Net-Zero Carbon Economy By 2050

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Sustainability Report

The Al-Attiyah Foundation

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INTRODUCTION

NET-ZERO CARBON ECONOMY BY 2050

A growing number of countries are committing to ambitious target of net-zero emissions by 2050, as a show of commitment to implement the Paris Agreement. Sectoral net zero roadmaps are also beginning to emerge. For example, the International Energy Agency (IEA) is due to publish, in May this year, it's first comprehensive roadmap for the entire global energy sector to reach net-zero emissions by 2050.

Is a net-zero carbon economy a realistic proposition or a pipe dream? What commitments have been made so far, and what needs to be done to make them reality?

THE ABDULLAH BIN HAMAD AL ATTIYAH FOUNDATION

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

- The Paris Agreement's aim of limiting global warming to no more than 1.5°c by 2100 implies that global carbon dioxide emissions would have to reach net-zero around 2050, with any continuing emissions being offset by withdrawals.
- Accordingly, net-zero carbon aspirations are increasingly common for countries, sub-national regions and companies, with about 70% of the global economy now covered by firm or indicative net-zero targets.
- However, some major emitters such as Brazil, Russia and Australia, have set weak or no net-zero goals.
- The adoption of net-zero goals by influential countries and companies will encourage or even compel others to follow, to avoid losing market access.
- Reaching net-zero requires a radical transformation of the entire economy, including energy production and use, transport, industry, buildings and agriculture.
- As decarbonisation will probably be too slow to meet net-zero by 2050, and some level of residual emissions will be unavoidable, offsets will be essential, via some combination of bio-sequestration, bio-energy with carbon capture and storage, and direct air capture of CO_2.
- With the exception of Ukraine and Denmark, progress on decarbonisation by many countries, is still far short of the pace required to meet that goal of the Paris Agreement - about 3.2% reduction on 2019 levels annually to 2050. Greece, Finland and the UK are also not too far behind.

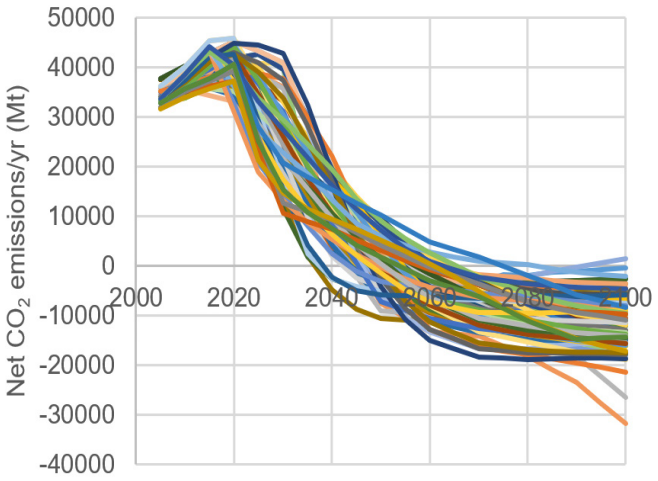
NET-ZERO CARBON ASPIRATIONS FOLLOW LOGICALLY FROM CLIMATE MODELS AND COMMITMENTS

Under the Paris Agreement (2015), countries pledged to limit global warming by 2100 to "well below" 2°c above pre-industrial levels and, if possible, make efforts to limit warming at 1.5°c. Yet, the world is still very far away from meeting this goal. In fact, a UN report published in 2020 shows that the world is on track for an average temperature rise of 3°c. According to the World Economic Forum, if the world is to reach a 1.5°c or 2°c target, net carbon dioxide (CO_2) emissions will have to be reduced by 50% (about 23 $GtCO_2e$) by 2030 from 2019 levels, and reach net-zero around 2050.

Based on the latest generation of climate models, CMIP6 (used in the lead up to the Intergovernmental Panel on Climate Change's (IPCC) 6th assessment report, expected in 2021-22), warming will likely exceed 1.5°c between 2026 and 2042, under the scenarios where emissions are not quickly reduced. The 2°c threshold is expected to be exceeded between 2034 and 2052 in the highest emissions scenario, and between 2038 and 2072 for modest mitigation[i].

(Figure 1) shows a wide range of emissions trajectories compatible with 1.5°c of warming. The common features are a peak in emissions between 2020 and 2030, and reaching net-zero between 2035 and 2080 (in nearly all cases, between 2042 and 2065). There is then a period of net negative emissions (i.e. net CO_2 removal from the atmosphere), of between 2-18 billion tonnes (Gt) per year.

Figure 1 1.5°c-compatible emissions pathways[ii]



With climate change discourse increasingly adopted by governments, corporations and social groups, the use of phrases such as "carbon-neutral", "zero-carbon" and "net-zero" have become rather blurry. The focus of this report is on a net-zero carbon economy. [Zero-carbon implies not emitting anthropogenic carbon dioxide or other greenhouse gases (GHGs) at all.]

