energetics

# Capital markets are leading the way to net zero

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# About Energetics

Working with ASX200 and all levels of government, Energetics is a s pecialist energy and climate change risk management consultancy.

**We're more than carbon neutral. Sustainability is core to Energetics' business.**

In June 2008, Energetics became one of Australia's first consulting firms to achieve carbon neutrality through the Australian Government's Greenhouse Friendly Program. In 2019 we became a 'Climate Active' certified organisation and in 2020 we added our services to our Climate Active certification. In 2021 we achieved a significant milestone when our science based target (SBT) was verified by the global Science Based Targets initiative (SBTi).

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# Table of contents

Climate change is "widespread, rapid and intensifying".

**United Nations Intergovernmental Panel on Climate Change (IPCC), Sixth Assessment Report, 9 August, 2021.**

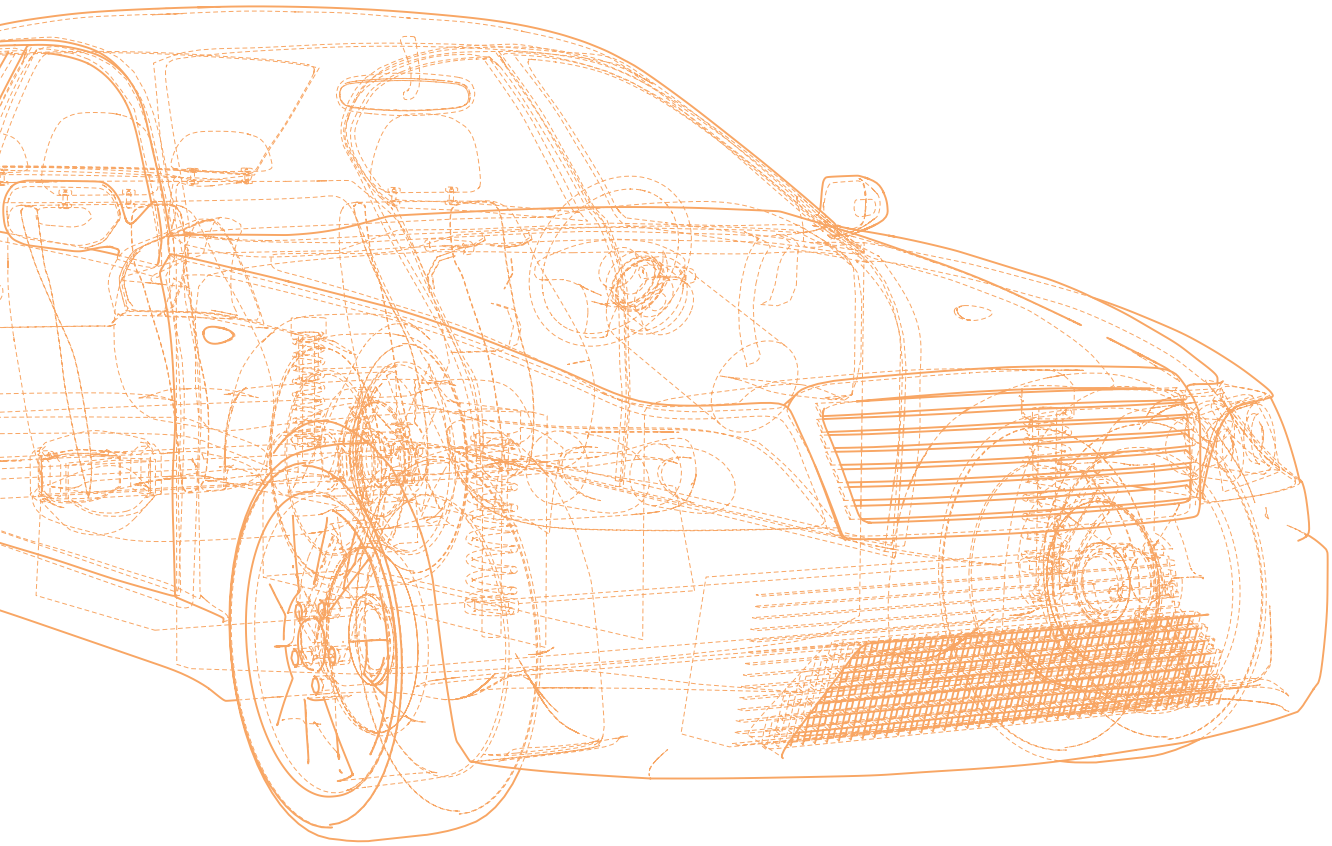
For the world to avoid damaging temperature rises, global emissions must reach net zero before 2050. Realising this goal requires new low emissions technologies and capital markets willing to support these technologies. The global capital markets are now aligning with the goal as seen by the actions of investors and regulators who realise that climate change poses a risk to existing and future investments. Further, capital markets are willing to invest in cost effective low emissions technologies. The evidence can be seen in the growth of solar PV and wind generation. However much more is needed.

Some technologies that are expected to be part of a zero emissions world are in place today. As well as renewable electricity generation, we can add electric vehicles. However, many net zero technologies do not exist, or if they do exist, have not been commercialised or deployed at scale.

So, while the impetus to support net zero is clear, what can we expect of the transition?

The International Energy Agency (IEA) forecasts that the total annual investment in energy infrastructure will rise to $US5 trillion by 2030, adding an extra 0.4% point a year to annual global GDP growth, and this is likely a conservative assessment. This suggests that the transition to a low emissions world will not create a cost burden but instead offer positive outcomes to investors.

This paper examines emerging views of the capital markets regarding climate risk and how the need to address climate change risk is beginning to direct the vast resources of the world's capital markets. The paper then explores low cost, low emissions technologies and how they can potentially change the market by offering solutions for emissions abatement that do not incur an economic penalty.



# Renewable energy is ‘business as usual’: cheaper and now less risky than fossil fuel based generation

GenCost, a collaboration between CSIRO and the Australian Energy Market Operator (AEMO) to deliver an annual process of updating electricity generation and storage costs, released its most recent report in June 2021[1]. The headline graph included in Figure 1 highlights two important issues.

