



## Carbon Neutrality & The 75th UN General Assembly January – 2021

# Sustainability Report

The Al-Attiyah Foundation









## INTRODUCTION

### CARBON NEUTRALITY & THE 75<sup>TH</sup> UN GENERAL ASSEMBLY

World leaders, captains of industry and civil society organisations, see the Paris Agreement as the last hope for humanity to address the impact of climate change and preserve foundations for a healthy planet. Consequently, many state and non-state actors are signaling their intentions to ramp up climate change action, with announcements of ambitious net-zero roadmaps, at or immediately after the 75th UN General Assembly. What were the critical decisions and noteworthy announcements? How achievable are the targets on carbon neutrality, and how do they relate to the Paris Agreement's goal? What are the implications of these targets for the energy sector? How does the way forward relate to other key global challenges considered by the UNGA?



## Sustainability Report

This research paper is part of a 12-month series published by The Al-Attiyah Foundation every year. Each in-depth research paper focuses on a prevalent sustainable development topic that is of interest to The Foundation's members and partners. The 12 technical papers are distributed to members, partners, and universities, as well as made available online to all Foundation members.



## EXECUTIVE SUMMARY

- Six major economies have recently announced goals to reach net-zero carbon dioxide emissions: China (by 2060), the EU, UK, Japan, South Korea, and the new Biden administration in the US (all by 2050).
- This represents eight of the world's top ten economies, including the EU countries Germany, France, and Italy, while Canada, in 9th place, is drafting carbon neutrality legislation; India is the exception in the top ten.
- Including Canada, countries with committed carbon neutral dates account for slightly more than 60% of global CO<sub>2</sub> emissions from fossil fuel combustion.
- Russia, Brazil, Australia, and Indonesia are other major emitters still without carbon neutrality goals.
- For all countries, achieving carbon neutrality requires prioritising and accelerating investments in green and digital technologies combined with progressive increases in carbon prices to incentivise switching to low-emissions technologies and generate revenues for supporting the transition to climate-friendly investments.
- These plans' overall commonality see a colossal scale-up of renewable energy and batteries, complemented with the use of CCUS; synthetic fuels, such as hydrogen; electric vehicles; and improved energy efficiency.
- Direct electrification remains the most cost-effective and efficient solution so far to decarbonise transport. In 2050, the aviation and marine sectors will depend heavily on renewable synthetic fuels, such as biofuels, synthetic methane, hydrogen, and power-to-liquids.
- China has to cancel its newly planned coal mining and coal power plants capacity and double its green projects' development, particularly hydrogen and CCS, to reach its 2060 net-zero target.
- In the EU, the goal of 2050 carbon neutrality is to be achieved by scaling up renewable energy (solar to 61% of electricity generation, wind 33%, hydro 4%, nuclear 1%), electric transport vehicles, and hydrogen for industry.
- The UK has had to define new targets post-Brexit. Its ambitions for 2030 now exceed those of the EU, and the recent emissions trajectory has been the best of all major economies because of the phase-out of coal. Along with offshore wind, its plans have a bigger role for CCUS and nuclear power than the EU as a whole, and the UK has also stressed the need for binding targets on international shipping and aviation.
- Japan's new pledge necessitates: (1) an ambitious pace and scope of transforming the country's energy and industry sectors; and (2) a broader buy-in from the business community beyond the power sector.
- South Korea set an ambitious net-zero target by 2050 but has to address its coal power problem to achieve it.
- The new US administration will have to start by reversing several climate-related rollbacks made by the previous administration before making progress towards carbon neutrality.



- Areas of divergence between plans include the role of nuclear (more popular in China than in the EU), CCUS, carbon dioxide removal from the atmosphere, and 'blue' versus 'green' hydrogen.
- Areas that are not well-addressed in general in the plans mainly include carbon neutral or carbon-negative agriculture.
- The delivery of higher global ambition by sub-national actors (cities, provinces/states, corporations) is considered integral to achieving carbon neutrality among all countries.

#### GLOBAL EFFORTS TOWARDS NET-ZERO ARE INCREASING BUT INSUFFICIENT

In order to avoid the worst-case climate warming scenarios predicted by the Intergovernmental Panel on Climate Change (IPCC), nations are required to put together immediate and substantial effort to decarbonise the global economy. So far, global investment into clean energy technology, including renewables, low-carbon transport, energy storage, electric heat and other areas, reached a record high of US\$501.3bn for the first time, beating 2019 by 9% despite the economic slump caused by the pandemic. According to Bloomberg, companies, governments, and households invested US\$303.5bn in new renewable energy capacity in 2020, up 2% year-on-year<sup>1</sup>. Investors also put US\$139bn into electric vehicles and charging stations, up 28% year-on-year. Meanwhile, domestic installation of energy-efficient heat pumps accounted for US\$50.8bn, a 12% growth year-on-year.





## GLOBAL EFFORTS TOWARDS NET-ZERO ARE INCREASING BUT INSUFFICIENT

Carbon capture and storage's global investment has tripled to US\$3bn in 2020, while hydrogen was down 20% at US\$1.5bn, although this still represented the second-highest annual number so far. A worldwide divestment of fossil fuels equalled the growth in clean energy investments at approximately US\$14.5tn.

The Paris Agreement set the ambition to limit global warming to no more than 2°C by 2100 and aim to limit warming to no more than 1.5°C. To achieve these goals, global emissions would have to peak soon, around 2020, reach zero before 2100 in the 2°C case, and about 2050 in the 1.5°C case. This implies that major economies will have to be carbon neutral around mid-century and probably carbon-negative (i.e. actively drawing down atmospheric CO<sub>2</sub>), sometime afterwards.

This was to be achieved by Nationally Determined Contributions (NDCs), where each country would voluntarily submit actions that would limit its emissions over time. These NDCs are to be updated with more stringent measures ahead of COP26 in Glasgow in November 2021. At the end of 2020, 45 parties had submitted updated NDCs<sup>ii</sup>.

However, the efforts reflected in the NDCs are not sufficient to meet the Paris goal. The Climate Action Tracker identifies only eight countries<sup>iii</sup> that submitted stronger NDC<sup>iv</sup> targets by the end of 2020, while others<sup>v</sup> did not increase ambitions, with 118 countries announcing no updates. A few countries, including Iran, Iraq, and Turkey, have not yet submitted their first NDC. Sometimes, countries with ambitious targets lack progress in implementing their climate strategies and fulfilling their commitments.