At a corporate or national level, carbon neutrality involves balancing GHG emissions by offsetting (or removing from the atmosphere) an amount of carbon dioxide equivalent to that produced. This can be done through carbon credits – permission to emit carbon dioxide (CO_2) in exchange for offsetting those emissions – or by investing in renewable energy projects or other ventures that reduce emissions. However, a commitment to be carbon-neutral does not imply reducing overall GHG emissions. A carbon-neutral industry has only to offset the GHG emissions it produces, even if they are rising. [The concept of net-zero, on the other hand, is different in that it is carbon neutrality within a carbon budget defined by the goal of the Paris Agreement.]

The boundaries of net-zero also have to be defined. For a country, they can include emissions within its borders, but also those from imports – e.g. European purchases of carbon-intensive Chinese goods. For a company, they are typically divided into Scope 1 (direct emissions), Scope 2 (emissions from purchased electricity and heat), and Scope 3 (emissions from the supply chain, including products bought by the company or sold by it, for instance fossil fuels combusted by the end-user). This presents enormous challenge for unaccounted emissions if not all countries or companies are committed to net-zero, or for double or multiple-counting of reductions.

From a global point of view, net-zero carbon requires the active removal of CO_2 from the atmosphere somewhere to balance out continuing emissions elsewhere[iii]. This can be achieved by biological means, such as reforestation, technological approaches (direct air capture) or possibly other methods.

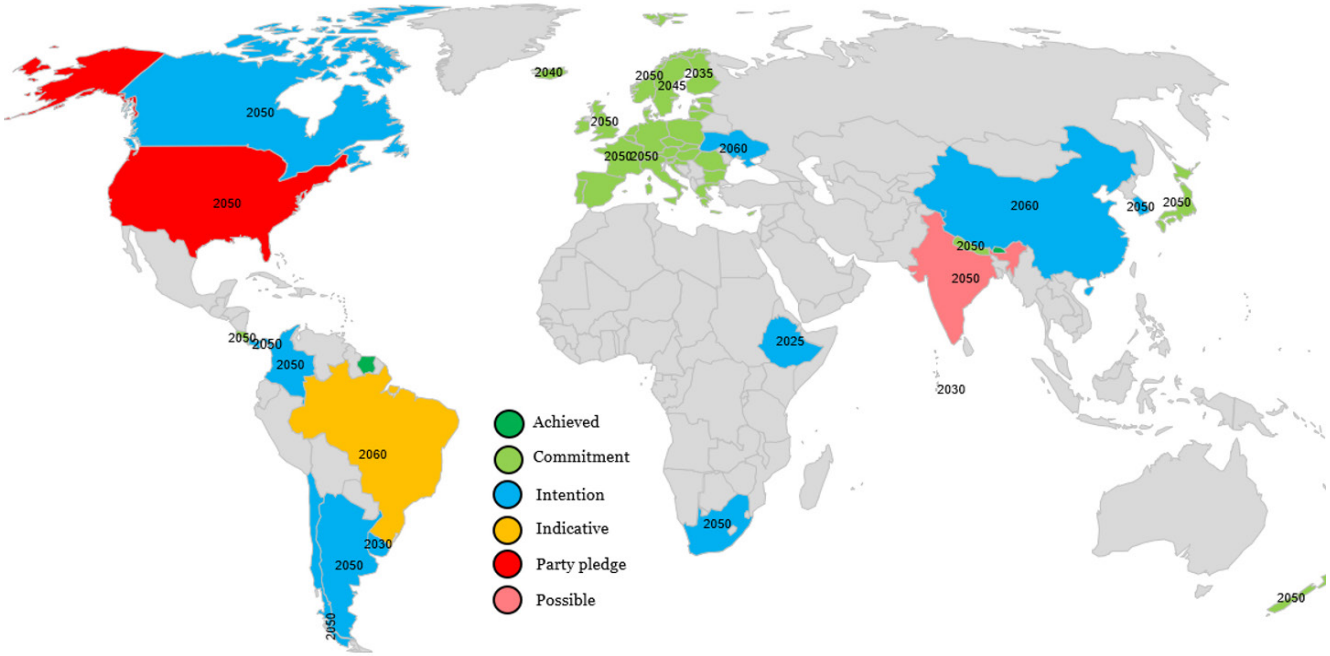
NET ZERO-CARBON ASPIRATIONS HAVE BECOME INCREASINGLY POPULAR FOR COUNTRIES AND COMPANIES

The pressure to advance on the Paris goals, and to have a credible long-term target to guide policy, has led an increasing number of countries to set net zero-carbon goals, usually by 2050 or 2060. Companies too have such aspirations, sometimes for compatibility with national targets, but often in advance of domestic policy and for reasons of appearing as good corporate citizens or helping to transform the organisation for a low-carbon future.

So far, national net-zero commitments, in various forms, embrace about 65% of world emissions and 70% of the global economy (Figure 2). The strongest pledges have been made by the EU and UK, and some other countries including New Zealand, Panama and Nepal, often being enshrined in national law. Japan, South Korea and some Latin American countries have somewhat weaker adherence. China's latest five-year plan, by contrast, did not give many details on how its 2060 net-zero goal would be met. Joe Biden, as a US presidential candidate, committed to the 2050 goal[iv], and his administration is beginning to lay out steps to get there. A net-zero law has been drafted in Canada, a 2050 net-zero target is currently being debated in India, and Indonesia is considering a 2070 date. Notable emitters that are yet to formally announce their commitment to net-zero by around mid-century include Russia (4.5% of world 2019 CO_2 emissions from fossil fuels), Australia (1.3%), Mexico (1.3%), Brazil (1.3%), Iran (2%) and Saudi Arabia (1.7%).

