Time to get on with it

The Low Carbon Economy Index 2018

Tracking the progress G20 countries have made to decarbonise their economies. #LCEI

pwc

www.pwc.co.uk/lowcarboneconomy

Contents

Time to get on with it

With emissions on the rise again, we need to just get on with it.

Emissions are on the rise again as the shift towards low carbon energy lags behind global economic growth. The Paris Agreement target of limiting warming to two degrees looks even further out of reach. There is no shortage of solutions – governments and business just need to implement them.

Last year, global GDP grew by 3.8%, largely due to rapid growth in emerging economies such as China and India. This economic growth went hand in hand with a rise in global energy demand of 2.1%; more than twice the rate in 2016. As most of the increased energy demand was met with fossil fuels, global emissions are now on the rise again – by 1.1% – having plateaued for the past three years.

Carbon intensity continued to fall at a rate consistent with the previous few years, at 2.6%. But even this falls short of the 3% average decarbonisation rate needed to meet the weak national targets pledged in the 2015 Paris Agreement. The gap between the current decarbonisation rate and that needed to limit global warming to two degrees is widening. It's now 6.4% per year for the rest of this century. There seems to be almost zero chance of limiting warming to well below two degrees (the main goal of the Paris Agreement), though widespread use of carbon capture and storage technologies, including Natural Climate Solutions, may make this possible. Each year that the global economy fails to decarbonise at the required rate, the two degree goal becomes more difficult to achieve.

The IPCC is launching a special report in mid-October on the impacts of global warming of 1.5 degrees above pre-industrial levels and related emissions pathways. Our Low Carbon Economy Index shows just how challenging it will be to achieve an emissions pathway to 1.5 degrees. The the carbon budget for 1.5 degrees is even smaller and the reduction trajectory even steeper.

New technologies have the potential to bring about disruptive systemic economic and social change and reduce emissions. For example, our analysis on A-EVs shows that in one scenario a systemic deployment of Autonomous-Electric Vehicles alone could bridge one third of the emissions gap needed to limit warming to 2 degrees. But this would also require a paradigm shift in vehicle ownership models. Other 4IR technologies such as Blockchain also have the potential to disrupt the existing high carbon economic model.

Back to black

Coal consumption returned to growth, rising by 1%. This has been the biggest factor in emissions changes in recent years and, in China, grew by 3.5 Mtoe. Although it remains below the 2013 peak, growth in coal demand was also driven by countries such as Turkey (12.7%), Indonesia (7.4%) and India (5%) – where coal still remains the largest energy source. All three of these countries have seen high GDP growth, as well as growth in their heavy industrial sectors.

Scaling renewables

Wind, solar and other renewable energy sources grew rapidly, increasing by 17%. Solar energy was the fastest growing energy source, with an overall growth of 35%, including 41% in the US, 76% in China and 87% in India. This was largely driven by falling prices and increased government investment, particularly in China, which accounted for almost half the solar panels installed.

The Holy Grail? Some countries are sustaining the low carbon transition

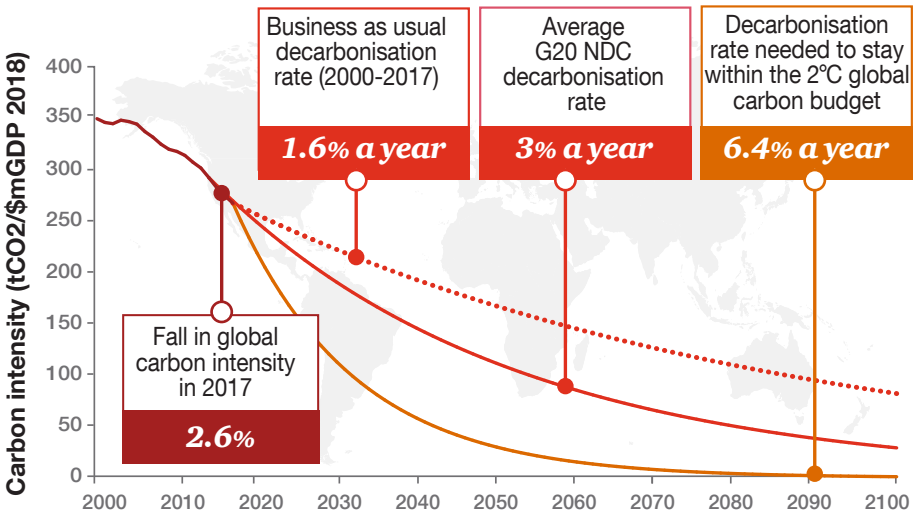
China has retained its leading position among the G20 with a decarbonisation rate of 5.2%. This takes it to a 41% reduction in carbon intensity over the past ten years, and demonstrates the potential for economies to drive year-on-year progress. GDP growth in China was driven primarily by growth in services, high-tech and equipment manufacturing as well as technological upgrading, while investment in energy intensive industries fell, thereby making growth greener.

