Emissions reductions delivered by renewable energy

2015 to 2025

CLEAN ENERGY COUNCIL

Green Energy Markets

November 2024

Foreword

Australia has committed to cut its emissions by 43 per cent by 2030 over 2005 levels as part of its contribution to international efforts to combat global warming.

Decarbonising the electricity sector is not only important because it represents the largest source of emissions in the Australian economy, but because it enables decarbonisation through electrification of other sectors currently reliant on oil and gas, including transport, buildings and industries.

The good news is that the emissions intensity of the electricity sector has fallen significantly over the past decade.

Since 2015, when Australia's renewable energy policy settings were rebooted, a quiet revolution has been taking place, with 40 GW of new rooftop and large-scale renewable energy capacity deployed across the country. This saw the share of renewables climb from 16 per cent to just shy of 40 per cent in 2023.

This report, prepared for the Clean Energy Council by Green Energy Markets, calculates that this investment in clean energy generation has delivered a 30 per cent reduction in power sector emissions in 2023. In aggregate, this has resulted in more than 200 million tonnes of avoided greenhouse gas emissions since 2015 relative to if we had continued to rely on the existing 2015 power plant fleet.

Further, when we take into account the new generation currently under construction, we expect this total saving to rise to more than 340 million tonnes by the end of 2025, with power sector emissions almost 40 per cent lower in 2025 than what would have otherwise occurred without this new investment in renewable energy.

While climate news and good news are rarely found in the same sentence these days, this success in driving down Australia's electricity sector emissions is a true cause for celebration.

Even more so when considering the broader economic benefits that the clean energy transition is delivering: downward pressure on electricity prices from more low-cost renewables entering the grid each and every year; increased economic activity across regional and rural communities as a result of the billions of dollars of new investment, and the creation of thousands of new construction and other ongoing jobs.

The challenge now is to move even faster in decarbonising the electricity sector, given its critical role in setting Australia on a path to net zero emissions and meeting our international obligations.

Kane Thornton
Chief Executive
Clean Energy Council

Contents

Summary of results

Overview of this report

- This report estimates the amount of greenhouse gas emissions likely to have been avoided since 2015 as a result of the growth of renewable energy in Australia's two main electricity grids – the east-coast National Electricity Market (NEM) and Western Australia's South-West Interconnected System (SWIS).
- It also examines the potential future emission reductions if renewable energy were to grow to reach the Australian Government's target of 82 per cent share of electricity generation by 2030.
- 2015 was chosen as the benchmark year because this was the point at which a political settlement was reached between the Liberal-National Party (in government at the time) and the Labor Party on revised renewable energy target legislation, which ushered in a degree of policy stability. A surge in investment in new renewable energy capacity and electricity generation followed shortly after.

Emissions avoided to date (2015-2023)

- Renewable energy generation in 2023 was two and half times greater than what it was in 2015 and its share of generation increased from 16 per cent to around 40 per cent.
- The growth in renewable generation since 2015 is estimated to have avoided 55 million tonnes of CO_2 emissions in the 2023 calendar year, relative to a situation in which we had continued to rely on the generation fleet in place back in 2015. This is equal to a **30 per cent reduction in electricity emissions.**
- The aggregate emissions reduction between the 2015 to 2023 period was **more than 200 million tonnes.**

Projected emission reductions to 2025, including projects under construction

- Furthermore, there is a significant amount of large-scale renewable energy project capacity currently in construction, and rooftop solar capacity is continuing to grow at a significant rate.
- By the end of 2025 it is expected that renewable generation will be more than three times greater than it was in 2015 and its share of overall generation will be around 48 per cent. This will deliver 75 million tonnes of emission reductions in that year relative to if we had kept the 2015 mix of generation plant in place. This is a 39 per cent reduction on electricity emissions. That is equivalent to reducing the emissions from all of Australia's cars, light commercial vehicles, and aeroplanes to zero.
- By the end of 2025, we calculate that the aggregate emissions reduction between 2015-2025 will be 340 million tonnes.