Net-zero commitments by national governments are supplemented by 15 regions, 398 cities, 786 businesses and 16 investors with net-zero pledges made at COP25 in December 2019[v]. Although inevitably there is a lot of overlap, some Australian and US states, including California and New York, and cities such as Amman, Dakar, Dar Es Salaam, Dhaka, Dubai, Hanoi, Istanbul, Jakarta, Kampala, Karachi, Kuala Lumpur, Lagos, Melbourne, Nairobi, Rio de Janeiro, São Paolo, Tel Aviv and others do extend coverage beyond national targets.

Figure 2 National net zero-carbon commitments



A wide range of companies have made net-zero commitments (Table 1)[vi]. These commitments are, still, somewhat mixed and not all include Scope 3

Table 1 Examples of corporate net-zero commitments

Date	Oil & gas, mining	Industrial	Aviation	Other
2017				Google
2020				EY
2030				Ikea Microsoft Apple Facebook BBC AstraZeneca
2039		Unilever		
2040				Sainsbury's Amazon
2045			Finnair	BT
2050	Shell BP Total Equinor Petroleum Development Oman Glencore Rio Tinto	Cemex Lafarge Holcim Ford Volkswagen BMW Toyota Renault BASF	Airbus Qantas American Cathay Pacific Iberia Malaysia Qatar Airways Royal Jordanian	Barclays Maersk

emissions. They are often not clear on how much is to be achieved using offsets or how these will be sourced.

Companies will, of course, have to comply with national net-zero rules where they operate, located, listed, and headquartered. Where net-zero carbon goals include "Scope 3", they cover the entire supply chain, making it increasingly difficult for even small or privately-held corporations to operate unless they too make progress on net-zero schedules set by their business partners, clients and customers. Multinational firms are also expected to apply their net-zero policies worldwide, even in countries that have not themselves made such commitments.

LONG-TERM NET-ZERO GOALS ARE BECOMING POPULAR

The only countries that have achieved carbon neutrality so far are Bhutan and Suriname, based largely on hydropower for electricity, and their large forestry sectors to absorb other emissions.

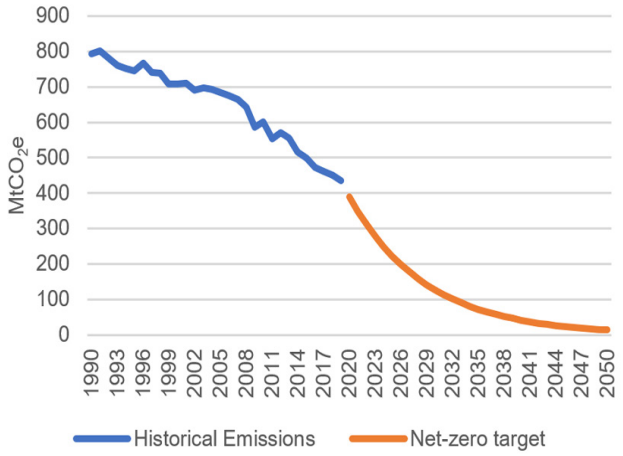
Countries that recently advanced their net-zero targets include Sweden, the UK, New Zealand, Denmark, France and Hungary. Sweden enshrined a net-zero target by 2045 in law in 2017, and plans to have net-negative emissions after it achieves its net-zero target. Sweden also listed interim targets in its climate policy framework, which include 63% emissions reduction on 1990 by 2030 and 75% lower by 2040, covering all GHGs. Other short-term policies towards net-zero are (1) the ban of sales of fossil fuel-powered cars by 2030 and (2) the phase out of coal power plants. The last coal plant in Sweden was planned to be closed by 2022, but the operator closed the plant two years early in April 2020[vii].

One item that sets Sweden apart from other countries is its transparent approach regarding offsetting. Its net-zero framework lists maximum quantity of offsets that can be used to achieve its interim targets: 8% by 2030 and 2% by 2040, with the overall net zero target by 2045 requiring a maximum of 15% offsets.

The UK is now halfway to achieving its net-zero target, with GHG emissions estimated to have been 51% below 1990 levels in 2020 (Figure 3), according to Carbon Brief. This was reached mainly due to a record 11% reduction in emissions in 2020, due to CoVid-19.

While this is a milestone for the UK, it also shows how challenging it will be for the country to eliminate the remaining emissions. The good progress so far has mainly come from phasing out coal power and increasing the share of renewables in electricity generation.