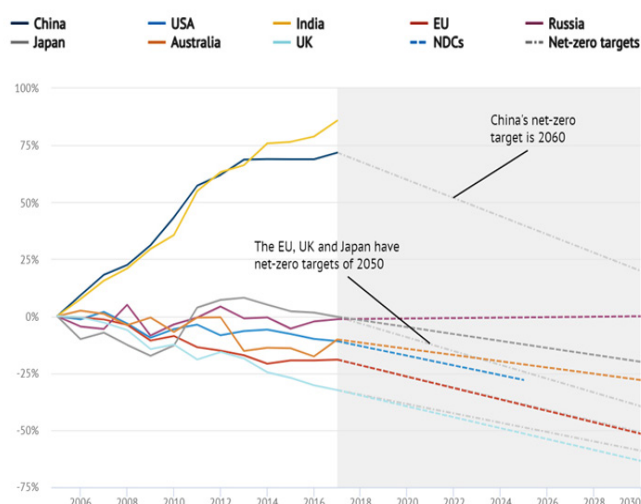
### COUNTRIES' NET-ZERO EFFORTS DIFFER, BUT COORDINATED INTERNATIONAL ACTION IS REQUIRED

Table 1 lists the countries that have publicly announced their commitments to carbon neutrality. However, only the commitments of the major economies (China, EU, UK, Japan, South Korea, and the US) are discussed in detail.

Each of the major economies covered in this paper has a variety of potential paths to net-zero. These have been studied by national policy bodies, academia, think tanks, and corporate work. Large quantities of renewable energy, efficiency, and electric vehicles are standard features. The roles of afforestation/reforestation and other land-use offsets, nuclear, CCUS, hydrogen, carbon dioxide removal (CDR) and some other technologies vary.

Given the reality of hard-to-abate sectors, continuing fugitive emissions, and the possibility of some countries not achieving their net-zero targets by 2050-60, carbon offsets and carbon dioxide removal (CDR) will likely be used on a large scale. (Figure 1) shows the emission

Figure 1 Carbon neutral trajectories of major economies<sup>vi</sup>





trajectory of major economies since 2005 and their implied path towards net-zero. It can be seen that the UK and EU's NDC pathways would approximately match their carbon neutrality targets. China's implies a sharp downturn in recent roughly flat emissions.

Table 1 National carbon neutral commitments

Country / bloc	Carbon-neutral commitment	Date made
Costa Rica	Plan for carbon-neutral by 2021 and zero-emissions by 2050	25-Feb-2019
UK	Law; net-zero by 2050	27-June-2019
Switzerland	Government declaration; by 2050	28-Aug-2019
New Zealand	Law; net-zero by 2050	7-Nov-2019
EU	European Council endorsed objective Europe Climate Law proposed	Dec-2019
	Various national targets in law	4-Mar-2020
Norway	By 2030 if other countries cut emissions; by 2050 unconditionally	20-Jun-2020
China	CCP Chairman's announcement; by 2060	22-Sep-2020
Japan	Prime minister's announcement: by 2050	26-Oct-2020
South Korea	President's announcement; by 2050	28-Oct-2020
US	President Biden's campaign platform	2019, 2020; inaugurated 20-Jan-2021
Canada	Draft legislation; carbon neutral by 2050	19-Nov-2020





## CHINA'S CARBON NEUTRALITY TARGET IS A BIG BUT ACHIEVABLE CHALLENGE

<b>2030</b>	<p>Paris Agreement: Peak CO<sub>2</sub> emissions latest by 2030</p> <p>Non-fossil share: 20% in 2030</p> <p>Carbon intensity: -60% to -65% below 2005 by 2030</p>
<b>2060</b>	<p>China set its first long-term climate goal targeting carbon neutrality by 2060 to limit global warming to 1.5°C.</p>
<b>Climate Action Tracker: Highly Insufficient &lt; 4°C</b>	<p>China's CO<sub>2</sub> emissions projections from current policies have been revised downward amid the Covid-19 pandemic. Current policies will result in GHG emissions of 12.9-14.7 GtCO<sub>2</sub>e/year in 2030, if implemented.</p> <p>Out of the three NDCs, emissions from the carbon intensity target have been revised downward by -3 to -8% to 14.4-16.9 GtCO<sub>2</sub>e in 2030 due to the new Covid-19 GDP projections.</p> <p>However, the country's NDCs and national actions are inconsistent with limiting global warming to below 2°C, with the 1.5°C goal looking far-fetched.</p>

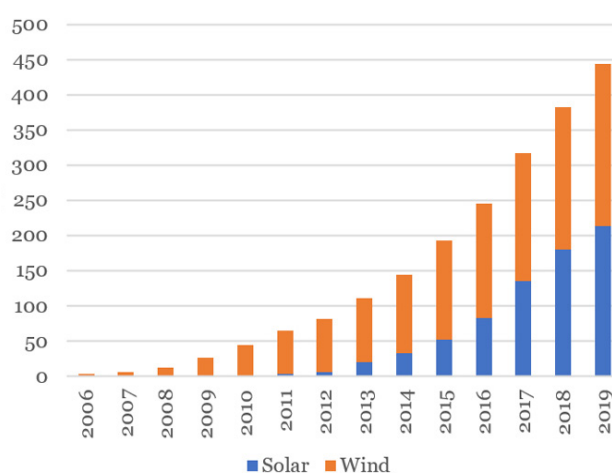
During the EU-China summit in September 2020, the EU urged China, the world's largest emitter, to actualise its climate ambitions by peaking CO<sub>2</sub> emissions by 2025 and reaching net-zero by 2060, hence, putting an end to all coal-fired power plants investments nationally and abroad. A week later, Chairman Xi Jinping made an ambitious pledge at the 75th United Nations General Assembly (UNGA), held virtually, aiming to peak emissions before

2030 and achieve carbon neutrality by 2060. He added that the country would adopt more vigorous policies to enhance its NDCs and called on other countries to follow a green economic recovery approach post-Covid-19. In the meantime, the government is likely to announce more explicit steps for its 2030 target in its 14th version of the Five-Year Plan, currently under discussion by policymakers, which will be released at the National People's Congress in March 2021<sup>vii</sup> to set the economic and energy course for 2021-25.