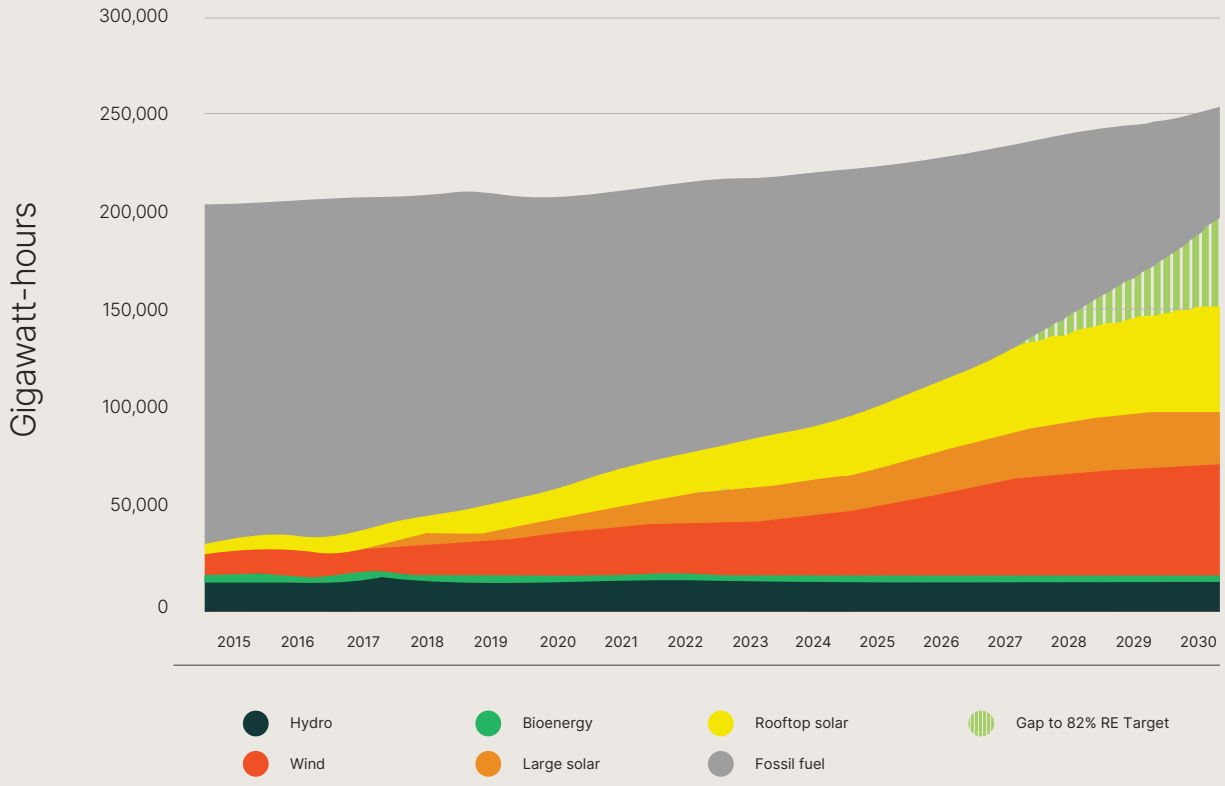
Further emission reductions to 2030

- Expected growth in rooftop solar, as well as the completion of projects that are currently in construction or have already secured offtake or underwriting contracts, and will hopefully be committed to construction, should ultimately see renewable generation grow to become four and half times higher in 2030 than it was in 2015.
- This would see renewables reach a 60 per cent share of generation, so further new projects (and an acceleration in growth of rooftop solar) will need to come forward to achieve the Australian Government's 82 per cent renewable energy target. If this target is achieved, then emissions in 2030 alone will be 178 million tonnes lower as a result of the growth in renewable energy generation since 2015, with an aggregate emissions reduction of 998 million tonnes between 2015 to 2030.