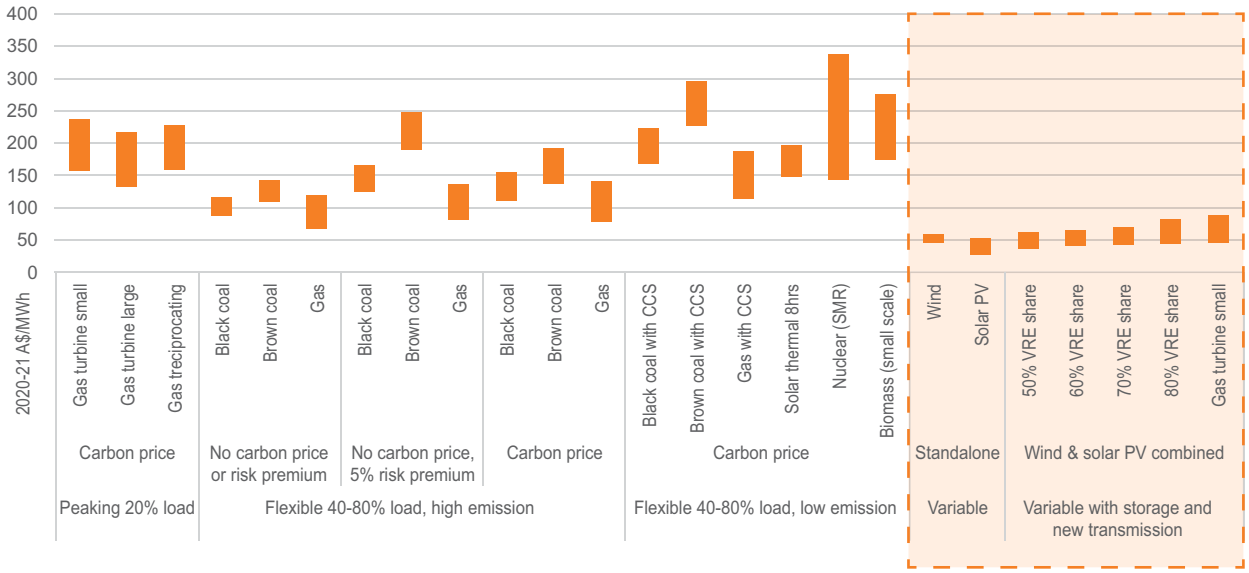



**Figure 1: Calculated Levelised Cost of Energy (LCOE) by technology and category for 2030[2]**

The first insight to be drawn from Figure 1 is confirmation that renewable generation remains the lowest cost option for new generation capacity, even after accounting for the cost of grid integration of variable renewable generators. Further, fully integrated variable renewable generators are more attractive even before the so-called 'climate policy risk premium' is applied to the cost of fossil fuel fired generation, which is the second of the issues highlighted by the graph.

> The 'climate policy risk premium' now applies to the cost of fossil fuel fired generation.

The climate (policy) risk premium reflects the view of the capital markets, by investors, of the financial risk associated with an investment in power generation. Until recently, this risk premium applied to variable renewable generators and led to policy instruments such as the Renewable Energy Target that support investment in renewable generation. In 2021 it applies to fossil fuel fired generators. We see this turnaround in the proposal of the Australian Government to build a new gas-fired power station[3] as the private sector is not willing to invest in new fossil fuel fired power stations.

The lower cost of renewable generation coupled with its associated low emissions means that this decarbonisation technology is now considered business as usual.

As we enter a decisive decade in which global emissions must fall dramatically, what will drive new, major decarbonisation technologies out of the lab into commercialisation and ultimately to become business as usual?

1 CSIRO | GenCost 2020-21: Final report
2 Ibid
3 ABC News | Why is the government going to build a gas-fired power station at Kurri Kurri?

# The times are a changing: the net zero investor movement

On 10 June 2021, 457 investors that manage more than US$41 trillion in assets released a joint statement to all world governments urging a global race-to-the-top on climate policy, and warning that nations and businesses will miss out on trillions of dollars in investment if they aim too low and move too slow[4]. This statement called on governments to commit to a domestic mid-century, net zero emissions target and outline a pathway with ambitious interim targets including clear decarbonisation roadmaps for each carbon-intensive sector. Further, these global investors saw domestic policies that supported private investments in zero emissions solutions as central to achieving the net zero goals. The policies could include, "a robust carbon pricing, the removal of fossil fuel subsidies by set deadlines, the phase out of thermal coal-based electricity generation by set deadlines in line with credible 1.5°C temperature pathways, the avoidance of new carbon-intensive infrastructure (eg. no new coal power plants) and the development of just transition plans for affected workers and communities"[5].

In the Global Investor Statement to Governments the investors highlighted several key themes. First, the objective is to mobilise private sector capital to achieve the necessary reductions in emissions. This is a recognition that the magnitude of investment required is beyond the capacity of governments to fund.

Secondly, a mixture of market-based measures such as carbon pricing and the removal of subsidies, and non-market-based measures such as the phasing out of thermal coal-based electricity generation is required. The role of market-based measures versus non-market-based measures to drive the transition to net zero emissions is discussed in more detail later in this report, but one key consideration is the value of market-based mechanisms in driving rapid technological change.

Finally, the investors recognise the impact that the transition to net zero emissions will have and the need to plan to mitigate its financial impacts. This is a key factor when considering the role of governments in facilitating the transition. There will be winners and losers in the transition, which brings the challenge of politics to an already complex problem.

The pivotal role of financial stakeholders in managing the challenges arising from climate change is reflected in the position of BlackRock, the world's largest asset manager. In its most recent letter to the global community of CEOs, BlackRock called on investors to assess climate change impact[6]. BlackRock has formed the view that all investors need to factor climate change into their decision making. Additionally, BlackRock stated that accounting for climate change does not equate to accepting lower returns.

The quickly accelerating net zero investor movement provides two insights:

**Financial data is necessary to assess climate risk on investments**

Investors require financial data to assess the impact or the risk of climate change on their current or prospective investments, and this requires a robust approach. This is the domain of the Taskforce for Climate-related Financial Disclosure[7] (TCFD).

