



World Economic Situation and Prospects

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Global issues: The global energy mix and its role in CO₂ emissions mitigation

After three years of remaining flat, global energy-related carbon dioxide (CO₂) emissions increased by 1.5 per cent in 2017 and are estimated to have risen further in 2018. This puts even greater policy importance on the 24th Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), which is being held on 3-14 December in Katowice, Poland. The COP is the supreme decision-making body of the UNFCCC. This annual session of the COP, known as the COP24, is expected to decide on effective implementation of the Paris Agreement on climate change. As an input to the COP24, the Intergovernmental Panel on Climate Change (IPCC) published the *Special Report on Global Warming of 1.5°C* in October. The new IPCC report envisages dramatic climatic and economic consequences when the average global temperature increases beyond 1.5°C above pre-industrial levels. The report concludes that limiting global warming to 1.5°C requires a fundamental shift in the way the world powers economic growth, including rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities. Specifically, global net human-caused emissions of CO₂

Summary

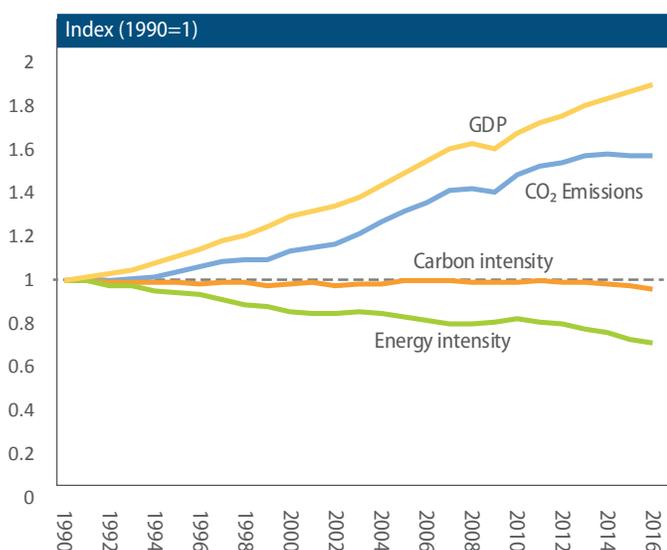
- CO₂ emissions expected to reach an historical high in 2018
- The low cost of coal relative to alternative energy sources is slowing progress towards energy transition in many regions
- Phasing out coal use requires a reliable and stable alternative energy supply, plus support to the economic and employment transition in regions dependent on coal production

needs to fall by 45 per cent from 2010 levels by 2030, reaching net zero around 2050.¹

However, as economic activity expands, the level of global CO₂ emissions is still rising. According to available data, global CO₂ emissions are expected to reach an historically high level in

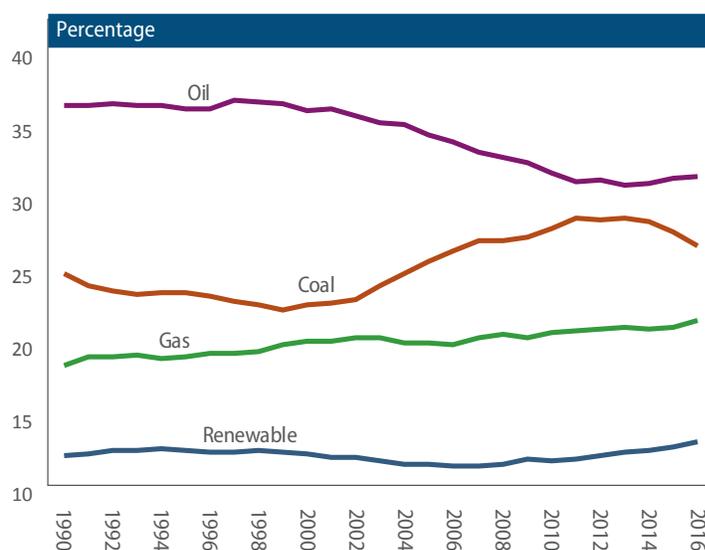
¹ Intergovernmental Panel on Climate Change (2018), *Special Report on Global Warming of 1.5°C*, available from <https://www.ipcc.ch/report/sr15/>.