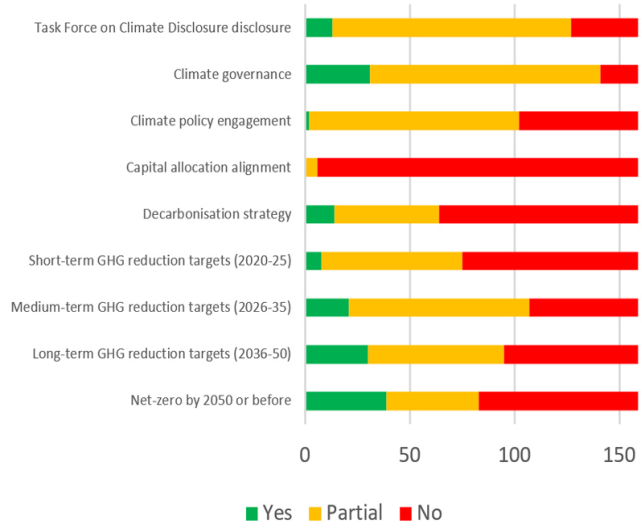
Figure 3 UK emissions in 2020 were 51% below 1990 levels



Further reductions will require the transformation of transport, industry, home heating, agriculture and other sectors. In December 2020, the UK announced an ambitious interim target to reduce emissions by at least 68% by 2030, from 1990 levels. However, a public accounts committee report mentions that despite "green rhetoric", government policy is falling short, as ministers struggle to instruct their departments to include net-zero targets when setting policy. The report also highlighted the lack of coordination between central and local government on emissions reduction, while the public has been engaged in the process[viii]. The UK will host the COP26 climate summit in November in Glasgow, with the goal of bringing countries together to fulfil the Paris Agreement.

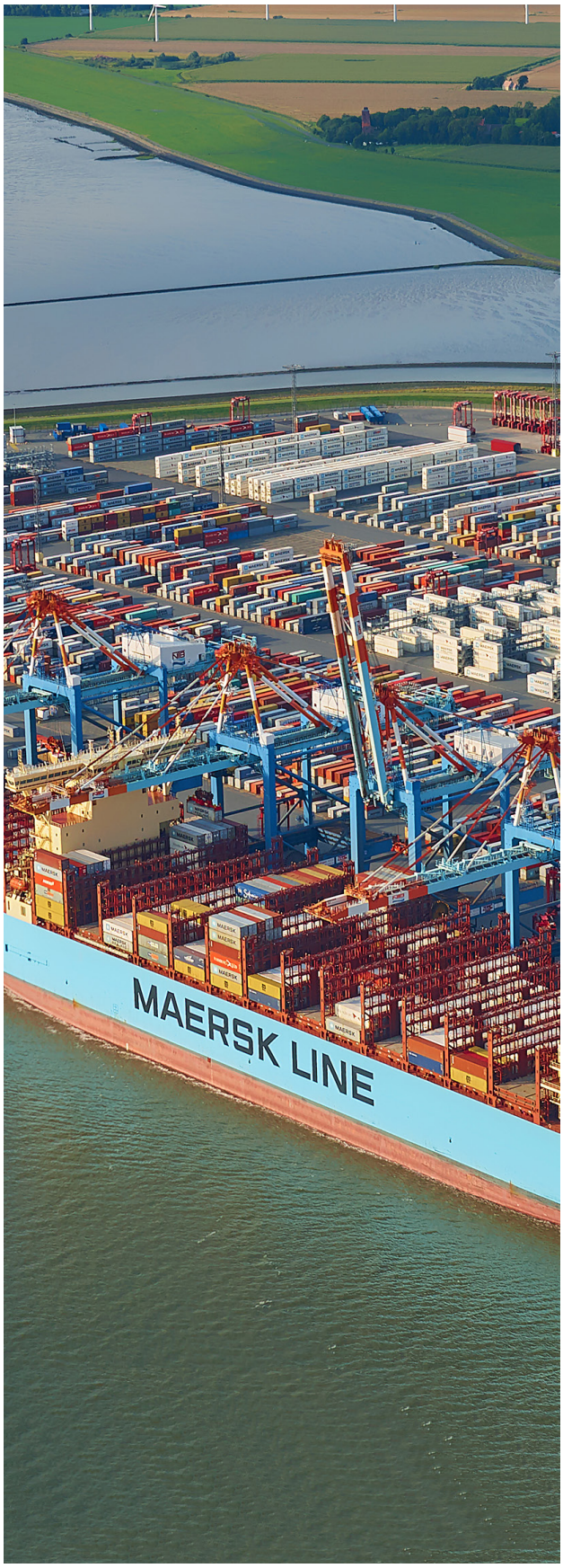
New Zealand, on the other hand, passed multi-partisan climate legislation end-2019, setting a net-zero target by 2050. The legislation established the Climate Change Commission, an independent expert body, to outline the roadmap to net-zero, with the agricultural sector included. The country is focussing more on biogenic methane, as it accounts for up to 43% of its total emissions – about 70% of which comes from agriculture. It set a target of 10% emissions reduction by 2030 and 24-47% by 2050, from 2017 levels[ix].

Figure 4 Climate Action 100+ assessment of leading companies' net-zero goals[xi]



On a corporate level, targets are increasingly popular but the supporting steps are still mostly inadequate. Analysis by Climate Action 100+ covering 159 companies found relatively higher levels of commitment to net-zero goals by 2050, but weak on setting short-term targets and strategy, that are aligned with capital allocation (Figure 4).