**Financial risk assessments that incorporate climate risk are increasingly informing decision making in global capital markets**

While the challenge of quantifying climate change risk has been examined in the literature[8], assessments of financial risk associated with climate change are increasingly informing decision making in global capital markets. Investors will play an increasing role in financing the transition to net zero emissions as they see less risk associated with businesses leading the transition[9].

4 *The Investor Agenda | 2021 Global Investor Statement to Governments on the Climate Crisis*
5 Ibid
6 *Reuters | Funds leader BlackRock calls on investors to assess climate change impact*
7 *Task Force on Climate-related Financial Disclosures*
8 *Fiedler et al. | Business risk and the emergence of climate analytics*
9 *Energetics | Net zero commitments: what role are investors playing?*

# Initiatives from the financial regulators

Financial regulators are taking more aggressive positions on how businesses should report the impact of climate change on their operations. In fact, the TCFD is an initiative of the Financial Stability Board (FSB), as the FSB was concerned about the growing climate-related risks to assets. Individual central banks and regulators are now taking action. Amidst many examples is France's Article 173, which is driving a move from voluntary reporting of climate related risk to mandatory reporting of the risk[10]. Financial regulators in Australia are part of this trend:

- The Australian Prudential Regulation Authority (APRA) has recognised that banks, insurers, and superannuation trustees need to properly manage the financial risks of climate change[11], and ensure that their financial assets are not compromised. To this end, APRA has begun a series of Climate Vulnerability Assessments (CVAs) of the major Australian banks[12].
- The Australian Securities and Investments Commission (ASIC), Australia's watchdog for the corporate, markets and financial services, has launched a crackdown on the practice of 'greenwashing' where companies embellish their environmental credentials to court favour with investors interested in financing the transition to net zero carbon emissions[13].

As a result, considerations of climate change risk are altering the direction of capital allocation. Funds are being made available to businesses that are most likely to actively manage the transition to net zero emissions – acknowledging and rewarding shifts in business models.

The challenge for regulators and for the capital markets is the assessment of risk. The emerging awareness of climate-related financial risks has prompted efforts to integrate knowledge of climate change risks into financial decision making and disclosures, but the rules by which climate science can be used to inform assessments of climate-related financial risk have not yet been developed. With this in mind, Fiedler et al (2021)[8] looked at the science behind assessing the physical risk of climate change. They noted that business and regulators want to measure and assess climate risk at a far greater level of detail than currently seen in many physical risk assessments. For such modelling, a deeper engagement with climate science is needed[8]. The consequence of a failure to properly assess risk can result, in worst-case scenarios being considered, a refusal of insurance companies to provide insurance cover for certain types of long-life assets because they cannot quantify the risks those assets face[14].

The assessment of risks due to the impact of policies and technology on existing businesses and their assets is also challenging, for the following reasons:

**Government policies are slave to politics.** Fearing electoral consequences, many politicians shy away from carbon taxes and other market-based strategies. The interaction between policy development and people, namely the 'winners' and the 'loser' was explored by Peng et al (2021)[15]. They noted that models that assess the impact of policies on climate outcomes often fail to account for the role of politics and the way that political leaders respond to the views of the electorate. We have seen this in Australia, with the demise of several Prime Ministers and opposition leaders being linked to domestic climate change politics. Therefore, the policy certainty that investors seek may never be guaranteed especially if the policies lead to increases in costs for essential services such as energy.

**Transition risks are linked to technology.** The potential emergence of low cost, low emissions technologies introduces risks to businesses that rely on an existing technology framework. While businesses themselves will take actions to mitigate the transition risks and they may receive some form of government support, the potential for disruption remains.

**Government policies and technology interact.** The widespread uptake of low emissions technologies could reduce the need for policy interventions that put a price on emissions. Instead, governments can pursue policies that directly drive innovation.

The role of technology and the policies that support innovation are discussed below. But first, it is worth having a closer look at the role of the capital markets.

10 *IPE | ESG: France's Article 173: taking stock*
11 *APRA | Understanding and managing the financial risks of climate change*
12 *APRA | APRA's response to climate-related financial risks*
13 *The Australian | ASIC's 'greenwashing' crackdown on dubious ESG claims*
14 *Energetics | How will the changing climate impact the risk profile of assets?*
15 *Peng et al. | Climate policy models need to get real about people — here's how*

# The role of the financial markets: the transition to low emissions need not be costly

The view of the International Energy Agency (IEA) on the role of the financial markets is clear.

> Accelerated delivery of international public finance will be critical to energy transitions, especially in developing economies, but ultimately the private sector will need to finance most of the extra investment required. Mobilising the capital for large-scale infrastructure calls for closer co-operation between developers, investors, public financial institutions and governments. Reducing risks for investors will be essential to ensure successful and affordable clean energy transitions. Many emerging market and developing economies, which rely mainly on public funding for new energy projects and industrial facilities, will need to reform their policy and regulatory frameworks to attract more private finance. International flows of long-term capital to these economies will be needed to support the development of both existing and emerging clean energy technologies[16].

The IEA forecasts that the total annual investment in energy infrastructure will rise to $US5 trillion by 2030 and this adds an extra 0.4% point a year to annual global GDP growth. This suggests that the transition to a low emissions world will not create a cost burden but instead offer positive outcomes to investors.

The global capital markets are large. Global GDP was around $US84 trillion in 2019[17]. In the same year, the global bond market (the value of outstanding issues) was worth $US124 trillion and the value of the global equities market was $US106 trillion[18]. While this is not a true comparison as GDP and capital value are not comparable, it does indicate the size of the global capital markets. Two factors are important. First, the global capital markets are large enough to finance the transition to net zero emissions. They do not need to rely on government support beyond a stable investment environment.

Second, very little global capital is currently directed towards the transition to a low emissions future. While sustainable investing started in equities, strong demand from investors and policy support saw the emergence of green bonds, growing the stock to an estimated $590 billion in 2019 from $78 billion in 2015[19]. However, it still represents a small fraction of the total capital market and has considerable room to grow. The low carbon transition could require $3.5 trillion in energy sector investment every year for decades which is twice the current rate; a total estimated $90 trillion in infrastructure investment is required between 2015 and 2030[20].