The remaining top performers – Mexico, Argentina, the UK and Brazil – were all able to reduce emissions while growing their economies. This year, the UK has sustained progress with a decarbonisation rate of 4.7%. The Latin American countries were able to move up the index due to growth in renewables. Mexico achieved a 5% reduction in carbon intensity in 2017, building on solid decarbonisation rates seen in previous years.

but no one is on track for two degrees...

In contrast with our report last year, not one of the G20 countries achieved the 6.4% rate required to limit warming to two degrees this year. That goal is slipping further out of reach – at current levels of decarbonisation, the global carbon budget for two degrees will run out in 2036.

Figure 1: Low Carbon Economy Index 2018: Transition pathways



Sources: BP, Energy Information Agency, World Bank, IMF, UNFCCC, National Government Agencies, PwC data and analysis.

Notes: GDP is measured on a purchasing power parity (PPP) basis. The NDC pathway is an estimate of the decarbonisation rate needed to achieve the targets released by G20 countries. NDCs only cover the period to 2030, we extrapolate the trend in decarbonisation needed to meet the targets to 2100 for comparison.

The global carbon budget for **2 degrees**

will run out in **2036**

2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035

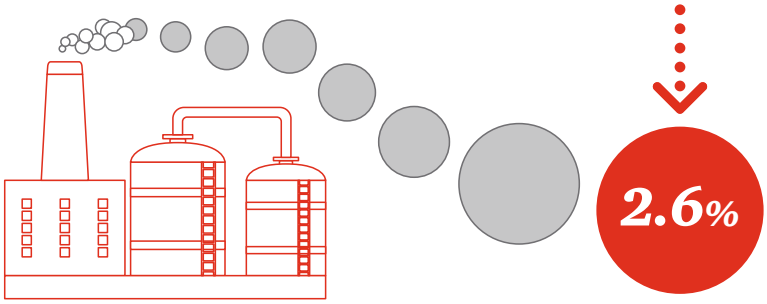
Global coal consumption **increased**

1%

6.4% **decarbonisation rate needed**

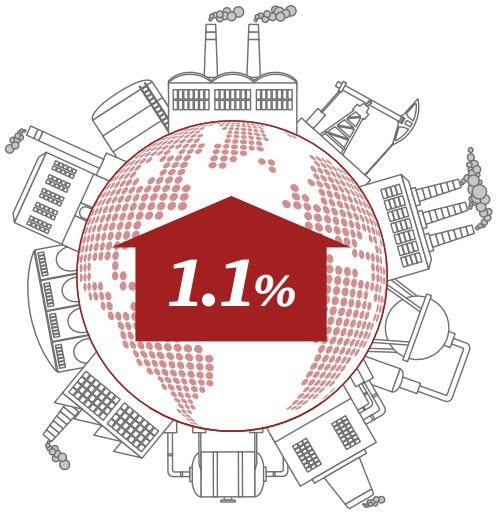
…to limit global warming to **2 degrees**