### Energy sector required actions

This ambitious pledge will require drastic changes to be made across China's giant economy, particularly its energy sector. By the end of 2019 non-fossil fuels accounted for over 15% of the country's primary energy mix (Figure 2). According to IHS Markit, to achieve the carbon neutrality target, China needs to increase solar and wind from 213 GW and 231 GW in 2019 to at least 2,200 GW and 1,700 GW, respectively, by 2060. This increasing penetration of variable renewables will have to be balanced by storage, geographic diversity, interconnections, demand management and other approaches to maintain a stable grid.

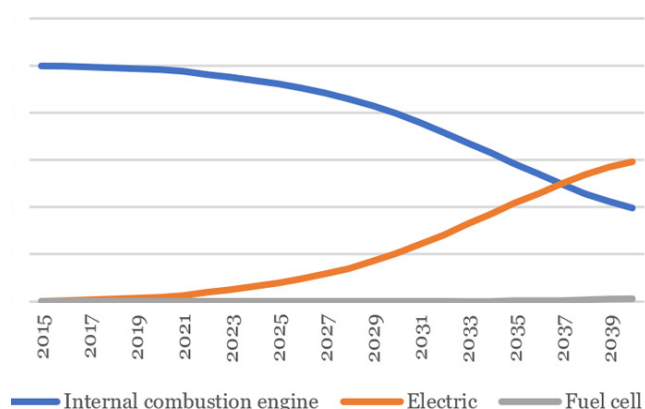
Figure 2 China's solar and wind installed capacity, 2006-19<sup>viii</sup>





This increase would reduce fossil fuels from the current 85% to 25% of the energy mix. Coal, which accounted for 58% of China's energy in 2019, is likely to take the biggest hit. According to China National Petroleum Corporation's "Beautiful China" scenario<sup>xi</sup>, coal's share in the country's energy mix will reduce to 14% by 2050. The government will also need to switch from gasoline and diesel-fuelled cars to electric and fuel-cell vehicles (Figure 3). According to Bloomberg, more electric vehicles are expected to be on China's road than internal combustion engines by the mid-2030s.

Figure 3 China's outlook for internal combustion engine versus electric and fuel-cell vehicles, 2015-40<sup>x</sup>



In industry, decarbonising the steel industry will require a set of solutions including, reducing steel production, which is expected to drop by 5% by 2025 from current levels, developing electric arc furnaces (EAFs) as a critical policy incentive for the next five-year period. EAF steelmaking consumes scrap steel and could be an effective way to reduce emissions compared to blast furnaces. A longer-term hydrogen-based steelmaking technology will, however, expedite the decarbonisation of the steel industry.

Overall, it is recognised that China would need to implement a range of policies to reach its net-zero goal by 2060. These policies will include a combination of energy efficiency rules and

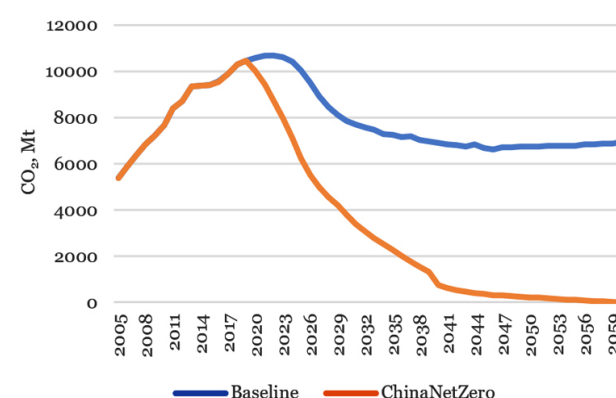
China is about to launch what will become the largest carbon market in the world this year.

### Potential cost and benefits of carbon neutrality

Although the total cost of the effort required to reach the new target through 2050 is massive (US\$15-20tn), it could contribute to 2-3% of China's GDP over the first half of the century. According to Carbon Brief, the massive scale of investments would raise the country's GDP by as much as 5% later this decade. Although the transition would impact the 3.5 million people working in coal mining, the green economy's development could increase employment in the medium-long term. According to the International Renewable Energy Agency (IRENA), green industries such as renewable energy, green construction, transport, and waste disposal would increase the country's employment by about 0.3%.

China's 2060 carbon neutrality outlook is as depicted in (Figure 4) below.

Figure 4 China's 2060 carbon neutrality outlook, 2005-60<sup>xi</sup>





# EUROPE'S CARBON NEUTRALITY TARGET REQUIRES A MASSIVE TRANSFORMATION ACROSS EU ECONOMY

<b>2030</b>	<b>Paris Agreement:</b> <ul style="list-style-type: none"> <li>Cut emissions by at least 55% below 1990 by 2030</li> </ul>
<b>2050</b>	<ul style="list-style-type: none"> <li>91-94% emissions reduction below 1990</li> </ul>
<b>Climate Action Tracker:</b> <b>Insufficient</b> <b>&lt; 3°C</b>	<p>Due to Covid-19's-imposed lockdown and economic inactivity, EU emissions in 2020 are expected to reduce by 10-11% lower than 2019's levels, leading to a decline of 34-35% in 2020 below 1990s levels. Economic recovery is expected to lead to a 2% increase in emissions as compared to 2020.</p> <p>The already implemented measures will result in an emissions reduction of 37% in 2030 below 1990 levels. Meanwhile, implementing renewable energy and energy efficiency goals at the EU level will lead to 48% emissions reduction by 2030. The power sector witnessed the fastest decarbonisation, with 44% emissions decline from 1990 to 2019. Despite the economic slump, the price of emissions allowances rebounded in mid-2020 reaching an all-time high of €34.25/tonne in early 2021.</p> <p>Despite the reductions, the Climate Action Tracker rates the EU target under the Paris Agreement as "Insufficient," since it is not rigorous enough to limit global warming to 2°C, let alone 1.5°C.</p>

## Current policy environment:

In December 2019, following a meeting of the European Council in Brussels, the EU endorsed the 2050 carbon neutrality target, without Poland's commitment<sup>xii</sup>. The US\$1.22tn plan outlined in the European Green Deal focuses on forming a legally binding agreement to review existing laws on climate merits

and adopting new legislation on the circular economy, building renovation, farming and innovation, and biodiversity. The EU is expected to mobilise a minimum of US\$122bn over the period 2021-27 under the "Just Transition Mechanism"<sup>xiii</sup>. This would be followed by financial and technical assistance to the most affected by the transition.