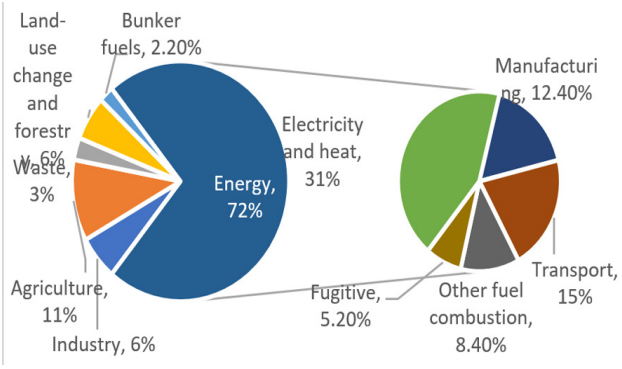
This is a concern, as investment cycles for long-term capital assets need to be moving into alignment with net-zero very soon. The impressive commitment by shipping line Maersk to have its first carbon-neutral container ship and liner deployed by 2023, is noteworthy because it is made despite the company not yet knowing what fuels they will use[x]. This kind of leap of faith is required in order to leapfrog the development of technologies that will facilitate the attainment of net-zero carbon economy.



NET-ZERO EMISSIONS REQUIRE A FUNDAMENTAL TRANSFORMATION

The energy sector is the most important source of global emissions, but other areas, notably land-use and agriculture, and industrial processes, are also important (Figure 5). Within energy, power and heat generation dominates, but again manufacturing and transport (ground, sea and air) are significant too.

Figure 5 Share of global emissions by sector, 2015 [xii]



Net-zero GHGs therefore requires the near-total elimination of emissions from all these different areas of economic activity, and the offsetting of a relatively small amount of residual emissions.

Some of these approaches are technically and commercially mature, or at least well-understood, such as renewable energy. Others are very immature or uncertain, including battery or hydrogen aviation, or non-animal meat. Others are relatively straightforward technologically, but very complicated in social and policy terms. For instance, agricultural carbon-neutrality, could be compounded by: the huge number of small farmers, often in remote areas or with limited capital or education; the variety of crops, climates and social systems; and the concurrent challenges of food security, water security, cultural practices, biodiversity, the sustainability of the nitrogen cycle, and so on .

Emitting sector	Typical / possible net-zero approaches
Electricity generation	Renewables, nuclear, carbon capture, use and storage (CCUS), green / blue hydrogen
Industry	Electrification, solar / nuclear heat, green / blue hydrogen, new processes and materials, CCUS, material efficiency / circular economy, process efficiency, CFC / HCFC / HFC replacement
Passenger ground transport	Electric vehicles, public transport, bicycles / walkability
Heavy ground transport	Electric vehicles, hydrogen, electric rail, hyperloop
Marine transport	Electric (short-range), auxiliary sails, biofuels, green / blue hydrogen, synthetic fuels, on-board CCUS
Aviation	Electric (short-range), green / blue hydrogen, biofuels, synthetic fuels, shift to rail
Buildings	Electrification, direct solar / geothermal heat, efficiency, green / blue hydrogen
Agriculture	Non-animal meat, methane-reducing feed, soil CO_2 sequestration, rotational grazing, composting manure, switch from beef to other meat, enhanced efficiency fertiliser to reduce N_2O
Forestry	Reforestation / afforestation, management for carbon sequestration, sustainable bioenergy, wood as building material
Waste	Waste reduction, methane capture, recycling, waste-to-energy with CCUS

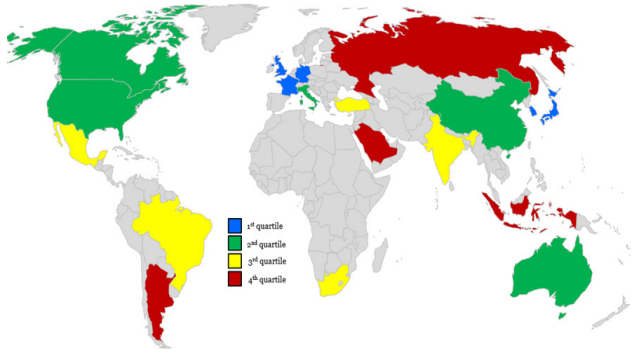
Some approaches simply replace existing fossil fuel technologies. Others involve fundamental economic or social changes, and may be slow to adopt or meet strong political opposition. For instance, battery vehicles can quite directly substitute for fossil-fuel cars, but alternative systems could include autonomous on-demand

networked vehicles, or public transport plus remote working, cycling and walkability, which would have very different implications for society, urban design and infrastructure.

ZERO-CARBON AMBITION STILL HAS A LONG WAY TO GO

Governments, industry, investors, and civil society would need to advance towards something more concrete and away from what at present, appears to be intentions and aspirations. Consistent plans, showcasing successes are required if current net-zero ambitions are to be turned into reality[xiii]. According to Net Zero Climate's indicators of quality, only 20% of the existing net zero targets meet basic robustness criteria, 60% include interim targets, 62% include a reporting mechanism and 44% include a published plan[xiv].

