



HORIZONS

One giant leap:

President Biden's vision for repowering America

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We believe the Biden administration will struggle to achieve its ambitious goals.

Transforming the US to a zero carbon economy

In 1962, President John F. Kennedy informed the American public that the United States would embark on a programme to put the first man on the moon, “not because it is easy, but because it is hard”. The “space race” spawned a technological revolution that shaped the world as we know it.

Almost 60 years on, US President Joe Biden has set an equally challenging, transformative goal of achieving net zero emissions in the US power sector by 2035 and the broader economy by 2050.

The President’s move comes on the heels of Europe’s highly ambitious net zero emission targets and ahead of the 26th United Nations Climate Change Conference (COP26) in Glasgow, Scotland, in November. The targets are undoubtedly bold. The question is, can the US meet its new moonshot mandate?

After examining the proposals in detail, we believe the Biden administration will struggle to achieve its ambitious goals. Technological limitations, policy design, market structures and even the political and constitutional foundations of the United States create roadblocks that will impede the pace of progress. Even so, efforts to meet them will bring about major change in the US market that will help lower global carbon emissions.

President Biden came into office as the US energy market was already decarbonising. The new Infrastructure Investment and Jobs Act, a flow of capital into new energy technologies and a global investor focus on environmental and social governance (ESG) promise to accelerate the change necessary for a net zero world. Just as electrification transformed the US economy in the 1920s and 1930s and the space race spawned a technological revolution, this “second electrification” will have far-reaching effects and presents huge growth opportunities for those companies able to grasp them.





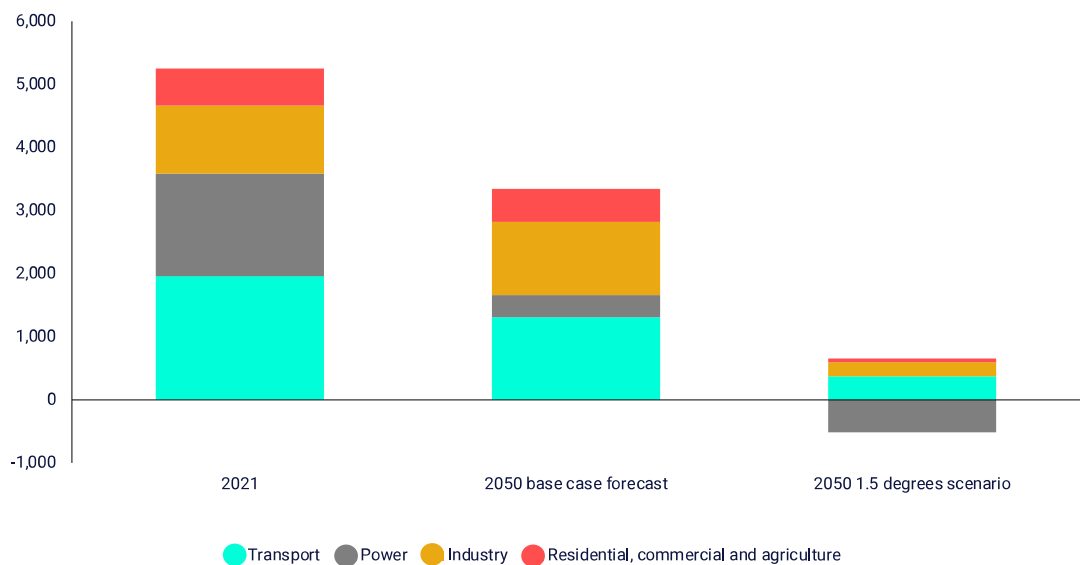
Pathways and roadblocks on the route to net zero

The course that President Biden has set is broadly aligned with Wood Mackenzie's roadmap for a world on course to limit global warming to a highly ambitious 1.5 °C. It will take tremendous effort. All sectors of the energy industry will have to be transformed. The use of oil and gas for transport and heating will need to be largely replaced by electricity, and that electricity will have to be produced with zero emissions.