The EU's emissions reduction target stood at 40% by 2030, against 1990 levels. However, this goal needs to be upgraded for the bloc to reach carbon neutrality by 2050. In October 2020, the EU Parliament unexpectedly voted to cut emissions by 60% by 2030. The text was then forwarded to the EU Council of Ministers representing the EU's 27 member states for final approval. Since the negotiations were politically sensitive, with all 27 member states required to approve and pass the emission reduction target to become a legally binding agreement, it was essential to identify concrete incentives to bring all 27 countries to agree on the target.

In December, EU leaders finally agreed to increase the bloc's emission-reduction target to 55% by 2030. Poland, which relies on coal for 80% for its electricity, is currently exempted from this target. The country demands more EU funding commitments to transition from fossil fuels to do its part in becoming carbon neutral by 2050. The EU is currently debating the inclusion of carbon dioxide removal (CDR) as part of its 2030 targets in line with its climate neutrality by 2050, which could cater for the extraction of emissions from the environment at scale after 2030<sup>xiv</sup>. This would entail the physical removal of carbon dioxide from the atmosphere and its permanent storage.

## EU carbon neutrality pathways

Considering the EU's 2050 target, SolarPower, Europe and LUT University developed a model outlining three different scenarios towards



a 2050 carbon neutral EU: laggard, moderate, and leadership. The model attempts to demonstrate the lowest-cost feasible energy mix with the transitioning sectors, power, heat, and transport, into an integrated energy system by 2050.

Table 2 EU carbon neutrality pathways

	<b>Laggard: Slower energy transition</b>	<b>Moderate: Medium- pace energy transition</b>	<b>Leadership: Rapid energy transition</b>
<b>RE energy share</b>	62% by 2050	100% by 2050	100% by 2050
<b>Paris Agreement</b>	-	Achieved 2.0°C	Achieved 1.5°C
<b>GHG emissions in the energy system</b>	-90% in 2050	-100% in 2050	-100% in 2040
<b>Fossil fuels phaseout</b>	-	Achieved in 2050	Achieved in 2040
<b>Nuclear phaseout</b>	-	-	Achieved in 2040

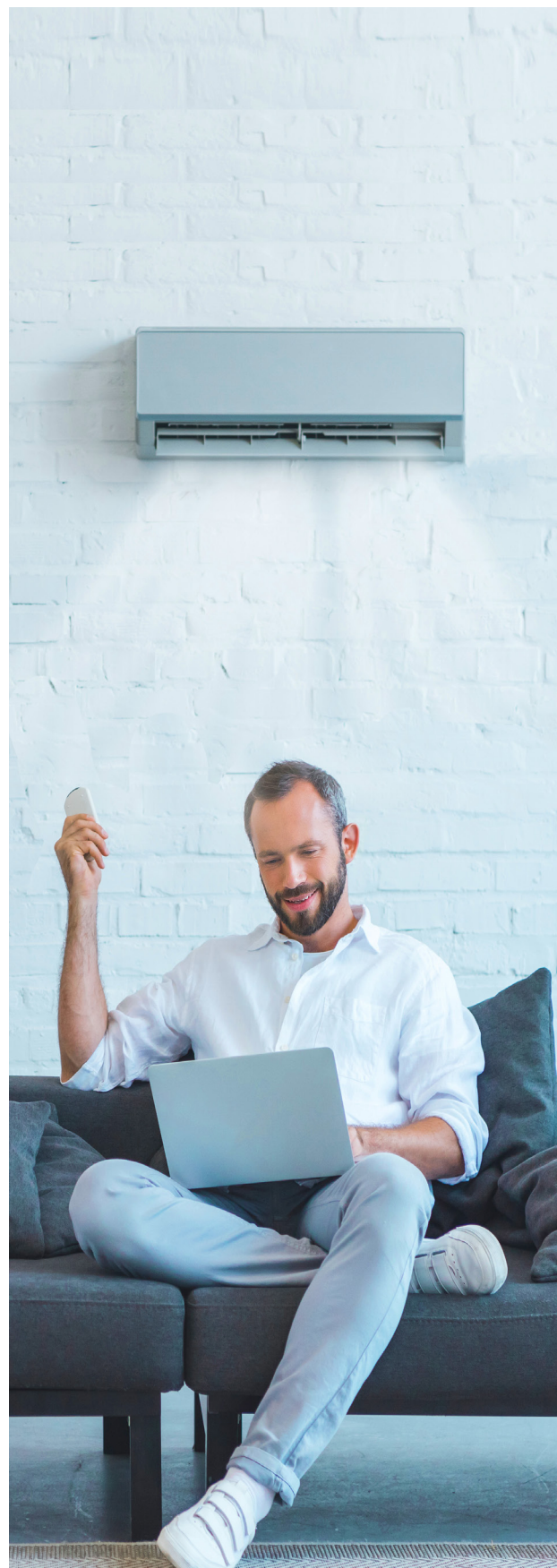
Renewable electricity is likely to become the prime energy carrier, reaching 100% by 2040 in the leadership scenario and almost 100% in the moderate scenario. However, a few nuclear power plants will remain in phase-out mode.

### Power sector

Solar PV will become the dominant power generation source across the three scenarios due to its cost-competitiveness. Solar needs to account for 61% of the electricity generation mix to achieve carbon neutrality by 2050. On the other hand, wind is required to make up 33% of the generation capacity, while hydro and nuclear should represent 4% and 1%, respectively.

### Heating sector

While the current heat market is 50% reliant on fossil fuels, a combination of direct and indirect heating is likely to dominate by 2050, hitting 62-68% in all scenarios. Renewable-based electric heating (direct) and heat pumps





(indirect) will account for the majority of heat generation capacities in 2050. This should be complemented to a small extent by biofuels and synthetic fuels, such as hydrogen—likely to be used in industrial process heat at later phases of the transition.

## Transport sector

While the transport sector is responsible for nearly a quarter of EU GHG emissions, it shows the lowest renewable energy shares compared to other sectors. In 2020, only 5% of the energy needed for transport was provided by renewables in Europe. Still, direct electrification remains the most cost-effective and efficient solution so far to decarbonise transport. In 2050, the aviation and marine sectors will depend heavily on renewable synthetic fuels, such as methane, hydrogen, and power-to-liquids) in the two 100% renewable scenarios. The laggard scenarios will still supply over a quarter of energy needs from fossil fuels.