Figure 1A
Decomposition of CO₂ Emissions



Source: UN/DESA staff estimation, based on IEA (2018), "World energy balances", IEA World Energy Statistics and Balances (database)
Note: Carbon intensity is carbon emissions per unit of energy consumed; Energy intensity is energy consumed per unit of output produced.

Figure 1B
Primary energy consumption share



Source: UN/DESA staff calculation, based on IEA (2018), "World energy balances", IEA World Energy Statistics and Balances (database)
Note: Primary energy consumption in terms of Total Primary Energy Supply (TPES) as defined in IEA World Energy Statistics and Balances.

2018.² Global energy consumption has jumped this year due to a robust expansion of the world economy as well as an extremely hot summer in the northern hemisphere. This energy demand-driven CO₂ emissions increase in 2018 is projected to outpace any offsets in emissions from emissions-reducing structural change.

Emission-reducing structural change can derive from shifts in the global industrial structure, energy efficiency gains in production, or shifts in the composition of global energy demand. Energy-related CO₂ emissions increased by 58 per cent beyond the 1990 level over 16 years (Figure 1A). An index decomposition analysis along the Kaya Identity³—which decomposes carbon emissions into contributions from economic activity, offset by gains in energy efficiency of production and the carbon intensity of the global energy mix—indicates that without any structural change in the way energy is consumed in the economy, emissions could have increased by 90 per cent by 2016 in parallel with world economic growth. However, the decline in the energy intensity of economic activities over the period offset 29 per cent of potential emissions. In other words, the world economy now needs less energy to produce the same level of output. Improvements in the carbon intensity of energy consumption have advanced at a far less impressive rate. A decline in carbon intensity has reduced carbon emissions by just 4 per cent since 1990. Together, structural change associated with energy intensity and carbon intensity have offset 33 per cent of the potential rise in carbon emissions since 1990. While this marks an important step, it falls well short of what is needed to reduce the level of emissions by 45 per cent by 2030.

To date, improvement in carbon intensity remains modest. Carbon intensity can be improved by renewable energy penetrations in energy consumption as well as by switching among fossil fuels. A switch from coal to natural gas can reduce CO₂ emissions up to 48 per cent, and a switch from oil to natural gas can reduce CO₂ emissions up to 25 per cent. However, the composition of primary energy consumption (Figure 1B) shows that the changes in the global energy mix have not been effectively mitigating emissions. While the share of oil has been in decline, it was mostly replaced by coal during 2000 to 2012. The share of natural gas has only moderately increased during this period, and the share of renewable energy has shown small but consistent increases only since 2007. In other words, energy transition has not advanced rapidly enough to materially impact carbon emissions. Over 2014–2016, however, there was an evident trend change. The modest decline in carbon intensity over this period was mainly driven by coal-to-gas conversions and a consistent increase in renewable penetration.

A coal-to-gas conversion needs modification to an existing combustion facility, such as in electricity plants, by which natural gas-firing capability is added to a boiler which was originally designed to operate on coal. It is less technically challenging than replacing the energy source with renewables, and can act as a temporary bridge in the transition towards a fully sustainable energy mix. Cost advantage alone can promote the conversion.

² This estimate is based on the evaluation of the latest data on electricity output for 2018 in the US, the EU, Japan and China, as well as the emissions forecast for the US by US Energy Information Administration (2018) Short-term Energy Outlook, November 2018, available form <https://www.eia.gov/outlooks/steo/>.

³ See <https://www.cicero.oslo.no/no/posts/klima/emissions-growth-slowdown> for the Kaya Identity-based decomposition analysis.

This is demonstrated by the ongoing coal-to-gas conversion in the United States, which has been prompted by a stable and cheap supply of natural gas due to rising domestic shale gas production. This has significantly reduced the price of natural gas in the United States, both relative to the rest of the world and relative to the price of coal. Despite recent policy changes to support the coal industry, coal consumption in the United States has continued to decline this year, while consumption of oil and natural gas have increased.