The financial system can play a fundamental role in the pathway to net zero by mobilising the resources needed for investments in climate mitigation as well as adaptation. While it is tempting to focus solely on instruments such as government mandated carbon prices, the greater impact will come as businesses and investors become more aware of the risks associated with climate change (the stick) but also the opportunities that arise from the development and deployment of low cost, low emissions technologies (the carrot).

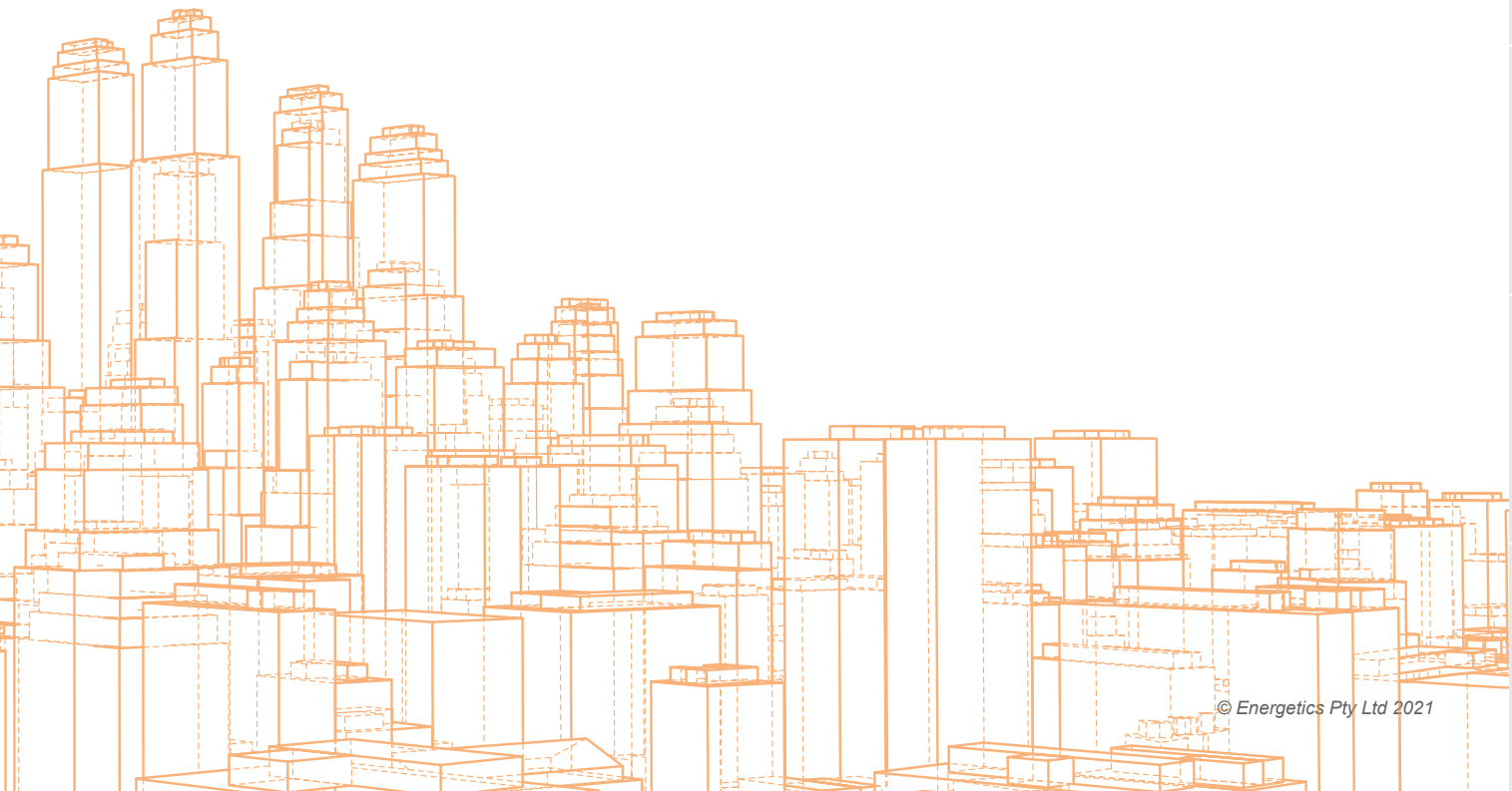
16 *IEA | Net Zero by 2050 A Roadmap for the Global Energy Sector*
17 *Global gross domestic product (GDP) at current prices from 1985 to 2026*
18 *2021 SIFMA Capital Markets Fact Book*
19 *Grippa, Schmittmann, and Suntheim | Climate Change and Financial Risk*
20 *Carney | Fifty Shades of Green*

# A review: investment money is flowing and low emissions technologies are not an economic wrecking ball

In the first half of this paper, we have given an example of a low emissions technology that is now business as usual. The technology is renewable power generation, and it is a very important one because of the contribution of electricity generation to global greenhouse gas emissions. We could also discuss other benefits of renewable power generation such as bringing electricity to remote parts of the developing world without requiring extensive networks to be built. However, this is not necessary. The low cost of renewable power generation says it all.

As outlined, investors are now alert to the risks posed by climate change and are implementing investment strategies to mitigate these risks. Financial regulators are also aware and are seeking to ensure that organisations take account of these risks. Finally, we commented on the size of the financial market and its role in funding the transition to net zero emissions. In summary, one can say that the capital markets see the value in redirecting investment so that it aligns with a low carbon future.

> The low cost of renewable power generation says it all.



# Appraising different technology options: what they offer now and could potentially offer into the future

The impact of low cost, low emissions technologies is reflected in Figure 1, which shows how variable renewable power generators are now the lowest cost source of electricity. While the challenge of building a power network around the renewable generation cannot be ignored, renewable generation has begun to displace fossil fuel fired generators as the preferred investment in power generation.

