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CO₂ emissions from fuel combustion: Overview



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2017

The following analysis is an overview from the publication *CO₂ Emissions From Fuel Combustion 2017*.

Please note that we strongly advise users to read definitions, detailed methodology and country specific notes which can be found online under *References* at www.iea.org/statistics/topics/CO2emissions/

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CO₂ EMISSIONS OVERVIEW

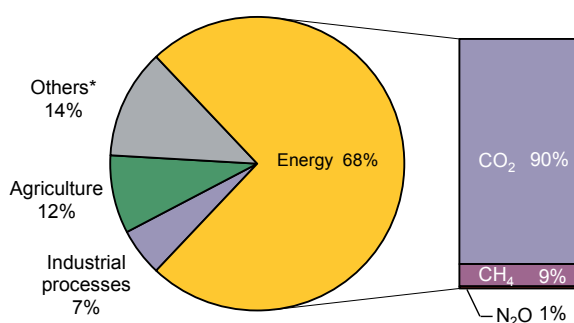
The growing importance of energy-related emissions

Climate scientists have observed that carbon dioxide (CO₂) concentrations in the atmosphere have been increasing significantly over the past century, compared to the pre-industrial era level of about 280 parts per million (ppm). In 2016, the average concentration of CO₂ (403 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 the levels of methane (CH₄) and nitrous oxide (N₂O).

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 CH₄ and N₂O from domestic livestock and rice cultivation, and to industrial processes not related to energy, producing mainly fluorinated gases and N₂O (Figure 1).

Figure 1. Estimated shares of global anthropogenic GHG, 2014



* Others include large-scale biomass burning, post-burn decay, peat decay, indirect N₂O emissions from non-agricultural emissions of NO_x and NH₃, Waste, and Solvent Use.

Source: based on IEA estimates for CO₂ from fuel combustion and EDGAR version 4.3.2 for CO₂, CH₄ and N₂O emissions and 4.2FT2010 for the F-gases; based on 100-year Global Warming Potential (GWP), see Part III.

Within the energy sector², CO₂ resulting from the oxidation of carbon in fuels during combustion dominates total GHG emissions.

CO₂ emissions from energy account for the largest share of global anthropogenic GHG emissions, representing over three quarters of emissions from

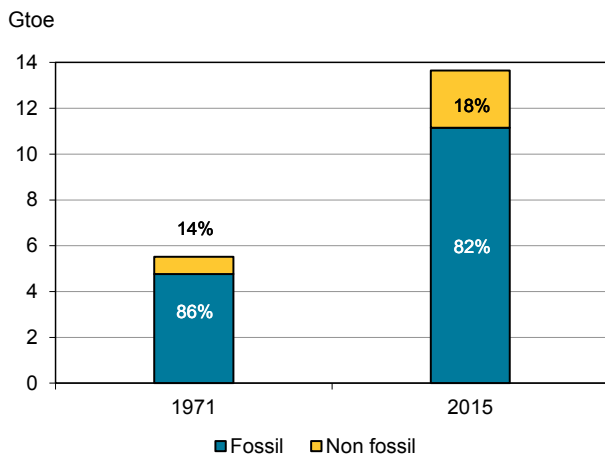
1. Globally averaged marine surface annual mean expressed as a mole fraction in dry air. Ed Dlugokencky and Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/).

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. CH₄ emissions from coal mining).

Annex I³ countries, and about 58% of global emissions.⁴ This percentage varies greatly by country, due to diverse national structures.

Increasing demand for energy comes from worldwide economic growth and development. Global energy demand as measured by total primary energy supply (TPES) increased by almost 150% between 1971 and 2015, still mainly relying on fossil fuels (Figure 2).

Figure 2. World primary energy supply*



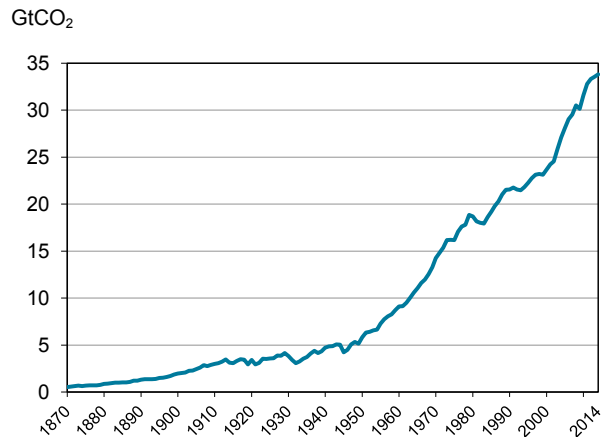
* World primary energy supply includes international bunkers. In this graph, non-renewable waste is included in Fossil.

Despite the growth of non-fossil energy (considered as non-emitting⁵), especially in electricity generation where it now accounts for 34% of the global figure (including nuclear, hydropower and other renewable sources), the share of fossil fuels within the world energy supply is relatively unchanged over the past four decades. In 2015, fossil sources accounted for 82% of the global TPES.

The growth in world energy demand from fossil fuels has played a key role in the upward trend in CO₂ emissions (Figure 3). Since the Industrial Revolution, annual CO₂ emissions from fuel combustion have

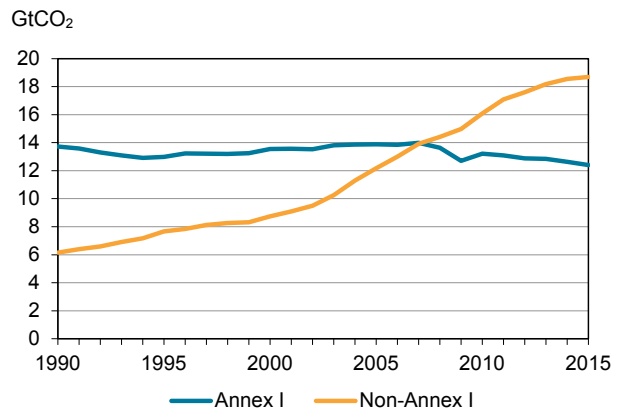
dramatically increased from near zero to over 33 GtCO₂ in 2015.

