IEA STATISTICS

2015 EDITION

# KEY TRENDS IN $CO_2$ EMISSIONS

Excerpt from:

# $CO_2$ EMISSIONS FROM FUEL COMBUSTION

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The following analysis is an excerpt from the publication "$CO_2$ Emissions from Fuel Combustion (2015 edition)".

Please note that we strongly advise users to read definitions, detailed methodology and country specific notes which can be found either in our publication or in the on-line data service (http://www.iea.org/statistics/topics/CO2emissions/).

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# KEY TRENDS IN $CO_2$ EMISSIONS FROM FUEL COMBUSTION

## The growing importance of energy-related emissions

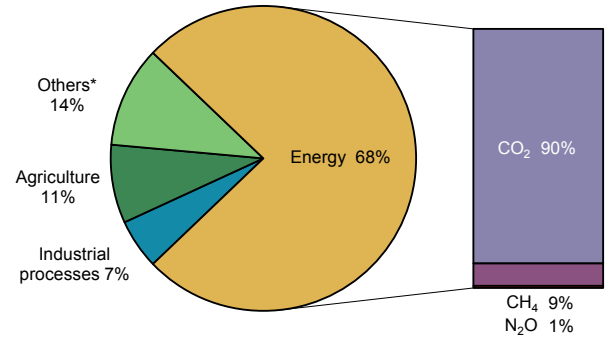
Climate scientists have observed that carbon dioxide ($CO_2$) concentrations in the atmosphere have been increasing significantly over the past century, compared to the pre-industrial era (about 280 parts per million, or ppm). The 2014 concentration of $CO_2$ (397 ppm)[1] was about 40% higher than in the mid-1800s, with an average growth of 2 ppm/year in the last ten years. Significant increases have also occurred in levels of methane ($CH_4$) and nitrous oxide ($N_2O$).

### Energy use and greenhouse gases

The *Fifth Assessment Report* from the Intergovernmental Panel on Climate Change (Working Group I) states that human influence on the climate system is clear (IPCC, 2013). Among the many human activities that produce greenhouse gases, the use of energy represents by far the largest source of emissions. Smaller shares correspond to agriculture, producing mainly $CH_4$ and $N_2O$ from domestic livestock and rice cultivation, and to industrial processes not related to energy, producing mainly fluorinated gases and $N_2O$ (Figure 1).

Within the energy sector[2], $CO_2$ resulting from the oxidation of carbon in fuels during combustion dominates total GHG emissions.

**Figure 1. Shares of global anthropogenic GHG, 2010***




* Others include large-scale biomass burning, post-burn decay, peat decay, indirect $N_2O$ emissions from non-agricultural emissions of $NO_x$ and $NH_3$, Waste, and Solvent Use.

Source: IEA estimates for $CO_2$ from fuel combustion and EDGAR 4.3.0/4.2 FT2010 for all other sources, (see Part III).

*Key point: Energy emissions, mostly $CO_2$, account for the largest share of global GHG emissions.*

$CO_2$ emissions from energy represent over three quarters of the anthropogenic GHG emissions for Annex I[3] countries, and about 60% of global emissions.

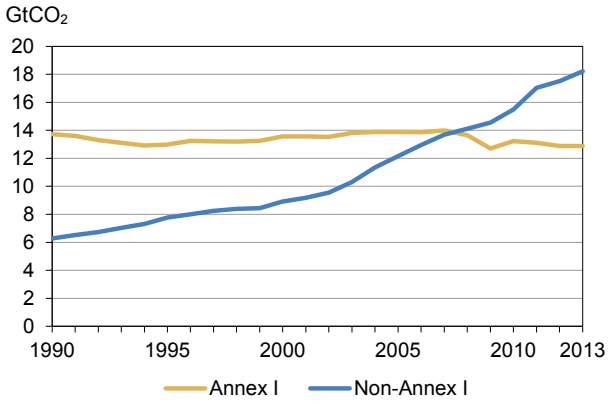
1. Globally averaged marine surface annual mean expressed as a mole fraction in dry air. Ed Dlugokencky and Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/).

2. The energy sector includes emissions from "fuel combustion" (the large majority) and "fugitive emissions", which are intentional or unintentional releases of gases resulting from production, processes, transmission, storage and use of fuels (e.g. $CH_4$ emissions from coal mining).

3. The Annex I Parties* to the 1992 UN Framework Convention on Climate Change (UNFCCC) are: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus*, the Czech Republic, Denmark, Estonia, European Economic Community, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom and United States. See *www.unfccc.int*.
* For country coverage and geographical definitions, please refer to Chapter 4 of the $CO_2$ online documentation file.

This percentage varies greatly by country, due to diverse national structures.

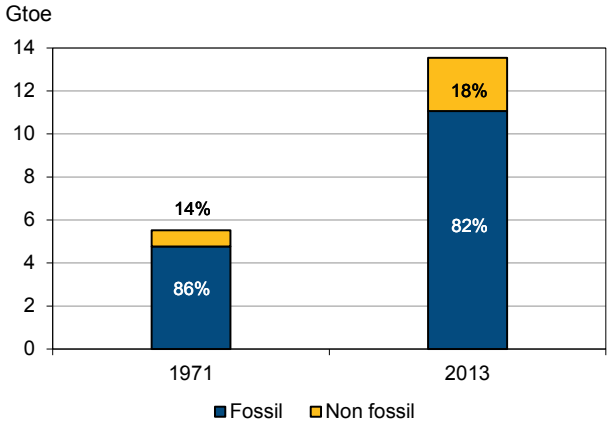
**Figure 2. Regional $CO_2$ emissions trends (1990-2013)**




*Key point: Emissions in non-Annex I countries have almost tripled since 1990, while emissions in Annex I countries have declined slightly.*

Increasing demand for energy comes from worldwide economic growth and development. Global total primary energy supply (TPES) increased by almost 150% between 1971 and 2013 mainly relying on fossil fuels (Figure 3).