Figure 2 shows the reason why variable renewable power generators (in this case, solar PV) are now the lowest cost source of electricity. The rapid reduction in the cost of solar PV systems saw them move from being a niche technology in need of policy support, to business as usual.

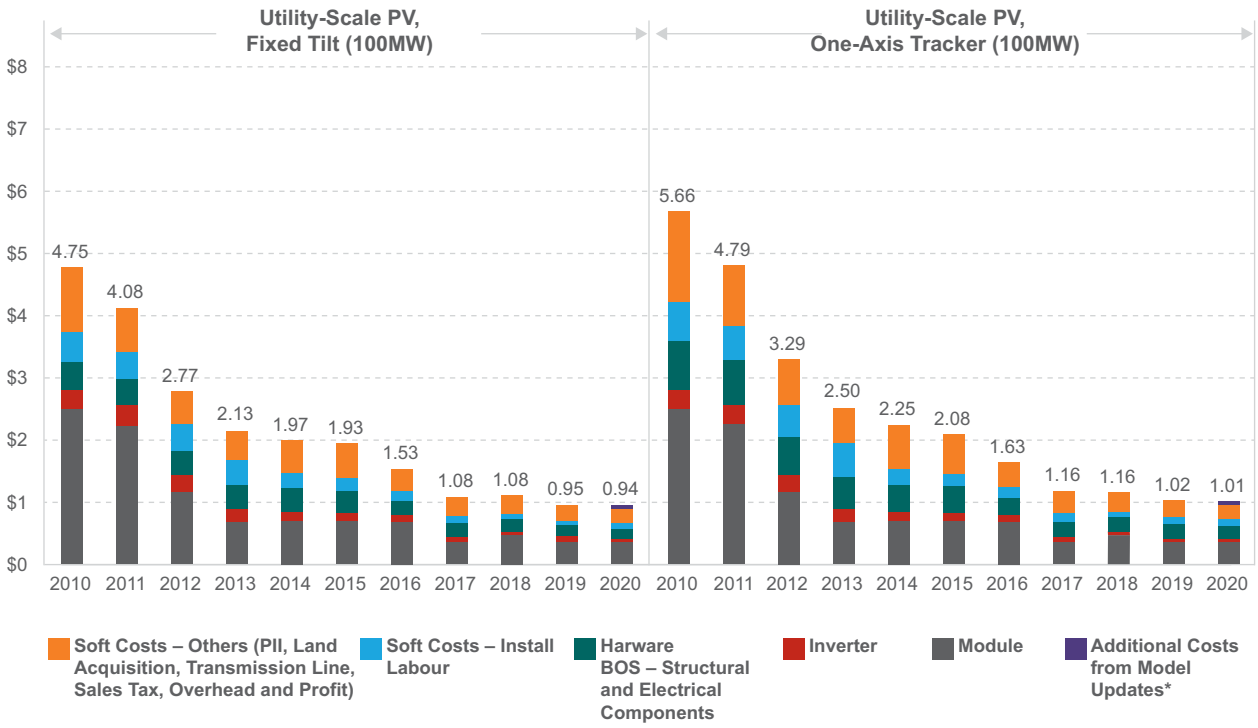



**Figure 2: Installed cost of solar PV systems[21]**

Many of the technologies identified as playing a role in global decarbonisation are on the road to being a low cost, business as usual technology. Batteries are an example. Figure 3 shows the observed battery prices and the downward trend is clear.

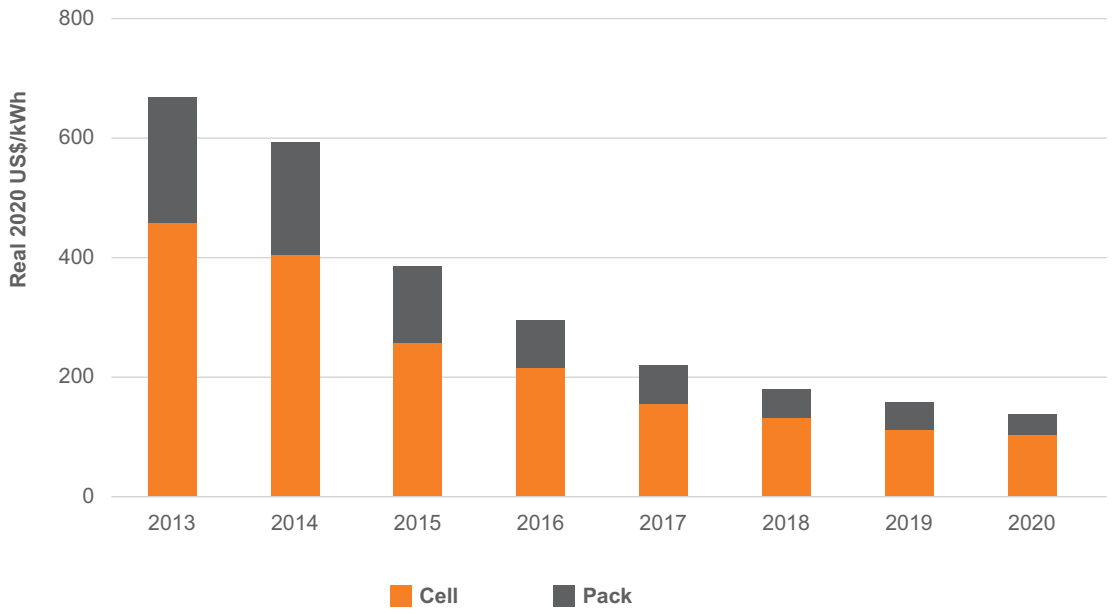



**Figure 3: Historical battery prices showing a clear downward trend[22]**

Projected prices are in Figure 4. It shows how the trend in battery prices is expected to continue.