Figure 3. Trend in CO₂ emissions from fossil fuel combustion, 1870-2014



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

Figure 4. Regional CO₂ emissions trends, 1990-2015



More recently, since 1990, emissions in non-Annex I countries have tripled, while emissions in Annex I countries have declined slightly (Figure 4).

The next section provides a brief overview of recent trends in energy-related CO₂ emissions, as well as in some of the socio-economic drivers of emissions.

3. See *Geographical coverage*.

4. Based on 100-year Global Warming Potential (GWP), see Part III.

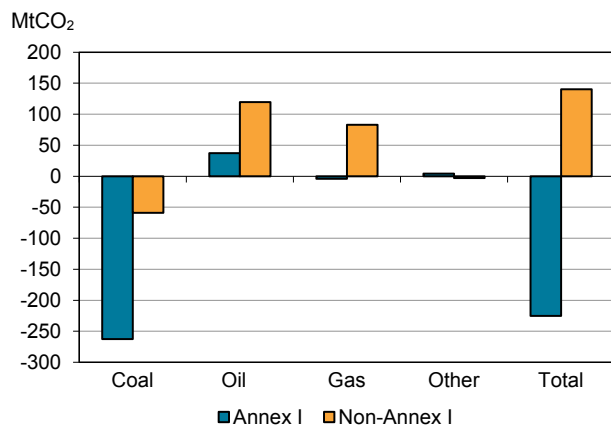
5. Excluding the life cycle of all non-emitting sources and excluding combustion of biofuels (considered as non-emitting CO₂, based on the assumption that the released carbon will be reabsorbed by biomass re-growth, under balanced conditions).

Recent emissions trends

In 2015, global CO₂ emissions reached 32.3 GtCO₂, which is comparable to the 2014 level⁶ (-0.1%). This contrasts with the growth rates seen in 2013 (1.7%) and 2014 (0.6%), and with the average annual growth rate since 2000 (2.2%). The year 2015 was the first year since the 1990s in which our data do not show a global increase in CO₂ emissions from fuel combustion whilst the global economy keeps growing.

Emissions in non-Annex I countries continued to increase (0.8%), although at a slower rate than in previous years, while emissions in Annex I countries decreased (-1.8%) due to visible declines in emissions from coal (-6.5%). In absolute terms, the global emissions trend was driven by increases from oil and natural gas in non-Annex I countries, compensated by decreased emissions from coal mainly in Annex I countries (Figure 5).

Figure 5. Change in CO₂ emissions, 2014-15

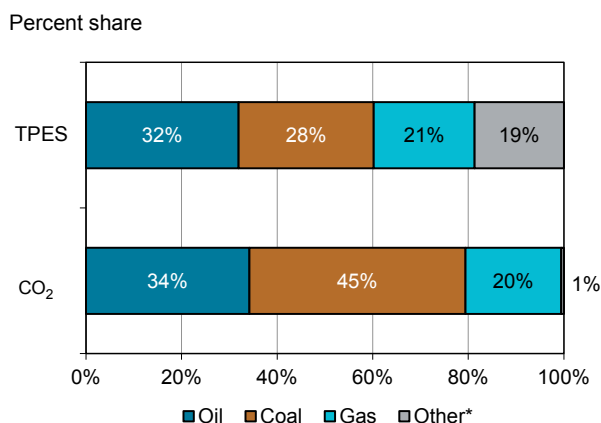


Emissions by fuel

Although coal represented 28% of the world TPES in 2015, it accounted for 45% of the global CO₂ emissions due to its heavy carbon content per unit of energy released, and to the fact that almost of fifth of the TPES derives from carbon-neutral fuels (Figure 6).

Compared to gas, coal is nearly twice as emission intensive on average.⁷

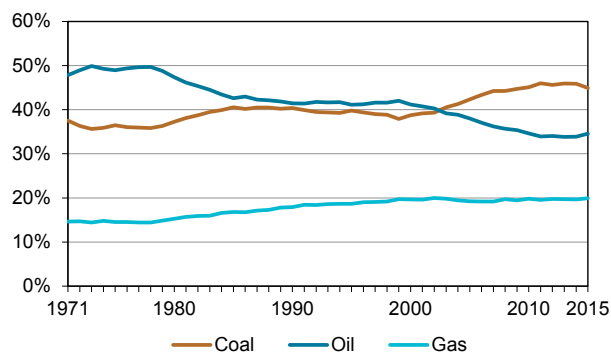
Figure 6. World primary energy supply and CO₂ emissions: shares by fuel in 2015



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

From the late 1980s until the early 2000s, coal and oil were each responsible for approximately 40% of global CO₂ emissions, with emissions from oil generally exceeding those from coal by a few percentage points. However, the trends differed at a regional level. In Annex I countries, oil is the largest source of fuel combustion emissions, whereas, in non-Annex I countries emissions from coal ranked highest. Since then, mainly due to the increasing influence of non-Annex I countries, coal has increased from 39% in 2002 to 45% in 2015, while oil has decreased from 40% to 35%, with natural gas approximately stable at 20% of global emissions (Figure 7).

