

# What Does Australia's Energy Future Look Like...?

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The article organises Australia's pathway around four commitments: accelerate electrification, build more renewable generation, develop long-duration energy storage and create hydrogen solutions for uses that are difficult to electrify directly. These elements are interdependent. Electrification moves buildings, transport and some industrial heat onto electricity; additional renewable generation supplies that demand; storage helps balance variable output; and hydrogen may serve selected feedstock, high-temperature or transport applications. For businesses, the sequence begins with efficiency and load understanding, followed by feasibility work that tests which technologies suit the site's temperatures, operating profile, network capacity, commercial constraints and emissions objectives.

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We all want clean air, zero pollution, and healthy communities... so how do we make that idyllic scenario a reality? One critical thing to address is the decarbonisation of our society through electrification, renewable energy, and hydrogen.

The Australian government has recently declared that it will reach net-zero emissions by 2050.

This commitment sounds nice... but what does it actually entail? Considering the Australian government has made a lot of statements supporting hydrogen technology while also maintaining plans to develop new gas-fired power stations, what could the energy mix of Australia's future look like?

If Australia is serious about its commitment to reach net-zero emissions and maintain energy security, there should be a commitment to:

- Incentivise electrification
- Deliver more clean renewable energy
- Implement long-duration energy storage
- Develop hydrogen solutions for hard-to-abate sectors

### #### Electrification of Society - Moving From Gas To Electricity

Electrification is transitioning a process from being powered by thermal energy, such as natural gas or oil, to being powered by electricity. While some heavy industry will be difficult to decarbonise through electricity, there are many household & commercial appliances as well as industrial processes that will need to modernize and transition to electric power. Beyond being good for the environment, this electrification also grants greater energy security as Australian oil refineries and reserves have taken a serious hit.

For residential homes and commercial buildings , solar systems with battery storage will become the norm. To optimise the use of solar power, homes and buildings will have to embrace electric cooking appliances and heat pumps for air conditioning and hot water needs.

For transport , greater adoption of electric vehicles will decarbonise the transportation sector. Both personal vehicles and the smaller commercial fleet will go electric, and a modern recharging station powered by a clean-energy grid will empower drivers with the freedom of travel without pollution. Long haul vehicles may end up using green hydrogen as their fuel source.

There are ways electrification can occur in heavy industry as well. For example, cement manufacturers will likely need to look at alternate fuel options and electric plasma arc burners as a way forward. Heavy industry, such as cement and steel manufacturing, are hard-to-abate sectors that will likely be supported by natural gas for a number of years still. For these heavy industries, decarbonization through energy efficiency is key. This could involve improving steam system efficiency or capturing waste heat from industrial processes for direct use or for electricity generation. Energy efficiency is a great way for businesses to decarbonize and should be the first step in the decarbonization process. It reduces the amount of energy that must be produced in the first place and frees up cash for other purposes. In our experience there is still much to be achieved through energy efficiency in Australian manufacturing.

Where electrification proves difficult, opportunity opens up down the road for combinations of green hydrogen and biogas from waste treatment as a natural gas substitute.

Electrification of society will naturally increase electricity demand - and renewable energy sources provide the clean energy solutions to bring the supply.

#### #### Renewable Energy - Solar & Wind Dominant Electric Grid

Renewable energy sources have to make up a larger share of Australia's energy profile. Currently, renewables only make up 7% of Australia's energy consumption, and only 24% of Australia's electricity generation comes from renewables. Biomass, photovoltaic solar, wind, and hydropower make up the overwhelming majority of that activity.

Biomass is currently the most heavily sourced renewable energy in Australia, but biomass carbon neutrality depends on regrowing plants to sequester atmospheric carbon, which may not make sense on a timetable that is relevant for keeping pace with the Paris Climate Agreement. The development of biomass should be a secondary choice behind other renewables like solar and wind power and requires careful regulation to ensure sustainable use.

Solar and wind both present huge potential, and they will be heavy players in the energy mix if Australia is to effectively decarbonise according to schedule. The good news is that solar and wind energy are trending in the right direction. Solar energy generation experienced a 42% increase in Australia over the past year while wind generation grew by 15%. That trajectory is set to continue as the development of Renewable Energy Zones progresses towards construction of thousands of megawatt solar and wind farms over the coming decade. Solar and wind are not only clean energy sources - they are also the lowest cost. Introducing more solar and wind capacity presents an excellent way for Australia to decarbonize while driving down energy costs.

In addition to utility-scale power, solar still has immense potential at the residential and commercial level. Solar provides Australians with the lowest levelized cost of energy. Beyond serving as a cheap, reliable, and clean energy source, residential solar offers benefits of distributed energy. It alleviates pressure on the larger grid, reduces the need for centralized power stations and increased capacity of transmission lines.

In some states, electricity generation contributes a significant portion of carbon emissions. In Victoria, for instance, half of all carbon emissions come from generating electricity. By transitioning from

fossil-fuel based electricity to clean, renewable power sources, Australia can make considerable progress towards a net-zero emissions economy.

Renewable energy sources provide extensive benefits, yet one thing that becomes necessary for the reliable operation of a clean energy grid is heavy-duty energy storage.