In 2017, global carbon intensity ***fell by***



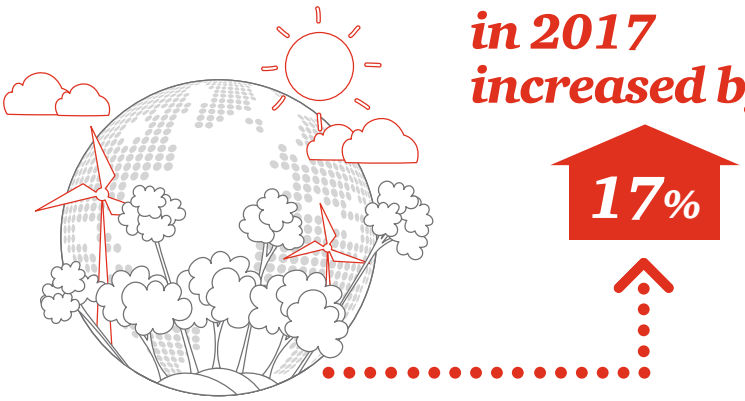
Due to growth in global energy demands…

global emissions were rising by



Wind, solar and other renewables

in 2017 increased by…



The Index

Our Low Carbon Economy Index tracks the rate of the low carbon transition in each of the G20 economies and compares this with their national targets.

Top performers in 2017 are China and Mexico, who reduced their carbon intensities by 5.2% and 5%. While both countries exceeded their NDC targets, they did not achieve the annual global decarbonisation rate required to limit warming to two degrees.

The UK remains at the top of the G20 leader board in terms of its long-term decarbonisation since 2000, although it fell to 4th place this year. These countries are the exceptions rather than the rule – the rest of the G20 didn't do so well.

Table 1: Low Carbon Economy Index 2018 – country summary

Country	Change in carbon intensity 2016-7	Paris target annual change in carbon intensity 2015-2030	Annual average change in carbon intensity 2000-2017	Change in energy related emissions 2016-2017	Real GDP growth (PPP) 2016-7	Carbon intensity (tCO2 / $m GDP) 2017
World	-2.6%	-3.0%	-1.6%	1.1%	3.8%	265
G7	-2.9%	-3.6%	-2.2%	-0.9%	2.1%	223
E7	-3.6%	-1.7%	-1.7%	1.9%	5.6%	317
China	-5.2%	-3.4%	-2.9%	1.4%	6.9%	402
Mexico	-5.0%	-2.4%	-0.5%	-3.1%	2.0%	197
Argentina	-4.9%	-1.6%	-0.2%	-2.2%	2.9%	194
UK	-4.7%	-3.2%	-3.7%	-2.9%	1.8%	138
Brazil	-4.5%	-2.9%	-0.6%	-3.5%	1.0%	134
US	-3.7%	-3.9%	-2.6%	-1.5%	2.3%	261
South Africa	-3.6%	-2.7%	-1.9%	-2.3%	1.3%	527
Germany	-2.8%	-3.2%	-2.0%	-0.6%	2.2%	181
India	-2.5%	-1.9%	-1.9%	4.0%	6.6%	249
Australia	-1.8%	-4.5%	-2.0%	0.1%	2.0%	334
Japan	-1.8%	-4.2%	-1.1%	-0.1%	1.7%	219
EU	-1.7%	-3.2%	-2.3%	0.7%	2.4%	166
France	-1.2%	-3.2%	-2.5%	0.6%	1.8%	115
Canada	-0.8%	-4.5%	-1.6%	2.3%	3.0%	345
Korea	-0.4%	-4.3%	-1.2%	2.7%	3.1%	402
Italy	-0.4%	-3.2%	-1.8%	1.1%	1.5%	140
Russia	-0.2%	0.7%	-2.8%	1.4%	1.5%	418
Indonesia	-0.1%	-3.9%	-1.5%	5.0%	5.1%	157
Saudi Arabia	1.7%	0.7%	1.5%	1.0%	-0.7%	397
Turkey	3.6%	1.9%	-0.9%	11.3%	7.4%	179

Key: **Top 5 in Index** **Bottom 5 in Index**

Sources: BP, Energy Information Agency, World Bank, IMF, UNFCCC, National Government Agencies, PwC data and analysis.

