement of Opportunities](https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo)
* [Integrated System Plan](https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/2022-isp-inputs-assumptions-and-scenarios)

## Climate targets

**Updated NDC (2022)**

* Reduce greenhouse gas emissions 43% below 2005 levels by 2030.
* Net-zero emissions by 2050

## Policies in place (mainly for inclusion in Reference)

**Buildings**

* Current policies for buildings are documented [here](https://www.energy.gov.au/government-priorities/buildings). It is unlikely that the suite of policies listed will be a trend break from efficiency and consumption trends of the past.

**Transport**

* Relevant federal policies are listed [here](https://www.energy.gov.au/government-priorities/vehicles-and-fuels).
* Here are more details on Australia’s attempt to [reduce transport emissions](https://www.dcceew.gov.au/energy/transport).
  + Includes Driving the Nation fund to support EV charging and hydrogen refueling.
* A baseline (REF) shift to EVs will mostly be driven by income levels (Australia not as well off as US but shouldn’t be too far behind in transition rates).
  + Consumer choice with some support via policy will drive change but I suspect a large minority of consumers will not be rushing to EVs (it will take additional carrots or sticks to drive required change that may be sought after in TGT)
  + See [example](https://www.globalvillagespace.com/australia/australias-big-car-obsession-a-troubling-issue/) for preference for SUVs, with these vehicles lagging electrification of smaller vehicles
* Fuel quality standards continue to underwhelm. For example, see [here](https://www.acfa.org.sg/newsletters/australia-new-fuel-standards-disappointing-below-international-standards).

**Industry**

* [Safeguard mechanism](https://www.dcceew.gov.au/climate-change/emissions-reporting/national-greenhouse-energy-reporting-scheme/safeguard-mechanism)
  + Applicable for large emitters to begin to tread a path that is consistent with net zero commitments.

**Power (not necessarily policy but relevant for likely trends)**

* [Integrated System Plan](https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/2022-isp-inputs-assumptions-and-scenarios), including generation costs assumptions.
  + [Electricity Statement of Opportunities](https://www.aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2023/2023-electricity-statement-of-opportunities.pdf?la=en)
* [Capacity investment scheme](https://www.energy.gov.au/government-priorities/energy-supply/capacity-investment-scheme).
* Delivering [priority transmission](https://www.energy.gov.au/government-priorities/energy-supply/delivering-priority-transmission-projects)

**Supply (including refineries)**

* [East coast gas policy](https://www.energy.gov.au/government-priorities/energy-markets/gas-markets) (a case study in how not to do things)
  + Still dominated by a cartel. Government unwilling to step in and change things for the betterment of the Australian people.
  + [ACCC reports](https://www.accc.gov.au/inquiries-and-consultations/gas-inquiry-2017-30) that close to 90% of east coast 2P gas resources are associated with east coast gas exporters. There is no incentive for them to deliver surplus production (and lower prices) for domestic consumption.
* Commitment to [supporting domestic refineries](https://www.energy.gov.au/government-priorities/energy-security/australias-fuel-security).
* Still no east coast gas import terminals and good chance there never will be. See [Gas Statement of Opportunities](https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2023/2023-gas-statement-of-opportunities.pdf?la=en&hash=10261137C785EA7B5A7E0E417A96B700).

**Hydrogen**

* Consolidated [source](https://www.dcceew.gov.au/energy/hydrogen) of policies/initiatives.

## Energy Outlooks

* [Australia’s long-term emissions reduction plan](https://www.dcceew.gov.au/sites/default/files/documents/australias-long-term-emissions-reduction-plan.pdf) provides modelling that lays a foundation for Australia’s 2050 net zero NDC commitment.
  + The plan gets Australia 85% of the way to net zero, though some of the assumptions are very ambitious.
  + The remaining 15% is left as a reduction that will be met by unspecified means. The rationale is that there is too much uncertainty in the trajectory that Australia will eventually take, for it to be laid out with certainty now.