Calculating emissions avoided from the deployment of renewable generation

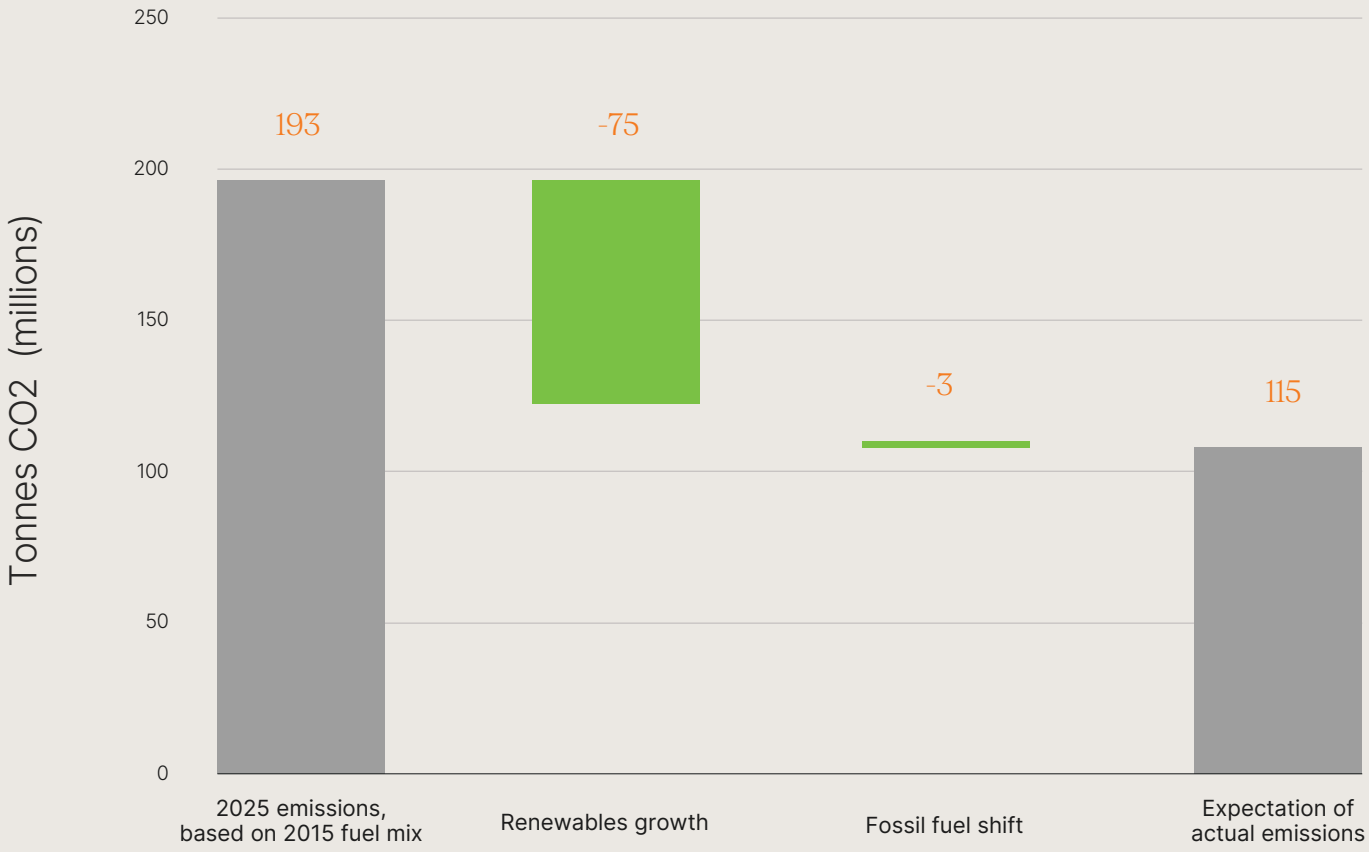
- To appreciate how renewable energy has managed to deliver such large emissions reductions, it is important to understand how substantially the fuel mix of the NEM and SWIS has changed since 2015, and will continue to do so over the years ahead.
- The chart below illustrates how the NEM and SWIS electricity fuel mix has changed to 2023 and what is likely to unfold to 2030. The forward projections are based on anticipated growth in rooftop solar under AEMO's central estimates and the completion of wind and solar farm projects currently in construction, as well as projects with power offtake or underwriting contracts being constructed.
- As the green striped section in the chart shows, there remains substantial work to do, and an acceleration in the roll-out of renewable energy is needed if we are to achieve Australia's 82 per cent renewable electricity generation target by the end of 2030.
- Nonetheless, very large emissions reductions will have been achieved by 2025 based on projects already in construction and current rooftop solar installation trends alone.