Figure 2: Developed economies NDCs

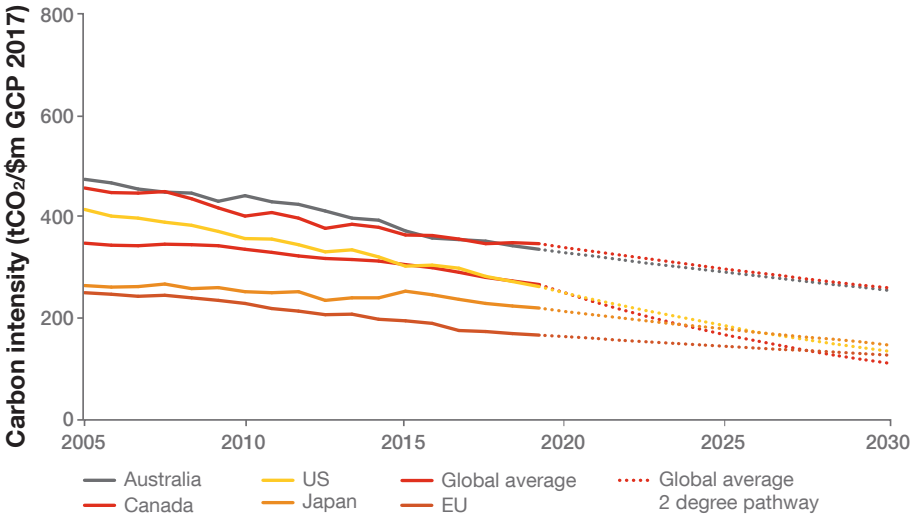
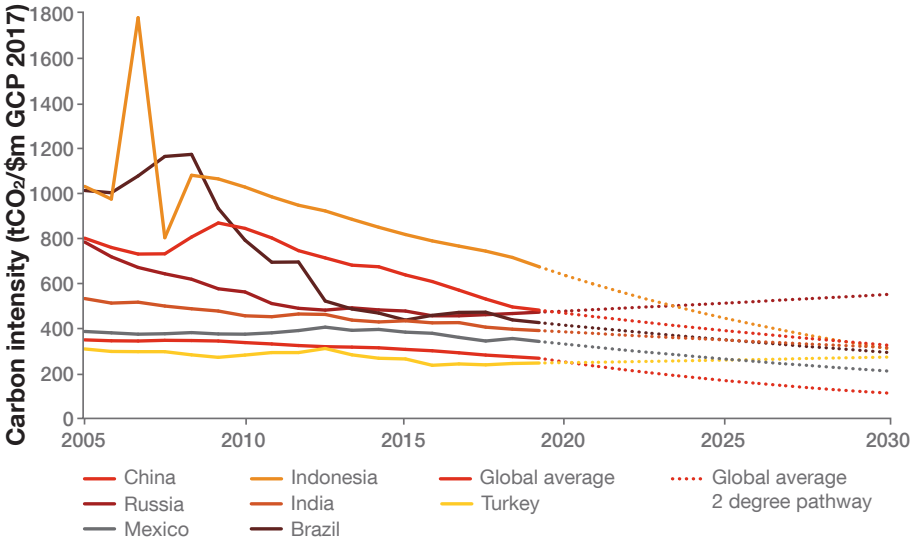


Figure 3: Emerging economies NDCs



Note: The pink dotted line indicates the transition that global average carbon intensity needs make between 2015 and 2030 to be on a 2°C pathway.

Figures 2 and 3 show the historic and projected changes in carbon intensity of major economies if they achieve their national targets. Table 2 shows the targets submitted by each of the G20 countries. Most G20 countries' targets will require a step change in effort to reduce their carbon intensity.

