Statistics report

CO_2 Emissions from Fuel Combustion

Overview

2020

IEA

Highlights

This overview summarises the key messages from the 2020 edition of the IEA *CO_2 Emissions from fuel combustion* dataset. In recognition of the fundamental importance of understanding energy related environmental issues, these data provide a full analysis of emissions stemming from energy use and have become an essential tool for analysts and policy makers in many international fora. Emissions were calculated based on the 2020 edition of the IEA energy balances and the default methods and emission factors of the 2006 IPCC *Guidelines for national greenhouse gas inventories*.

The highlights from the 2020 edition are:

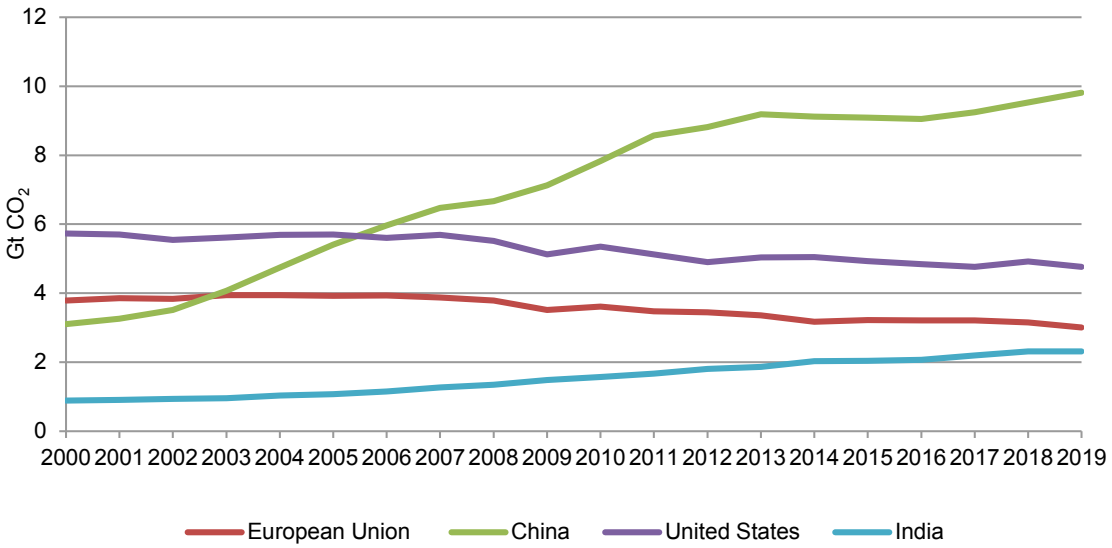
- Global CO_2 emissions reached a historical high of 33.5 $GtCO_2$ in 2018, driven by a robust growth in population and economic activity, while exhibited a slight decline (less than 1%) in 2019, mainly due to a decline in power sector emissions in advanced economies and milder weather conditions across continents.
- The emissions growth in 2018 was largely driven by non-OECD countries, led by China and India. Additionally, the United States experienced an increase of over 3%, while the European Union emissions continued to decline. Provisional data for 2019 show opposing trends across geographies, with a decline in emissions in advanced economies, including top emitters such as the United States; a continued increase in China; and stable levels in India.
- Power generation, together with transport, accounted for over two thirds of total emissions in 2018 while the remaining third was mainly associated with the industry and buildings sectors. After allocating electricity and heat emissions across final sectors, industry was the largest emitting sector, accounting for almost 40% of global CO_2 emissions.
- Should India and Africa reach similar levels of per capita emissions than those of the European Union in 2018, an additional 13 $GtCO_2$ (more than one third of current levels) would be released in the atmosphere each year. This figure shows the pivotal role of building more resilient and cleaner energy systems, particularly in emerging economies.

Global Trends

Global CO_2 emissions flattened in 2019 following a historical high

Global CO_2 emissions[1] reached a historical high of 33.5 $GtCO_2$ in 2018 driven by a robust growth in population and economic activity, while exhibited a slight decline (less than 1%) in 2019[2] , mainly due to a decline in power sector emissions in advanced economies and milder weather conditions across continents.

CO_2 emissions from fuel combustion: trends for selected economies



Global CO_2 emissions reached a historical high in 2018 while exhibited a slight decline in 2019.