#### #### Energy Storage - Long-duration Storage & Hydrogen

Energy storage cannot be overlooked in the energy mix of the future. Long-duration storage is a novel concept in the realm of utility-scale energy supply, with pumped hydro the only form used at scale. Hydrogen is a very abundant element and can be used to store energy but generating it cleanly is currently expensive. One way or another, some form of heavy-duty energy storage is critical for an energy grid dominated by intermittent energy sources like wind and solar.

Even though solar power is fairly predictable, we cannot control the coming of night, just as we can't control how hard the wind blows onto wind farms. These factors highlight the importance of heavy-duty electricity storage which will be needed to supply electricity when direct supply is not available, such as at night or on windless days. Storage will also be needed to receive excess electricity so as not to destabilise the electric grid. Therefore, energy storage is important for both reliable electricity delivery and the smooth operation of an electricity grid powered by solar and wind.

There have been impressive advancements with lithium-ion battery technology, but that technology is best suited for emergency backup or peak-demand shaving due to the fact that lithium-ion batteries cannot deploy maximum output for more than 4-8 hours. Recent research has shown pathways to more environmentally friendly and cheaper battery storage for electricity.

There are a number of companies looking to solve the long term storage problem, which has led to the development of some innovative technologies and processes. One company that is emerging with promising technology is Form Energy, which has stated that its essential process involves the rusting and un-rusting of iron. In October 2020, a coalition of community choice aggregators in California, US - a progressive state that has repeatedly pushed the envelope on US environmentalism - released a request for proposals for 500 megawatts of long-duration storage capacity. This is a hallmark move for the industry, for once this problem is solved, it will make possible the development of a 100% clean-energy electric grid.

Hydrogen presents another solution to long-duration storage. Green hydrogen results from using clean energy sources to power the electrolysis of water to separate its oxygen and hydrogen constituents. This green hydrogen can then be deployed later in a gas turbine or fuel cell to generate electricity.. Some of the drawbacks of hydrogen are its high burning temperature and its low volumetric-energy density, unique qualities that will have to be considered when integrating it into existing energy infrastructure.

Hydrogen is not currently cost-competitive as a general energy source and has a large cost gap to overcome. Innovation, time, and effective market mechanisms will be important to make hydrogen a more viable option. This is crucial, as hydrogen will undoubtedly have an important role in providing long-duration energy storage within a clean energy grid.

#### #### Green Hydrogen Economy - Hydrogen to Tackle Hard-To-Abate Sectors

For those hard-to-abate sectors - heavy industry and heavy-duty transport which contribute roughly 30% of global CO2 emissions - there is significant opportunity for hydrogen to step in where electrification seems unfeasible.

Chemical feedstock - Hydrogen is already widely used as a chemical feedstock for many industrial processes, such as oil refining and ammonia production. Although hydrogen is extremely abundant, it's not found in nature as an isolated element. Hydrogen must be extracted from compounds in an energy-intensive process and unfortunately, most of the hydrogen in Australia (and the rest of the

world) is extracted from fossil fuel sources, resulting in carbon emissions. Because it's produced from fossil fuel sources, it is called grey hydrogen. By replacing grey hydrogen with green hydrogen, Australia can decarbonise processes that are already heavily hydrogen dependent.

Steel manufacturing - Steel is a primary material used in construction, manufacturing, and transport. Manufacturing steel typically involves using carbon as a reducing agent to remove oxygen from iron ore - a process that creates CO<sub>2</sub> emissions. This emission heavy process could be significantly decarbonised by replacing carbon with green hydrogen as the reducing agent.

Apart from serving as the reducing agent, hydrogen can also be the fuel source to generate the high process heat needed for steel production.

A steel production process using green hydrogen as the fuel source and reducing agent is currently being developed in Sweden with the aim of developing a commercial scale process for fossil-free steel around 2026. The first batch has already been produced in the pilot plant.

Transportation fuel - Hydrogen can play a role in aviation and long-haul shipping. Given its drawbacks, it seems unlikely that pure hydrogen will be widely adopted for commercial aviation. Airports would need to build new airport infrastructure to accommodate hydrogen storage. The low energy density of hydrogen gas means that using it as a fuel source aboard planes would require heavy and complex storage and an increase in the size of aeroplanes. Considering these costs it seems much more likely that hydrogen will be used as a precursor ingredient to produce synthetic jet fuel.

Shipping, on the other hand, doesn't encounter the same problems as aviation when facing hydrogen's low energy density. By using green hydrogen to power gas turbines or fuel cells, the shipping industry can drastically reduce its greenhouse gas emissions.

A 100% clean-energy economy requires a radical transformation of both demand-side and supply-side behaviour. While there is still a need for innovative development to fully realize this future energy mix, many technologies are already available today. Through energy efficiency improvements, electrification, and the adoption of renewable energy, businesses and organizations can make leaps toward reaching their own decarbonisation goals... achievements that will play into the broader narrative of Australia's journey to net-zero emissions.

With low carbon technologies and solutions available today, it requires the will of people and businesses to create Australia's energy future - a future that will establish economic prosperity, energy security, and a thriving legacy for our country.