Figure 7. Fuel shares in global CO₂ emissions



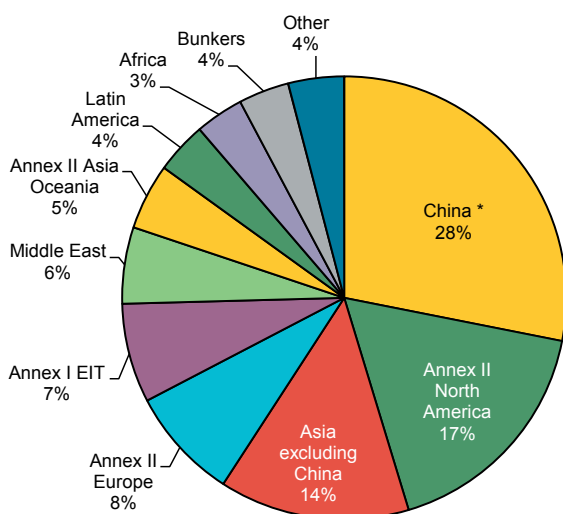
6. The IEA CO₂ emissions estimates are derived from the IEA energy balances, which use official country data to the maximum extent possible. The IEA is continuously working together with national administrations worldwide to ensure data quality improvements in the longer-term. As this work progresses, revisions to the underlying energy data and thus the CO₂ estimates may occur.

7. 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.

Emissions by region

Non-Annex I countries, collectively, represented 58% of global CO₂ emissions in 2015, while Annex I countries represented 38%, with international marine and aviation bunkers responsible for the remaining 4%. On a regional level, the contributions to global CO₂ emissions vary greatly: in 2015, China (28%) and Annex II North America³ (17%) were responsible for the largest share of emissions, followed by Asia excluding China⁸ (12%), Annex II Europe⁹ (8%) and Annex I EIT⁹ (7%), with smaller shares coming from the Middle East (5%), Annex II Asia Oceania (5%), Latin Americas (4%) and Africa (4%) (Figure 8).

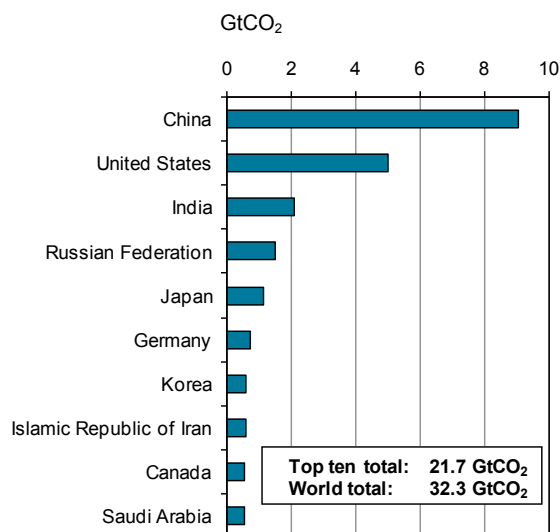
Figure 8. CO₂ emissions by region, 2015



* China includes Hong Kong, China.

Regional differences conceal even larger differences among individual countries. Over two-thirds of global emissions for 2015 originated from just ten countries, with the shares of China (28%) and the United States (15%) far surpassing those of all others. Combined, these two countries alone produced 14.0 GtCO₂. The top ten emitting countries include five Annex I countries and five non-Annex I countries (Figure 9).

Figure 9. Top ten emitting countries, 2015

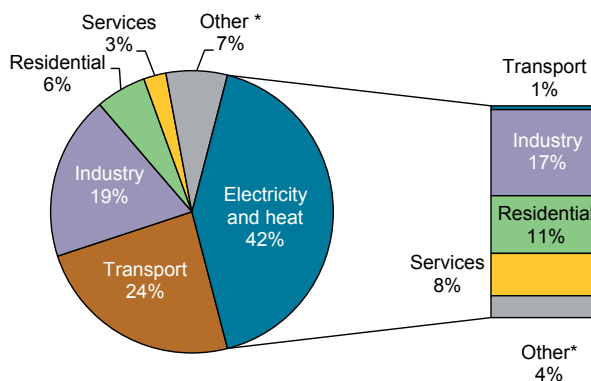


As different regions and countries have contrasting economic and social structures, the picture changes significantly when moving from absolute emissions to indicators such as emissions per capita or per GDP. A more comprehensive analysis is given in the section *Coupling emissions with socio-economic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

Emissions by sector

Two sectors produced two-thirds of global CO₂ emissions from fuel combustion in 2015: electricity and heat generation, by far the largest, which accounted for 42%, and transport, accounting for 24% (Figure 10).

Figure 10. World CO₂ emissions from fuel combustion by sector, 2015



The graph 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.

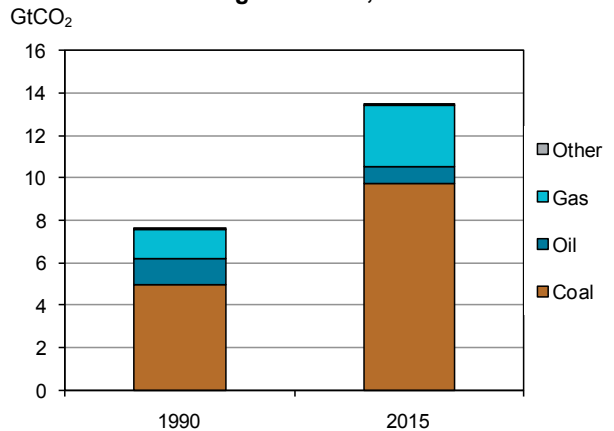
8. For the purposes of this discussion, Asia excludes China and includes Korea. Japan is included in Annex 2 Asia Oceania.
9. See *Geographical coverage*

Despite an increase in the share of renewables, 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 2014 and 2015, CO₂ emissions from electricity and heat decreased by 0.9%, compared with an increase of 0.4% between 2013 and 2014, and 1.4% between 2012 and 2013. 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 65% in 1990 to 72% in 2015 (Figure 11). This trend is however changing and in the last years a progressive switch from coal to gas in electricity and heat generation can be observed. As an impact, 2015 was the first year when global emission from coal combustion decreased significantly since the post-crisis rebound.