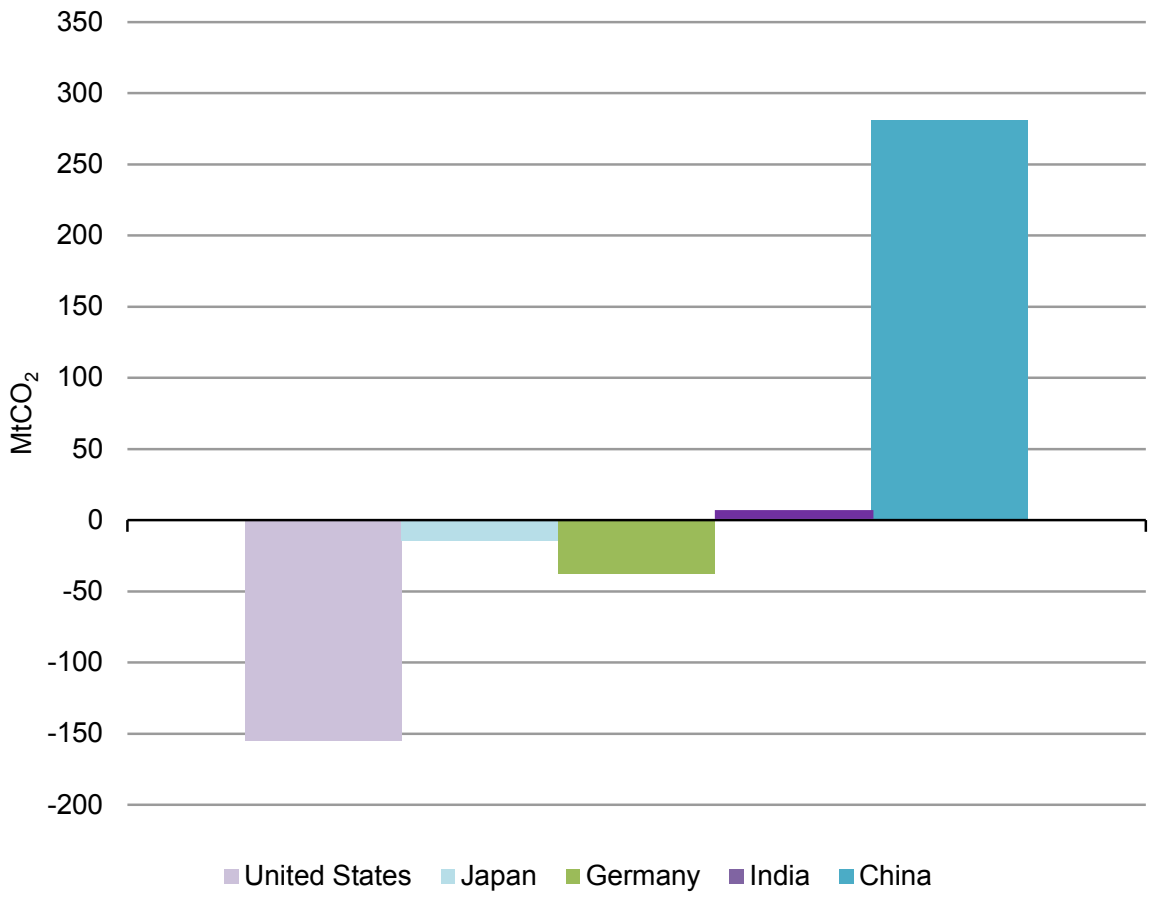
Similar to the past several years, the emissions growth in 2018 was largely driven by non-OECD countries, led by China and India. Additionally, the United States

[1] In this document, CO_2 emissions refer to CO_2 emissions from fuel combustion, based on the 2020 edition of the *IEA CO_2 emissions from fuel combustion*, unless further specified. For information on sources and methods, please refer to: http://wds.iea.org/wds/pdf/Worldco2_Documentation.pdf.

[2] The 2019 global emission figure is taken from *IEA (2020), Global CO_2 emissions in 2019* publication, https://www.iea.org/articles/global-co2-emissions-in-2019.

experienced an increase of over 3%, reversing the declining trend shown since 2015; while the European Union[3] and Japan continued to decline. Provisional data for 2019 show opposing trends across geographies, with a decline in emissions in advanced economies, including top emitters such as the United States, Germany and Japan; a continued increase in China; and stable levels in India.