Actual and projected generation fuel mix - 2015 to 2030 (NEM & SWIS combined)



- The chart below illustrates that if we had relied on the existing 2015 generation fleet, then electricity emissions in 2025 would be 193 million tonnes. Emissions will instead be 115 million tonnes, 75 million tonnes of that difference due to the growth of renewable energy. Three million tonnes are due to a switch away from brown coal to black coal.

Reduction in 2025 electricity emissions due to change in generation fuel mix since 2015



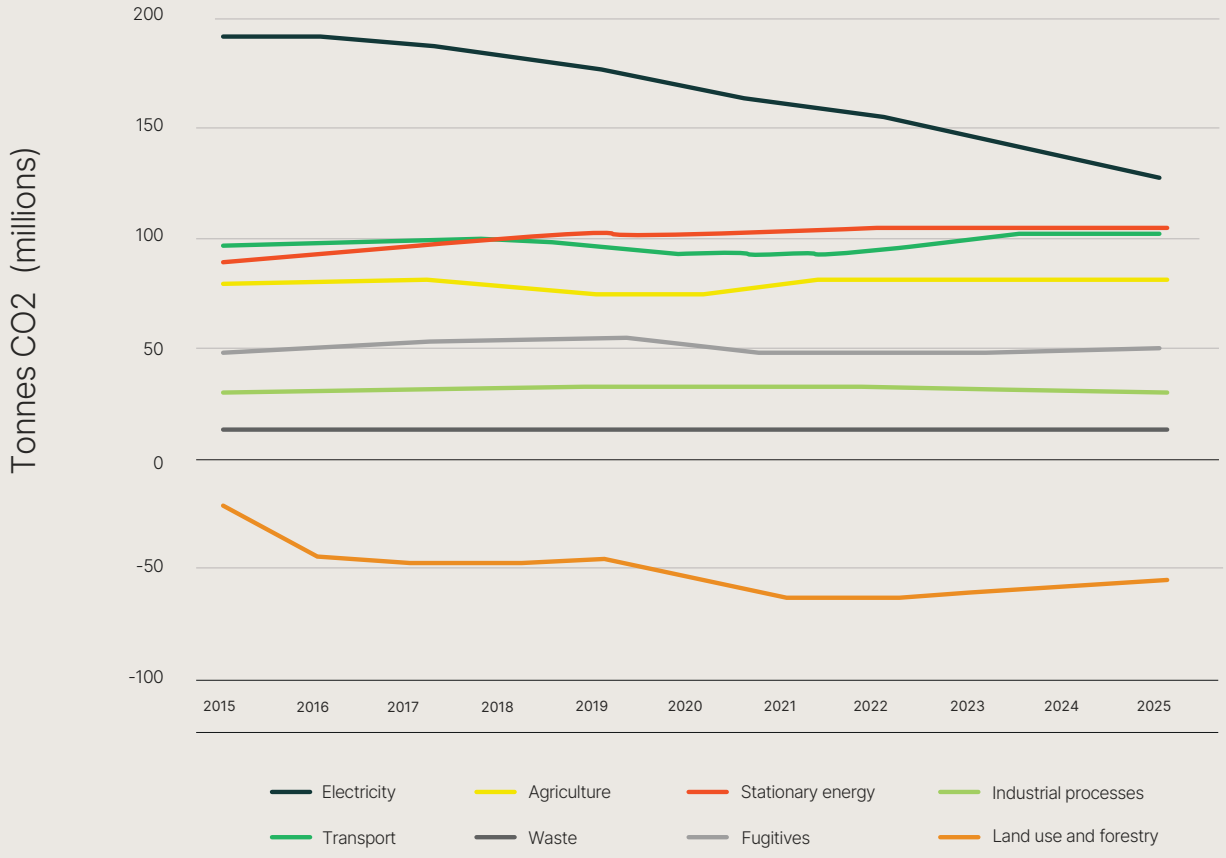
Understanding what would have happened in the absence of renewable energy growth