## Storage

Europe will resort to a combination of storage technologies, with batteries providing most storage needs, reaching a 67–70% shares, depending on the scenario and application<sup>xv</sup>. Meanwhile, gas and thermal storage are likely to be employed in the heat sector.

## Industry

In terms of industry decarbonisation, the EU set a new roadmap for a carbon neutral cement-concrete value chain by 2050. The European Cement Association published its new Carbon Neutrality Roadmap, which focuses on how CO<sub>2</sub> emissions can be reduced. By 2030, the organisation aspires to be in line with the Paris Agreement's 2°C scenario, implying an emissions decrease of 30% for cement and 40% down the value chain<sup>xvi</sup>.

Meanwhile, the iron and steel industry, responsible for about 4% of CO<sub>2</sub> emissions in Europe, and 9% globally, can utilise green hydrogen to decarbonise. At current prices, replacing coal with hydrogen would raise a tonne of steel by about one third. This gap is expected to narrow in the near future, and could even disappear by 2030, as carbon pricing mechanisms are put in place. Producing the necessary amount of hydrogen for a decarbonised steel industry would require electricity production to increase by 20%, thus boosting renewable energy production beyond what is needed to replace fossil fuels.

## Policy Considerations

Achieving the model's moderate scenario will require substantial efforts at the EU and country levels. This includes prioritising investments in green and digital technologies combined with progressive increases in carbon prices to generate much-needed revenues and give price signals for emissions reductions<sup>xvii</sup>.

Meanwhile, after three reforms that reduced the number of available permits, Europe's Emissions Trading System (ETS) is back on track, despite lower production due to the pandemic.

Accelerating the transition requires a substantial uptake of cheap, clean energy, with several member states supporting new and unproven technologies, including hydrogen. The carbon pricing revenues could support this.

However, carbon pricing alone is insufficient to accelerate the transition in some sectors, like transport and buildings. The EU would have to adopt complementary policies to address specific obstacles, such as incomplete markets, availability of public goods, and financing constraints.



## UK'S NET-ZERO TARGET, ALTHOUGH HIGHLY CHALLENGING, REMAINS TECHNICALLY FEASIBLE

<b>2030</b>	<b>Paris Agreement:</b> <ul style="list-style-type: none"> <li>2020 NDC: 68% emissions reduction below 1990 by 2030</li> </ul>
<b>2050</b>	Net-zero GHG emissions by 2050
<b>Climate Action Tracker: Insufficient &lt; 3°C</b>	<p>The pandemic's economic slowdown is expected to result in a 13-17% decline in UK GHG emissions in 2020 below 2019 levels. Accordingly, the UK can now achieve its previous 2030 climate target of 57% emissions reduction below 1990 levels under current policies. However, this target was established in 2016 and is not sufficient to reach net-zero by 2050.</p> <p>Since the parliament passed the net-zero legislation in 2019, the UK has been strengthening its announced suite of climate policies, with a more potent target of 68% by 2030 making the UK one of the first countries globally to bring its emissions into line with the Paris Agreement's 1.5°C.</p>

The UK, post-Brexit, now has 2030 targets that are more ambitious than those of the EU. The upcoming Climate Ambition Summit (COP26) in Glasgow is expected to pressure countries to upscale their 2030 targets similar to that of the UK.

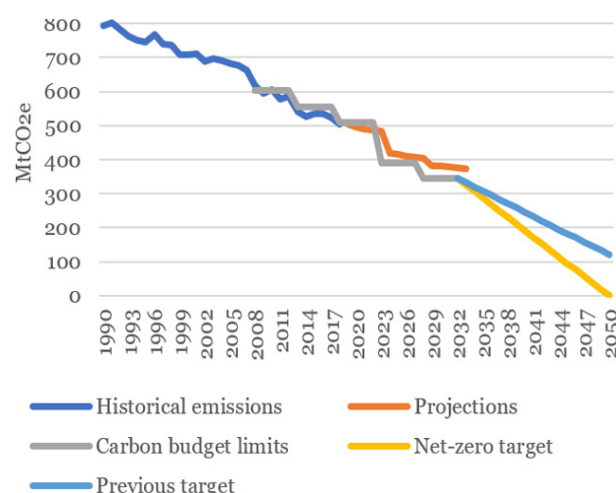
Among the efforts towards a net-zero 2050 were:

1. The announced £3bn investment for improving the energy efficiency of homes and public buildings;
2. A £350m investment to reduce emissions from heavy industry; and
3. An £800m investment to establish carbon capture and storage at two UK sites by 2030.

The government is also planning to ban the sale of petrol and diesel cars in 2032, three years earlier than previously planned. In addition, there are plans to double the country's international climate finance funding from £5.8bn to £11.6bn over the period 2021-2025, placing the UK amongst the world's leading providers of climate finance.

The country's pathway to carbon neutrality by 2050 (Figure 5) is documented more specifically in Prime Minister Boris Johnson's £12bn ten-point plans<sup>xviii</sup> which focuses on (i) reducing emissions as much and as fast as possible and (ii) removing GHG emissions at the same rate as the release of unavoidable emissions<sup>xix</sup>.

Figure 5 UK's pathway to net-zero



## UK'S NET-ZERO TARGET, ALTHOUGH HIGHLY CHALLENGING, REMAINS TECHNICALLY FEASIBLE

The plan aims to mobilise £42bn of private investment by 2030, to reduce UK emissions by 180 Mt/CO<sub>2</sub>e between 2023 and 2032. This also includes more investment in new nuclear power and a quadruple increase in offshore wind capacity. Technologies such as solar and wind power are now no longer dependent on government support since subsidies enabled costs to reduce significantly quicker than expected.

Table 3 Measures required for net-zero by 2050 <sup>xx</sup>

Sector	Measure	2017	2050 Scenario	
			Core	Further ambition
Power	Share of low-carbon generation	50%	97%	100%
	Low-carbon generation (TWh)	155	540	645
Buildings (share of low-carbon heat)	Low-carbon heat in existing homes	4.5%	80%	90%
	Low-carbon heat in non-residential buildings		100%	100%
Industry	CCS	0%	50%	100%
	Low-carbon heat	<5%	10%	85%
Surface transport (share of fleet)	Battery electric cars and vans	0.2%	80%	100%
	Electric and hydrogen HGVs	0%	13%	91%
Aviation	gCO <sub>2</sub> per passenger-km	110	70	55
	Sustainable biofuel uptake	0%	5%	10%
Shipping	Ammonia uptake	0%	75%	100%
Land use and forestry	Afforestation (% of UK land area)	13%	15%	17%
	Peatland restoration (% area in good condition)	25%	n/a	55%
Engineered removals (MtCO <sub>2</sub> )	BECCS	0	20	51
	Direct air capture	0	n/a	1

According to Carbon Brief, reaching net-zero by 2050 would require the deployment of 75 GW of offshore wind, compared to the current 8 GW and the 30 GW to be developed by the government's 2030 "sector deal." This includes up to 7,500 turbines, making up 2% of the UK seabed. Currently, there are nearly 2,000 turbines in UK waters. Table 3 lists the measures that are required to take the UK to carbon neutrality by 2050.