Emissions from electricity generation specifically increased by 45% between 2000 and 2015. At a regional level, trends over the same period differed (Figure 12). Both Annex II Europe and Annex II North America showed a decrease in total emissions from electricity generation. In Annex II North America, this was driven by improvements in i) the thermal efficiency of generation; ii) the CO₂ intensity of the fossil fuel mix (both reflecting a shift from coal towards natural gas), and iii) an increase in the share of electricity output from non-emitting sources. In Annex II Europe, the share of electricity output from fossil fuels fell 20% between 2000 and 2015 lead by decreases in Italy and

Figure 11. CO₂ emissions from electricity and heat generation*, 1990 - 2015

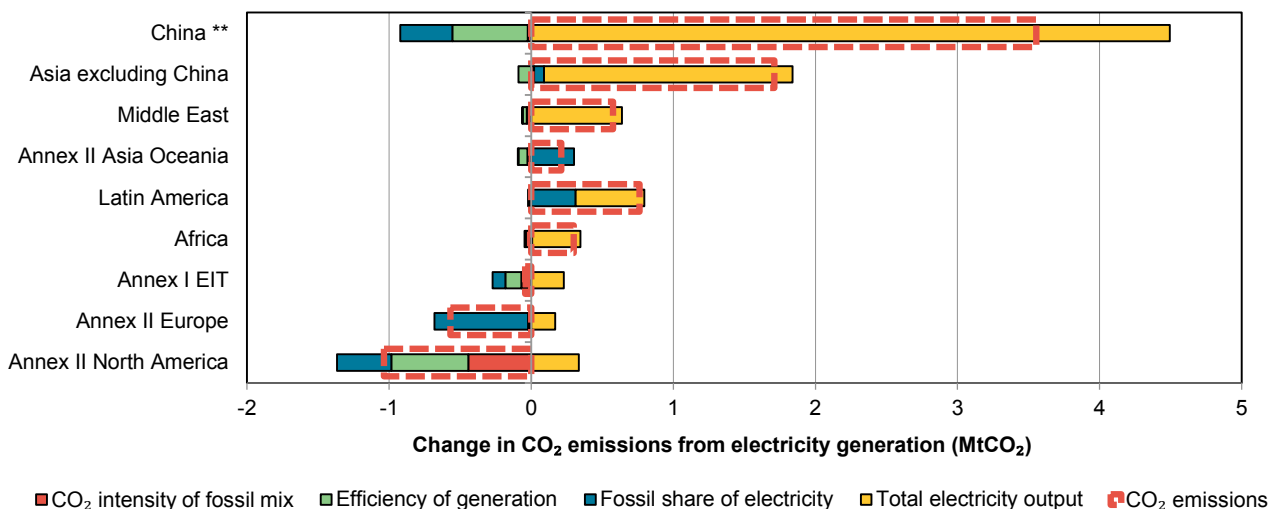


* Refers to main activity producers and autoproducers of electricity and heat.

the United Kingdom. In Italy, the share of fossil-based electricity declined significantly (2000: 81%; 2015: 61%), as output from oil products fell, while that from solar PV, wind and hydro increased. Likewise, in the United Kingdom, electricity output from coal and gas decreased, while that from wind and combustible renewables increased, lowering the share of fossil fuels in the electricity mix (2000: 75%; 2015: 68%).

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 accident at Fukushima Daiichi in 2011.

Figure 12. CO₂ emissions from electricity generation: driving factors*, 2000-2015



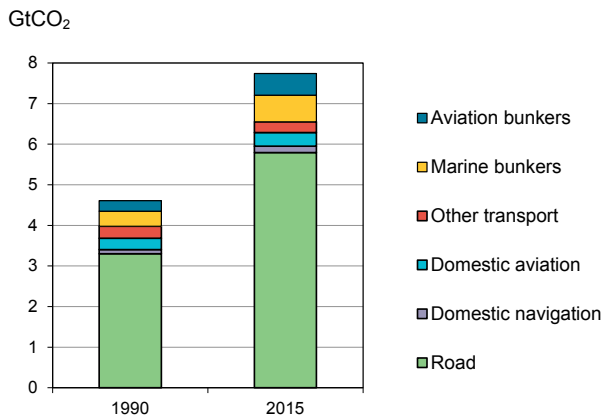
* Electricity decomposition: CO₂ emissions = CO₂ intensity of fossil mix x fossil share of elec. x thermal efficiency x elec output.

** China includes Hong Kong, China.

Outside Annex I, all regions exhibited an increase in emissions from electricity generation, driven primarily by increased output. This was particularly notable in China, where total output has increased over four-fold since 2000, and in the remainder of Asia¹⁰, where output more than doubled. In both of these regions, much of the increased output was met through carbon intensive coal-fired plants⁵. However, in China, efficiency improvements and a recently increased share of non-fossil generation (from a combination of increased output from wind, solar PV, hydro and nuclear sources) reduced emissions per unit of output.

For transport, the 68% increase since 1990 (Figure 13) was led by increasing emissions from the road sector, which accounted for three quarters of transport emissions in 2015. Despite efforts to limit emissions from international transport, between 1990 and 2015, emissions from marine and aviation bunkers grew even faster than those from road (marine: +77% aviation: +105%).

Figure 13. CO₂ emissions from transport, 1990-2015

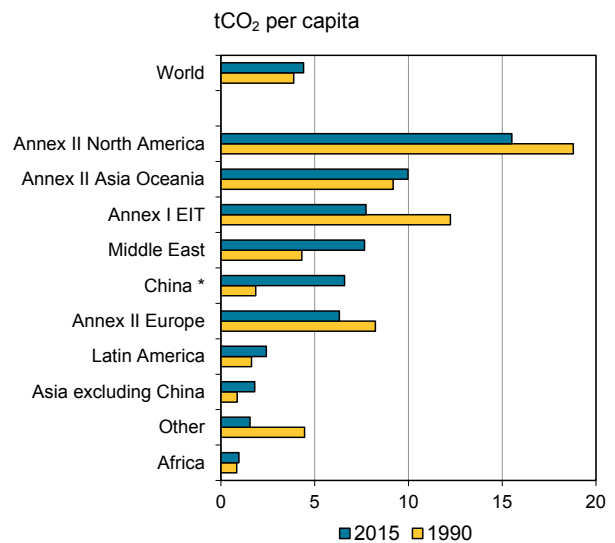


Coupling emissions with socio-economic indicators¹¹

Per-capita emission levels vary significantly across the world, highlighting the 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 in 2015 were very diverse, ranging from 1.6 tCO₂ for India and 6.6 tCO₂ for China to 15.5 tCO₂ for the United States. On average, industrialised countries emit far larger amounts of CO₂ per capita than developing countries, with the lowest levels worldwide observed in Africa.