- In 2015, renewable energy made up just 16 per cent of electricity generation. Meanwhile highly emissions intensive brown and black coal made up 70 per cent of generation combined.
- At that time, the average emissions intensity of electricity was 1 tonne of CO_2 per MWh and total emissions across the NEM and SWIS were between 172 to 175 million tonnes.
- It is important to note that in 2015 the existing fleet of coal generators had substantial levels of spare capacity. While some of the lower cost coal generators realised capacity factors above 85 per cent, a large proportion were operating at between 50-70 per cent utilisation. All up, around 60,000 GWh of extra generation could theoretically be extracted from the 2015 fleet of coal generators if they were to all lift their capacity factors to the 85 per cent capacity factors achieved by the best performing coal plants.
- Meanwhile electricity demand between 2015 and 2023 grew by just 15,000 GWh, well within the scope of the under-utilised coal plants to expand output. Indeed, even by 2030 electricity demand is not expected to have grown by more than 60,000 GWh relative to 2015 levels.
- The average emissions intensity of the coal plants that were under-utilised in 2015 was 0.94 tonnes of CO_2/MWh.
- If renewable energy had instead remained static at 2015 levels, then any electricity demand growth would likely have been met by expansion in the generation of these under-utilised coal plants. It is highly unlikely to have been supplied by growth in gas generation due to the high cost of gas as a fuel when compared with coal.
- In calculating likely future emissions in the absence of renewable energy growth, any extra electricity demand relative to 2015 levels is multiplied by this 0.94tCO_2/MWh emissions intensity factor. This is then added on top of the 2015 emissions to provide an estimate of what emissions would have been in the absence of the growth in renewable energy.

Renewable energy's emission reductions in context

- As shown in the chart below, thanks to the rapid growth of renewable energy, Australian emissions from the electricity sector will have fallen considerably in absolute terms over the period 2015 to 2025.
- By comparison most other sectors' emissions will have either remained the same or increased over the same time period.
- As some further context, the emission reductions delivered by the growth of renewable energy in the NEM and the SWIS grids since 2015 are equivalent to reducing the emissions from all Australia's cars, light commercial vehicles, and aeroplanes to zero.
- The relatively rapid progress in decarbonising the electricity sector will deliver wider benefits to the broader Australian economy by supporting the decarbonisation of the transport and stationary energy sectors (in particular via electrification), resulting in further emissions reductions and energy productivity improvements.