Table 2: NDC targets for G20 countries

Country	Target description
South Africa	Emissions in a range between 398 and 614 MtCO2e by 2025-30
Mexico	22% reduction against baseline scenario by 2030
Korea	37% reduction against baseline scenario by 2030
Canada	30% reduction against 2005 absolute emissions by 2030
Japan	26% reduction against 2013 absolute emissions by 2030
Australia	26% to 28% reduction against 2005 absolute emissions by 2030
US	26% to 28% reduction against 2005 absolute emissions by 2025
India	33% to 35% reduction against 2005 carbon intensity by 2030
China	60% to 65% reduction against 2005 carbon intensity by 2030
EU	40% reduction against 1990 absolute emissions by 2030
Brazil	37% reduction against 2005 absolute emissions by 2025 and indicative 43% against 2005 by 2030
Russia	25% to 30% reduction against 1990 absolute emissions by 2030
Indonesia	41% reduction against business as usual emissions by 2030
Turkey	21% reduction against business as usual scenario by 2030
Saudi Arabia	130 MtCO2e reduction on annual dynamic baseline by 2030

UK – Setting records in the low carbon transition

The UK remains at the top of the G20 leaderboard for its long term decarbonisation rate since 2000, although its rate last year was 4.7%, a little lower than the year before. In 2017, emissions fell by 2.9% as coal and gas consumption fell while oil consumption remained constant.

These fossil fuels were replaced with renewable generation and there was also a marginal reduction in energy use. On 22nd April 2017, Britain went a full day without using coal to generate electricity for the first time since 1882.

Another cause of the lower rate was relatively low GDP growth last year, which some suggest is the result of squeezed household spending power from inflation and uncertainty around the prospect of leaving the EU in March 2019. The UK's GDP growth has been driven primarily by consistent and strong growth in the service sector, while construction output fell and manufacturing growth remained relatively low compared with other parts of the economy.

Fossil fuels remain the dominant source of energy and still account for 80% of the UK's primary energy in 2017, a drop of 1% compared to 2016. Oil and gas dominated the fossil fuel share, with coal only accounting for 5% of the total energy mix due to rapid reductions recently in the use of coal for power generation.

The UK has continued to scale-up electricity supply from renewable sources. This will need to meet the growing electricity demand as the wider energy sector is electrified and to facilitate the reduction in fossil fuels.

The UK saw a 33% increase in wind energy, and a 22% increase in solar capacity. On the 26th May 2017 Britain generated a record amount of solar power – 8.7 GW representing 24.3% of total generation across the UK. This trend is set to continue. A second auction of contracts for difference was held last year and secured 3.3GW of capacity, mainly offshore wind, achieving record low prices. The government has said it will support up to 10GW of offshore wind in the 2020s.

Following the success in decarbonising the electricity sector, achieving the UK's Clean Growth Strategy will depend on investments in other sectors, such as transport, buildings and industry. For example, while record growth in electric vehicle sales was seen in 2017, accelerating electrified transport will require large investments in charging infrastructure. The Road to Zero Strategy will see £1.5bn of investment into electric vehicle development in order to phase out all fossil fuel car sales by 2040.