## JAPAN'S NET-ZERO GOAL FACES MANY HURDLES

### 2030

#### Paris Agreement:

- 26% below 2013 by 2030 (15% below 1990 by 2030) (17% below 2010 by 2030)

### 2050

#### Net-zero carbon emissions long-term goal

### Climate Action Tracker: Highly Insufficient < 4°C

Japan's energy and industry CO<sub>2</sub> emission dropped for the first six months of 2020 by an estimated 7.5%, compared to the same period in 2019, due to Covid-19. This came as GHG emissions were already falling by an average 2.5% per year between 2013-2018 and 3.9% in 2018.

The Tracker estimates GHG emissions in 2020 to fall by 6-11% lower than 2019, although Japan would meet its NDC target even without the pandemic's estimated impact. The current policies suggest emissions reduction projections of 18-29% below 1990 levels in 2030.

However, the country's target is rated as highly insufficient, in the sense that if all countries were to adopt this level of ambition, global warming would likely surpass 3-4°C.

In October 2020, Japan became the latest major economy to announce a long-term



climate neutrality target by Prime Minister Suga Yoshihide. Previously, the country committed to an 80% reduction in its GHG emissions by 2050, which has been upgraded to a net-zero carbon target by 2050. The new pledge necessitates (1) an ambitious pace and scope of transforming the country's energy and industry sectors and (2) a broader buy-in from the business community beyond the power sector.

Japan's power sector, which currently relies on fossil fuels for over 70% of supply, represents its leading source of GHG emissions. The shutdown of a large part of nuclear capacity following the 2011 Fukushima accident, and its subsequent slow restart, has kept emissions high. Although the sector witnessed a 24% emission reduction between 2013 and 2018, it remains culpable for about half of the country's CO<sub>2</sub> emissions, followed by transport (19%), industry (18%), and commercial and residential sectors (10%). Although the country has a long way to go, achieving the 2050 climate neutrality target is quite possible, building on the 2030 low-carbon action plans of 100 private companies and business associations under the auspices of Japan's Business Federation (Keidanren). These plans focus on maximising the use of available technologies and expand renewables and energy efficiency measures across manufacturing processes and business operations.

In addition, the Japan Climate Leaders' Partnership has been calling for increased adoption of a 2050 carbon neutrality pledge across corporations through the promotion of global initiatives like RE100 within Japan. Companies that pledged a net-zero 2050 include JERA, Kawasaki Heavy Industries, Toyota, and Sony.

Japan has already begun formulating its triennial Basic Energy Plan, due out in 2021. The existing plan, which was issued in 2018, anticipates a share of 63% natural gas and

coal in the country's electricity mix by 2030, followed by 22-24% of renewables and 20-22% of nuclear. According to the latest study by the Institute of Energy Economics, Japan (IEEJ), the country's CO<sub>2</sub> emissions from the power sector will decrease from about 1,080 Mt currently to 940 Mt in 2030 and to 738 Mt in 2050 under the reference scenario.



The carbon neutrality pledge necessitates substantial revision in the current vision. According to Japan's Renewable Energy Institute (REI), achieving climate neutrality would require a complete phase-out of coal by 2030 and a 45% increase of renewable electricity. However, the shift to renewables is hard for Japan since there is not enough space for solar and wind farms. Japan intends to be a technology and market leader in hydrogen, with possible imports from Australia and the Middle East.

Therefore, the Basic Energy Plan should clearly outline how much the carbon neutrality pledge can mobilise required investment in low-emission technology development. Japan's carbon pricing could also have a positive impact on financial institutions. For instance, the Mitsubishi UFJ Financial Group targets US\$190m worth of sustainable financing by 2030.

#### SOUTH KOREA NEEDS TO ADDRESS ITS COAL PROBLEM TO REACH CARBON NEUTRALITY

In October 2020, President Moon Jae-in announced that South Korea aims to achieve carbon neutrality by 2050. This came after July's US\$65bn "Green New Deal" announcement. While climate activists celebrated the goal, many emphasised the challenging task that must be accomplished to get to net-zero.

The investment will create 659,000 jobs in several sectors, including energy-efficient renovations for public buildings, expanding renewable energy, and promoting climate-friendly transport options (electric and hydrogen-powered cars).

# 더 늦기 전에 2050





However, in order to achieve its net-zero goal, South Korea has to address its coal problem. The country is the world's 12th largest economy but the 7th largest carbon-emitter. South Korea's energy sector is characterised by the dominance of fossil fuels, which in 2018 accounted for 85% of total primary energy supply (TPES), a strong dependence on energy imports at 84% of TPES, and the dominance of industrial energy use at 55% of total final consumption, the highest share among IEA countries. In 2018, South Korea had the lowest energy share from renewable sources in energy supply among all IEA countries.

The Korean government is committed to advance the country's energy transition by increasing the share of renewable electricity to 20% by 2030 and to 30-35% by 2040, to gradually phase-out coal and nuclear from the energy mix while significantly improving energy efficiency and by fostering the country's nascent hydrogen industry. This mammoth task is encapsulated in a recent report which showed that South Korean institutions, both public and private, financed US\$50bn worth of coal projects in the past 12 years<sup>xxiv</sup>.

In its Green New Deal, South Korea aims to have 1.13 million electric and 200,000 hydrogen vehicles on the road by 2025. Regarding coal, the government plans to phase out all coal plants or convert them to run on LNG. However, it did not set a deadline for ending coal power.

Thus, achieving carbon neutrality by South Korea remains questionable and highly contingent on the country's coal phase-out and acceleration of clean energy development.