Even in our base-case scenario – which we view as the most likely outcome – US zero-carbon generation capacity from wind, solar, nuclear and hydro is likely to grow rapidly, to about 1,170 GW in 2035. That corresponds to a rise of roughly 845 GW from 2020 levels. The new US goals require even faster growth.

Wind and solar power would have to become the largest sources of generation by 2035, alongside massive expansion in carbon capture and zero-carbon hydrogen. We further calculate that for the US to achieve its goals, total energy demand would have to peak at the end of 2021.

US emissions are not on course for net zero



Source: Wood Mackenzie

Electrification means using energy more efficiently across the board. Electric vehicles (EVs), for instance, are around four times more efficient at converting energy to movement than internal combustion engine vehicles. Heating buildings with heat pumps is three times more efficient than using gas or oil-fired boilers. Huge gains can be made from improving the energy performance of our buildings, through simple measures such as insulation.

Digitalisation will also enable the smarter use of energy in buildings, industrial processes and in cities worldwide. These assumptions are all key elements of reaching a net zero pathway in the US.

In the following table, we compare our base-case outcomes with our net zero scenario.

Wood Mackenzie base-case outlook vs. net zero scenario for the United States (2050)

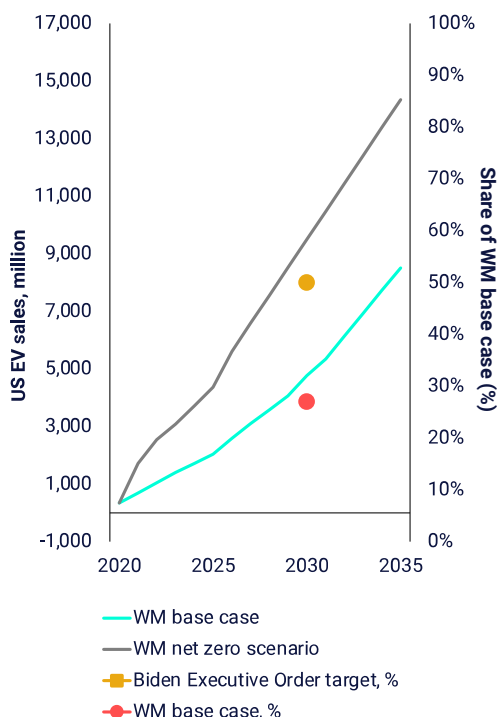
	Wood Mackenzie base case	Wood Mackenzie net zero scenario	Difference
Hydrocarbon share of total energy consumption	67%	32%	-35 percentage points
Power demand	5,731 TWh	11,158 TWh	+5,419 TWh
Wind + solar power capacity	2,260 GW	2,705 GW	+500 GW
Battery storage = power sector	551 GW	677 GW	+100 GW
Carbon removal CCUS and DAC	640 mt	961 mt	+368 mt
Green and blue hydrogen production	33 mt	115 mt	+82 mt

Source: Wood Mackenzie

Net zero EV adoption will pose major challenges for power markets

In August, President Biden signed an executive order setting a goal that 50% of all new passenger cars and light trucks sold in the US by 2030 be zero emissions, including battery electric vehicles, plug-in hybrids and fuel-cell vehicles.

Wood Mackenzie EV sales forecast base-case vs. net zero scenario



Our net zero scenario for the US transport sector suggests annual EV sales through the end of the decade would need to be around 50% higher than in our base case, which shows a zero-emissions market share of only 27% in 2030.

Key measures that would accelerate EV adoption in the United States include expanding the number of EVs eligible for tax breaks, making tax credits available at the point of sale, establishing incentives for at least 10 years and increasing incentives from US\$7,500 to US\$12,500 per vehicle. Combined, these steps would kick EV sales into high gear.

EV sales that reach a net zero pathway will pose a challenge for power markets, though. New EV buyers would on average see a 20% to 30% increase in their household power consumption. If they charge their cars during their peak consumption hours, utilities could face customers whose maximum demand will double. When and how consumers charge their EVs will need to be closely managed in a net zero world. Should EV sales accelerate beyond our base case, transmission providers and utilities would need to sharpen their focus on managed charging, reliability and grid resilience to handle the surge in power demand.