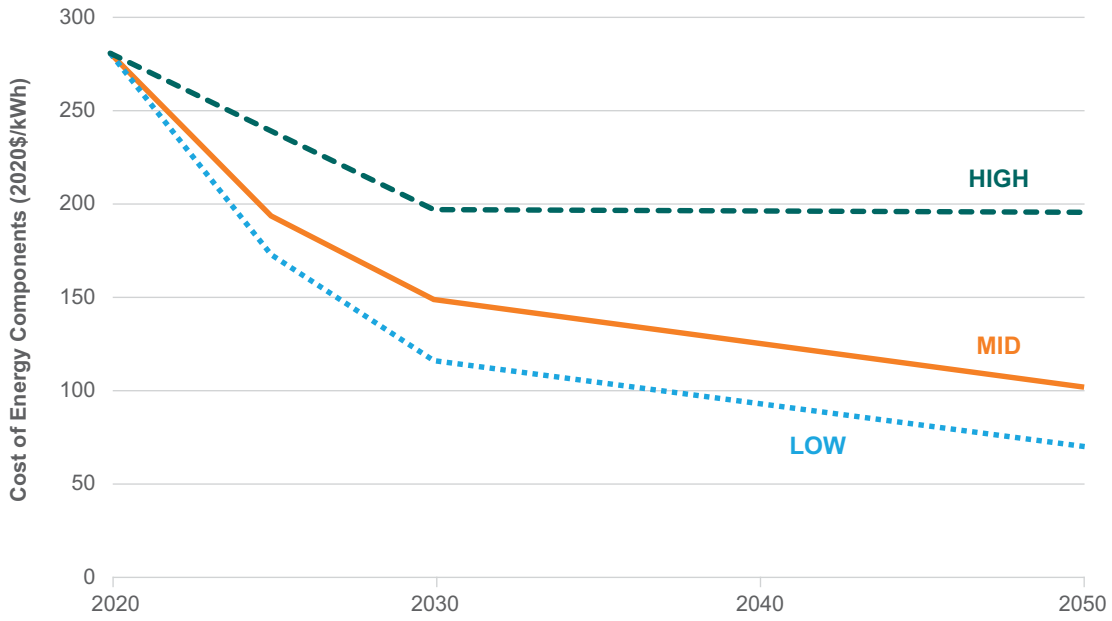



**Figure 4: Projected battery prices[23]**



22 Bloomberg | Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh
23 W Cole, W Frazier and C Augustine | Cost Projections for Utility Scale Battery Storage: 2021 Update

The role of falling battery prices on EV affordability is in Figure 5. As the cost of an EV approaches that of a ICEV, the lower operating cost of a BEV will mean the lifetime cost of the BEV is well below the cost of an ICEV.

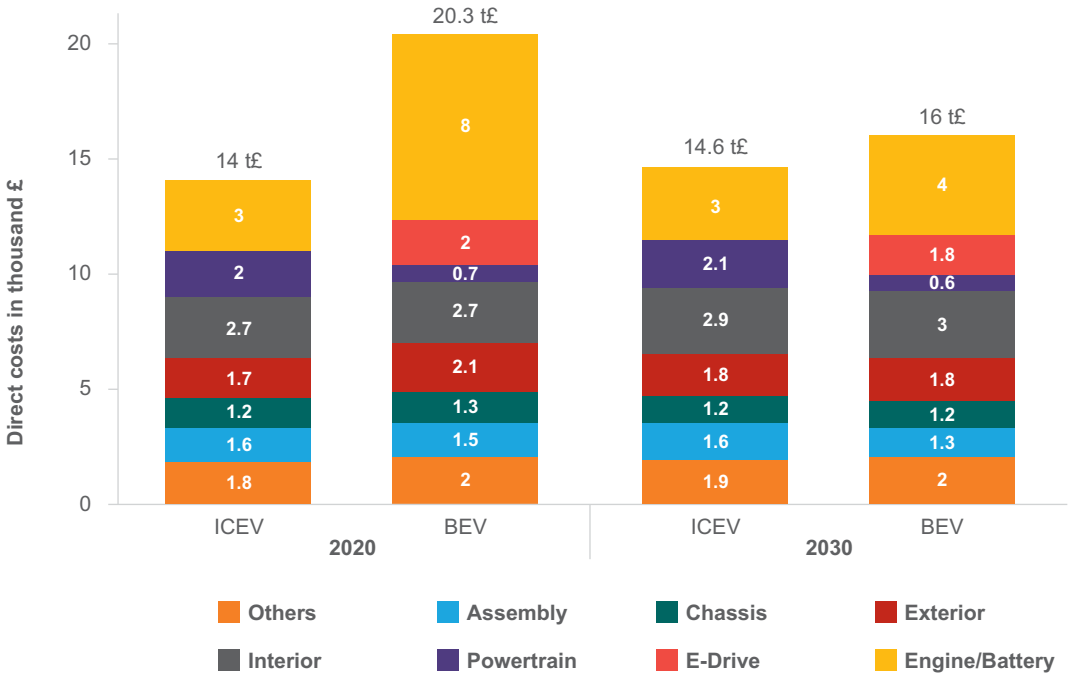



**Figure 5: Cost structure of current and future BEVs compared to ICEVs[24]**

While there is no guarantee that battery prices will continue to fall, the trends in Figure 3 and Figure 4 are encouraging. As with solar PV, the falling prices of batteries will come from a combination of improved technology in new battery chemistries[25,26], or electrode materials[27], and production at scale. As an example, consider the battery technology developed to the point of commercialisation by Form Energy[28]. Their air breathing iron-iron oxide battery offers a route to very low cost, multi-day battery storage. Importantly, Form Energy is supported by a large volume of private (venture) capital which is willing to balance the risk of failure with the promise of large returns. Further, the acceleration of battery deployment into existing cost-effective grid-scale applications will drive down production costs.

Examples of technologies to reduce emissions from power generation and light vehicle transport are well used. Unfortunately, options for abating other sources of emissions such as heavy vehicle transport, various industrial heating and materials conversion tasks and emissions from agriculture are less clear. Many technologies have been proposed. However, it is difficult to know whether these technologies will be cost effective before 2050 and so their role in decarbonisation could well be driven by policy intervention (at a net cost to society), rather than being the technology of choice by consumers or investors. While hydrogen as a potential zero emissions replacement fuel and reductant in conversion processes is the obvious example, the example explored below addresses emissions due to agriculture.