Australian emissions by sector – 2015 to 2025

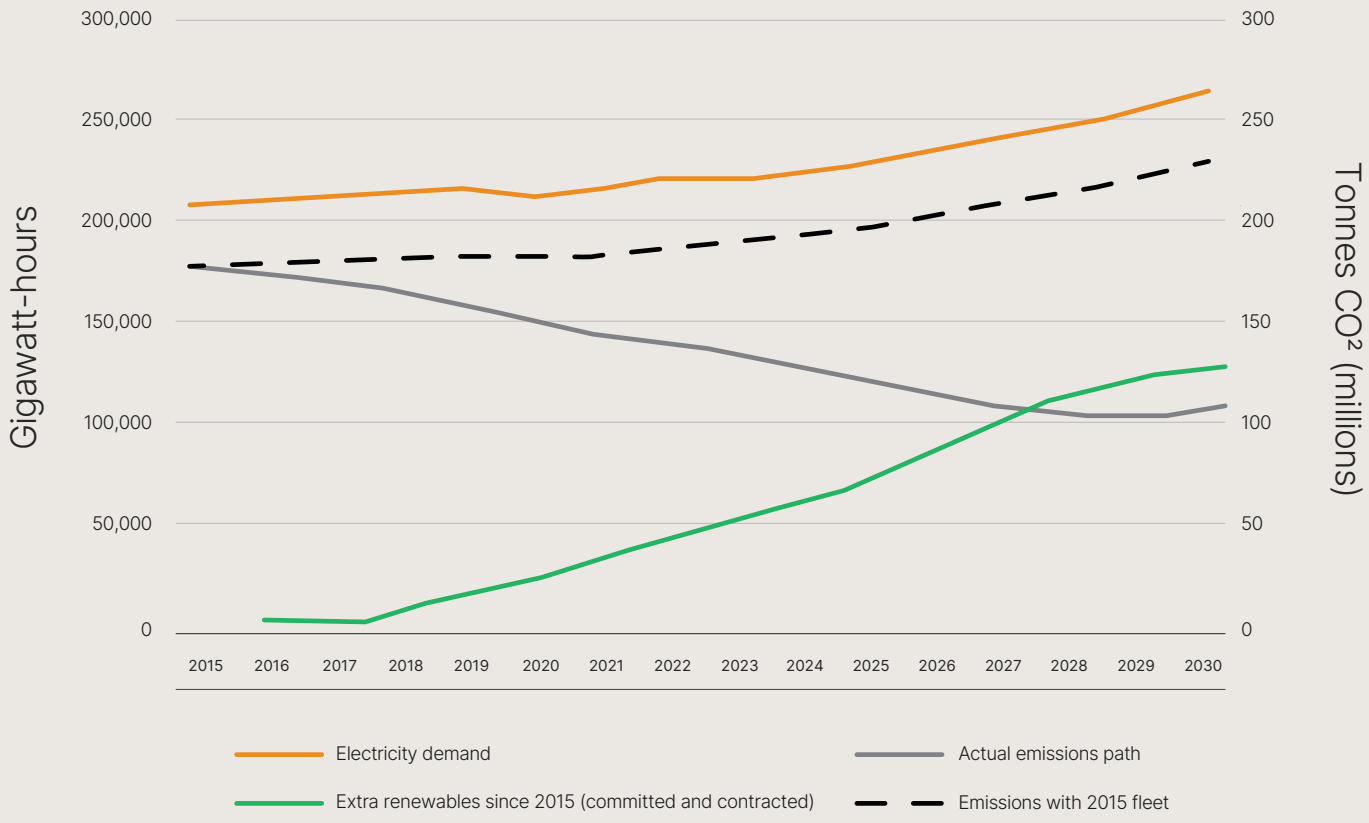


Source: Australian Government Department of Climate Change, Energy, the Environment and Water - Australia's Emissions Projections 2023

Projected emissions reductions to 2030 based on likely projects

- The following chart (page 10) illustrates estimated pathways from 2015 to 2030 for electricity demand, emissions and post-2015 growth in renewable energy generation across the NEM and the SWIS, which includes those projects that are currently under construction or that have obtained an offtake or underwriting contract.
- The orange line denotes actual and projected future electricity demand from 2015 onwards.
- The green line illustrates how the level of renewable energy generation has increased relative to 2015 levels. Because growth in renewable energy (green line) has managed to exceed growth in the electricity demand (orange line), actual emissions (shown by the grey line) have been steadily declining since 2015.
- Even if no new renewable energy projects were committed beyond those already contracted today, this growth in renewable energy generation can be expected to continue until around 2028, after which point electricity demand would outpace renewable energy growth.
- The black dashed line shows what would have happened to electricity emissions if renewable energy had not grown, and electricity demand growth was supplied by expansion in output from the generation fleet that was in place in 2015.
- The gap between the black dashed line and the grey line is the emissions reduction which has largely been delivered by growth in renewable energy. It should be noted that a small part of the emissions saving was also delivered by black coal substituting for more emissions intensive brown coal. Gas has contracted and not delivered any emission reductions.