Source: Wood Mackenzie



Houston, we have a (few) problem(s)

The US power sector is not ready for net-zero lift-off

The US goal of a net zero power sector by 2035 is one of the most ambitious decarbonisation targets globally and one of the most difficult to implement. On one hand, proposed policies will accelerate zero-carbon supply by way of an extension of investment and production tax credits and the Clean Electricity Performance Program. These incentives, combined with the cost competitiveness of renewable technologies, makes adding wind and solar relatively inexpensive. On the other hand, solutions that maintain reliability and resilience are both expensive and full of unknowns.

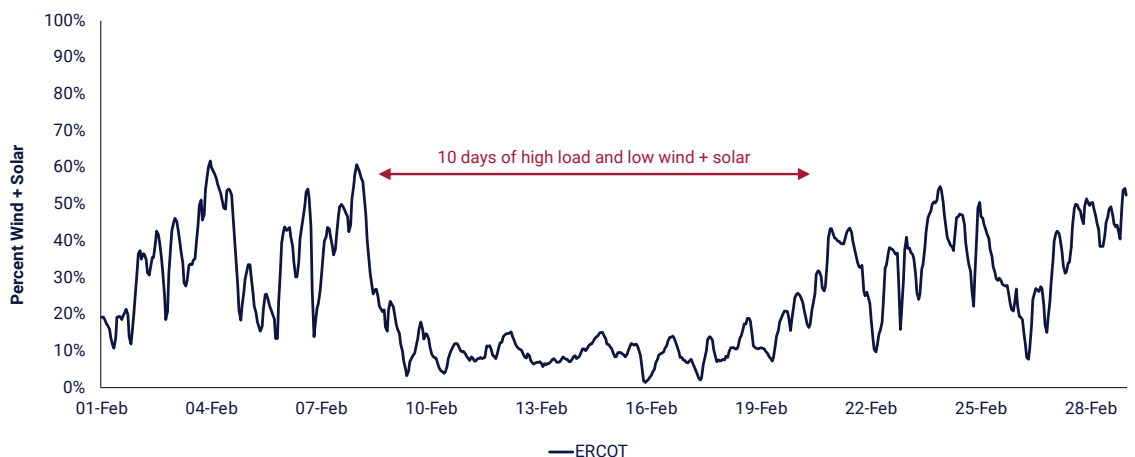
As wind and solar expand and coal retreats, markets will need to identify how much battery storage is needed. The power outages in Texas caused by storm Winter Storm Uri in 2021 are an example of what the power sector will need to handle. Still conditions reduced wind power output across broad swathes of the US, and when freezing temperatures in Texas forced some fossil fuel plants offline, blackouts were unavoidable. Without the gas, coal and nuclear plants that kept running, the supply shortfall would have been even worse.

A multi-day storage solution is needed in a net zero world, but major technology innovation will be required to provide it. The remaining gas-fired power plants will need to be fitted with carbon capture and storage, but the technology's ability to deal with large-scale carbon emissions in the power sector needs to be proven. More high-voltage transmission lines will need to be deployed, too, along with more progress on advanced transmission technologies.

In short, we think achieving a net zero US power sector by 2035 will be extremely challenging. Based on our understanding of technologies, market policies, the challenges of quickly building transmission lines and the electrification of energy, we believe that 66% clean generation by 2035 is more feasible.