Figure 14. CO₂ emissions per capita by major world regions, 1990 - 2015



* China includes Hong Kong, China.

Globally, per-capita emissions increased by 13% between 1990 and 2015, however, contrasting trends were observed amongst the top five emitting countries, generally reducing gaps (Figure 15). 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 (-30%) and the United States (-19%), although following very different patterns. Values for Russia dramatically dropped in the early 1990s, and increased somewhat since then, while values for the United States began falling in the mid-to-late 2000s, having remained stable for many years.

For emissions per unit of GDP¹², all the five largest emitters have shown reductions between 1990 and 2015, in line with the decoupling observed globally

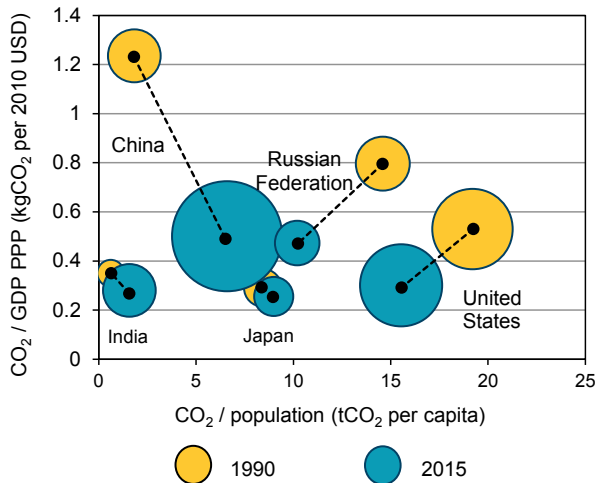
10. For the purposes of this discussion, Asia excludes China and includes Korea. Japan is included in Annex 2 Asia Oceania.

11. No single indicator can provide a complete picture of a country's CO₂ 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.

12. Throughout this analysis, GDP refers to GDP in 2010 USD, using purchasing power parities. A note of caution is necessary concerning the indicator of CO₂ 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).

(-31%). This trend was most pronounced for China and the Russian Federation, whose 1990 levels were significantly higher than those of other countries, and for the United States.

Figure 15. Trends in CO₂ emission intensities for the top five emitting countries*, 1990 - 2015



* The size of the circle represents the total CO₂ emissions from the country in that year.

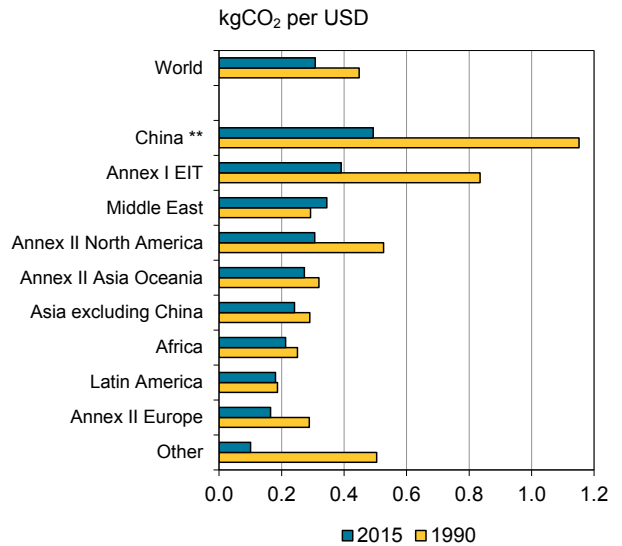
Levels of emissions per GDP also vary significantly across regions, but much less in 2015 than in 1990 (Figure 16). Although climate, economic structure and other variables can affect energy use, relatively high values of emissions per GDP indicate a potential for decoupling CO₂ emissions from economic 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).¹³

On a global level, CO₂ emissions grew by 40% between 2000 and 2015. A simple decomposition¹⁴ shows the main driving factors of the world CO₂ emissions trend. Globally, economic growth partially decoupled from energy use, as energy intensity decreased by 21% over the period. However, with a practically unchanged carbon intensity of the energy

13. 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/.

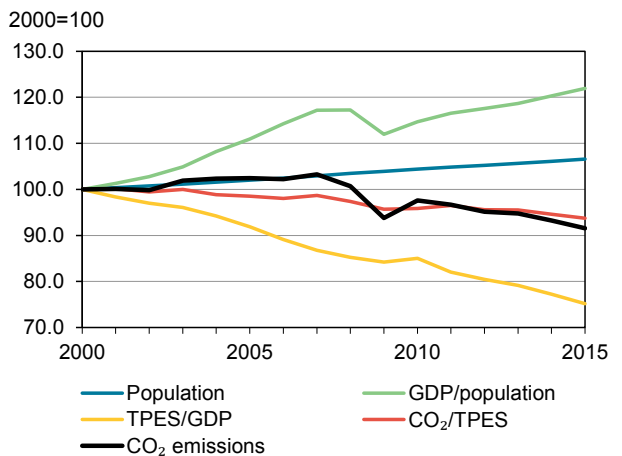
14. CO₂ emissions can be decomposed into the product of four factors: population, per capita GDP, TPES/GDP, CO₂/TPES. For a more detailed description of the Kaya decomposition, see the chapter *Indicator sources and methods* in Part I.