**Figure 3. World primary energy supply***

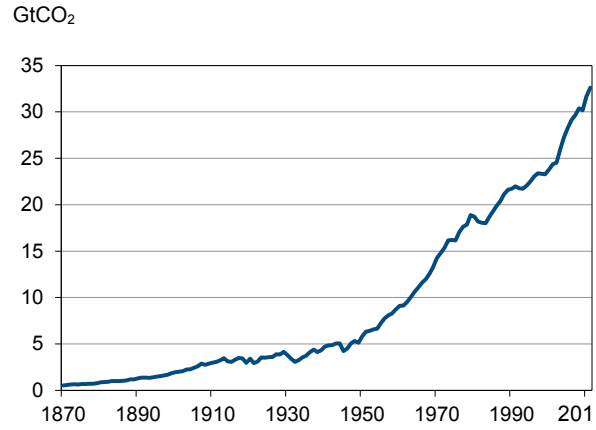



* World primary energy supply includes international bunkers.

Despite the growth of non-fossil energy (such as nuclear and hydropower), considered as non-emitting,[4] the share of fossil fuels within the world energy supply is relatively unchanged over the past 42 years. In 2013, fossil sources accounted for 82% of the global TPES.

Growing world energy demand from fossil fuels plays a key role in the upward trend in $CO_2$ emissions (Figure 4). Since the Industrial Revolution, annual $CO_2$ emissions from fuel combustion have dramatically increased from near zero to over 32 $GtCO_2$ in 2013.

**Figure 4. Trend in $CO_2$ emissions from fossil fuel combustion**




Source: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, US Department of Energy, Oak Ridge, Tenn., United States.

*Key point: Since 1870, $CO_2$ emissions from fuel combustion have risen exponentially.*

The next section provides a brief overview of recent trends in energy-related $CO_2$ emissions, as well as in some of the socio-economic drivers of emissions.

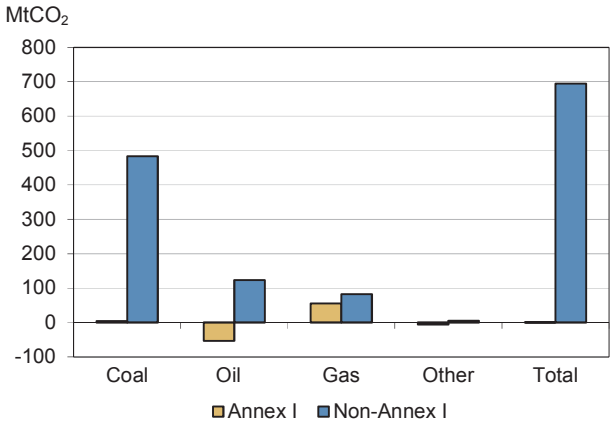
## Recent emissions trends

In 2013, global $CO_2$ emissions reached 32.2 $GtCO_2$, an increase of 2.2% over 2012 levels. This was higher growth than in 2012 (0.6%), but lower than the average annual growth rate since 2000 (2.5%).

Emissions in non-Annex I countries continued to increase (4.0%), with the rate of growth higher than in 2012 (2.8%), while emissions in Annex I countries were flat (0.0%) with lower emissions from oil (-1.1%) balanced by higher emissions from natural gas (1.4%). In absolute terms, global $CO_2$ emissions increased by 0.7 $GtCO_2$ in 2013, driven primarily by increased emissions from coal and (to a lesser extent) oil in non-Annex I countries (Figure 5).

4. Excluding the life cycle of all non-emitting sources and excluding combustion of biofuels (considered as non-emitting $CO_2$, based on the assumption that the released carbon will be reabsorbed by biomass regrowth, under balanced conditions).

**Figure 5. Change in $CO_2$ emissions (2012-13)**

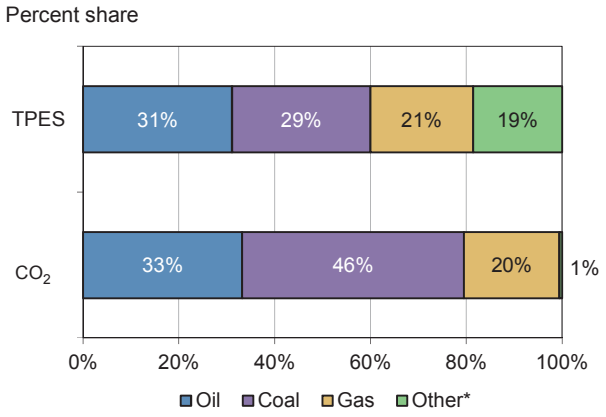



*Key point: In 2013, global emissions growth was driven primarily by increased consumption of coal in non-Annex I countries.*

## Emissions by fuel

Although coal represented 29% of the world TPES in 2013, it accounted for 46% of the global $CO_2$ emissions due to its heavy carbon content per unit of energy released, and to the fact that 19% of the TPES derives from carbon-neutral fuels (Figure 6). Compared to gas, coal is nearly twice as emission intensive on average.[5]

**Figure 6. World primary energy supply and $CO_2$ emissions: shares by fuel in 2013**



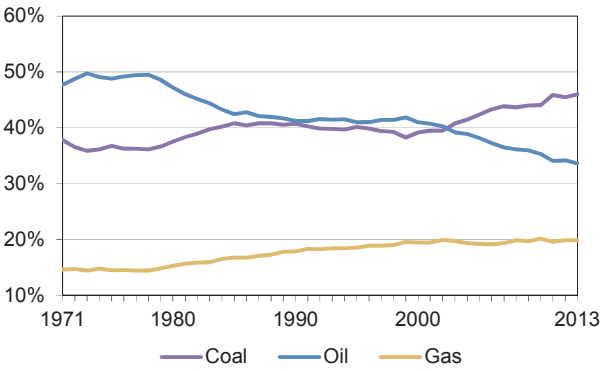

* Other includes nuclear, hydro, geothermal, solar, tide, wind, biofuels and waste.

*Key point: Globally, coal combustion generates the largest share of $CO_2$ emissions, although oil remains the largest energy source.*

From the late 1980s until the early 2000s, coal and oil were each responsible for approximately 40% of global $CO_2$ emissions, with emissions from oil generally exceeding those from coal by a few percentage points. However, trends differed at a regional level. In Annex I countries, oil was the largest source of fuel combustion emissions, whereas, in non-Annex I countries emissions from coal ranked highest.