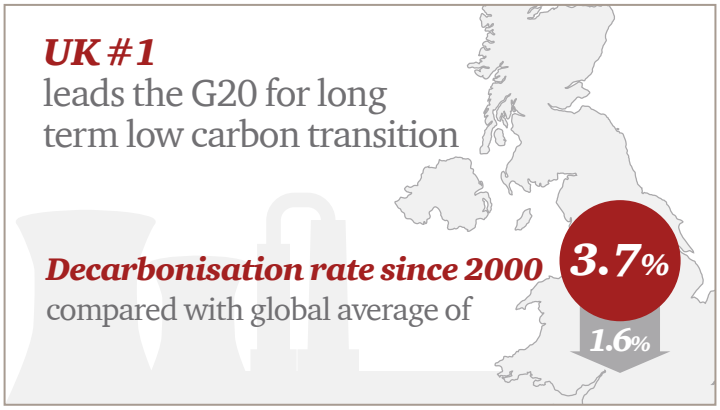
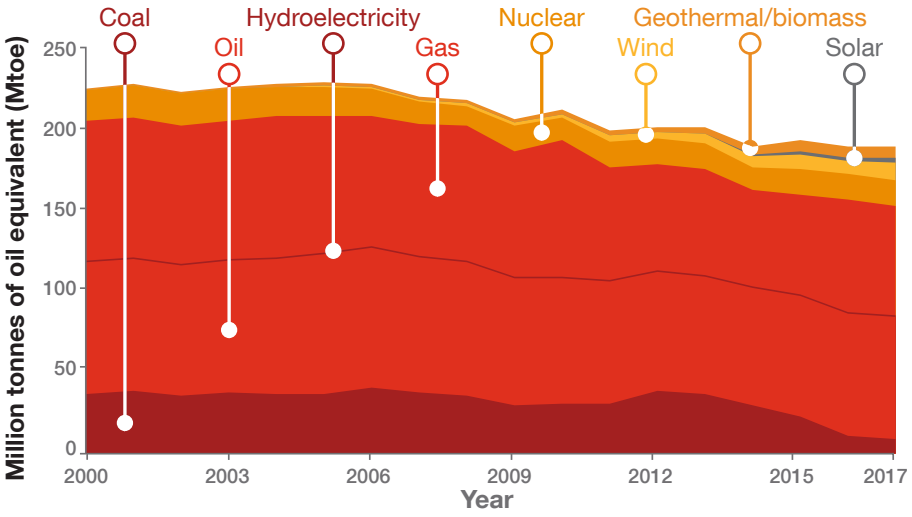


Figure 4: UK's energy mix 2000-17



China – Leading the way in renewable investment

China is the top performer in the index, with a decarbonisation rate of 5.2%. This follows a consistent trend seen over previous years, with China reducing its carbon intensity by around half over the past 10 years.

With high GDP growth of 6.9%, China still saw energy demand rise and a 1.4% increase in emissions. This growth was largely due to the growing investment in infrastructure, real estate and heavy industry, high consumer spending and thriving exports.

Coal use in China marginally increased by 1% in 2017, following several years of reductions in consumption. Levels in 2017 still remained 3.5% below a peak reached in 2013, and the proportion of coal in the overall fuel mix also continued to decline.

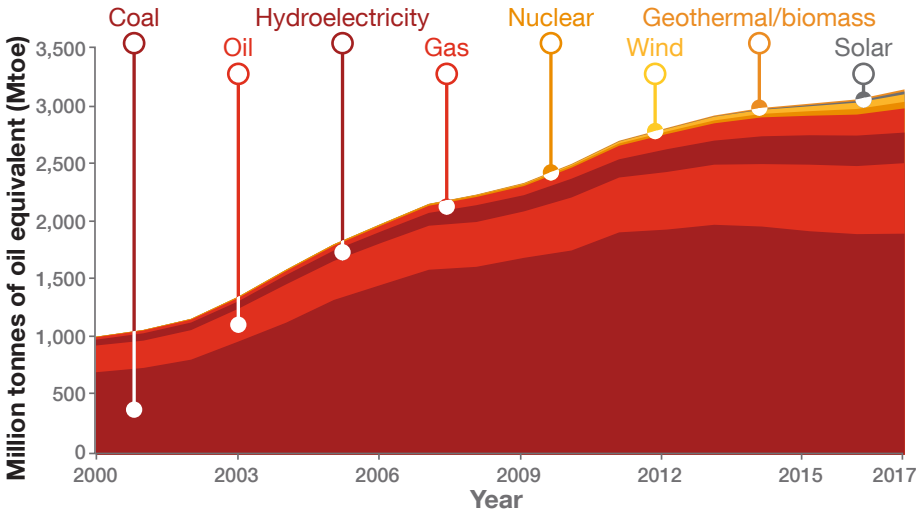
The rise in coal consumption is attributed to new coal-fired power generation plants being opened – a trend seen in other emerging economies. Despite this growth, political signals do not suggest that coal consumption will grow long term in China again as pollution control is at the top of the political agenda.