Figure 16 CO₂ emissions per GDP* by major world regions, 1990 - 2015



* GDP in 2010 USD, using purchasing power parities.
** China includes Hong Kong, China.

Figure 17. Annex I CO₂ emissions and drivers (Kaya decomposition)¹⁴, 2000 - 2015



mix¹⁵, the combined growth in population (20%) and in per capita GDP (43%) led to a significant increase in global CO₂ emissions between 2000 and 2015. 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.

15. Also known, in its index form, as Energy Sector Carbon Intensity Index (ESCI), as in the IEA publication *Tracking Clean Energy Progress 2016*.

In Annex I countries as a whole, CO₂ emissions in 2015 were actually 8% lower than in 2000 (Figure 17). Significant decoupling of energy consumption from economic activity (TPES/GDP: -25%) acted to decrease emissions but per-capita economic output grew (GDP/population: +22%), as did population (+7%), however, the energy sector's carbon intensity (CO₂/TPES) declined mildly (-6%).

By contrast, emissions in non-Annex I countries doubled over the same period (Figure 18), as very strong growth in per-capita economic output (+90%) combined with population growth (+23%). The CO₂ intensity of the energy mix also increased (CO₂/TPES: +12%), mainly due to higher coal consumption in larger countries. However, a significant decrease in the energy intensity of the economic output (TPES/GDP: -18%) tempered those increases. 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 CO₂ emissions trends is essential when designing sound and effective emissions reduction policies at a national and international level.

Figure 18. Non-Annex I CO₂ emissions and drivers (Kaya decomposition)¹⁴, 1990 - 2015

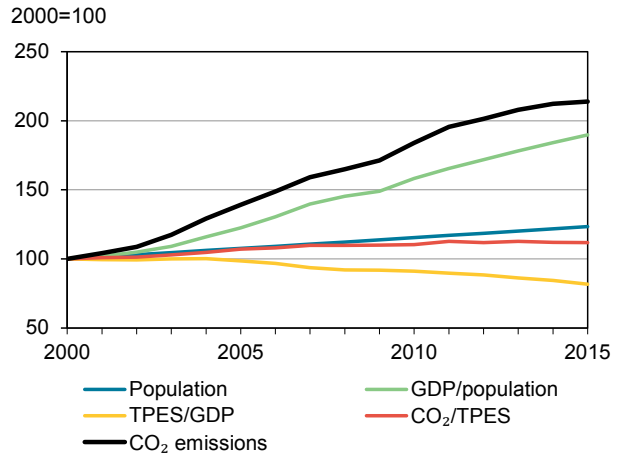
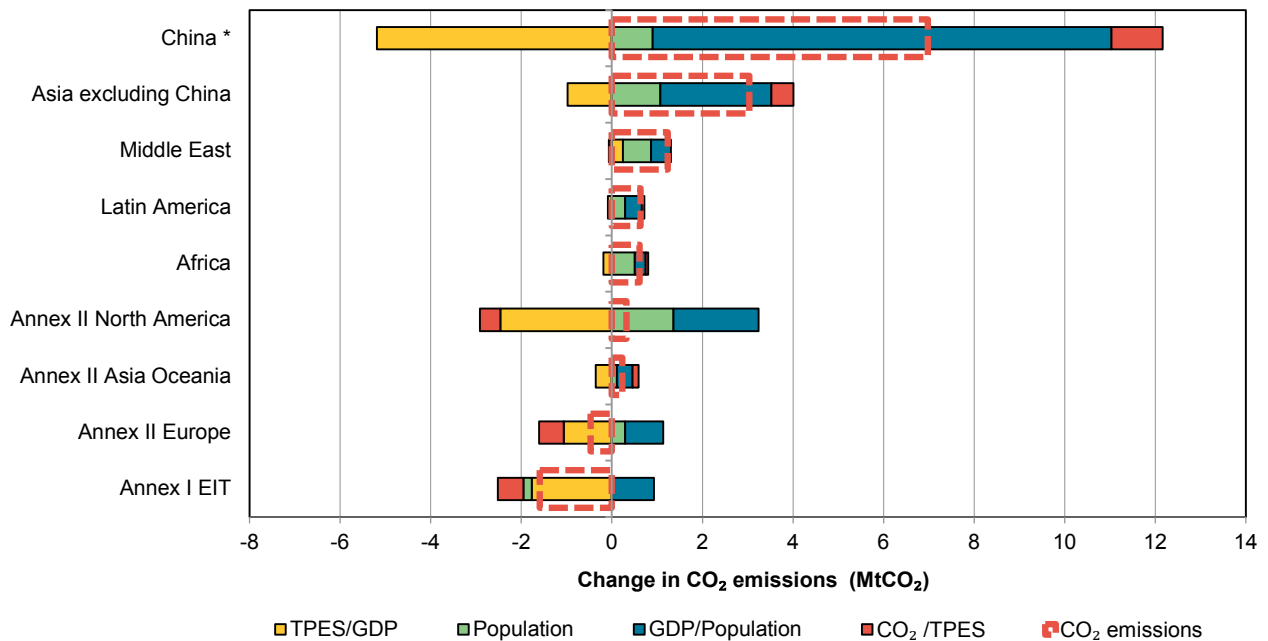


Figure 19. Global CO₂ emissions and drivers (Kaya decomposition), 1990-2015



* China includes Hong Kong, China.

Developing a low-carbon world

With the energy sector accounting for approximately two-thirds of global GHG emissions, action in the energy sector can make or break efforts to achieve global climate goals. 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.

Timely and accurate CO₂ and GHG statistics (complemented by other energy sector metrics that provide insight into underlying transformation of the energy system) will prove central to measuring achievement of international climate targets 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. The Capacity-building Initiative for Transparency launched at COP21 will be critical to making this happen. The IEA will also continue to support countries through provision of energy and emissions statistics, and training developed and developing country officials in policy, modelling, and energy statistics.