### THE US HAS MAJOR CATCHING-UP TO DO TO MATCH CHINA, JAPAN, AND THE EU'S CLIMATE AMBITIONS

<b>2025</b>	<p><b>Paris Agreement:</b>  <b>Withdrew from the Paris Climate Agreement under the Trump administration, but re-joined recently on President Biden's inauguration day</b></p> <ul style="list-style-type: none"> <li>• 26-28% below 2005 by 2025 (10-17% below 1990 by 2025)</li> </ul>
<b>2050</b>	<p><b>Under the Obama administration, the US had a mid-century strategy:</b></p> <ul style="list-style-type: none"> <li>• 80% below 2005 levels by 2050 (68-76% below 2005 by 2050) (76% below 1990)</li> </ul>
<b>Climate Action Tracker: Critically Insufficient 4°C</b>	<p>In 2020, US emission are expected to decrease due to Covid-19, but the Trump administration's climate inaction and response to the Covid-19 pandemic are likely to counteract some of the decline in emissions.</p> <p>US GHG emissions in 2020 are expected to be 10-11% lower than 2019. Limited travel mobility has impacted transport, decreasing gasoline consumption by 24% in 2020's 2nd quarter, compared to 2019 levels.</p> <p>The previous administration did not launch a green recovery. Instead, the pandemic was used as a justification to continue relaxing environmental regulations, allowing industries to emit more GHGs and exempting them from penalties for violating these rules.</p>

After a three-year waiting period, due to the complex Paris Agreement withdrawal rules, the US became the first nation in the world to

## THE US HAS MAJOR CATCHING-UP TO DO TO MATCH CHINA, JAPAN, AND THE EU'S CLIMATE AMBITIONS

formally withdraw from the Paris Agreement in November 2020. On 20 January, the US was able to re-join the climate agreement after President Joe Biden signed the executive order on his inauguration day, which would take effect after 30 days. Re-joining the Paris Agreement was one of Mr. Biden's key campaign pledges, along with promises to decarbonise the power sector by 2035 and achieve carbon neutrality no later than 2050.

These plans, however, must be supported by concrete and vigorous plans and policies to reduce emissions. Analysts from E3G said that "the easy part is re-joining Paris", suggesting that the US needs to forward an ambitious NDC for 2030, taking into consideration major economies' ambitious pledges made recently at the virtual 75th UNGA event<sup>xxv</sup>. This means that the US has to go beyond its initial target when it first joined the accord (28% by 2025 against 2005 levels).

Although submitting a plan at the COP26 meeting in November seems to be a tight deadline, the administration's experts plan to publish its targets and roadmap even several months before that. This is mainly to take a leadership position in encouraging other countries to step up their climate targets. This would entail enforcing stricter domestic legislation and reversing the rollbacks of the Trump-era.

Right on his inauguration day, President Biden cancelled the US\$9bn Keystone XL oil pipeline project connecting the US with Canada. He also paused oil and gas leasing in federal lands and waters, including the Arctic National Wildlife refuge. He reversed major rollbacks: methane emissions in the oil and gas sector, fuel efficiency standards for cars and light trucks, energy efficiency standards for appliances and buildings, and air pollution controls. Besides, the new administration issued a wide-ranging

executive order that includes the immediate review followed by government agencies' appropriate action to address the Trump-era regulations that do not favour public health, harmful to the environment, "unsupported by the best available science," or not serving US national interest.

### Potential pathways to net-zero

Princeton University's study outlines five distinct technological pathways for the US to decarbonise its economy. All of the pathways





were found to include annual spending on energy within the historical range of what the US spends on energy each year, around 4–6% of GDP. Following a BAU pathway, the country would spend about US\$9.4tn on energy over the next decade, without decarbonisation measures. However, in all five net-zero scenarios, energy spending would cost only an estimated 3% of GDP (US\$300bn) more for the decade. This percentage is likely to shrink further as oil and gas prices are higher than modelled.

The study suggests six pillars for rapid decarbonisation. These include:

- Change in consumer energy investment and use behaviours to enhance efficiency and electrification. Subsequently, this would drive consumers towards EVs, leading to over 300 million personal EVs on the road and 130 million residences to use heat pumps.
- Acceleration of wind and solar, with 10–100 of GW per year, should be sustained for decades.
- Advance the major bioenergy industry by constructing 100 new conversion facilities and producing 620 Mtpa biomass feedstock (1.2 Bt/y). Hydrogen and synfuels industries have to develop, with 8–19 EJ hydrogen capacity through electrolysis or biomass/methane reforming fitted with CCS technology required. The largest hydrogen use would be for fuels synthesis in most scenarios.
- Development of 0.9–1.7 GtCO<sub>2</sub>e of carbon storage, with CO<sub>2</sub> likely to be captured at around 1,000 facilities. This should be backed up by a 21,000–25,000 km interstate CO<sub>2</sub> trunk pipeline network to facilitate CO<sub>2</sub> transport to storage facilities.
- Non-CO<sub>2</sub> emissions (N<sub>2</sub>O, methane and fluorocarbons) abatement by 20% below 2020 emissions by 2050.
- Enhanced forest management, as there is a potential sink of 0.5 to 1 GtCO<sub>2</sub>e/y impacting half or more of all US forest area (> 130 Mha).



# THE US HAS MAJOR CATCHING-UP TO DO TO MATCH CHINA, JAPAN, AND THE EU'S CLIMATE AMBITIONS

The scenarios highlighted in the research include "high electrification" or E+ scenario in which buildings and transportation are electrified, with 100% of cars are electric by 2050. The "less electrification" or E- scenario, electrifies at a slower pace and employs more liquid and gaseous fuels for longer. As for the "high biomass" or E- B+ scenario, the US will allow more biomass to be used in the energy system, which could require converting some land currently used for agriculture to grow energy crops, unlike other scenarios. The "renewable constrained" or E+ RE- scenario uses limits the construction of wind turbines and solar power plants to be no faster than the fastest rates previously achieved by the US. Finally, the "100% renewable" or E+ RE+ is the most technologically restrictive. It assumes no new nuclear plant will be built and does not allow underground storage of CO<sub>2</sub> while eliminating all fossil fuels by 2050. Henceforth, it entirely relies on a massive and rapid deployment of wind and solar coupled with larger hydrogen production.