Since 2002, when at a global level, oil still contributed the largest share of emissions, these shares have changed significantly. Due to the increasing influence of non-Annex I countries energy consumption, coal has increased its share of $CO_2$ emissions from 40% in 2002 to 46% in 2013, while the share from oil has decreased from 39% to 33%, with the share of emissions from natural gas staying approximately stable at 20% (Figure 7).

**Figure 7. Fuel shares in global $CO_2$ emissions**




*Key point: The global fossil fuel mix changed significantly in recent years, with coal replacing oil as the largest source of $CO_2$ emissions.*

In 2013, $CO_2$ emissions from the combustion of coal increased by 3.4% to 14.8 $GtCO_2$. Currently, coal fills much of the growing energy demand of those developing countries (such as China and India) where energy-intensive industrial production is growing rapidly and large coal reserves exist with limited reserves of other energy sources.

## Emissions by region

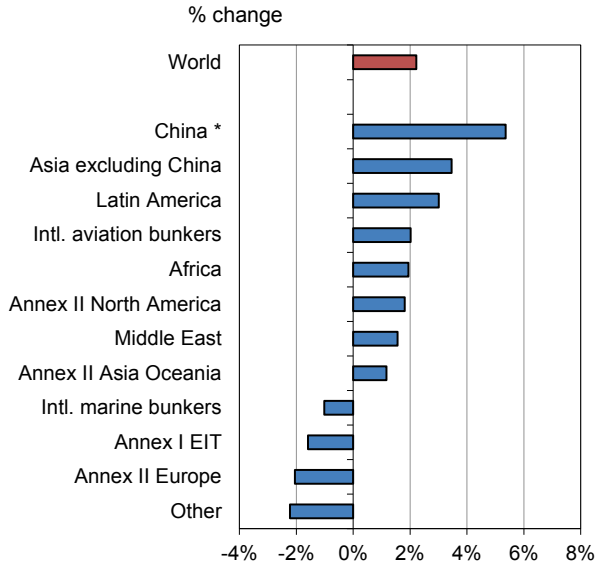
Non-Annex I countries, collectively, represented 57% of global $CO_2$ emissions in 2013. At the regional level, annual growth rates varied greatly: with moderate to strong increases exhibited in China (5.4%), Asia excluding China (3.5%) and Latin America[6] (3.0%),

5. Default carbon emission factors from the *2006 IPCC Guidelines*: 15.3 tC/TJ for gas, 15.7 to 26.6 tC/TJ for oil products, 25.8 to 29.1 tC/TJ for primary coals.

6. For the purposes of this discussion, Latin America includes non-OECD Americas and Chile.

whereas, declines were observed in Annex II Europe (-2.0%), and Annex I EIT (-1.6%). Weaker emissions growth occurred in Africa (1.9%), Annex II North America (1.8%), the Middle East (1.6%) and Annex II Asia Oceania (1.2%) (Figure 8).

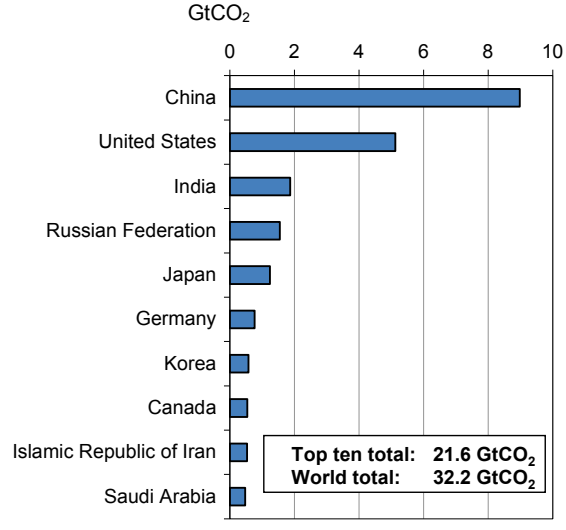
**Figure 8. Change in $CO_2$ emissions by region (2012-13)**




* China includes Hong Kong, China.

*Key point: Emissions in Europe fell in 2013; emissions in all non-Annex I regions grew, with Asia showing the largest relative increase.*

**Figure 9. Top ten emitting countries in 2013**




*Key point: The top ten emitting countries account for two-thirds of global $CO_2$ emissions.*

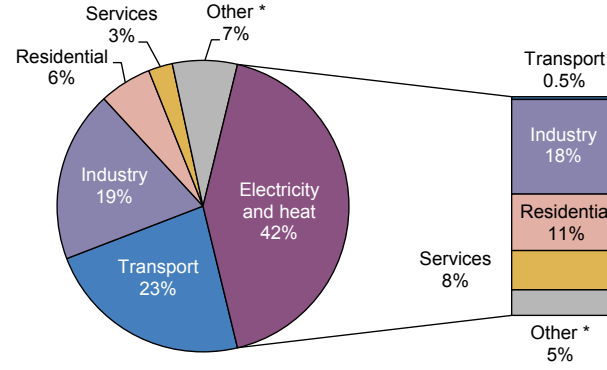
Regional differences in contributions to global emissions conceal even larger differences among individual countries. Two-thirds of global emissions for 2013 originated from just ten countries, with the shares of China (28%) and the United States (16%) far surpassing those of all others. Combined, these two countries alone produced 14.1 $GtCO_2$. The top-10 emitting countries include five Annex I countries and five non-Annex I countries (Figure 9).

As different regions and countries have contrasting economic and social structures, the picture changes significantly when moving from absolute emissions to indicators such as emissions per capita or per GDP. A more comprehensive analysis is given in the section *Coupling emissions with socio-economic indicators* later in this chapter.

## Emissions by sector

Two sectors produced nearly two-thirds of global $CO_2$ emissions in 2013: electricity and heat generation, by far the largest, which accounted for 42%, while transport accounted for 23% (Figure 10).

**Figure 10. World $CO_2$ emissions by sector in 2013**




Note: Also shows allocation of electricity and heat to end-use sectors.