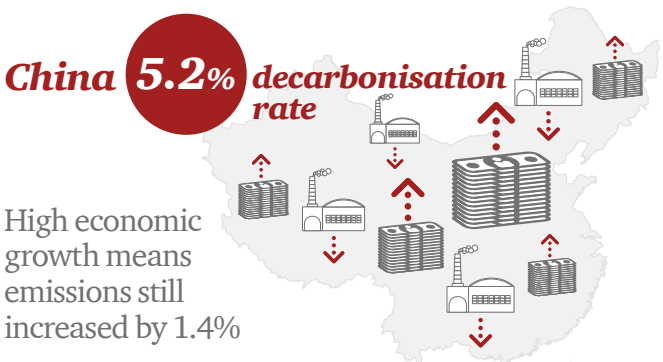
China also saw the highest percentage increase in use of natural gas, at 15%. This is largely associated with efforts to clean up residential heating and small industrial boilers that previously relied on coal.

Despite growth of fossil fuels, China has positioned itself as a global engine for renewable deployment. It has made significant strides toward meeting its pledge under the Paris Agreement to generate 20% of its energy in 2030 from low-carbon sources. Renewable power generation rose by 25 Mtoe in 2017, with a 71% increase in solar energy, and a 20% increase in wind energy.

China has also continued to scale research and development of renewable energy sources, and now produces 60% of all solar cells worldwide. While recent policy action to remove subsidies from solar may slow domestic investment, this could drive down the price of the technology and encourage growth elsewhere. China also intends to support investment in renewables across the world through its One Belt One Road initiative, announced in 2017.

Figure 5: China's energy mix 2000-17





Latin America – Action on targets in the Paris Agreement signals a step change in efforts to phase out fossil fuels

Latin American countries such as Mexico, Argentina and Brazil are moving up the index and now feature in the top five. These countries have set ambitious targets to reduce fossil fuel consumption and grow renewables and have directed investment to scale renewable power, particularly in wind and solar.

Mexico is at second place in the index this year and has seen a year on year decarburization rate improvements, from 4.4% in 2015, to 4.6% in 2016 and 5% in 2017. Mexico has reduced its total energy consumption by 3% this year. Mexico has also made steps towards achieving its pledge under the Paris agreement to cut its GHG emissions by 25 percent compared with business as usual (BAU) levels by 2030. For example, solar output grew by 46% in 2017 whereas Mexico has reduced its total energy consumption by 3%. Following recent energy reform, Mexico has held a series of private auctions that are set to see another nine solar projects totaling 1.7 gigawatts, and now holds the record for cheapest average solar bids in the world. The additions in clean technologies would allow the mitigation ~ 54 million tons of CO2eq (MtCO2eq) by 2030. Moreover, wind and solar generation would represent 70% of the total clean energy additions in 2032.

Similarly, Argentina has declared 2017 the year of renewable energy and has launched an ambitious renewable energy bidding program. While the consumption of fossil fuels fell slightly, hydroelectricity, wind and solar grew.

Brazil has the largest installed hydropower capacity in South America and is the second largest producer of ethanol globally. The country is building on this progress in renewables to scale up wind and solar power. Almost 85% of the country's installed solar capacity is represented by 935 MW of large-scale solar plants contracted by the Brazilian government that became operational at the end of 2016. Wind power is also fast growing in Brazil, with a 28% increase in capacity 2017. This forms part of a national target for wind to account for 12% of the power mix by 2026, up from 4% in 2017.

Climate change – an emerging business risk

The global average decarbonisation rate is less than half of what is needed. So where does this leave us? The gaps between current progress, the Paris Agreement's national targets and the two degrees global goal indicate the potential for major disruptions:

1. Physical climate risks

Recent weather events suggests businesses still have to deal with increasingly frequent or severe physical impacts from climate change. Businesses will need to increase their resilience to protect assets, supply chains, operations and people in anticipation of physical disruptions; and to recover when they occur.