We believe that **66% clean generation by 2035** is more feasible

Percent of wind and solar in the Texas Power market February 2021



Source: Wood Mackenzie



Back down to earth: scaling carbon removal to a net zero world

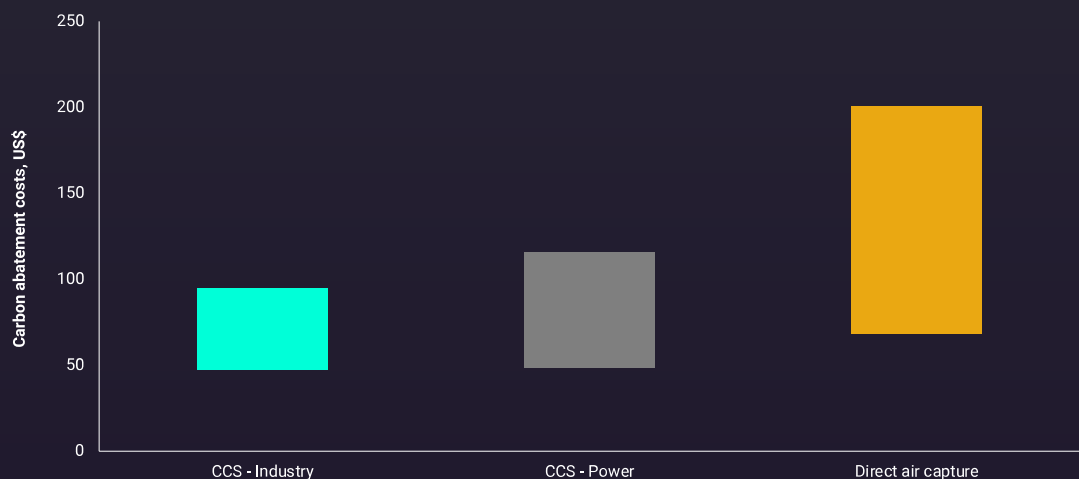
Even in a net zero economy, not all hydrocarbons will be removed from the US energy system. They will be needed to back up renewables in the power market and in many industrial processes. Emissions from fossil-fuel combustion will have to be captured. In our net zero scenario, the US needs to reach 1 billion tonnes per annum of carbon capture and storage capacity by 2050, up from 25 million today.

The Infrastructure Investment and Jobs Act expands support for carbon capture, utilisation and storage (CCUS). The 45Q tax credit, introduced in 2008 and expanded in 2018, incentivises carbon removal with credits of US\$34 per tonne of carbon dioxide in 2020, rising to US\$50 per tonne in 2026. The infrastructure deal takes incentives a step further by focusing national policy on building new transport infrastructure, outlining goals to focus on industrial-sector emissions and identifying options to lower overall costs through reduced taxes.

We see others measures that would accelerate CCUS:

- Providing carbon tax credits for at least 20 years would give infrastructure investors the clarity they need. The 45Q credit ends once a facility is in service for more than 12 years. CCUS or direct air capture (DAC) projects have long payback periods, similar to liquid natural gas (LNG) terminals or power plants, so extending the timeline of tax-credit availability should provide reassurance to investors.
- Offering grants for the most expensive carbon-capture technologies, such as DAC, and heavy industrial applications would help plug the funding gap in early-stage technologies. Critically, these initiatives need to focus on boosting carbon capture from hard-to-decarbonise sectors.
- New commercial models are required. Similar to regulated utilities, carbon hubs may need to be promised a fixed return on investment to attract capital. A whole new sector could emerge: the “carbon utility”.

Wood Mackenzie implied carbon-abatement cost ranges for our US net zero scenario (US\$)



Source: Wood Mackenzie



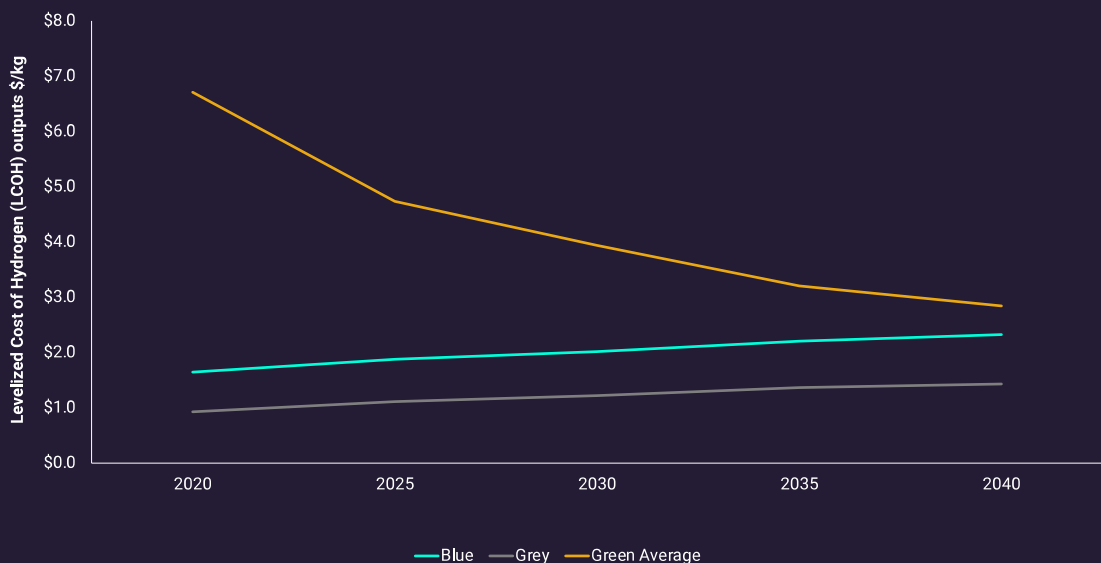
Multiple orbits: Clearer hydrogen policy support is needed