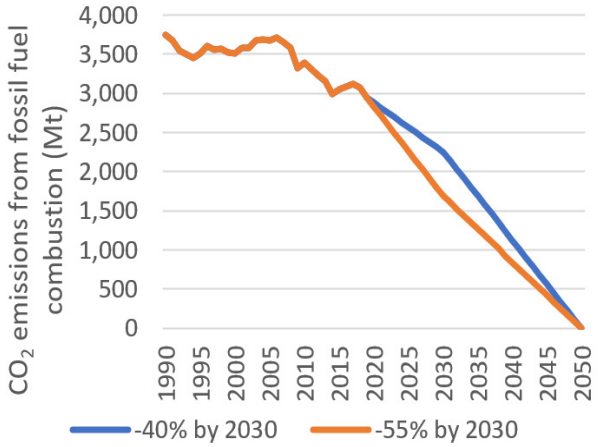
Figure 6 G20 net-zero progress remains uneven [xv]



As the world's most climate-ambitious region, the EU is a good test for the feasibility of net-zero goals. Figure 7 shows the EU's CO_2 emissions from fossil fuel combustion (this excludes other sources of CO_2 and other GHGs).

After a bumpy plateau to 2007, actually reaching a post-1990 high in 2006, decarbonisation accelerated from 2008 onwards, partly due to the global financial crisis. This chart does not yet include the impact of the Covid-19 pandemic in 2020 onwards. Emissions fell by 59 Mt/yr during 2007-2019. In December 2020, the EU made

Figure 7 EU CO_2 emissions trajectory (excluding UK) [xvi]



its interim goal for emissions reduction more ambitious, a 55% cut on 1990 levels (instead of the previous 40%)[xvii]. Under the previous target, emissions would have had to fall 63 Mt/yr annually to 2030, and by 113 Mt/yr from 2030

Table 2 Major economies' emissions trajectory [xviii]

Country / bloc	CO2 fossil fuel emissions as % of 1990		Decarbonisation rate 2007-19, %/year
	2007	2019	
EU	97%	78%	1.6%
• Greece			3.1%
• Finland			3.0%
• Denmark			3.4%
UK	96%	65%	2.7%
Norway	127%	116%	0.7%
US	118%	99.9%	1.3%
Canada	126%	127%	NA
China	310%	420%	NA
India	227%	412%	NA
Japan	118%	103%	1.1%
Russia	68%	69%	NA
Ukraine	43%	24%	3.6%

to 2050. However, under the new target, the required cut in emissions is 114 Mt/yr to 2030, and 84 Mt/yr from 2030 to 2050. These rates of decrease are not implausible but are certainly

ZERO-CARBON AMBITION STILL HAS A LONG WAY TO GO

very ambitious, given that the "easy" gains by decarbonising the power sector should have been mostly achieved by 2030.

The EU and UK are, at least, moving in the right direction, as is Ukraine (Table 2). The Table shows that other major economies with net-zero aspirations have either seen increases in emissions or slow decrease or flat rate of emissions. Emissions in China and India are on the rise, while emissions in the US and Japan have decreased slowly. Emissions remain relatively flat in Canada and Russia, as post-Soviet deindustrialisation and energy efficiency gains appeared to have been exhausted. An average rate of decarbonisation on 2019 levels of 3.2% annually would be required to hit net-zero by 2050. Of the major economies, only Ukraine and Denmark have achieved this in recent years, although within the EU, Greece (due to economic crisis) and Finland are relatively close.

The scale of activity required even for interim decarbonisation is indicated in Table 3 for the EU. The EU has to reduce its emissions by a bigger percentage in the next 11 years (2019-30) than it achieved during 1990-2019. In some areas, such as phasing out coal, it appears ahead of schedule. Wind, solar and electric vehicles have made good advances on meeting likely 2030 requirements. Two other low-carbon industries, hydrogen and CCUS, have to scale up dramatically from virtually zero today, although the technology is available in pilot and demonstration schemes.

The Energy Transitions Commission, a group of forty energy producers, industrial firms and financial groups, estimates that reaching net-zero will require some $1-2 trillion of additional annual investment worldwide up to 2050, about 1-1.5% of GDP. On the other hand, the group estimates that climate change already cost the EU and US $4 trillion between 2000-19[xxi].

Table 2 Major economies' emissions trajectory[xix]

	1990	2019	2030 Base Case	Accelerated transition
Emissions reduction vs 1990	0%	-24%	-46%	-53%
Coal in primary energy	26.6%	11.2%	9%	6%
Oil in primary energy	40.5%	38.4%	34%	30%
Gas in primary energy	17.4%	24.6%	25%	25%
Passenger electric vehicles, million	~0	1.8	20.6	77.5
Wind & solar capacity, GW	4.9[xx]	281	647	726
Electricity demand, TWh	2275	2892	2993	3350
Low-carbon hydrogen, Mt	~0	~0	1.9	2.5
CCUS, Mt	~0	~0	0	17

Energy transitions typically take long periods. It took 50 years for coal to fall from near-100% of global primary energy[xxii] to below 50%, 75 years for oil to rise from near-zero to about 50% of world primary energy, and about 20 years for nuclear power to gain some 10% of market share. Renewable energy and other low-carbon systems will have to move much faster, with supportive government policies and

public opinion, but also in the face of barriers of technology, cost and consumer tastes. Long-lived capital stocks, such as buildings, factories, power plants and electricity grids, pipelines, mines, railways and roads, urban layouts, aeroplanes and ships, last for decades or even centuries and will have to be retrofitted for carbon neutrality, or scrapped prematurely.