Annual change in CO_2 emissions for top emitters, 2019



Emissions in 2019 showed opposing trends across geographies, with a decline in most advanced economies; a continued increase in China; and stable levels in India.

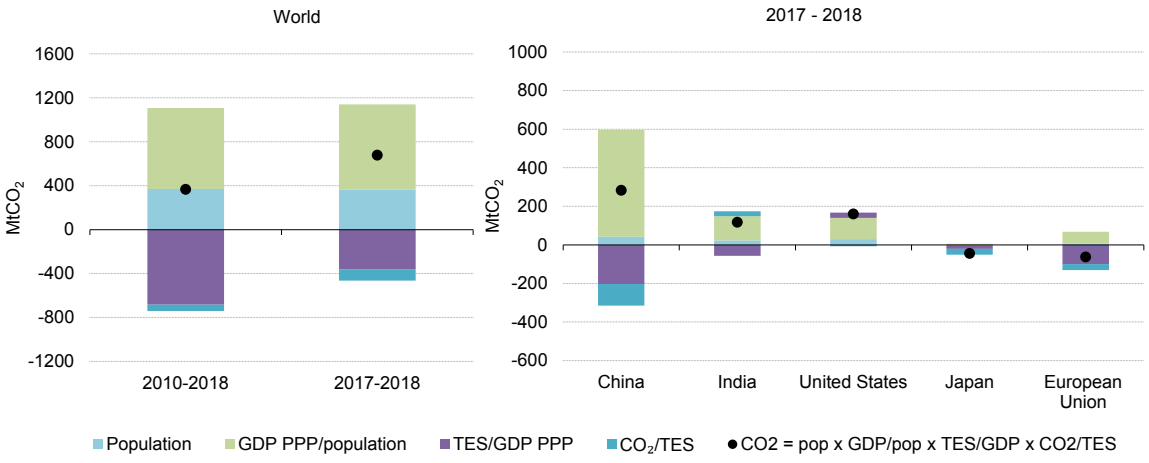
In 2018, the global energy intensity[4] continued to decline, thanks to changes across economies worldwide alongside further implementation of energy efficiency

[3] As of the 1st of February 2020, the United Kingdom is no longer part of the European Union and has entered into a transition period until 31 December 2020. However, in this publication with data up to 2019, the UK is still included in the European Union aggregate.

[4] Energy intensity of the economy, defined as total energy supply/GDP (PPP).

measures. Moreover, the increased penetration of low carbon technologies and further shift from coal generation resulted in a decrease of the global carbon intensity. Despite such advancements, a robust growth in global economic activity and population led to an increase in energy demand and a year-on-year growth of 675 million tonnes in global CO_2 emissions from fuel combustion.

Drivers of annual changes in CO_2 emissions: world and selected economies



The 2018 growth of global CO_2 emissions was driven by a robust growth in global economic activity and population.