# Scenarios Description

### Macroeconomics

One option for population assumptions is the United Nations Department of Economic and Social Affairs (UNDESA) World Population Prospects 2022 projection[[1]](#footnote-2). The High projection is most relevant for Australia and reflects high immigration policy settings. This High scenario sees population reach 34.5 million by 2050 and approach 37.5 million by 2060.

But this ‘High’ estimate is lower than Australian Treasury’s [2023 Intergenerational Report](https://treasury.gov.au/publication/2023-intergenerational-report) which estimates Australia population will reach 36 million by 2050 and 39.5 million by 2060.

A choice will need to be made on whether to use UN DESA High of the 2023 IGR from Australia.

GDP projections are made internally via a Swan Solow growth model that takes over from projections by the IMF until 2027. The IMF projections align with best-available expectations for the Australian and global economies in the short- to medium-term. Under this framework, real GDP grows at a CAGR of 2.0% from 2028 to 2060, using the UN DESA High. With a higher population assumption from the 2023 IGR, real growth will be higher. Per capita growth should be similar.

Whatever choice of population is finally chosen, GDP and population are assumed to stay the same in both scenarios.

### The Reference scenario

REF for Australia is a continuation of existing energy demand and supply trends subject to the influence of policy in place at the time of analysis.

**Agriculture**

* Some agriculture related policies are attached to [Emissions Reduction Fund](https://www.agriculture.gov.au/agriculture-land/farm-food-drought/climatechange/mitigation-strategies).

**Buildings**

* Residential and commercial use of gas is becoming strained due to policies that have prioirtised exports above all else.
  + Electrification was already gathering pace, but with the natural gas markets the way they are, electrification will be even more incentivised.
* Australia is [building at some of the fastest rates](https://www.macrobusiness.com.au/2023/09/why-more-supply-will-never-fix-the-housing-market/) in the OECD
  + Square metres per capita is likely to trend down as higher density living is needed to cater to rapid population growth with low/zero median income growth. See [Average Floor Area of New Residential Dwellings](https://www.abs.gov.au/articles/average-floor-area-new-residential-dwellings) for historical trends.

**Transport**

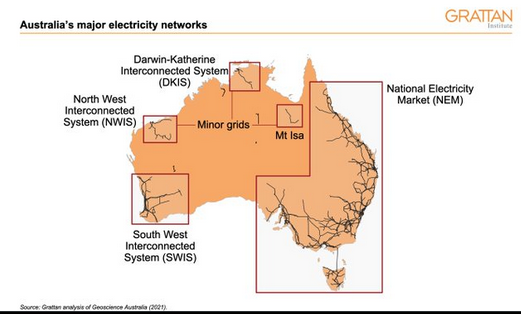
* Ethanol and biofuels [aren’t a big deal](https://www.accc.gov.au/consumers/petrol-and-fuel/ethanol-and-other-biofuels).
  + Additional context from [Argus](https://www.argusmedia.com/en/news/2286032-australia-to-raise-biofuels-consumption-usda).
* Discussion of electrification of transport in the AEMO [ESOO](https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo)
  + [Assumption](https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf?la=en) document talks about three scenarios that sees percent of road transport that is EV in 2040 at 72%, 60% or 32%, depending on the scenario. The lower assumption is likely to be most relevant to REF.
  + Progressive change in Figure 5-1 of [CSIRO EV report](https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2023-inputs-assumptions-and-scenarios-consultation/supporting-materials-for-2023/csiro-2022-electric-vehicles-projections-report.pdf) likely to be a solid reference for REF. Note the significant revision to sales share from one year to the next.
    - Appendix Table B1 gives sales share and Table B2 gives fleet share for 4 scenarios
* Some [freight forecasts](https://www.bitre.gov.au/forecasts) from BITRE
  + Rail freight low growth is likely due to lower coal production.

**Industry**

* Linkage of industry policy to carbon neutrality/energy transition ambitions is made in speeches but there is no influential policy yet (e.g. Inflation Reduction Act in US)
* Historical trends inform projections.