2. Policy risks in low carbon transition

Countries with strong climate ambition are implementing policies to accelerate the low carbon transition. Examples include China's plans for a carbon market and the UK's plans to shut all coal-fired power stations by 2025. The falling cost of low carbon technology costs allows policymakers to consider options that weren't viable just a few years ago. But for those yet to act, there is the risk of knee-jerk climate policy responses at some point in future. Investors are waking up to the risks and opportunities of climate change and are demanding better climate disclosure.

3. Market and technology risks

Technology innovation and deployment will determine whether countries can achieve the Paris Agreement's two degrees goal. New technologies have the potential for disruptive systemic economic and social change which could achieve the emissions reductions required. These technologies include smart power and heating systems in buildings, autonomous electric vehicles, advanced biofuels and 3D printing. For example, our analysis on A-EVs showed that a systemic deployment of Autonomous-Electric Vehicles alone could bridge 1/3 of the emissions gap needed to limit warming to 2 degrees. Other 4IR technologies such as Blockchain has the potential to achieve ambitious emissions reductions.

Responding to climate risks is a strategic business priority

In our view, the call for disclosure on how businesses are likely to be impacted and how they plan to respond strategically and tactically will only increase in the coming months. Climate change is an emerging risk that has short, medium and long term implications for businesses and needs to be on the radar of forward-thinking business leaders.

Methodology

The low carbon economy index
The purpose of our model is to calculate carbon intensity (tCO2/$m GDP) for different countries and the world, and the rate of carbon intensity change needed in the future to limit warming to two degrees by 2100.

The countries the study focuses on are individual G20 economies, as well as world totals. The G20 is also portioned into 3 blocks: G7 economies (US, Japan, Germany, UK, France, Italy, Canada), E7 economies which covers the BRICs (Brazil, Russia, India and China), and Indonesia, Mexico and Turkey and other G20 (Australia, Korea, EU, South Africa, Saudi Arabia, Argentina).

For GDP data, the study draws on World Bank historic data. For long-term GDP projections the study draws on the latest version of PwC's 'World in 2050' model. This was last published in February 2017 and details and a methodology summary can be found here: http://www.pwc.com/world2050.

For emissions, the study considers energy-related carbon emissions drawn from the BP Statistical Review (2018). For biofuels we adjust BP Statistical Review (2018) data from production to consumption using US Energy Information Administration data.

We use Intergovernmental Panel on Climate Change data for the energy related emissions associated with limiting warming to two degrees by 2100.

The national targets
Our analysis of the national targets in this report considers the full national greenhouse gas inventory. Therefore, this analysis includes emissions from industrial process, fugitives (leaks from pipes), land use change and forestry. This is because some countries' targets focus on actions to reduce emissions in those sectors (which are outside our normal energy-based LCEI model). This means that despite the emission intensity numbers not being directly comparable to those in Table 1, the rate of change implied by these NDCs is representative of what is required in Figure 1.

NDC targets were taken from the UNFCCC portal.

Where available national greenhouse gas inventory data was taken from the UNFCCC for 1990 to 2012. This was supplemented with national government department data where gaps existed in UNFCCC data. Where there were still missing years we used the rate of change in energy related emissions from the BP Statistical Review (2018) and applied this to the UNFCCC or national government department data.

Where NDCs mention emissions from Land Use, Land Use Change and Forestry (LULUCF) we assume a net-net approach has been used. If LULUCF is not mentioned in NDCs we assumed it is not included in the target.

Contacts

Authors

Jonathan Grant
E: jonathan.grant@pwc.com

Lit Ping Low
E: lit.ping.low@pwc.com

Sam Unsworth
E: samuel.j.unsworth@pwc.com

Corinna Hornwall
E: hornwall.m.corinna@pwc.com

Mary Davies
E: mary.davies@pwc.com

www.pwc.co.uk/lowcarboneconomy

Design Services 31599 (09/18).