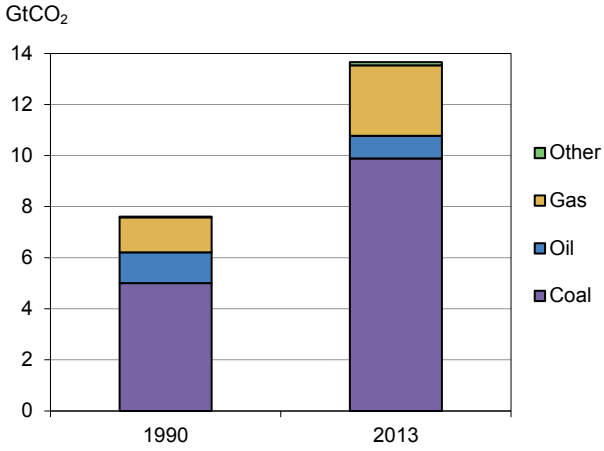
* Other includes agriculture/forestry, fishing, energy industries other than electricity and heat generation, and other emissions not specified elsewhere.

*Key point: Two sectors combined, generation of electricity and heat, and transport, represented nearly two-thirds of global emissions in 2013.*

Generation of electricity and heat worldwide relies heavily on coal, the most carbon-intensive fossil fuel. Countries such as Australia, China, India, Poland and South Africa produce over two-thirds of their electricity and heat through the combustion of coal.

Between 2012 and 2013, $CO_2$ emissions from electricity and heat increased by 2.1%, similar to the increase in total emissions. While the share of oil in electricity and heat emissions has declined steadily since 1990, the share of gas increased slightly, and the share of coal increased significantly, from 66% in 1990 to 72% in 2013 (Figure 11). Carbon intensity developments for this sector will strongly depend on the fuel mix used to generate electricity, including the share of non-emitting sources, such as renewables and nuclear, as well as on the potential penetration of CCS technologies.

**Figure 11. $CO_2$ emissions from electricity and heat generation***




* Refers to main activity producers and autoproducers of electricity and heat.

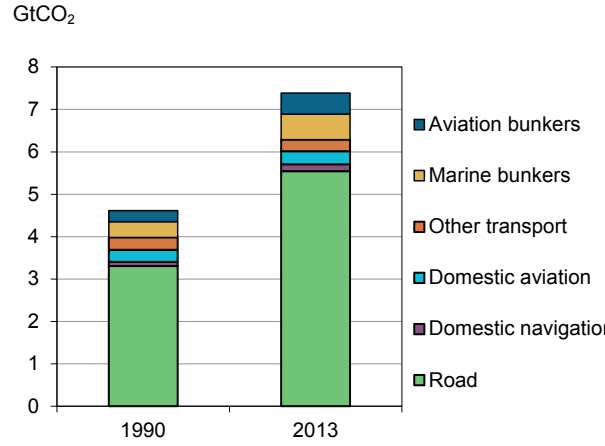
*Key point: $CO_2$ emissions from electricity and heat almost doubled between 1990 and 2013, driven by the large increase of generation from coal.*

Emissions from electricity generation specifically (excluding heat generation emitting energy sector) increased by 50% between 2000 and 2013. At a regional level, trends differed (Figure 13). Both Annex II Europe and Annex II North America, showed a decrease in total emissions from electricity generation between 2000 and 2013. In Annex II North America, this was driven by improvements in the thermal efficiency of generation and the $CO_2$ intensity of the fossil fuel mix (both reflecting a shift from coal towards natural gas). In addition, an increase in the share of electricity output from non-emitting sources was observed. In Annex II Europe, the decrease was driven primarily by a decreased share of electricity output from fossil fuels, down almost 20% between 2000 and 2013. In addition, a slight decrease in emissions due to improved efficiency levels also occurred.

By contrast, Annex II Asia Oceania showed an increase in emissions from electricity generation, primarily due to a higher share of electricity output from fossil fuels. This predominantly reflected events in Japan, where sizeable fossil-fuel-powered generating capacity was brought online in the wake of the Great East Japan Earthquake in 2011.

Outside Annex I, all regions exhibited an increase in emissions from electricity generation, driven primarily by increased electricity output. This was particularly notable in China, where total electricity output almost quadrupled since 2000, and to a lesser extent in Asia excluding China, where output almost doubled. In both of these regions, much of the increased output was met through carbon intensive coal-fired plants[5]. However, in China, efficiency improvements reduced emissions per unit of output, slightly tempering the increase in emissions.

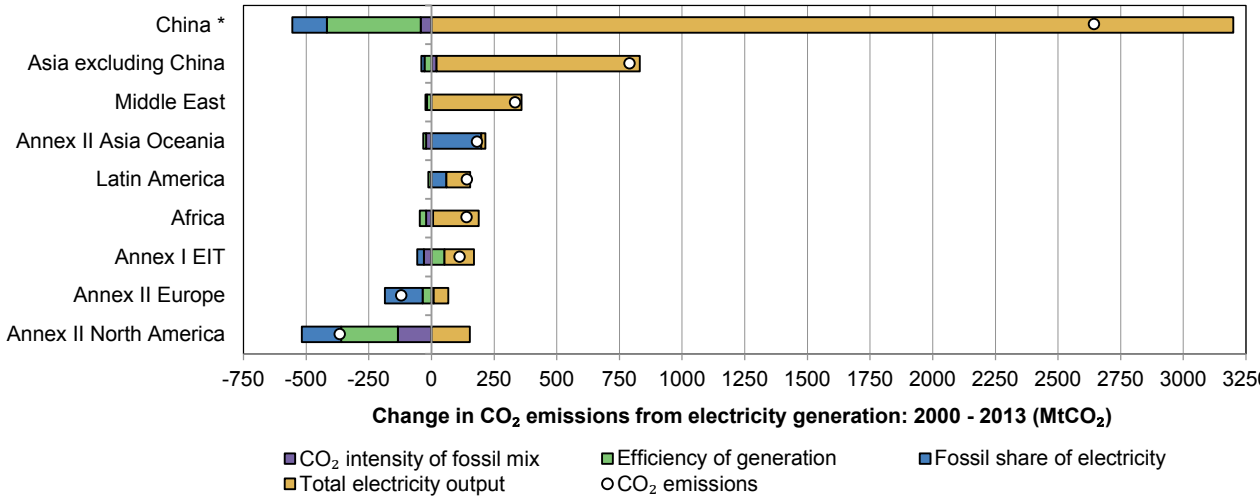
**Figure 12. $CO_2$ emissions from transport**




*Key point: $CO_2$ emissions from road are driving the growth of transport emissions.*

For transport, the fast emissions growth was driven by emissions from the road sector, which increased by 68% since 1990 and accounted for three quarters of transport emissions in 2013 (Figure 12). It is interesting to note that despite efforts to limit emissions from international transport, emissions from marine and aviation bunkers, 64% and 90% higher in 2013 than in 1990 respectively, grew even faster than those from road.