However, in other parts of the world, coal has a substantial cost advantage over other fossil fuels. Coal is generally the cheapest option, and its price is more stable than oil or natural gas. For many countries, India for example, coal is the only fossil fuel domestically available. The use of domestically-available energy sources can alleviate balance-of-payments constraints. China is by far the world's largest consumer of coal, with a global share of over 50 per cent. Although consumption levels have receded marginally since their peak in 2013, new production capacity in the coal sector continues to be added. Japan, an active coal importer, maintains its coal-fired power plants, aiming for energy security through energy source diversification. Application of new technology such as ultra-supercritical pressure boilers and carbon capture and storage is expected to help mitigate some CO₂ emissions from coal-fired electricity plants over the coming years.

To accelerate coal-to-gas conversions, careful coordination is needed to make up the short-term economic loss by coal phase-out, disentangling intertwined economic interests of coal at regional, national and international levels. Coal-dependent regions are often economically impoverished with limited outside employment opportunities. It is crucial to support the economic and employment transition to alternative industries in these areas. Also, coal phase-out requires a reliable and stable supply of alternative energy. At the COP23 in 2017, more than 20 countries launched the Powering Past Coal Alliance to share real-world examples and best practices to support the phase-out of coal.⁴

Developed economies

North America: Fossil fuel sectors are expanding

Fossil fuel production continues to expand in North America. In the first three quarters of 2018, oil production increased by over 16 per cent in the United States compared to a year earlier, while natural gas production increased by 11 per cent. Real private fixed investment in mining exploration, shafts and wells increased by over 30 per cent in the first three quarters of 2018 compared to a year earlier, while the mining industry added 60,000 jobs in the year to September 2018. Shifts in environmental policy in the United States, which include easing of restrictions on drilling, coal use and new car emissions standards, have helped support this expansion of activity. This short-term support to economic activity has also slowed progress towards an environmentally sustainable economy.

Canada is also among the world's largest energy producers, and is a net exporter of crude oil, natural gas and hydroelectricity, primarily to the United States. Investment in mining and

⁴ Government of Canada (2017), Coal phase-out: the Powering Past Coal Alliance, available from <https://www.canada.ca/en/services/environment/weather/climatechange/canada-international-action/coal-phase-out.html>.

oil extraction industries increased sharply in 2018, supported by higher oil prices in the first half of the year. While Canada continues to make important strides in its climate policy, including the Pan-Canadian Framework on Clean Growth and Climate Change, it has the world's third-largest proven oil reserves, after Saudi Arabia and the Bolivarian Republic of Venezuela, and the mining, quarrying and oil and gas extraction sector accounts for 8–9 per cent of production in the economy. Mining and extraction activities are themselves very energy-intensive, and consumption of fossil fuels per unit of output in Canada is high relative to other developed economies. The sector also has a relatively low labour content, accounting for just 1.5 per cent of jobs in Canada.

Europe: Coal continues to play a significant role, despite ramp up in renewables

The share of coal in electricity generation in Europe has been on a steady decline over the past years, falling from around 40 per cent at the beginning of the 1980s to roughly 20 per cent in 2017. The shift since 2005 partly reflects the introduction of European Union (EU) carbon taxes. However, in terms of the absolute quantity of electricity generated, coal has remained fairly constant, with only some moderate decline in recent years. This is also reflected in the level of CO₂ emissions from coal, which have been declining for many years, but only at a very moderate rate. Bulgaria, the Czech Republic and Poland have the highest percentage of energy generated by coal in the EU; Poland is also the second largest coal producing country in Europe.

While the EU has seen a sharp increase in renewable forms of electricity generation capacity over the past years, as well as more use of natural gas, these shifts reflect lower supplies from nuclear and oil, and increasing levels of electricity demand. This highlights the challenge to substitute stable baseload electricity generation capacity from sources such as coal, without endangering the stability of the electricity grid. A potentially significant new development has been the recent rise in CO₂ prices in Europe. After falling to less than 5 EUR/ton in 2017, the price has increased more than fourfold to around 20 EUR/ton. The causes include adjustments by policymakers to the trading system, with the potential for a more meaningful impact on the future composition of the energy market.