The Paris Agreement: International action beyond 2020

The global community adopted the historic Paris Agreement in December 2015, the first international climate agreement to extend mitigation obligations to all countries, both developed and developing. The Agreement was ratified in record pace by October 2016 and came into force 4 November 2016, just before the start of the 22nd Conference of the Parties (COP22). As of 21 August 2017, there are 195 signatories to the Paris Agreement of which 160 have also formally joined the agreement (by for example depositing their instruments of ratification).

Since the Agreement's adoption and entry into force, countries have shifted their focus to implementing their commitments under the accord, such as negotiating a "rulebook", which includes rules and guidelines for

emissions accounting and transparency of mitigation action and financial support.

Previous climate agreements: Kyoto and Cancún

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 Parties have also agreed to take commitments under a second commitment period which will run from 2013 to 2020. The Doha Amendment to the Kyoto Protocol, which would bring this second commitment period into force requires ratification by 144 countries (two-thirds of those participating); as of 9 August 2017 only 80 have ratified.

Countries comply with their Kyoto Protocol targets by reducing emissions from fossil fuel combustion, reducing emission in other sectors (e.g. 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).

Through its flexibility mechanisms and provisions for international trading, the Kyoto Protocol has made CO₂ 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.

Despite its extensive participation (192 Parties), 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 second commitment period targets imply action on less than 13% of global CO₂ emissions in 2014 (Table 2).

Alongside agreement of a second Kyoto Protocol commitment period, developed and developing countries submitted voluntary emission reduction pledges for 2020 under the Copenhagen Accord and Cancún Agreements. With the participating Parties producing over 80% of global emissions, these pledges have far greater coverage. Table 2 summarises the 2020 targets of the ten highest-emitting Parties, all remaining IEA member countries, and their progress towards these targets. While Annex I Parties submitted absolute

emission reduction targets (e.g. 20% below 1990 levels), non-Annex I Parties submitted “nationally appropriate mitigation actions”, many of which are intensity-based targets (e.g. reductions on a CO₂/GDP basis in China and India) or targets specifying reductions below business-as-usual scenarios (e.g. Korea, Mexico, Indonesia, South Africa). In addition, a number of these developing country targets are conditional

on international support – either requiring support to be implemented or to achieve greater levels of ambition and GHG emissions reductions. Although the ambition of these pledges is insufficient to limit temperature rise to 2°C above pre-industrial levels, the breadth of participation in mitigation commitments marked a significant improvement on the coverage of the Kyoto Protocol, and laid the groundwork for the Paris Agreement.

Table 1. 2020 greenhouse gas reduction targets of the ten largest emitters (based on 2015 emissions) and IEA member countries ⁽¹⁾

Ten highest emitting Parties (as per IEA estimates of CO ₂ emissions from fuel combustion in 2015)							
	1990	2005	2015	2020 GHG target	base year level	2015 level	change %
	MtCO ₂						
China (incl. Hong Kong, China)	2 109	5 399	9 084	Reduce CO ₂ emissions per unit of GDP by 40-45% below 2005 levels.	0.72 kgCO ₂ / 2010 USD PPP	0.49 kgCO ₂ / 2010 USD PPP	-32%
United States ⁽²⁾	4 802	5 702	4 998	In the range of a 17% emission reduction compared with 2005	5 702 Mt	4 997 Mt	-12%
European Union	4 028	3 921	3 201	20% averaged 2013-2020 reduction compared with 1990 under the Kyoto Protocol; 20% reduction in 2020.	4 028 Mt	3 160 Mt	-21%
India	530	1 080	2 066	Reduce the emissions intensity of GDP by 20-25% below 2005 levels.	0.30kgCO ₂ / 2010 USD PPP	0.28 kgCO ₂ / 2010 USD PPP	-6%
Russian Federation	2 163	1 482	1 469	15-25% below 1990.	2 16 Mt	1 469 Mt	-32%
Japan	1 042	1 178	1 142	3.8% below 2005.	1 18 Mt	1 142 Mt	-3%
Korea	232	458	585	None ⁽³⁾		585 Mt	
Islamic Republic of Iran	171	418	552	None			
Canada	420	541	549	17% below 2005.	541 Mt	549 Mt	+2%
Saudi Arabia	151	298	531	None			
Other IEA member countries							
	1990	2005	2015	2020 GHG target	base year level	2015 level	change %
	MtCO ₂						
Australia	260	372	381	5% reduction relative to 2000.	335 Mt	381 Mt	+14%
New Zealand	22	34	31	5% below 1990 levels.	22 Mt	31 Mt	+43%
Norway	27	34	37	Average 16% reduction 2013-2020 compared with 1990 under the Kyoto Protocol; 20% reduction in 2020.	27 Mt	37 Mt	+34%
Switzerland	41	44	37	Average 15.8% reduction 2013-2020 compared with 1990 under Kyoto Protocol; 20% reduction in 2020.	41 Mt	37 Mt	-8%
Turkey	127	217	317	None			

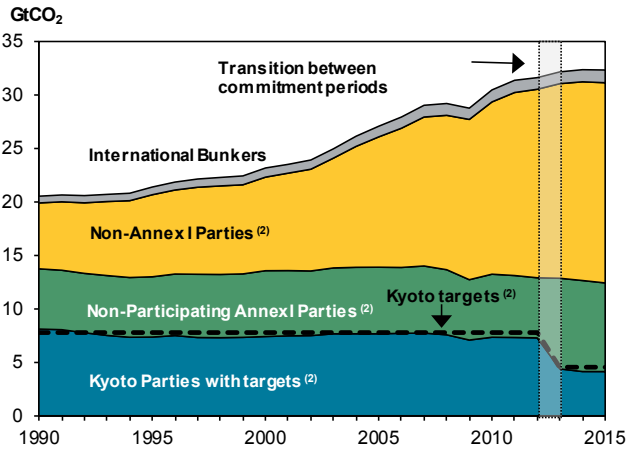
1. Voluntary targets under the Cancún Agreement, and (where indicated) second commitment period targets under the Kyoto Protocol.