**Figure 13. $CO_2$ emissions from electricity generation: driving factors (2000-2013) [1]**




* China includes Hong Kong, China.

*Key point: Since 2000, global emissions from electricity generation have increased in line with electricity output. Efficiency improvements have been offset by an increased share of output from fossil fuels.*

## Coupling emissions with socio-economic indicators[7]

Indicators such as those briefly discussed in this section strongly reflect energy constraints and choices made to support the economic activities of each country. They also reflect sectors that predominate in different countries' economies.

The range of per-capita emission levels across the world is very large, highlighting wide divergences in the way different countries and regions use energy (Figure 14). For example, among the five largest emitters, the levels of per-capita emissions were very diverse, ranging from 1.5 $tCO_2$ for India and 6.6 $tCO_2$ for China to 16.2 $tCO_2$ for the United States. On average, industrialised countries emit far larger amounts of $CO_2$ per capita than developing countries. The lowest levels worldwide are in Africa and Asia excluding China.

Emissions per unit of GDP[8] also vary across regions (Figure 15). Although climate, economic structure and other variables can affect energy use, relatively high values of emissions per GDP indicate a potential for decoupling $CO_2$ emissions from economic growth, including through fuel switching away from carbon-intensive sources or from energy efficiency at all stages of the energy value chain (from raw material extraction to energy end-use).[9]

All the five largest emitters have shown reductions of emissions per unit of GDP between 1990 and 2013, in line with the average reduction observed globally (28%). This decreasing trend was most pronounced for China and the Russian Federation, whose 1990 levels were significantly higher than those of other countries (Figure 16), and for the United States.

Per-capita emissions, which increased by 16% globally between 1990 and 2013, showed contrasting trends among the top five emitting countries. China more than tripled its per-capita emissions, while India more than doubled theirs (as did some other rapidly expanding economies), reflecting strong per-capita GDP growth. Conversely, per-capita emissions decreased significantly in both the Russian Federation (26%) and the United States (16%), although following very different patterns. Values for Russia dramatically dropped in the

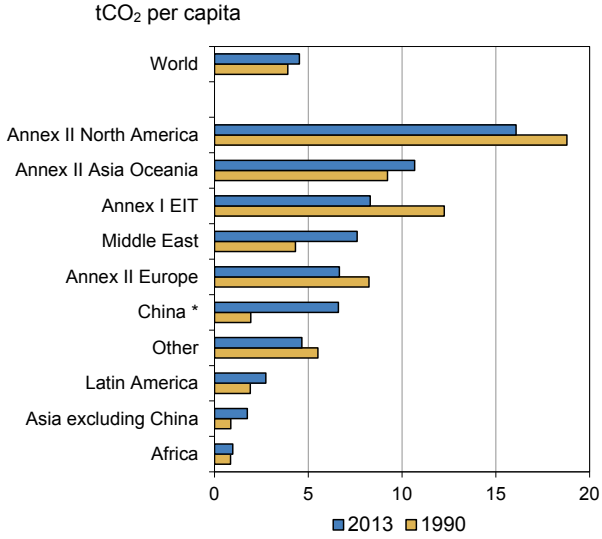
7. No single indicator can provide a complete picture of a country's $CO_2$ emissions performance or its relative capacity to reduce emissions. The indicators discussed here are certainly incomplete and should only be used to provide a rough description of the situation in a country.

8. Throughout this analysis, GDP refers to GDP in 2005 USD, using purchasing power parities. A note of caution is necessary concerning the indicator of $CO_2$ emissions per GDP. It can be very useful to measure efforts over time for one country, but has limitations when comparing countries, as it is very sensitive to the base year used for the GDP purchasing power parity (PPP).

9. The IEA's Policies and Measures Databases offer access to information on energy-related policies and measures taken or planned to reduce GHG emissions, improve energy efficiency and support renewable energy development and deployment. The online databases can be consulted at: *www.iea.org/policiesandmeasures/*.

early 1990s, and slowly increased since then, while values for the United States began falling in the mid-to-late 2000s, having remained stable for many years.

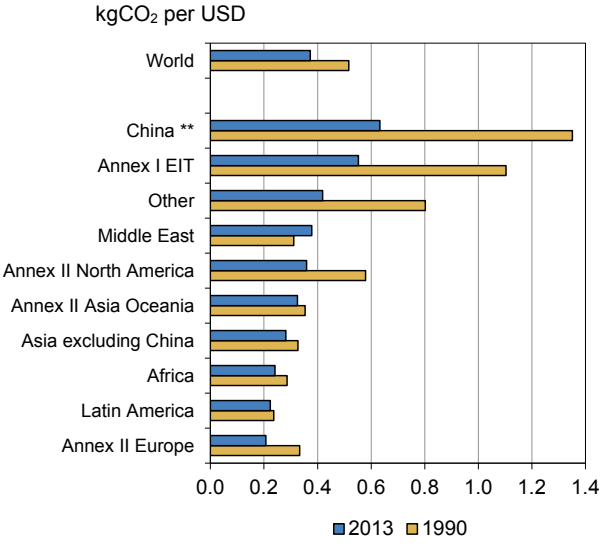
**Figure 14. $CO_2$ emissions per capita by major world regions**




* China includes Hong Kong, China.

*Key point: In general, per-capita emissions have increased across non-Annex I regions over time.*

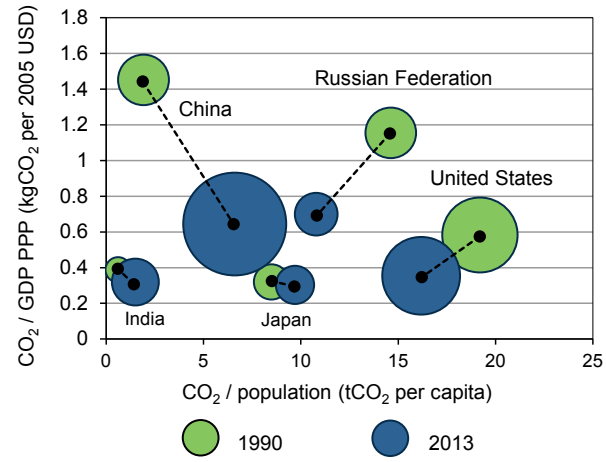
**Figure 15. $CO_2$ emissions per GDP* by major world regions**




* GDP in 2005 USD, using purchasing power parities.
** China includes Hong Kong, China.