Economies in transition

CIS: Coal industries in the Russian Federation and Kazakhstan are booming

In the Commonwealth of Independent States (CIS), the Russian Federation and Kazakhstan are among the top coal producers in the world, ranking sixth and tenth respectively. In 2017, despite falling Russian corporate sector profits, the coal industry exhibited remarkable profitability, with 185.5 million tons of exports worth \$13.5 billion. Although around 75 per cent of Russian coal is consumed domestically for power generation, the industry benefited from stronger import demand, in particular from China, where domestic coal output has been downscaled. To increase exports to Asia, new coal production centres are being built in the country's Far Eastern Federal District, and the existing infrastructure connecting coal production facilities with the District's ports is under improvement.

In Kazakhstan, coal production is also expanding at a robust rate, as the Government seeks to raise exports and meet the needs of domestic power and steel industries; in 2017, 106 million tons of coal were produced, and 29 million tons exported. The coal industry is also important for Ukraine. However, most of the country's coal reserves are located in the East of the country, where production is impaired by the ongoing political conflict, suspension of government subsidies, and outdated equipment. Among those countries, the Russian Federation has the smallest share of coal in electricity generation, around 15 per cent, while in Ukraine that figure approaches 38 per cent, and in Kazakhstan, around 80 per cent of electricity output is based on coal. The ongoing use of coal may impede meeting emission reduction targets; the Russian Federation remains the fourth largest contributor in terms of CO₂ emissions globally. In Kazakhstan, according to the country's "National Concept for Transition to a Green Economy up to 2050", the share of renewable energy in electric power should reach 30 per cent by 2030.

In South-Eastern Europe, Serbia has large coal reserves and meets most of its electricity demand from domestic production, which relies around 70 per cent on coal, while the remaining is generated in hydropower plants.

Developing economies

Africa: Africa split between oil, coal and hydroelectricity

Electricity production in Africa differs substantially by sub-region. Oil-rich North Africa relies primarily on hydrocarbons. Sub-Saharan Africa except South Africa relies on hydroelectricity for 51 per cent of electricity generation, with 45 per cent generated from fossil fuels. The East Africa sub-region has the lowest fossil fuel share in electricity generation, at 21 per cent, with 67 per cent of electricity generated from hydropower. This share has the potential to increase once Ethiopian hydropower projects are completed. In Southern Africa, 79 per cent of electricity comes from fossil fuels.⁵

South Africa is the largest electricity producer in sub-Saharan Africa, accounting for around 70 per cent of electricity production in the region. Fossil fuels account for 91 per cent of this production⁶, of which around 80 per cent comes directly from coal—a legacy of rich coal deposits. Renewables contribute only around 3 per cent.⁷ Modifying the energy mix in South Africa is extremely challenging, especially since a rapid decrease in coal use would be followed by lay-offs in the mining sector, intensifying the already severe socio-economic challenges. At the same time, South Africa already suffers from electricity shortages, which further complicate the transition process. Nevertheless, three-quarters of coal plants are expected to cease operations by 2040.

⁵ U.S. Energy Information Administration (2018), Hydro and fossil fuels power electricity growth in Sub-Saharan Africa, available from <https://www.eia.gov/todayinenergy/detail.php?id=37153>.

⁶ Ibid.

⁷ Jarrad G. Wright (2018), Economic impacts of South Africa's energy mix. CSIR Energy Centre, available from http://www.nstf.org.za/wp-content/uploads/2018/03/20180416-NSTF-Economic_Impacts-RSA_Energy_Mix-PRESENTED.pdf.

East Asia: ASEAN countries reaffirm commitment towards developing renewable energy in the region

In October, the Association of Southeast Asian Nations (ASEAN)⁸ formed a new partnership with the International Renewable Energy Agency (IRENA), aimed at promoting stronger renewable energy investment and deployment in the region. The ASEAN countries aim to increase the share of the region's renewable energy from 9 per cent in 2014 to 23 percent of all primary energy sources by 2025. To achieve this target, a study by IRENA revealed that ASEAN needs to invest \$27 billion in renewable energy annually over the next eight years, which is ten times higher than investment volumes in 2016.

In tandem with strong economic and population growth, ASEAN's energy demand is increasing at a rapid pace. This poses a significant challenge for policymakers in the region to meet these demands in a sustainable way. The International Energy Agency (IEA) highlighted that the region's energy demand has risen by 70 per cent since 2000 and is projected to increase by a further 65 per cent by 2040. Fossil fuels still account for the bulk of the region's energy mix. Nevertheless, the use of hydropower, wind and solar energy is gradually rising. Looking ahead, more decisive actions by policymakers is needed to improve the diversity of the region's energy supply and accelerate its transition towards a low-carbon environment.