The Infrastructure Investment and Jobs Act attempts to expand hydrogen markets rapidly. The Regional Hydrogen Hub Program is intended to develop projects in at least four locations, with at least two located in regions with the largest natural gas resources. The hubs are designed to focus on multiple end-use segments across power, industry, heating, and transport. This is a positive signal for hydrogen markets and decarbonisation, but carbon price support will influence the pace and scale of implementation.

The US will need to take several approaches to deploying hydrogen. Blue hydrogen, produced from natural gas with CCUS, is likely to dominate on the US Gulf Coast. Petrochemicals and other heavy industries in Texas and Louisiana provide ample demand centres, while proximity to the natural gas industry and limitations on wind- and solar-based hydrogen provide a clear opportunity for blue hydrogen to decarbonise this region. Green hydrogen, produced via water electrolysis, is likely to dominate in regions with the strongest wind and solar resources. The administration has also outlined that at least one hydrogen hub should be based on nuclear energy, known as yellow hydrogen.

We see a range of carbon price support for low-carbon hydrogen of US\$40 to US\$60 per ton as being needed for it to be commercially viable by 2030. Accelerating low-carbon hydrogen faster than that would require carbon prices to be higher – up to US\$150 per ton for green hydrogen in heavy industrial applications. Enacting a national carbon price would be politically challenging in the US and it is not an idea the Biden administration has advocated. Support for low-carbon hydrogen may have to come from multiple sources: federal loan or grant programmes, for instance, combined with cost-abatement support from state budgets.