Power generation remained the largest emissions driver

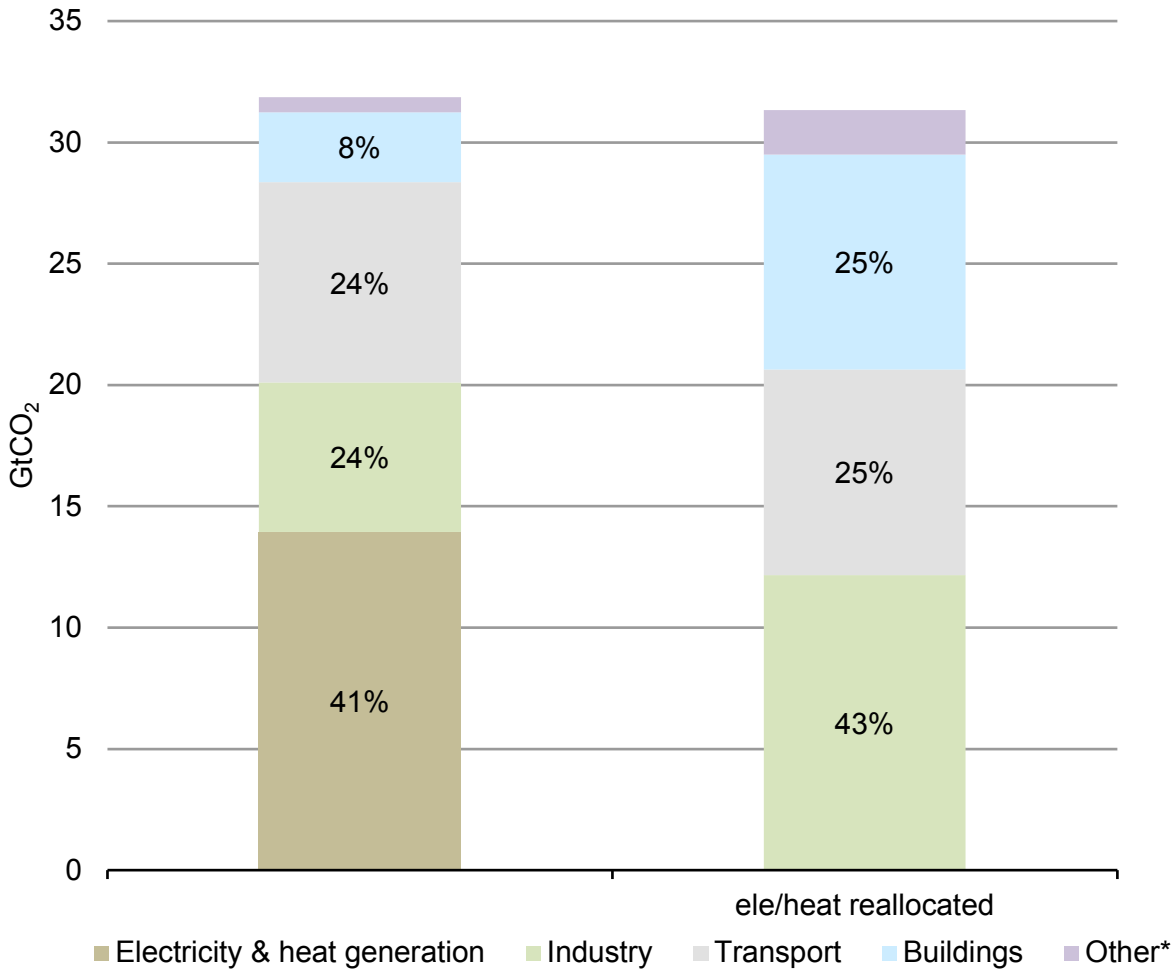
Power generation[5], together with transport, accounted for over two thirds of total emissions in 2018 - these two sectors being responsible for almost the entire global growth since 2010. The remaining third was mainly associated with the industry and buildings sectors. Considerable shares of the energy use in buildings took place in OECD countries, while Asia was responsible for the majority of industry consumption.

In 2018, industry was the largest final emitting sector[6], accounting for almost 40% of global emissions; while buildings and transport corresponded to over a quarter

[5] Refers to generation of electricity and heat.
[6] After allocating electricity and heat emissions across final sectors.

each. The buildings sector used about half of the global electricity, and industry over 40%. The transport sector, not yet visibly electrified, used less than 2% of global electricity.

Global CO_2 emissions by sector, 2018



* Other includes agriculture/forestry, fishing and non-specified final energy consumption.

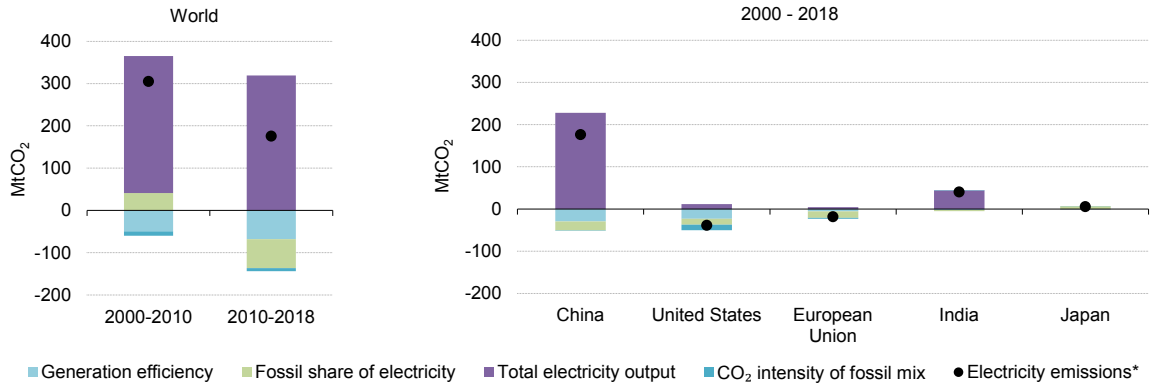
Power generation, together with transport, accounted for over two thirds of total emissions in 2018; industry was the largest final emitting sector.