24 *König et al. | An Overview of Parameter and Cost for Battery Electric Vehicles*
25 *Forbes | What Batteries Will Power the Future?*
26 *University of Tokyo | A new battery chemistry promises safer high-voltage lithium-ion batteries*
27 *National Research Council of Science & Technology | Researchers develop new electrode structure for all-solid-state secondary battery*
28 *Form Energy | Enabling a 100% Renewable Grid*

Livestock production is the largest anthropogenic source in the global methane budget[29]. Enteric fermentation from ruminants dominates this source. Livestock manure management makes a smaller contribution[30]. Reducing enteric emissions means either reducing meat consumption, finding alternative sources of protein, or reducing emissions from cattle and other ruminants. The first option requires changes to human behaviour and preferences, an activity that is always challenging. The second is the domain of technologies such as factory grown meat and is being explored by several businesses[31]. The third approach looks at changing the diet of ruminants to reduce the formation of methane in their guts.

Several studies[32-33], have demonstrated that feeding livestock certain species of seaweed such as tropical/subtropical red seaweed *Asparagopsis taxiformis* can reduce methane emissions by up to 95% while increasing the weight of the animals. The latter result is important because it has the potential to deliver more productive herds and provide a financial benefit that offsets the cost of the seaweed additives. Therefore, the low emissions technology may not rely on either policy interventions or a price on emissions to be adopted.

Taking the example of enteric emissions, the question arises as to how best to facilitate the commercialisation of cost effective, low emissions technologies. Looking back at the historical cost of solar PV, it is fair to say that we would not have low-cost solar PV (and other renewable generation options such as wind) without strong policy interventions such as the Renewable Energy Target in Australia. These interventions encouraged uptake of the technologies at scale which in turn drove down the price to the point where the policy levers are no longer required. This raises the question of the appropriate type and duration of policy interventions needed to facilitate the transformation for net zero emissions.

The question of driving innovation is explored in the next section. But first, it is useful to consider the balance between short-term outcomes and long-term outcomes. For deep greenhouse gas emission reductions, a long-term perspective on costs is essential[34]. Some activities that appear expensive in the short-term may turn out to be low-cost approaches in the long-term, because of induced innovation. Mobile phones are a good example. They were once very expensive but today, how many homes rely on a fixed phone line? Climate change is a long-term, intergenerational problem, and technological change and innovation are central to longer-term efforts to reduce greenhouse gas emissions.

> When society chooses how best to address climate change, the optimal long-term decision may differ from the short-term, often myopic decision. It may make sense to support emerging clean technologies that currently appear expensive but have promise of significantly reducing costs in the future if policy support offered today for these technologies helps them realise their low-cost potential[35,36].

The challenge for policy makers is to let go of technologies that are not living up to their promise, and which are unlikely to be well received by the market. Doggedly supporting technologies to the point where the market rejects them is costly and underpins concerns about governments seeking (unsuccessfully) to ‘pick winners’.

29 *Dept Industry, Science, Energy and Resources | NGGII Paris Agreement Inventory*
30 *Chang et al. | Revisiting enteric methane emissions from domestic ruminants and their δ13CCH4 source signature*
31 *The Guardian | Lab-grown meat firms attract sixfold increase in investment*
32 *Vijn et al. | Key Considerations for the Use of Seaweed to Reduce Enteric Methane Emissions From Cattle*
33 *CSIRO | FutureFeed*
34 *Gillingham | Carbon Calculus*
35 *Acemoglu et al. | Transition to Clean Technology*
36 *Vogt-Schilb, Meunier and Hallegatte | When Starting with the Most Expensive Option Makes Sense: Optimal Timing, Cost and Sectoral Allocation of Abatement Investment*

While it is not easy to foresee how a technology will develop, we know that mature technologies are less likely to see major leaps than emerging ones. This would mean that carbon capture and storage (CCS), which is an assembly of well understood technologies, may only have a minor role in decarbonisation, whereas emerging technologies such as photocatalysts for direct hydrogen production may prove to be critical technologies as they emerge from the laboratory and are deployed at scale.

If the solution to human induced climate change is the development of low emissions, low cost technologies, then policies that support the identification and commercialisation of technologies rather than the meeting of short-term emissions reduction targets, offer greater value. In the Australia context, this means that ARENA and the CEFC are appropriate but that the Safeguard Mechanism and the Climate Solutions Fund are not. In addition, policies that support technologies that never have a benefit other than reducing emissions, should not be supported. By this latter measure, CCS may not be part of the future. Similarly, nature based climate solutions should have limited appeal unless linked to other beneficial outcomes such as biodiversity, improved farm productivity and restoration of degraded land.

# Unleashing innovation

Focused effort can result in dramatic advances in technology. Figure 6 show the state of aircraft in 1903 when the Wright brothers achieved the first powered, controlled, sustained flight of a heavier than air vehicle.

**Figure 6: The first powered, controlled, sustained flight in 1903[37]**

Figure 7 shows some of the aeroplanes seen in the USA around 1938. The 35 years between 1903 and 1938 had seen improvements in technology – larger planes, monoplanes, larger engines but still with propellers, driven by piston engines but at a relatively slow pace. Many of the planes in the air in 1938 were biplanes like the Wright Flyer and made from similar materials.