2. The United States announced on 1 June 2017 its intention to withdraw from the Paris Agreement.

3. In 2016, Korea replaced its 2020 target of 30% below business-as-usual with a 2030 target as defined in its nationally-determined contribution (NDC).

Table 2. World CO₂ emissions from fuel combustion and Kyoto Protocol second commitment period targets^(1,2)

	1990 MtCO ₂	2015 MtCO ₂	% change 90-15	Kyoto Target		1990 MtCO ₂	2015 MtCO ₂	% change 90-15	Kyoto Target
KYOTO PARTIES WITH TARGETS^(1,2)	5,383.4	4,126.0	-23.4%	-19.3%⁽²⁾	OTHER COUNTRIES	99.8	53.2	-46.7%	
<i>Annex I Europe</i>	3,118.9	2,648.9	-15.1%		<i>Non-participating</i>				
Austria	56.3	62.1	10.4%	-20%	<i>Annex I Parties⁽¹⁾</i>	8,576.4	8,505.7	-0.8%	
Belgium	106.2	92.5	-13.0%	-20%	Canada	419.5	549.2	30.9%	none
Cyprus ⁽³⁾	3.9	5.9	51.6%	-20%	Japan	1,042.0	1,141.6	9.6%	none
Denmark	51.0	32.0	-37.3%	-20%	New Zealand	21.7	31.2	43.3%	none
Finland	53.8	42.1	-21.8%	-20%	Russian Federation	2,163.2	1,469.0	-32.1%	none
France ⁽⁴⁾	345.5	290.5	-15.9%	-20%	Turkey	127.5	317.2	148.9%	none
Germany	940.3	729.8	-22.4%	-20%	United States	4,802.5	4,997.5	4.1%	none
Greece	69.9	64.6	-7.6%	-20%					
Iceland	1.9	2.1	8.4%	-20%	<i>Other Regions</i>	6,027.6	18,523.4	207.3%	none
Ireland	30.1	35.3	17.3%	-20%	Africa	529.0	1,140.4	115.6%	none
Italy	389.3	330.7	-15.0%	-20%	Middle East	535.9	1,739.7	224.6%	none
Luxembourg	10.7	8.8	-18.0%	-20%	N-OECD Eur. & Eurasia ⁽⁵⁾	602.3	511.3	-15.1%	none
Malta	2.3	1.6	-28.9%	-20%	Latin America ⁽⁵⁾	810.1	1,574.8	94.4%	none
Netherlands	147.7	156.0	5.6%	-20%	Asia (excl. China) ⁽⁵⁾	1,441.1	4,472.7	210.4%	none
Norway	27.5	36.7	33.7%	-16%	China (incl. Hong Kong)	2,109.2	9,084.6	330.7%	none
Portugal	37.9	47.0	24.2%	-20%					
Spain	202.6	247.0	21.9%	-20%					
Sweden	52.1	37.1	-28.8%	-20%	INTL. MARINE BUNKERS	371.6	657.0	76.8%	
Switzerland	40.7	37.3	-8.4%	-15.8%	INTL. AVIATION BUNKERS	258.9	529.7	104.6%	
United Kingdom	549.3	389.8	-29.0%	-20%	WORLD	20,509.0	32,294.2	57.5%	
<i>Economies in Transition</i>	1,905.0	1,043.0	-45.2%						
Belarus	99.8	53.2	-46.7%	-12%					
Bulgaria	74.6	43.8	-41.3%	-20%					
Croatia	20.3	15.5	-23.7%	-20%					
Czech Republic	150.3	99.6	-33.8%	-20%					
Estonia	36.0	15.5	-56.8%	-20%					
Hungary	65.7	42.5	-35.3%	-20%					
Kazakhstan	237.2	225.1	-5.1%	-5%					
Latvia	18.8	6.8	-63.5%	-20%					
Lithuania	32.2	10.5	-67.3%	-20%					
Poland	344.8	282.4	-18.1%	-20%					
Romania	168.3	69.5	-58.7%	-20%					
Slovak Republic	54.8	29.4	-46.3%	-20%					
Slovenia	13.5	12.8	-5.2%	-20%					
Ukraine	688.4	189.4	-72.5%	-24%					
<i>Others</i>									
Australia	259.7	380.9	46.7%	-0.5%					
European Union	4,028.2	3,201.2	-20.5%	-20%					



1. The country composition and specific reduction targets shown in the table refer to those agreed to under the second commitment period (CP) of the Kyoto Protocol (2013-2020), as per the Doha Amendment.
2. The respective targets, gases and participating Parties differ between the first and second commitment periods of the Kyoto Protocol (CP1: 2008-2012, CP2: 2013-2020). The actual country targets apply to a basket of several greenhouse gases and allow sinks and international credits to be used for compliance. The overall "Kyoto targets" for each CP are estimated for this publication by applying the country targets to IEA data for CO₂ emissions from fuel combustion for 1990, and are shown as an indication only. These do not represent the total targets for the multi-gas baskets, and assume that the reduction targets are spread equally across all gases. The EU, its 28 Member States, and Iceland have agreed to meet the aggregate target of -20% in CP2, through "joint fulfilment" under Article 4 of the Kyoto Protocol.
3. Please refer to the chapter *Geographical Coverage* in Part I.
4. Emissions from Monaco are included with France.
5. Composition of regions differs from elsewhere in this publication to take into account countries that are not Kyoto Parties.

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- IEA (2015), *World Energy Outlook Special Briefing for COP21*, OECD/IEA, Paris.
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