Around one half of the global increase in emissions between 2000 and 2018 came from power generation in Asia. China and India together were responsible for pushing up the emissions associated with electricity generation by 220 $MtCO_2$ per year, on average. A significant increase in electricity demand (+580 TWh annually)

was the main driver of the increase in global emissions from electricity generation - only marginally offset by enhancements in generation efficiency and in carbon intensity.

The increasing contribution of Asia, heavily reliant on coal-fired plants, meant that despite falling carbon intensities across most major emitters in the last two decades, the world average carbon intensity of electricity generation remained relatively flat. However, improvements in renewables penetration and in power plants efficiency registered since 2010 contributed to decreasing the annual growth rates of emissions up to 2018 to half the values of those in the previous decade.

Drivers of the annual changes in emissions from electricity generation



* Electricity emissions = CO_2 intensity of the fossil mix × reciprocal of generation efficiency × fossil share of electricity × total electricity output.

A significant increase in electricity demand, led by China and India, drove the recent increase in global emissions from electricity generation.

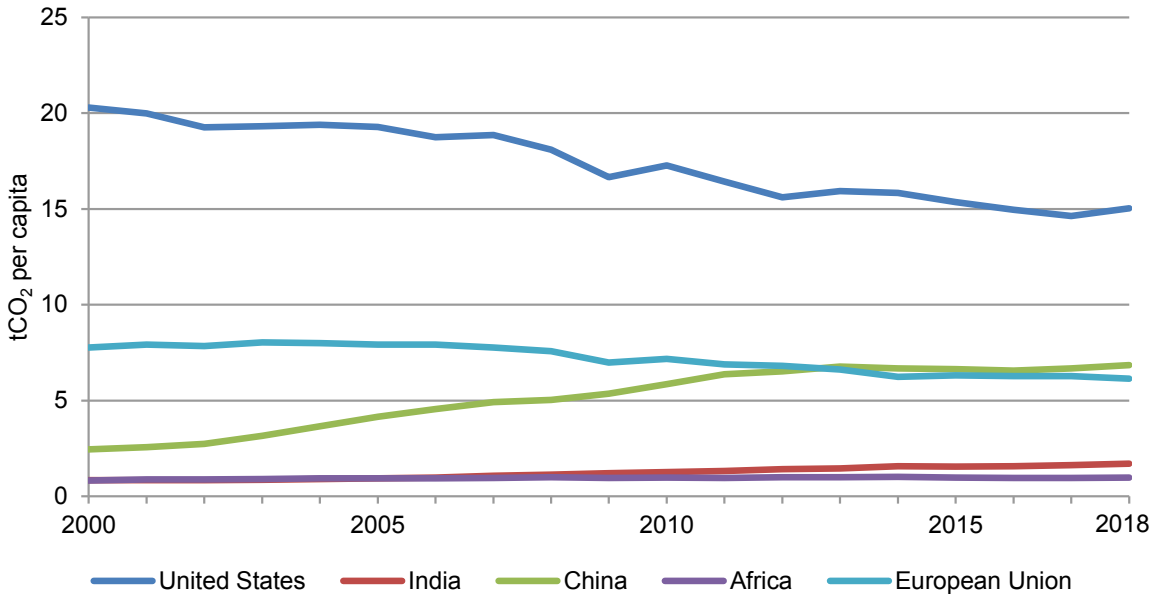
Great regional differences in per capita emissions remain

Great differences exist in per capita emissions across countries and regions. The global average was 4.4 tCO_2 per capita in 2018; however, over one-half of the global population emitted less than 2 tCO_2 per capita.

China's total CO_2 emissions almost tripled since 2000, while population grew by less than 10%. As a result, per capita emissions almost tripled, reaching values similar to those of the European Union in the early 2010s. Between 2000 and 2018, India doubled its emissions; however, its per capita value in 2018 was still around one quarter of that of the European Union. Africa kept the lowest per capita emissions among all regions - less than one tenth of those of the United States.

Should India and Africa reach similar levels of per capita emissions than for example those of the European Union in 2018, an additional 13 $GtCO_2$ (more than one third of current levels) would be released in the atmosphere each year. This figure shows the pivotal role of building more resilient and cleaner energy systems, particularly in emerging economies.