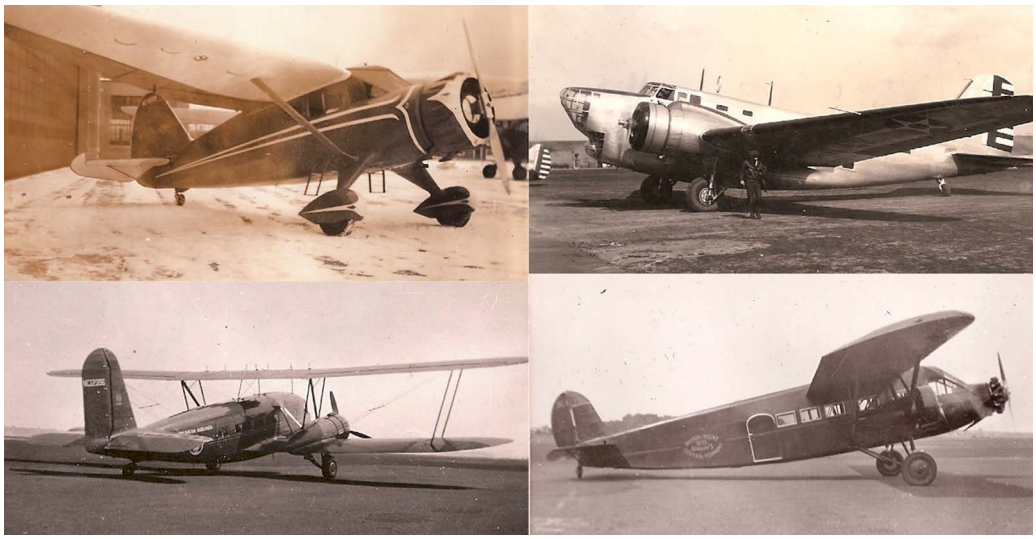


**Figure 7: Planes in operation in 1938[38]**

An aeroplane that started flying in 1943 is shown in Figure 8. The massive funds directed towards technology development during World War II saw dramatic improvements and the emergence of jet powered aircraft.

37 Library of Congress
38 *Acepilots | Aircraft photos – 1936 - 1938*

**Figure 8: The start of the jet age – the Gloster Meteor in 1943**[39]

Aeroplanes are an obvious example of the impact of focused R&D during times of national crisis. Another is medicine, where WW2 saw the widespread adoption of antibiotics. Prior to antibiotics, infectious disease was the leading cause of death worldwide[40].

A more recent example is the development of the COVID-19 vaccines where focused R&D coupled with a global sense of urgency reduced the typical 10 years to develop a vaccine to a few months[41].

For the world to avoid damaging temperature rises, emissions must fall to near zero by 2050. Many of the technologies that are needed to maintain or advance living standards throughout the world while not adding to greenhouse gas emissions do not exist; or if they do exist have not been commercialised or deployed at scale. While offsets from nature-based emissions abatement are put forward to reduce emissions, the volume of abatement available through nature based solutions is limited. Maximising the amount of vegetation all land on Earth could hold would offset about 10 years of greenhouse gas emissions at current rates. After that, there could be no further increase in carbon capture in the biosphere[42].

Mazzucato et al (2020)[43] argue that if businesses are confident about future technological and market opportunities, they will invest and innovate. Therefore, when looking at policies that could facilitate the deployment of large volumes of private capital towards the development of low emissions technologies, policy makers should seek to stimulate demand for these technologies. Businesses will see where future growth opportunities might lie and will have incentives to invest in those areas.

39 BAE Systems
40 *Foreign Policy Research Institute | Advances in Medicine During Wars*
41 *ABC News | How COVID-19 vaccines were developed in record time, without compromising safety*
42 *The Conversation | There aren't enough trees in the world to offset society's carbon emissions – and there never will be*
43 *Mazzucato, Kattel, and Ryan-Collins | Challenge-Driven Innovation Policy: Towards a New Policy Toolkit*


Drastic technological leaps happen in times of crisis, when money and urgency come together.

# Mobilising capital to address climate change

## Two arguments are made through this paper:

Investors are now looking for investments that align with the low emissions future and see climate change risk as a key consideration in investment decisions.

A net zero future requires new low cost, low emissions technologies.

We also argue that direct support of promising low emissions technologies is needed – an argument given more weight following the release of the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report in which the challenge of climage change was described as "widespread, rapid, and intensifying"[44]. The support for technologies that drive the necessary decarbonisation of economies can come from governments or from the private venture capital markets. Policy interventions need to be assessed on their ability to direct the large pool of private capital to support new low emissions technologies.

Policies that drive research and development (R&D) and the commercialisation of other low emissions technologies such as batteries for grid support, low carbon fuels for transport, low emissions protein sources, and low emissions building materials should see some of these technologies become cost effective.

Commercial demonstration of the successful technologies will provide the impetus for private capital to invest in these low emissions technologies and so drive the transition to net zero emissions.

Renewable energy is 'business as usual'
The times are a changing: the net zero investor movement
Initiatives from the financial regulators
The role of the financial markets
A review: investment money is flowing
Appraising different technology options
Unleashing innovation
Mobilising capital to address climate change
About the author

44 *Intergovernmental Panel on Climate Change | Climate change widespread, rapid, and intensifying*

# About the author

## Dr Gordon Weiss

Gordon joined Energetics in 1999 having spent almost 20 years working in a variety of operations and technical roles in process industries. Gordon's expertise lies in energy and carbon policy development, renewable energy technologies and energy management in the resources sector. He has worked with several Australia's governments on the development of energy and greenhouse gas programs and policies and helps some of Australia's largest energy users develop and operationalise their decarbonisation strategies.

Gordon now focusses on program and policy analysis, including assessment of business risk due to climate change, and the modelling of programs to reduce energy consumption and greenhouse gas emissions. He provides advice to governments on a variety of programs covering technologies such as demand management, energy productivity, renewable energy, and energy efficiency schemes.

He has been tracking the role of batteries in the energy space since 2014, and so has been advising Energetics' clients on the role that batteries can play in managing their energy costs since that time. This includes researching and writing many of the white papers that Energetics publishes that focus on the role of technology in the decarbonisation of energy systems and other production systems. He leads our participation in the Future Battery Industries CRC.

As well as his role at Energetics, Gordon is a member of the academic staff of the School of Chemcial and Biomolecuar Engineering at Sydney University, where he undertakes teaching and research activities.


# Acknowledgment

### Anna Kuiper | Consultant

Supporting research for this report was conducted by Anna Kuiper. A member of Energetics' Strategy and Policy team, she provides advice on climate-related risks and opportunities for ASX200, aligned with the Taskforce on Climate-related Financial Disclosure framework. With a background in corporate law specialising in regulatory compliance and European law, Anna is particularly known for her insights into global trends in policy, regulation and litigation. Her work with Energetics to date has included assisting clients in their decarbonisation journey by developing carbon inventories, setting emissions reductions targets, identifying abatement opportunities and presenting the results to stakeholders.

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