**Power**

* [Integrated System Plan](https://www.aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/2022-isp-inputs-assumptions-and-scenarios)
  + Forecasting assumptions workbook (excel file) will be useful to calibrate assumptions
  + Note: National Electricity Market (NEM) accounts for [90% of power delivered to Australia’s population](https://aemo.com.au/-/media/files/electricity/nem/national-electricity-market-fact-sheet.pdf).
* Interconnections in Australia are:
  + NEM (Qld, NSW, ACT, Vic., SA, Tas.)
  + South West Interconnected System (SWIS) (WA)
  + Minor grids
    - North West Interconnected System (NWIS) (WA)
    - Mt Isa (Qld)
    - Darwin-Katherine Electricity Network (NT)



* For large hydrogen production plans and things like SunCable, much of this is assumed to be built close to Asia, either off-grid, or perhaps integrated with the NWIS or Darwin-Katherine interconnections.
* Example of useful analysis for determining power mix (noting that much of the analysis is for the NEM only)
  + Figure 15 in the [ESOO](https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo) (not screenshotted below) is useful for the generation mix technologies in detail)

A graph of different colored lines

Description automatically generated

A screenshot of a chart

Description automatically generated

A graph of a graph showing the amount of electricity in the market

Description automatically generated with medium confidence

**Hydrogen**

* There was a review of Australia’s 2019 [National Hydrogen Strategy](https://www.dcceew.gov.au/energy/publications/australias-national-hydrogen-strategy) announced in 2023
* [Hydrogen Headstart](https://arena.gov.au/funding/hydrogen-headstart/)
  + Current plan in consultation phase

**Refining**

* The two remaining refineries in Australia are likely to remain operating for the medium-term for energy security considerations.
  + Commitment to [supporting domestic refineries](https://www.energy.gov.au/government-priorities/energy-security/australias-fuel-security) is via the Fuel Security Service Payment

**Supply**

* Natural gas exports via LNG (primarily from WA but also from east coast coal seam gas fields) are likely to continue being a prominent source of global supply.
  + [REQ](https://www.industry.gov.au/sites/default/files/2023-04/resources-and-energy-quarterly-march-2023.pdf)
* Australia is well placed to continue to supply international markets with thermal coal and metallurgical coal.
  + [REQ](https://www.industry.gov.au/sites/default/files/2023-04/resources-and-energy-quarterly-march-2023.pdf) for thermal coal, met coal, etc.
  + [Thermal coal](https://minerals.org.au/wp-content/uploads/2022/12/Best-in-Class-Australian-Export-Thermal-Coal-2021.pdf) report from Minerals Council
* AEMO could not confirm any LNG import terminals as of mid-2023
  + It seems unlikely that there will ever be an import terminal in Australia.

### The Target scenario

In TGT, it is assumed that the goal to reach net-zero emissions by 2050 is achieved in part through reductions from fossil fuel combustion in the energy sector. Technology deployment and behavioral changes are necessary to achieve the target and are assumed to be feasible. Upstream and midstream fugitive methane emissions are also substantially reduced.

**All sectors**

* Electrification
  + Demand sectors can refer the [ESOO](https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo) for viable electrification rates.
  + A transition away from gas to electricity will proceed at a faster rate than in REF, via unspecified policies.
* Energy efficiency
  + [ESOO](https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo) makes different assumptions about energy efficiency improvements in different scenarios, that could be the basis for increased efficiency in APERC TGT.
* Behavioural change
  + Industry has material efficiency assumptions
  + Transport could see more commuting via walking, biking, and public transport with better designed cities
    - Do car ownership realities of today dictate what 2050 will look like?
      * Less ownership; more on-demand?

**Agriculture**

* Advocacy based approach from [Farmers for Climate Action](https://farmersforclimateaction.org.au/wp-content/uploads/2021/09/FCA-EY-FINAL-Report-Low-emissions-future-for-Agriculture.pdf) has some options for the sector.

**Transport**

* High speed rail could potentially deliver lower road transport activity.
  + See [High Speed Rail Authority](https://www.hsra.gov.au/)
* [Subscription driving services](https://www.bcg.com/publications/2023/the-rise-of-the-car-subscription-market) could significantly reduce required fleet. Though passenger kilometres may remain unchanged.