Per capita CO_2 emissions in selected regions

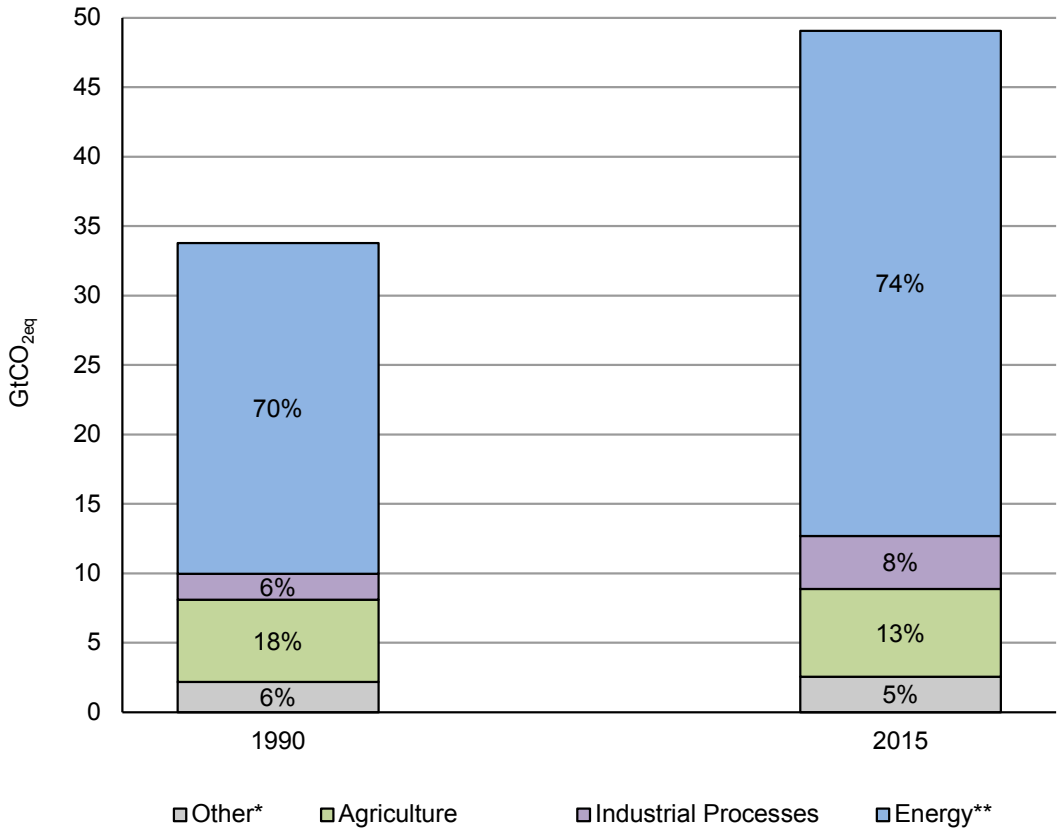


Great differences exist in per capita emissions across countries and regions.

Energy as a key driver for global emissions

Driven by CO_2 emissions from fuel combustion, energy-related greenhouse gas (GHG) emissions increased by 12.6 $GtCO_{2eq}$ since 2010, to comprise 74% of total GHG emissions in 2015. On the other hand, all other sources of GHG emissions combined, including industrial processes, agriculture and waste, increased by 2.7 $GtCO_{2eq}$. These figures signify the importance of controlling the global energy-related emissions to stabilize the anthropogenic sources of GHG emissions.

Global anthropogenic greenhouse gas emissions



* Other includes large-scale biomass burning (excluding CO_2), post burn decay, peat decay, indirect N_2O emissions from non-agricultural emissions of NOx and NH3, waste and solvent use.

** Energy includes IPCC categories fuel combustion and fugitive emissions from fuels.

Source: based on IEA estimates for CO_2 from fuel combustion and EDGAR version 4.3.2FT2016 for CO_2, CH4 and N_2O emissions and 4.2FT2010 for the F-gases; based on 100-year Global Warming Potential (GWP).