Table 4 US carbon neutrality potential pathways<sup>xxvi</sup>

	REF	E+	E-	E- B+	E+ RE-	E+ RE+
<b>CO2 emissions target</b>	-0.17 GtCO <sub>2</sub> in 2050					
<b>Electrification</b>	Low	High	Less high	Less high	High	High
<b>Wind/solar annual build</b>	n/a	10%/y growth limit	10%/y growth limit	10%/y growth limit	Recent GW/y limit	10%/y growth limit
<b>Existing nuclear</b>	50% -> 80-y life	50% -> 80-y life	50% -> 80-y life	50% -> 80-y life	50% -> 80-y life	Retire at 60 years
<b>New Nuclear</b>	Disallow in CA	Disallow in CA	Disallow in CA	Disallow in CA	Disallow in CA	Disallow
<b>Fossil fuel use</b>	Allow	Allow	Allow	Allow	Allow	None by 2050
<b>Maximum CO2 storage</b>	n/a	1.8 Gt/y in 2050	1.8 Gt/y in 2050	1.8 Gt/y in 2050	3 Gt/y in 2050	Not allowed
<b>Biomass supply</b>	n/a	13 EJ/y by 2050 (0.7 Gt/y biomass) (Not new land converted to bioenergy)		23 EJ/y by 2050 (1.3 Gt/y biomass)	13 EJ/y by 2050 (0.7 Gt/y biomass) (Not new land converted to bioenergy)	



## IMPLICATIONS FOR MAJOR OIL AND GAS PRODUCERS:

- Despite a large divide among oil and gas companies on how deeply to cut emissions, the industry is getting prepared for a radical shift in priorities. Energy company Ørsted (formerly DONG) evolved from an oil and gas company to a renewable energy leader in just a decade, setting a net-zero target by 2040.
- Total and Royal Dutch Shell had announced their own plans to reach net-zero emissions by 2050, building on previous pledges to boost spending on low-carbon energy sources, including wind, solar, and biofuels. Meanwhile, two of their American counterparts, ExxonMobil and Chevron, announced rather modest goals to reduce GHG emissions.
- Current strategies focus on reducing the carbon intensity of products sold or creating carbon credits. Members of the Oil and Gas Climate Initiative (OGCI) invest about US\$7bn each year in low carbon solutions, including growing attention to 'nature-based solutions' such as reforestation. In January 2021, Occidental Petroleum delivered two million bbl of 'carbon neutral' oil to India as part of developing a value chain for fully offset oil, intending eventually to do this via direct air capture of CO<sub>2</sub> for enhanced oil recovery<sup>xxvii</sup>.
- Companies have to incorporate the cost of carbon in economic evaluations.



## CONCLUSIONS

Although the aforementioned countries, except the US, have forwarded their pledges to reach carbon neutrality by 2050 (by 2060 for China), the degrees of target-achievability differ from one country to another. This comes as some countries are still heavily dependent on coal and fossil fuels for their energy needs. In contrast, others have reached considerable energy efficiency levels and developed a significant capacity for clean energy to reduce fossil fuel consumption. Setting policies and targets remains the easy part, while implementation requires consistent efforts and sometimes enforcement measures.

Without integrated and accelerated action, the world will likely exceed the 2°C Paris Agreement scenario. Therefore, it is crucial that:

- Other major emitters commit to their own carbon neutrality targets;
- Countries progress on clear and credible intermediate milestones towards the 2050/2060 goals and progressively raise ambitions;
- Countries do not abandon targets because of domestic politics, particularly relevant in the case of the US;
- Feasible plans and technologies are advanced for hard-to-abate sectors such as heavy industry, aviation, and agriculture;
- Given likely 'over-shooting' emissions trajectories and the persistence of fugitive emissions, approaches such as CDR and bio-sequestration are developed to reduce atmospheric CO<sub>2</sub> directly; and
- Policies are put in place to support individuals, communities, areas and countries that are disadvantaged by the move towards carbon neutrality.





## APPENDIX

- i. <https://qz.com/1958041/oil-companies-may-finally-invest-in-geothermal-in-2021/>
- ii. <https://www.carbonbrief.org/analysis-which-countries-met-the-uns-2020-deadline-to-raise-climate-ambition>
- iii. This includes Argentina, Chile, Ethiopia, EU, Kenya, Norway, UAE and the UK.
- iv. Nationally determined contributions according to the United Nations Framework convention on Climate change's
- v. Australia, Brazil, New Zealand, Russian Federation, Singapore, Switzerland and Vietnam
- vi. <https://www.carbonbrief.org/analysis-which-countries-met-the-uns-2020-deadline-to-raise-climate-ambition>
- vii. <https://pemedianetwork.com/petroleum-economist/articles/upstream/2021/china-s-shale-gas-set-for-double-boost?id=74194008>
- viii. BloombergNEF
- ix. One of the more ambitious climate outlooks by CNPC
- x. BloombergNEF
- xi. Carbon Brief Org.; the carbon price used in the model reaches US\$ 250/tCO<sub>2</sub>, in today's prices
- xii. Poland is very coal-dependent and will need more time to be able to tackle its CO<sub>2</sub> emissions.
- xiii. A tool to ensure the transition towards a carbon neutral economy takes places in a fair way, leaving no one behind.
- xiv. <https://www.nature.com/articles/d41586-020-03643-0>
- xv. Stationary batteries are primarily used in the power sector; batteries are also used in electric vehicles
- xvi. <https://cembureau.eu/library/press-releases/european-cement-industry-gears-up-for-2050-carbon-neutrality/>
- xvii. European Commission
- xviii. The ten-point plan sets out the approach government will take to reach net-zero
- xix. <https://theconversation.com/the-uk-has-bold-plans-to-reach-net-zero-emissions-but-it-must-go-beyond-just-turning-off-the-co-taps-150399>
- xx. <https://www.carbonbrief.org/in-depth-the-uk-should-reach-net-zero-climate-goal-by-2050-says-ccc>
- xxi. A coalition of over 150 companies
- xxii. RE100 is the global corporate renewable energy initiative with more than 280 members (businesses) committed to 100% renewable electricity, led by the Climate Group in partnership with CDP.
- xxiii. Builds on the existing (2018) energy plan
- xxiv. <https://chinadialogue.net/en/climate/south-korea-path-to-carbon-neutrality/>
- xxv. Financial Times
- xxvi. [https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton\\_NZA\\_Interim\\_Report\\_15\\_Dec\\_2020\\_FINAL.pdf](https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf)
- xxvii. <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/012921-us-occidental-supplies-first-cargo-of-carbon-neutral-crude-to-indias-reliance>











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