THERE ARE POSITIVE SIGNS THAT THE RACE TO NET-ZERO IS WINNABLE

There is growing belief that a zero carbon economy is attainable by a mid-century. The optimism is driven by several factors, including increasing momentum of climate action, and the encouraging trend in the development of technologies needed to achieve a zero carbon economy.

Solar and wind power, electric vehicles and batteries have all shown dramatic cost declines, in excess of most forecasts, as manufacturing and deployment have scaled up. Recent significant advances include floating wind power and bifacial solar panels. Other breakthrough technologies could dramatically lower the cost and expand the scope of decarbonisation, for instance:

- Solid-state batteries
- Hybrid silicon-perovskite solar cells
- Underground mineral CO_2 sequestration
- Advanced nuclear fusion and small modular reactors
- Hot-rock, closed-loop geothermal
- CO_2-cycle power and hydrogen generation
- Nuclear fusion
- Space-based solar power
- Electrolysis for reduction of iron ore and other ores
- Synthetic life producing biofuels and hydrogen
- Non-animal meat
- Hyperloop transport
- CO_2-based cement and ceramics
- Atmospheric CO_2 conversion to fuels, plastics and chemicals

Decarbonisation has other ancillary benefits, such as reducing air and water pollution and possibly improving international energy security.

THE ROLE OF OFFSETS IN NET-ZERO AMBITIONS

Reducing emissions close to zero does not present a realistic pathway to reach net-zero or to stabilise the climate. Firstly, nearly all realistic pathways to 1.5°c include some degree of overshooting the required atmospheric CO_2 concentration. Secondly, some degree of residual emissions will continue from fugitive sources, very essential and hard-to-decarbonise sectors, unavoidable continuing ecosystem change, and some countries that do not fulfil their commitments.

These residual emissions and the drawdown of atmospheric CO_2 to reverse overshooting require offsets.

In addition to generating carbon offset credits from projects such as renewables and energy efficiency, the following three approaches are gaining popularity:

- Biosequestration. This includes reforestation and afforestation; mangrove restoration; enhancing carbon take-up in soils and wetlands; agriculture practices that 'fix' CO_2, including 'biochar' (partly combusted organic material) as a soil additive; and possibly ocean fertilisation.
- Bioenergy with carbon capture and storage (BECCS). Biomass or biogas is combusted for energy and the resulting carbon dioxide is captured and stored underground permanently. Some BECCS facilities are already operating, mostly based on ethanol fermentation.
- Direct air capture (DAC). This uses technological methods to remove CO_2 from the atmosphere and to convert it into long-lived products such as cement or carbonated minerals, or dispose of it securely in underground formations. Short-lived uses of atmospheric CO_2, such as fertilisers or fuels, would displace fossil fuels but not reduce atmospheric carbon dioxide in the long term. A number of pilot DAC projects are operating and Occidental Petroleum has committed to the process, hoping to capture 1 $MtCO_2$/year for enhanced oil recovery and produce 'carbon-neutral oil'.

Biosequestration has low estimated costs, at least at current scales, in the range of $1-10 per tonne of carbon dioxide ($/$tCO_2$). This is likely to increase as the amount of required sequestration increase and certification becomes stricter. The scope of biosequestration and BECCS will be limited by the competing land uses and the need to preserve ecosystems and social systems. Monitoring and verification of precise quantities of carbon stored may be complicated and imprecise, although satellite and drone methods are likely to improve the situation. Biosequestration is vulnerable to leakage of the stored carbon, for example by the felling of a protected forest, or by a drought or forest fire.

DAC, on the other hand, has no particular scale limitations other than the speed with which the requisite machines can be built and scaled up[xxiii]. In that regard, it resembles the solar and wind industries. However, estimated costs are currently high, in the range of $200-300/$tCO_2$, because of the dilute nature of atmospheric carbon dioxide.

NET-ZERO PROGRESS HAS TO BE TRANSPARENTLY MONITORED AND REPORTED

In most national and corporate net-zero targets, there is recognition that the emissions reduction approaches required in 2030-50 will be more difficult and complicated than those which will be effective during 2021-30. Therefore, it is very important that any entity committed to a net-zero target has strict intermediate goals, and appropriate plans for getting there, along with the indicative long-term strategy to the end target of 2050 or 2060.

At a national level, countries report on their progress on the Paris Agreement goals through their Nationally Determined Contributions (NDCs). These NDCs are meant to be updated and made more stringent every five years. The first round of the review of NDCs would take place at COP26 in November 2021.