Wood Mackenzie Levelized Cost of Hydrogen for the United States



Source: Wood Mackenzie



Plenty of issues to resolve at ground control

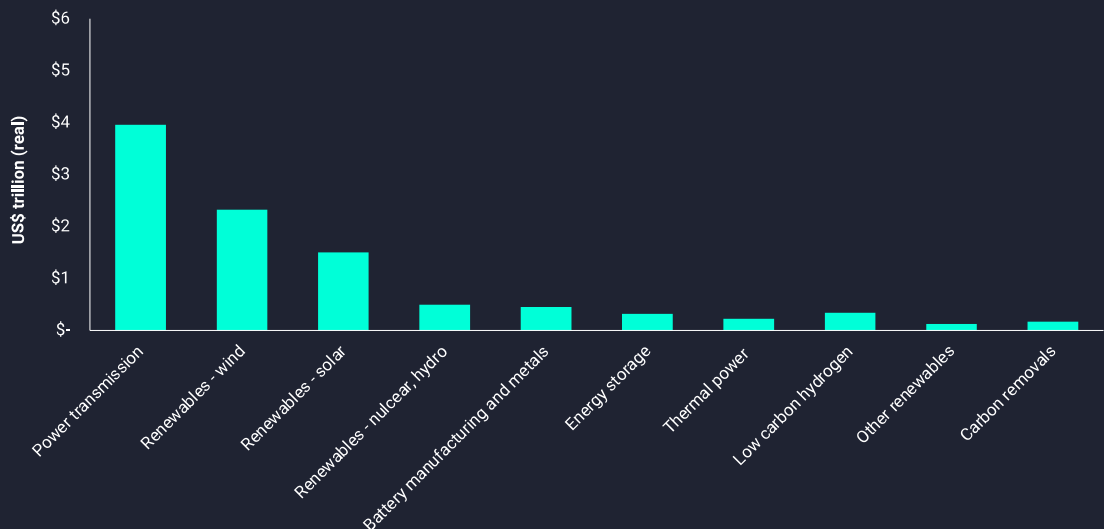
Scaling up net zero investing

Proposals for climate-related spending in the US today fall far short of the US\$10 trillion we think will be required between 2021 and 2050 to achieve the administration's objectives for cutting emissions.

Investors will need a better set of incentives to reallocate capital, as government funding clearly cannot reach the necessary scale. Two infrastructure bills – a bipartisan one valued about US\$1 trillion and a Democratic one valued at US \$3.5 trillion – were vigorously debated over the summer.

There is a much larger amount of private capital looking to invest in decarbonisation. For example, the Net Zero Asset Management Initiative has 128 signatories, with US\$43 trillion in assets under management globally, committed to supporting investing aligned with net zero emissions by 2050 or sooner.

Wood Mackenzie US net zero scenario: cumulative capex in new supply (2020-2050)



Source: Wood Mackenzie

Make it so, Joe

The priority areas for investment to put the US on a net zero pathway include:

- cross-state infrastructure for high-voltage power transmission
- a carbon abatement-cost fund to support carbon removal capacity, such as CCUS, DAC and low-carbon hydrogen
- energy storage technologies for both long-duration solutions in the power sector and for distributed, behind-the-meter, demand-side management



The wide range of investment opportunities means there are options available for a range of investors. Transmission should attract pension funds, with a lower risk appetite, helping to underpin the massive build-out in cross-state power lines. Riskier, higher-return options, such as energy storage and carbon removal, can be financed by venture capital and private equity.

To boldly go...

A bold solution to financing the transition to zero-carbon energy would be a national “net zero investment fund” to help channel private capital, similar in scale to Fannie Mae and Freddie Mac, the government-sponsored enterprises that support housing finance and together manage US\$5 trillion in assets. To increase the speed and scale of investments, the new fund could establish a “net zero dividend” for early-stage technologies, price carbon into investment decisions, fund direct grants and provide 15- to 20-year financing for large infrastructure projects.

President Biden's ability to make progress towards his climate objectives

will be more limited than for his counterparts in many other countries.

The limits to presidential authority

Making the changes required to put the economy on a path to net zero is particularly challenging in the US because of its system of government. The separation of powers and federalism put constraints on executive authority, and President Biden's ability to make progress towards his climate objectives will be more limited than for his counterparts in many other countries.

The bipartisan Infrastructure Investment and Jobs Act has plenty of energy-related provisions, including US\$65 billion for power infrastructure, US\$15 billion for EV charging and buses and new incentives for carbon capture and hydrogen. However, the Democrats' much larger US\$3.5 trillion plan, including a proposed new “clean electricity performance programme” to achieve 80% carbon-free electricity by 2030, has been more contentious.

President Biden can use executive actions and regulations to try to drive down emissions, but those will face legal challenges and could be reversed by future administrations. Regulations governing emissions from the electricity sector have been disputed in the courts for many years and it remains unclear what view judges will take in future legal battles.

The Obama administration's Clean Power Plan, setting limits on carbon dioxide emissions from electricity generation, was stayed by the Supreme Court in 2016. But in January 2020, the DC Circuit court struck down the Trump administration's more lenient regulations and called on the Environmental Protection Agency to put forward a new set of rules.



Conclusion:

Back at the table: US climate diplomacy at COP26

The United States is likely to fall short of President Biden's lofty aspirations. But by setting those goals, he has put the US back at the negotiating table with a chance to influence global climate policy at and around COP26 in November 2021.