*Key point: The $CO_2$ intensity of economic output has decreased in most regions, with the gap between the least and most $CO_2$ intensive regions narrowing.*

**Figure 16. Trends in $CO_2$ emission intensities for the top five emitting countries***




* The size of the circle represents the total $CO_2$ emissions from the country in that year.

*Key point: On a per-GDP and per-capita basis, emissions in the top five emitters have converged somewhat over time.*

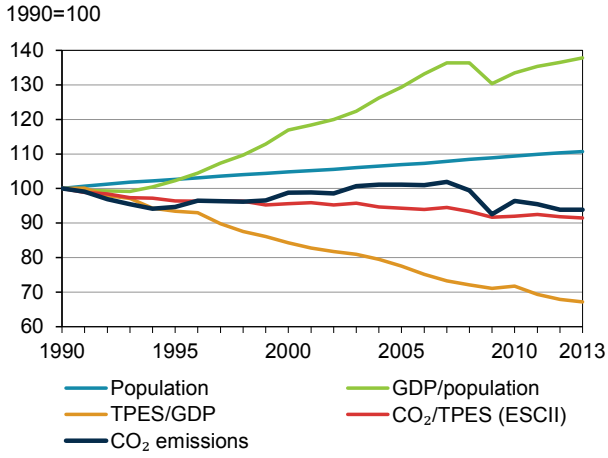
On a global level, $CO_2$ emissions grew by 56% between 1990 and 2013. A simple decomposition[10] can be used to show the main driving factors of the world $CO_2$ emissions trend. Globally, economic growth partially decoupled from energy use, as energy intensity decreased by 29% over the period. However, with a practically unchanged carbon intensity of the energy mix[11], the combined growth in population (35%) and in per capita GDP (60%) led to a dramatic increase in global $CO_2$ emissions between 1990 and 2013. However, due to differences in levels of economic, demographic and technological development and growth, emissions evolved at different rates in Annex I and non-Annex I countries and regions.

In Annex I countries as a whole, $CO_2$ emissions in 2013 were 6% lower than in 1990 (Figure 17). Significant decoupling of energy consumption from economic activity (TPES/GDP: -33%) acted to decrease emissions but per-capita economic output grew (GDP/population: +38%), as did population (+11%), however, the energy sector's carbon intensity (CO2/TPES) declined mildly (-8%).

10. $CO_2$ emissions can be decomposed into the product of four factors: population, per capita GDP, TPES/GDP, $CO_2$/TPES. For a more detailed description of the Kaya decomposition, see Part I, Methodology, Chapter 1: *IEA emissions estimates*.

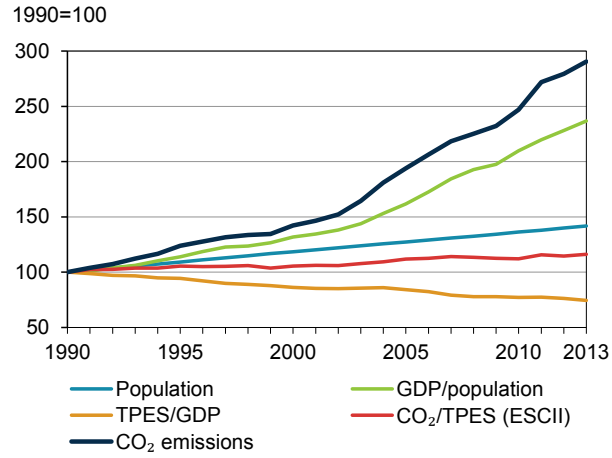
11. Also known, in its index form, as Energy Sector Carbon Intensity Index (ESCII), as in the IEA publication *Tracking Clean Energy Progress 2015*.

**Figure 17. Annex I $CO_2$ emissions and drivers (Kaya decomposition)[10]**




*Key point: Emissions in Annex I countries declined in recent years. This decline was driven by a significant reduction in the energy intensity of GDP, coupled with a slight fall in the carbon intensity of the energy mix, more than offsetting GDP growth.*

**Figure 18. Non-Annex I $CO_2$ emissions and drivers (Kaya decomposition)[10]**

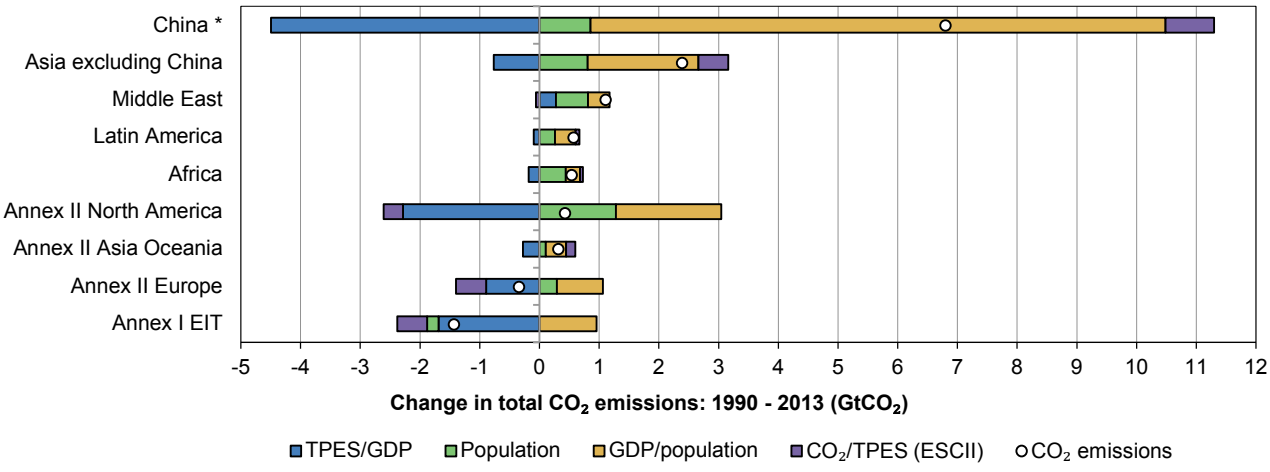



*Key point: In non-Annex I countries, emissions growth was driven by strong increases in per-capita economic output and in population.*

By contrast, emissions in non-Annex I countries almost tripled over the same period (Figure 18), as very strong growth in per-capita economic output (+137%) combined with population growth (+42%). The $CO_2$ intensity of the energy mix was approximately static until 2002 before increasing somewhat ($CO_2$/TPES: +16%), mainly due to higher coal consumption in larger countries. However, a significant decrease in the energy intensity of the economic output (TPES/GDP: -25%) tempered those increases to an extent.