**Industry**

* Increased minerals mining activity will see more mining activity
  + There is also potential for onshoring of steel production (eg producing green steel pellets to be exported rather than exporting hydrogen) and onshoring more non-ferrous metals processing.
    - For example, see [CSIRO](https://www.csiro.au/en/work-with-us/industries/mining-resources/resourceful-magazine/issue-26/net-zero-steel).
* Material efficiency
  + Greater recycling rates
  + Less materials needed for same end output

## Current context

A graph of energy consumption

Description automatically generated

## Key Assumptions for the Australia

|  |  |  |
| --- | --- | --- |
|  | Reference | Target |
| Macro | * Population: UNDESA “High” or 2023 Intergenerational Report * GDP: APERC macro model (IMF projections to 2027) | |
| Agriculture | * Energy efficiency, fuel efficiency, and fuel switching trends continue | * Fuel switching to electricity increases at a faster rate than REF |
| Buildings | * Energy efficiency trends per appliance and fuel switching trends continue * Domestic natural gas market remains in policy quagmire driving electrification. Realistic to see a more rapid shift than in 8th REF * Likely downtrend in square metres per capita due to rapid population growth | * More aggressive electrification and efficiency assumptions |
| Industry | * Energy efficiency and fuel switching trends continue (vary by subsector) * Small amount of hydrogen for steel starting in 2040 increasing through 2060 * Pilot and demo scale CCUS projects in some subsectors | * Material efficiency improvements for steel, cement, and chemicals subsectors * Higher fuel switching from coal to biomass and electricity in multiple subsectors. * Increased electrification of steel processes * Also very large increase in value add to iron ore driving very large increase in green steel pellet production * Greater energy efficiency improvements compared to REF * Hydrogen production processes in steel begins in 2030s * CCS emerges in the 2030s in steel, cement, and chemicals and is commercially scaled in the 2040s * Higher mining activity due to higher demand for minerals to manufacture energy transition technologies. * Higher non-ferrous metals production to enable energy transition technologies |
| Transport | * EV sales increase but the stock is still significantly ICE by the latter parts of the projection. * Refer CSIRO report for sales share and stock share of EVs (most pessimistic scenario likely to be good for REF) | * Refer CSIRO report for EV sales and stock shares with an energy transition scenario likely to be good for TGT * Some role for hydrogen vehicles * Diesel will remain for some freight applications * Aviation: operational efficiency and sustainable aviation fuel adoption supports decarbonization. * Some shifting towards more efficient transport modes, and potentially lower vehicle stock * Investigate potential of increased public transport or high speed rail. |
| Power and heat | * Batteries make some inroads into generation due to ancillary services and providing support for variable renewable generation. * Significant decarbonization occurs in REF | * More electricity demand than REF, and most of this demand is met via renewables, batteries, and whatever is best choice to support this variability |
| Hydrogen Supply | * Domestic production of blue (SMR w/ CCUS) and green (electrolysis) hydrogen and ammonia * Potentially some exports, but also supporting green steel pellet production | * Significant exports in line with hydrogen potential globally (Australia will be a superpower if hydrogen takes off) * But there is a significant case to consume a significant proportion of the hydrogen domestically with steel production and perhaps ammonia/methanol production |
| Refining | * No new refineries. Uncertain how long the remaining two will remain operational. | * Ok case for closure of refineries if EV take-up is high enough. |
| Fossil Fuel Supply | * Reduce fugitive methane emissions in line with international commitments * LNG export capacity is mostly maintained, with a small drop fall through decades as capacity is retired * Thermal and met coal production falls in line with global demand. Met coal demand is relatively robust in a world that still requires steel. | * LNG exports: capacity the same as REF (with lower utilisation) * Exports and production of coal, oil, and gas fall in line with the reductions from APEC in TGT (most demand for Australian production is international but domestic share is likely to become less prominent with time due to greater electrification, and faster decarbonization of domestic power system) |
| Climate | * NDC pathway not modeled. * Net-zero energy sector not realized by 2050 | * NDC, long-term emissions reduction strategy, and ESOO/GSOO used as guidelines. |

1. <https://population.un.org/wpp/> [↑](#footnote-ref-2)