All major economies are trying to identify the pathways to net zero emissions. The United States has a similar level of climate ambition to the European Union – a global leader in climate policy. But the implications of net zero commitments are huge. Supply chains for raw materials, the geopolitics of energy, and global energy prices will all change radically in a net zero world.

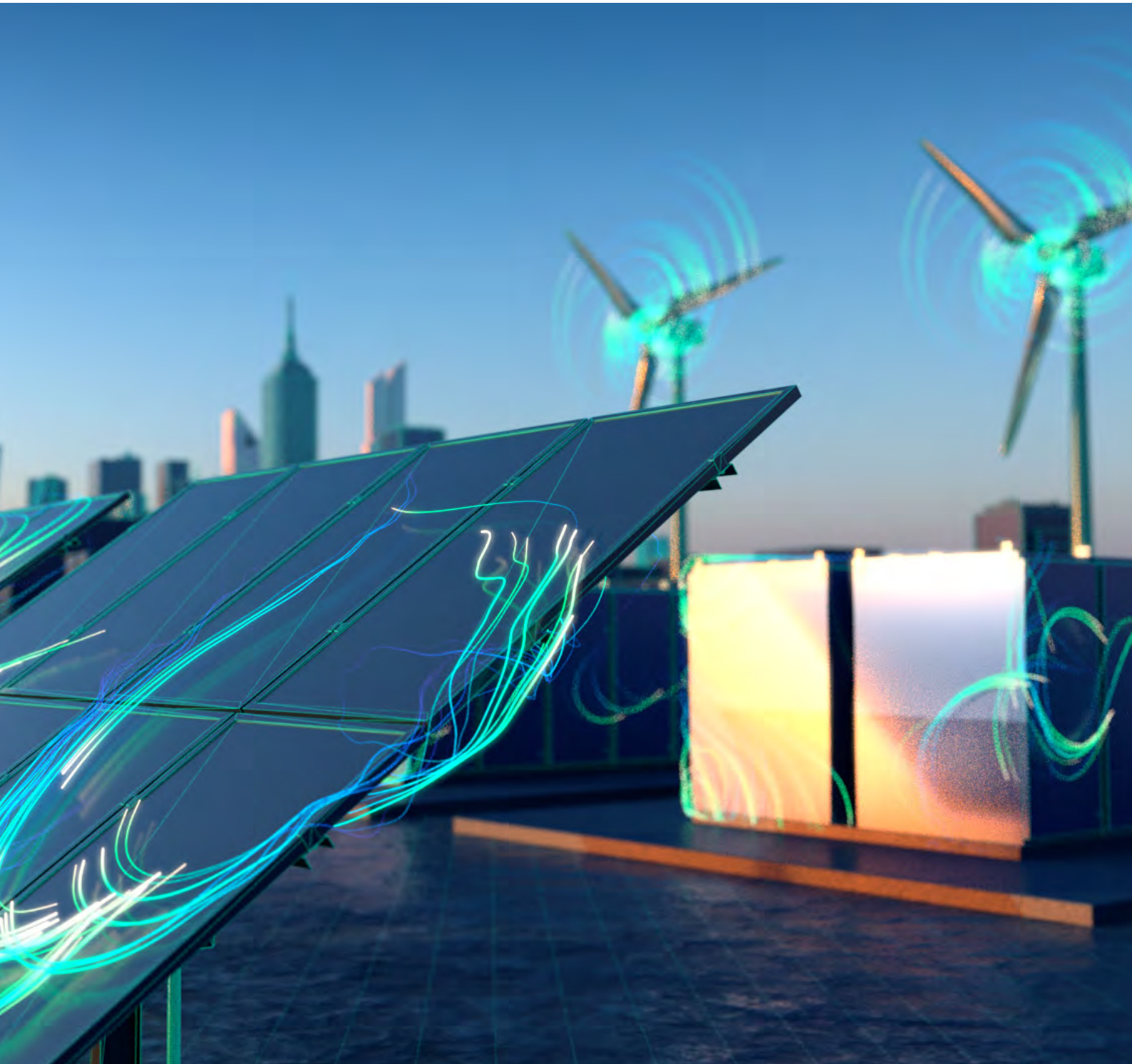
The Biden administration will need to work with other global leaders to define policies that accelerate decarbonisation. Key among them are setting near-term policies for low-carbon technology innovation, creating carbon market policies and addressing energy subsidies across the world.