### ## Procurement context

Check the current market date, contract term, meter and load data, instrument ownership and retirement evidence before making a purchasing or public claim.

### ## Related guidance

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Read the original article for the source publication and its full context.

### ### What four changes does the article say are central to Australia's energy future?

The article organises Australia's pathway around four commitments: accelerate electrification, build more renewable generation, develop long-duration energy storage and create hydrogen solutions for uses that are difficult to electrify directly. These elements are interdependent. Electrification moves buildings, transport and some industrial heat onto electricity; additional renewable generation supplies

that demand; storage helps balance variable output; and hydrogen may serve selected feedstock, high-temperature or transport applications. For businesses, the sequence begins with efficiency and load understanding, followed by feasibility work that tests which technologies suit the site's temperatures, operating profile, network capacity, commercial constraints and emissions objectives.

### What does electrification mean for buildings, transport and industry?

Electrification replaces processes powered directly by fossil fuels with equipment powered by electricity. The article points to electric cooking, heat pumps, electric vehicles and charging infrastructure in buildings and transport. Industrial applications are more varied: lower-temperature heat and auxiliary systems may electrify readily, while cement, steel and other high-temperature processes face harder technical constraints. A sound electrification study maps the existing energy service, required temperature and duty cycle, available electrical capacity, tariff exposure and operational risk. It should compare staged options and include efficiency improvements so new electrical equipment is not sized around avoidable energy waste.

### Why does the article treat energy efficiency as the first step for hard-to-abate industry?

Heavy industry may continue using combustion fuels where direct electrification is technically difficult, expensive or unable to meet process requirements. The article therefore places efficiency first: improve steam-system performance, reduce heat loss, optimise controls and recover waste heat for direct reuse or power generation. These measures lower fuel demand and emissions immediately while reducing the scale of later electrification, renewable heat or hydrogen infrastructure. Our approach begins with audits, metering and feasibility assessment, then separates estimated opportunities from implemented and verified results. This creates a defensible baseline and an investment pipeline instead of relying on a distant technology change to deliver every reduction.

### How does renewable generation support Australia's shift away from fossil fuels?

The article describes rapid growth in solar and wind and argues that further renewable generation is necessary as electricity demand rises through electrification. It also treats renewable sources differently rather than assuming each has the same emissions profile or development constraint. Biomass, for example, depends on feedstock, regrowth and carbon-accounting assumptions, while solar and wind output varies with weather and time. At business level, organisations can combine onsite generation, energy efficiency and renewable electricity procurement. The commercial assessment should consider load matching, export limits, network costs, certificate ownership, maintenance, operating life and the reporting framework used for renewable-electricity claims.

### Why is long-duration energy storage important, and what limitations does the article identify?

More variable renewable generation increases the need to shift energy across hours or longer periods when supply and demand do not align. The article distinguishes short-duration lithium-ion batteries, which are effective for peak management, backup and daily cycling, from storage required to cover longer gaps. Pumped hydro is cited as the established large-scale option, while emerging technologies and hydrogen may serve longer-duration roles but face cost, efficiency, infrastructure or maturity challenges. A site-level storage case should therefore define the service required—demand reduction, resilience, market participation or renewable matching—before selecting technology or calculating savings.

### What role could green hydrogen play in hard-to-abate sectors?

Green hydrogen is produced by using renewable electricity to split water through electrolysis. The article identifies potential roles as a chemical feedstock, a reducing agent and fuel in steelmaking, and an energy carrier for parts of shipping or other heavy transport. It also notes that hydrogen's low volumetric energy density, conversion losses and infrastructure needs make direct use less attractive in many applications, including broad commercial aviation. Businesses should compare hydrogen with

direct electrification, efficiency, renewable heat and process redesign on a common basis. Feasibility should include supply, storage, safety, equipment integration, electricity demand, cost and the credibility of the renewable input.

### How should a business evaluate batteries, hydrogen and other emerging energy technologies?

Begin with the operational problem rather than the technology. Define the required power, energy duration, temperature, availability, response time, site constraints and decision horizon. Establish the current energy and cost baseline, then compare alternatives using consistent capital, operating, maintenance and emissions assumptions. Separate demonstrated performance from vendor forecasts and include integration costs, network upgrades, certificate treatment and any conditional funding. Pilot or staged deployment may be appropriate where performance or commercial terms remain uncertain. Measurement and verification should be planned before implementation so the organisation can determine whether the technology delivered its intended operational, financial and emissions outcomes.

### What practical energy strategy follows from the article's view of Australia's future?

A practical strategy starts with efficiency because avoided consumption reduces cost and the size of every subsequent supply investment. The organisation can then electrify suitable loads, add onsite renewables where the site and load profile support them, and develop a procurement plan for remaining electricity. Storage should be selected for a defined operational or market service. Hard-to-abate processes need targeted studies covering renewable heat, alternative fuels, hydrogen or carbon-management options. Each project should move through feasibility, funding and certificate assessment, delivery and measurement. Regular performance reviews then compare actual results with forecasts and update the transition plan as technologies, tariffs and policy change.