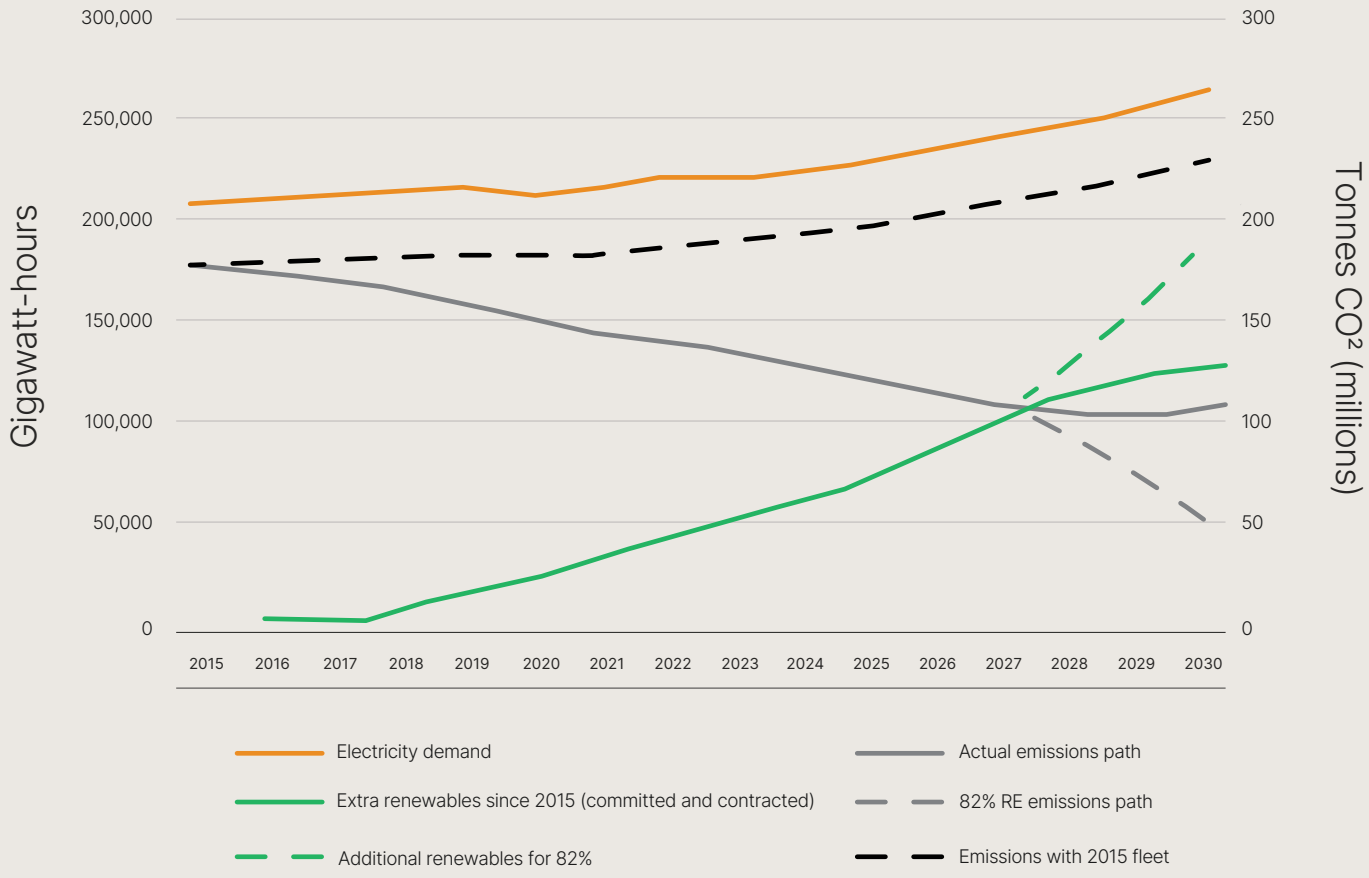
Estimated electricity demand, emissions and post 2015 growth in renewable energy