The Biden administration has made one giant leap with its proposals at home. It must make another abroad.



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Wind power **54,000+**



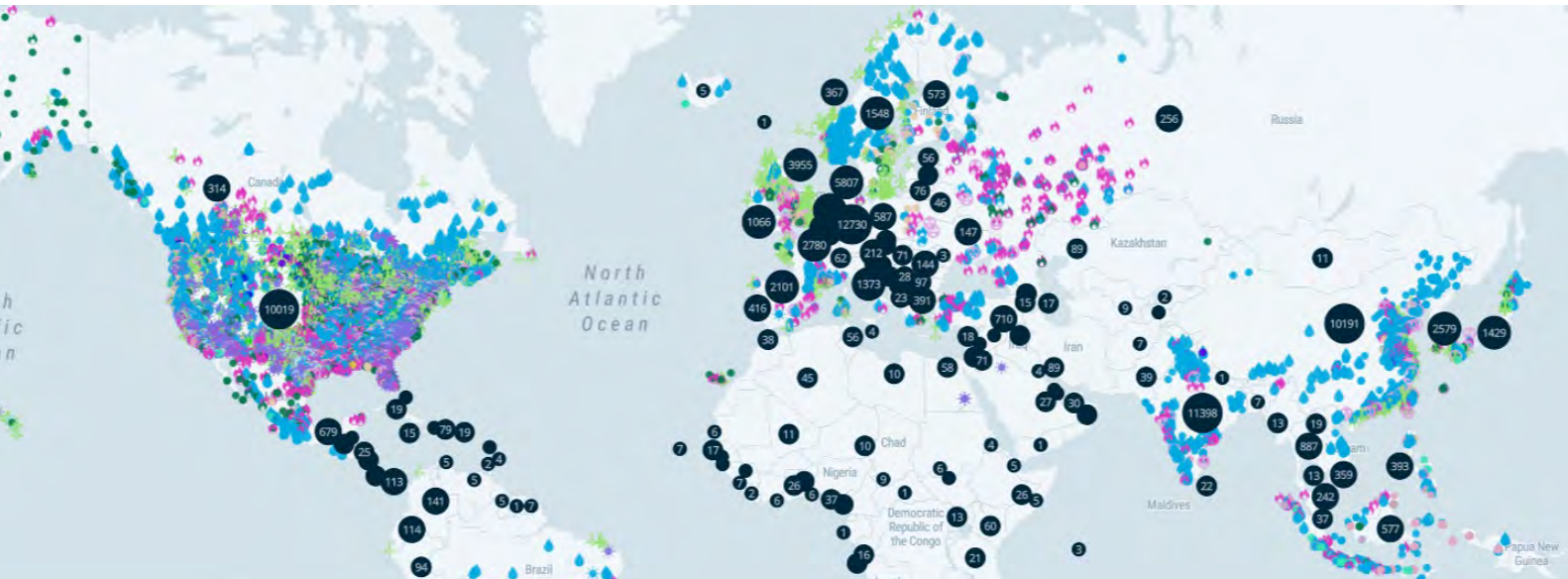
Solar power **27,000+**



Energy Storage **2,100+**



Conventional power **19,000+**



Across **180+ countries** and **27,000+ parent companies/subsidiaries**





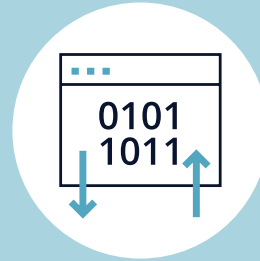
Lens Power

Key Business Outcomes

Strategically position your organization to quickly respond to market conditions and be on the forefront of the energy transition



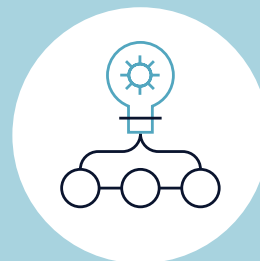
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