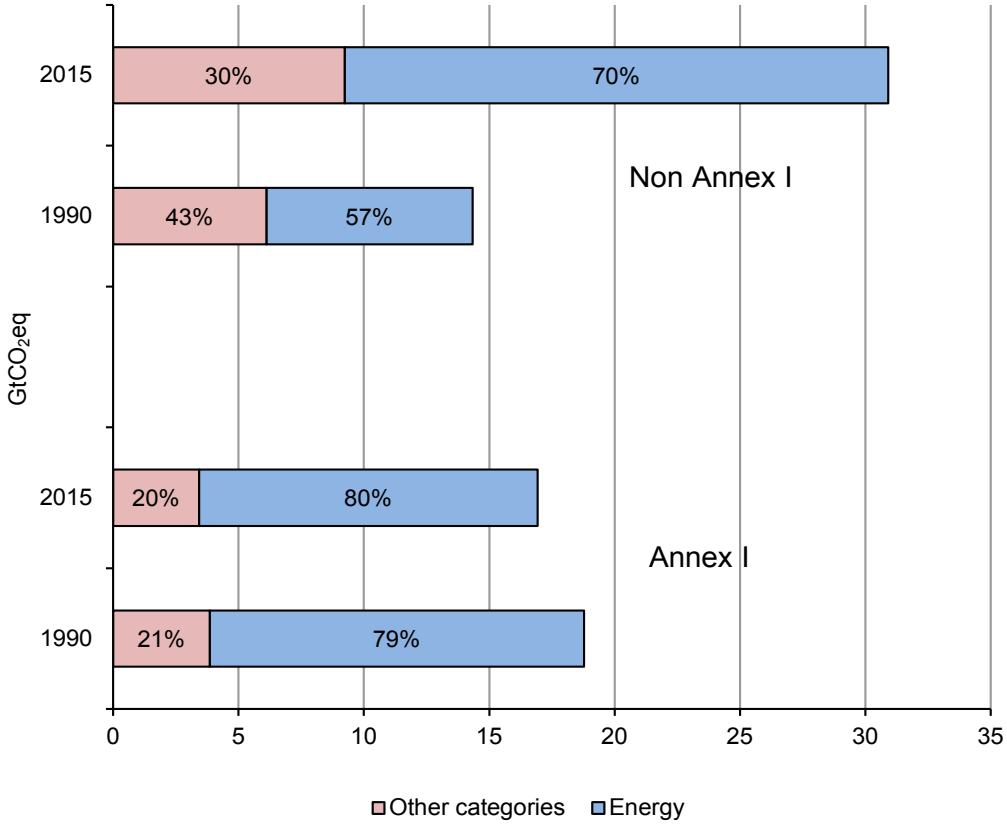
Driven by CO_2 emissions from fuel combustion, energy-related emissions represent the majority of global anthropogenic GHG emissions.

The rapid growth in energy-related emissions, which have more than doubled between 1990 to 2015, was mainly driven by energy consumption among non-Annex I countries[7]. Consequently, the share of energy-related GHG emissions grew from 57% to reach 70% in 2015. On the other hand, Annex I countries reduced their total GHG emissions by around 10% across both energy and other sources.

[7] Annex I and non-Annex I, refer to the UNFCCC regional grouping definition. For more information about the geographical coverage please refer to: http://wds.iea.org/wds/pdf/Worldco2_Documentation.pdf.

As around 90% of energy-related emissions are derived from the oxidation of carbon, CO_2 has been the largest source of energy-related GHG emissions. Globally, CO_2 emissions from the energy sector represented around three quarters of total GHG emissions in 2015, four percentage points more compared to 1990. Thus, they remain at the core of the climate change mitigation debate and represent one of the main issues to address in the broader political agenda.

GHG emissions – energy and other sources



The rapid growth in energy-related emissions, which have more than doubled between 1990 to 2015, was mainly driven by energy consumption among non- Annex I countries.

Overall responsibility:

Roberta Quadrelli

Statistics:

Francesco Mattion

Pouya Taghavi-Moharamli

Faidon Papadimoulis

Contacts:

Energy Data Centre

Emissions statistics

9, rue de la Fédération

75739 Paris Cedex

Tel: +33 (0) 1 40 57 66 33

emissions@iea.org

Media enquiries:

Tel: +33 (0) 1 40 57 65 54

ieapressofice@iea.org

INTERNATIONAL ENERGY AGENCY

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA

IEA association countries:

Brazil
China
India
Indonesia
Morocco
Singapore
South Africa
Thailand

IEA Publications
International Energy Agency
Website: www.iea.org
Contact information: www.iea.org/about/contact

Typeset in France by IEA - July 2020
Cover design: IEA