A decomposition showing the effect of changes in the four driving factors on regional emissions over time is presented in Figure 19. As can be seen, trends vary greatly across countries and regions. Therefore, a thorough understanding of the factors driving $CO_2$ emissions trends is essential when designing sound and effective emissions reduction policies at a national and international level.

**Figure 19. Global $CO_2$ emissions and drivers (Kaya decomposition): 1990-2013[10]**




*Key point: GDP growth has been a key driver of emissions across the globe, however, significant decoupling of GDP growth from energy consumption has occurred across regions.*

# Developing a low-carbon world

Traditionally, industrialised countries have emitted the large majority of anthropogenic greenhouse gases (GHGs). More recently, shares of developing country emissions surpassed those of industrialised countries, and have kept rising very rapidly. To shift towards a low-carbon world, mitigation efforts must occur across all countries: decarbonising the energy supplies of industrialised countries, and shifting developing countries onto a low-carbon development path.

The first binding commitments to reduce greenhouse gas emissions were set under the Kyoto Protocol's first commitment period (2008-12). Participating industrialised countries were required (as a group) to curb domestic emissions by about 5% relative to 1990 over this period. Thirty-eight countries have also agreed to take commitments under a second commitment period which will run from 2013 to 2020. The amendments to the Kyoto Protocol bringing the second commitment period into force require ratification by 144 countries (two-thirds of those participating); as of 1 October 2015 only 49 have ratified.

Countries comply with their Kyoto Protocol targets by reducing emissions from fossil fuel combustion, reducing emission in other sectors (i.e. land-use or direct industrial emissions), or through use of the Kyoto Protocol's "flexible mechanisms" by which industrialised countries can earn emission credits from emissions reduction projects in participating developing countries and economies in transition (EITs).

Despite its extensive participation (192 countries), the Kyoto Protocol is limited in its potential to address global emissions. The United States remains outside of the Protocol's jurisdiction, and developing countries do not face emissions targets. The Kyoto Protocol implies action on less than 14% of global $CO_2$ emissions in 2013, down from roughly one-quarter in 2012.

Through its flexibility mechanisms and provisions for international trading, the Kyoto Protocol has made $CO_2$ a tradable commodity, and has been a key driver for the development of national emissions trading schemes. However the smaller pool of countries with targets in the Kyoto Protocol's second commitment period, coupled with a large surplus of project credits carried forward from the first period, have led to low prices and project developers exiting the market.

## Building future international action

Recognising that the Kyoto Protocol framework is inadequate to deliver the global goal of limiting global temperature increase to less than 2°C above pre-industrial levels, countries are now negotiating a new climate agreement, to be finalised at COP21 in Paris in December 2015, and to apply from 2020. This will be the first international climate agreement to extend mitigation obligations to all countries, both developed and developing.

The COP21 agreement will build on the voluntary emissions reduction pledges for 2020 that were made at COP15 in Copenhagen. Developed and developing countries that submitted pledges under the Copenhagen Accord collectively account for over 80% of global emissions. Although the ambition of these pledges is currently insufficient to limit temperature rise to 2°C above pre-industrial levels, the breadth of participation in mitigation commitments marks a significant improvement on the coverage of the Kyoto Protocol.

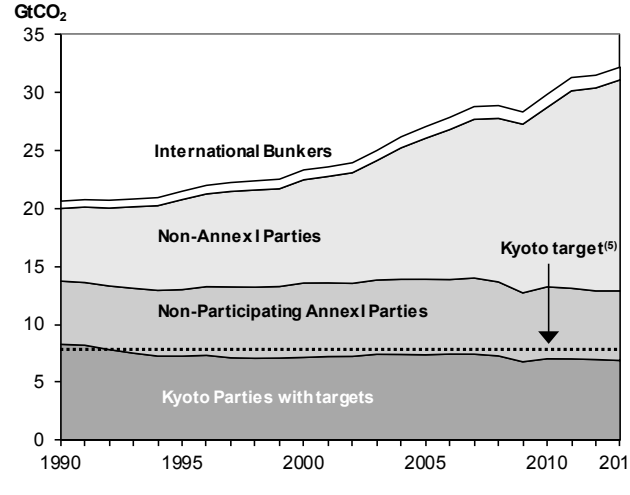
In order to respect countries' different responsibilities and capabilities, mitigation contributions in the COP21 climate agreement will be nationally determined. As of mid-October 2015, more than 150 countries have submitted their intended nationally determined contributions ("INDCs") for the COP21 agreement. These countries represent approximately 90% of energy $CO_2$ emissions, and over 6 billion people. A summary assessment of the energy sector impacts of the national climate pledges made in these INDCs was produced by the IEA and published in the *World Energy Outlook Special Briefing for COP21* on 21 October 2015.

As this assessment noted, action in the energy sector can make or break efforts to achieve world's agreed 2ºC target. However, as in all these efforts, timely and accurate $CO_2$ and GHG statistics will prove central to ascertaining compliance with international agreements and to informing policy makers and carbon market participants. The ability of countries to monitor and review emissions from their sources is essential in their engagement towards national and global GHG mitigation.