What further emissions reductions can be expected by achieving 82 per cent target

- Of course, bar major changes or reversals in energy policy, it is almost certain that further new large scale renewable energy projects will be contracted and committed to construction over the coming years beyond what is already in place. Therefore, emissions are likely to continue to decline beyond 2027.
- The following chart (page 12) illustrates how renewable energy generation would continue to expand and emissions fall under a scenario in which Australia achieved its 82 per cent renewable energy generation target by 2030.
- The dashed green line illustrates the extra renewable energy that would be required to progressively bridge the gap to 82 per cent renewables by 2030.
- The grey dashed line illustrates how emissions would further decline as a result of that extra growth in renewable energy.
- Due to time lags involved in bringing new renewable energy projects online, this 82 per cent scenario only allows for new capacity additions from 2027 onwards.
- Under this scenario, electricity emissions in 2030 would be 180 million tonnes lower than emissions would have been with electricity demand satisfied by the 2015 generation fleet. Almost all of this abatement (178 million tonnes) would be a product of the growth in renewable energy.

Estimated electricity demand, emissions and post 2015 growth in renewable energy, including scenario where 82% Renewables Target met



This modelling only includes projects that are considered likely to happen and does not factor in other projects that may well be added. As a result, projected pace of demand outstrips current supply of renewables, hence the slight uptick in projected emissions seen around 2029. This highlights the need for acceleration in the renewables sector.

Methods and sources

- All generation data presented in this report are based on generation after deducting transmission and auxiliary (power station's own electricity consumption) power losses.
- Generation and emissions data is presented on a calendar year, not financial year basis.
- This approach of presenting generation after deducting losses and on a calendar year basis is different to how generation is usually presented in reports from the Australian Government and the Australian Energy Market Operator; therefore the information contained within this report will be slightly different to these commonly used data sources for generation and emissions information.
- Deducting losses is important to accurately assess the degree to which renewable energy will actually displace fossil fuel generation. As an example, a kilowatt-hour of electricity generated by rooftop solar at a consumer's home will displace more than a kilowatt-hour generated on site from a large coal generator because it also avoids the electricity losses the coal generator incurs in running the power plant and then transporting the power over power lines to the consumer's home. As an alternative example, a remotely located solar farm that loses 15 per cent of its generation through transmission will need to generate more than a kilowatt-hour of power to displace a gas generator's kilowatt-hour of power that is located in a capital city and loses little electricity in transmitting it to customers. This report's research attempts to account for this issue.
- Historical generation from renewable generators (other than baseline hydro power plants) is based on large-scale generation certificate creation data from the Clean Energy Regulator's Renewable Electricity Certificate Registry, which accounts for losses.
- Historical generation for almost all fossil fuel generators and baseline hydro power plants, as well as rooftop solar, is derived from Australian Energy Market Operator's generator data sourced via Global Roam's NEMReview software and adjusted for transmission and auxiliary loss factors.
- For some smaller grid-connected fossil fuel generators which are not metered by the Australian Energy Market Operator, generation was derived from the Clean Energy Regulator's Designated Generation Facilities Report.
- Emissions for fossil fuel generators were based on estimates of emissions intensity that were derived from emissions and generation data from the Clean Energy Regulator's Designated Generation Facilities Report (adjusted for transmission and auxiliary losses).
- Projected generation for renewable energy plants from 2024 onwards is based on Green Energy Market's Power Project Database. This database has developed estimates of likely future generation from large scale projects in operation, under construction, or contracted but not yet committed.
- Projected future rooftop solar generation is based on the Australian Energy Market Operator's 2024 Central Estimates.

REPORT AUTHOR:

Tristan Edis, Director – Analysis & Advisory, Green Energy Markets

Level 20, 180 Lonsdale Street
Melbourne VIC Australia 3000

+61 3 9929 4100
info@cleanenergycouncil.org.au

cleanenergycouncil.org.au