South Asia: Fall in oil prices expected to provide additional tailwinds to the Indian economy

The Indian economy is expanding at a relatively robust pace, underpinned by robust private consumption, a moderately expansionary fiscal stance and benefits from previous structural reforms. Recently, the Indian economy—one the largest oil importers in the world—is also benefiting from the sharp decline in oil prices, from \$85 per barrel by early October to less than \$65 per barrel by mid-November. This decline is expected to provide significant relief to consumers and stabilize the ongoing deterioration of the current account deficit. Alongside the resumption of capital inflows, this has also helped to stabilize the domestic currency. Lower oil prices will also provide respite to the fiscal balance, easing the cost of energy-related subsidies. This will help ensure that the deficit does not breach the target of 3.3 per cent of GDP. Finally, the recent fall of oil prices is easing inflationary pressures, expanding monetary policy space. Against this backdrop, the Indian economy is projected to continue expanding at a relatively robust pace in the near term, and downside risks to the outlook have receded.

Western Asia: Turkey seeks a more stable energy mix

Turkey is highly import-dependent in its energy supply. A strong economic expansion in 2017 spurred growth in energy demand, which in turn tightened balance-of-payments conditions, followed by a substantial devaluation of the domestic currency and rapid consumer price inflation. The inflation rate rose to 25.4 per cent

⁸ Comprised of Brunei Darussalam, Cambodia, Indonesia, People's Democratic Republic of Lao, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam.

year-on-year in October, with energy prices up by 37.4 per cent, while the Turkish lira depreciated by 35.7 per cent against the dollar. Turkey has been seeking an energy mix which is less susceptible to these pressures. The increasing use of natural gas, which has a lower and less volatile price, is one stabilizing measure. The share of natural gas in total primary energy supply has risen from 5.6 per cent in 1990 to 29.9 per cent in 2017. The opening of the Blue Stream gas pipeline in 2003 allowed for stable natural gas imports from Russia, and additional gas import capacity has been added with the new Turk Stream pipeline, whose off-shore section was completed on 19 November. Another measure is the use of domestically produced brown coal to lower the import dependency of energy. Coal-fired electricity generation capacity is planned to expand in the coming year to cope with rising demand for electricity.

Latin America and the Caribbean: The region's energy sectors are undergoing significant shifts

The energy sector in Latin America and the Caribbean has undergone significant changes over the past few decades. According to the latest IEA data from 2016, the region remains a net exporter of energy, although the majority of countries, including Argentina, Brazil, Chile and Mexico, are net importers. There are only two large net exporters of energy: Colombia, which has seen a notable increase in coal and oil exports since 2000; and the Bolivarian Republic of Venezuela, which has suffered a sharp decline in oil exports since 2000 but remains the region's main energy exporter.

In terms of total primary energy supply (TPES), a key development has been the growing importance of natural gas. Production of natural gas has increased considerably in several countries, including Bolivia, Brazil, Peru and Trinidad and Tobago. On the other hand, three of the region's main producers of natural gas—Argentina, Mexico and the Bolivarian Republic of Venezuela—have seen declining or stagnant production since 2000. This weakness has resulted in a growing gap between supply and demand. The excess demand has been met by increased liquified natural gas and piped gas imports, raising concerns over energy security.

Renewable energy sources accounted for 26 per cent of the TPES in 2016, almost twice their share at the global level. Renewables in Latin America are dominated by liquid biofuels—Brazil accounts for 60 per cent of the region's total production—and hydro energy. While hydro energy currently contributes almost 50 per cent of total electricity production, its importance has been declining as a result of droughts, environmental and social concerns, and capacity constraints. Other renewable sources, including geothermal, solar and wind, are gradually picking up due to technological advances and institutional changes, but their overall role is still limited. In 2016, they accounted for approximately 9 per cent of total electricity generation. The share of renewables in electricity generation differs significantly by country, ranging from about 4 per cent in Cuba to almost 100 per cent in Costa Rica, Paraguay and Uruguay.