### Table 1. World $CO_2$ emissions from fuel combustion and Kyoto Protocol first commitment period targets [1]

| | 1990 $MtCO_2$ | 2013 $MtCO_2$ | % change 90-13 | Kyoto Target |
|---|---|---|---|---|
| **KYOTO PARTIES WITH TARGETS** [1] | **8,269.8** | **6,873.6** | **-16.9%** | **-4.6%** [2] |
| *Europe* | *3,107.9* | *2,770.5* | *-10.9%* | |
| Austria | 56.2 | 65.1 | 16.0% | -13% |
| Belgium | 106.2 | 89.1 | -16.1% | -7.5% |
| Denmark | 51.0 | 38.8 | -23.8% | -21% |
| Finland | 53.5 | 49.2 | -8.1% | 0% |
| France [3] | 345.5 | 315.6 | -8.7% | 0% |
| Germany | 940.3 | 759.6 | -19.2% | -21% |
| Greece | 69.9 | 68.9 | -1.4% | +25% |
| Iceland | 1.9 | 2.0 | 7.0% | +10% |
| Ireland | 30.1 | 34.4 | 14.1% | +13% |
| Italy | 389.3 | 338.2 | -13.1% | -6.5% |
| Luxembourg | 10.7 | 9.8 | -9.0% | -28% |
| Netherlands | 144.9 | 156.2 | 7.9% | -6% |
| Norway | 27.5 | 35.3 | 28.5% | +1% |
| Portugal | 37.9 | 44.9 | 18.6% | +27% |
| Spain | 202.6 | 235.7 | 16.3% | +15% |
| Sweden | 52.1 | 37.5 | -28.0% | +4% |
| Switzerland | 40.7 | 41.5 | 2.0% | -8% |
| United Kingdom | 547.7 | 448.7 | -18.1% | -12.5% |
| European Union - 15 | 3,037.9 | 2,691.7 | -11.4% | -8% |
| *Asia Oceania* | *1,330.6* | *1,654.5* | *24.3%* | |
| Australia | 259.6 | 388.7 | 49.7% | +8% |
| Japan | 1,049.3 | 1,235.1 | 17.7% | -6% |
| New Zealand | 21.7 | 30.7 | 41.3% | 0% |
| *Economies in Transition* | *3,831.3* | *2,448.6* | *-36.1%* | |
| Bulgaria | 74.6 | 39.3 | -47.3% | -8% |
| Croatia | 20.7 | 16.0 | -22.5% | -5% |
| Czech Republic | 150.3 | 101.1 | -32.7% | -8% |
| Estonia | 36.0 | 18.9 | -47.6% | -8% |
| Hungary | 65.7 | 39.5 | -39.9% | -6% |
| Latvia | 18.8 | 6.9 | -63.1% | -8% |
| Lithuania | 32.2 | 10.7 | -66.7% | -8% |
| Poland | 344.8 | 292.4 | -15.2% | -6% |
| Romania | 168.3 | 68.8 | -59.1% | -8% |
| Russian Federation | 2,163.2 | 1,543.1 | -28.7% | 0% |
| Slovak Republic | 54.8 | 32.4 | -40.9% | -8% |
| Slovenia | 13.5 | 14.3 | 5.9% | -8% |
| Ukraine | 688.4 | 265.0 | -61.5% | 0% |

| | 1990 $MtCO_2$ | 2013 $MtCO_2$ | % change 90-13 | Kyoto Target |
|---|---|---|---|---|
| **OTHER COUNTRIES** | **99.8** | **58.2** | **-41.6%** | |
| *Non-participating Annex I Parties* | *5,454.6* | *6,006.1* | *10.1%* | |
| Belarus | 99.8 | 58.2 | -41.6% | -8% |
| Canada [2] | 419.0 | 536.3 | 28.0% | -6% |
| Cyprus | 3.9 | 5.6 | 44.6% | none |
| Malta | 2.3 | 2.3 | 0.6% | none |
| Turkey | 127.1 | 283.8 | 123.3% | none |
| United States | 4,802.5 | 5,119.7 | 6.6% | -7% |
| *Other Regions* | *6,158.9* | *18,029.8* | *192.7%* | none |
| Africa | 529.0 | 1,074.7 | 103.2% | none |
| Middle East | 534.9 | 1,647.5 | 208.0% | none |
| N-OECD Eur. & Eurasia [4] | 621.0 | 526.3 | -15.3% | none |
| Latin America [4] | 812.8 | 1,579.3 | 94.3% | none |
| Asia (excl. China) [4] | 1,444.4 | 4,178.9 | 189.3% | none |
| China (incl. Hong Kong) | 2,216.9 | 9,023.1 | 307.0% | none |
| **INTL. MARINE BUNKERS** | **371.5** | **608.8** | **63.9%** | |
| **INTL. AVIATION BUNKERS** | **258.8** | **490.4** | **89.5%** | |
| **WORLD** | **20,623.0** | **32,189.7** | **56.1%** | |




(1) The actual country targets apply to a basket of six greenhouse gases and allow sinks and international credits to be used for compliance. The overall "Kyoto target" is estimated for this publication by applying the country targets to IEA data for $CO_2$ emissions from fuel combustion, and is only shown as an indication. The overall target for the combined EU-15 under the Protocol is -8%, but the member countries have agreed on a burden-sharing arrangement as listed. The country composition and specific reduction targets shown refer to those agreed to under the first commitment period of the Kyoto Protocol (2008-2012). Reduction targets and the composition of Parties that have agreed to targets differ under the second commitment period of the Kyoto Protocol (2013-2020).

(2) On 15 December 2011, Canada withdrew from the Kyoto Protocol. This action became effective for Canada on 15 December 2012.

(3) Emissions from Monaco are included with France.

(4) Composition of regions differs from elsewhere in this publication to take into account countries that are not Kyoto Parties.

(5) The Kyoto target is calculated as percentage of the 1990 $CO_2$ emissions from fuel combustion only, therefore it does not represent the total target for the six-gas basket. This assumes that the reduction targets are spread equally across all gases.

*Key point: The existing targets under the Kyoto Protocol are not sufficiently comprehensive to lead to reductions in global $CO_2$ emissions from fuel combustion.*

The nationally-determined targets will be complemented by an agreed framework for measuring, reporting and verifying emissions, and accounting for achievement of targets, and by enhanced actions on adaptation, technology development and on the provision of financial resources. While obligations are to start from 2020, emissions from the energy sector need to peak by around 2020 if there is to be a reasonable chance of limiting temperature rise to below 2°C (IEA, 2015). This highlights the need for ambitious commitments in the 2020-25 timeframe, but also the importance of complementary initiatives outside the UNFCCC that can constrain emissions in the period up to 2020.

## References

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