Climate Action Tracker[xxiv] is one organisation providing analysis of countries' progress on their climate goals. Although it does not solely focus on net-zero ambitions, compatibility with the Paris Agreement targets does relate to net-zero. On this yardstick, from the countries it rates, Climate Action Tracker assesses two (Gambia and Morocco) as "1.5°c Paris Agreement Compatible", six (India, Bhutan, Philippines, Ethiopia, Kenya, Costa Rica) as "2°c compatible", eleven (counting the EU as one) as "insufficient", six as "highly insufficient" and seven as "critically insufficient". It does this by attempting to relate each country's NDCs and actual climate actions to its likely emissions trajectory. Given the voluntary nature of NDCs and reporting, such independent assessments are important. They could eventually lead to trade sanctions and reputation hazard for countries rated poorly.

At a corporate level, various NGOs monitor progress, such as Climate Action 100+[xxv], which is coordinated by five regional investor networks, and Carbon Tracker[xxvi]. Increasingly, investors and stock exchanges are likely to make adherence to standards such as the Task Force for Climate-related Financial Disclosure a requirement. However, carbon reporting standards are still evolving and corporations' claims to be 'net-zero' can be inconsistent and debatable.

IMPLICATIONS FOR MAJOR OIL AND GAS PRODUCERS

- The gaining momentum towards net-zero will have a very large impact on global demand for oil and gas, investment, financing and insurance of fossil fuels, and the way such fuels are produced, transported and used.
- Leading oil and gas producers should seek to develop non-emitting uses for their products, including CCUS, petrochemicals, non-metallic materials, hydrogen and others.
- They should articulate robust goals for their own decarbonisation, and participate in initiatives for certification to ensure their reduced carbon footprint is properly recognised and rewarded.
- There is a major role for atmospheric CO_2 drawdown in net-zero plans. Hydrocarbon producers should look to secure sufficient bio-offsets well in advance, as prices will likely rise. They can partner with developers of biosequestration projects as well as governments of countries with high potential, such as those with areas of tropical forest, wetlands or mangroves.
- This is also a business opportunity for oil and gas producers, who can use their subsurface reservoirs and expertise to offer safe CO_2 disposal as a service. They should encourage policy mechanisms, such as carbon taxes, that reward CCUS.

CONCLUSIONS

Adoption of net-zero carbon goals has advanced surprisingly swiftly since the 2015 Paris Agreement, and especially from 2019 onwards. The growing number of countries and companies announcing them may soon make it unavoidable for most entities to not have a target of their own.

The enormous scale of efforts and the implied speed entailed in reaching net-zero by 2050, make the race to net-zero a daunting global task. However, the race has indeed began and the momentum is building.

The required progress on net-zero, on a scale consistent with the Paris Agreement, implies enormous investments and massive changes in the economy, international trade, infrastructure and perhaps society and geopolitics. Most businesses will be substantially affected, but those in the energy, electricity, mining, agriculture, heavy industry, automotive, shipping and aviation sectors, face probably the greatest changes. Companies and major emitting or fossil-fuel exporting countries need to be planning, researching and investing already towards a carbon-neutral future.

APPENDIX

i. https://www.weforum.org/agenda/2020/12/analysis-world-paris-agreement-climate-targets-change-emissions-global-warming/
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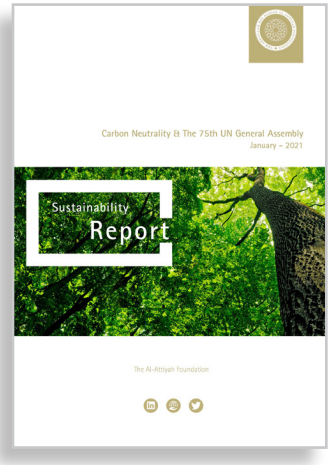
February – 2021

Greening The LNG Industry

As countries continue to ramp up their climate change ambitions, the role of natural gas will be enhanced, as burning natural gas produces less greenhouse gas emissions (GHG) than burning coal and crude oil.

(QRCO.DE)

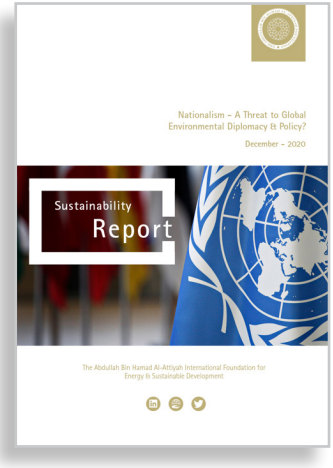


January – 2021

Carbon Neutrality & The 75th 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.

(QRCO.DE)



December – 2020

Nationalism – A Threat to Global Environmental Diplomacy & Policy?

Globalisation, the process of increasing globalism of trade, information, migration, and culture, has been recently under pressure from renewed nationalism.Populist nationalist leaders in countries such as the US, UK, and Brazil have challenged international agreements and often threatened to withdraw from climate and environmental action.

(QRCO.DE)

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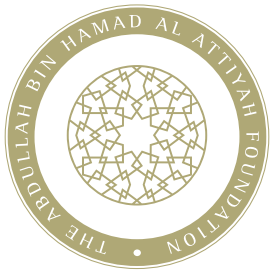

Barzan Tower, 4th Floor, West Bay, PO Box 1916 - Doha, Qatar

Tel: +(974) 4042 8000, Fax: +(974) 4042 8099
www.abhafoundation.org

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The Al-Attiyah Foundation