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CLIMATE

General Commission for Sustainable Development

Key figures on climate
France, Europe and Worldwide

2020 EDITION

I4CE
INSTITUTE FOR CLIMATE ECONOMICS
Une initiative de la Caisse des Dépôts et de l'Agence Française de Développement

summary

Key figures on climate
France, Europe and Worldwide

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Data may not always sum to the total due to rounding

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foreword

In keeping with previous editions, the 2020 edition of *Key figures on climate* has been prepared for the 25th Conference of the Parties on Climate Change (COP25) to be held in Madrid (Spain) from the 2 to 13 December 2019, under the Presidency of Chile.

This publication is unique in offering an exhaustive overview of today's climate issues: the reality of climate change and its impacts, greenhouse gas emissions at global, European and national levels as well as the sectoral distribution of these emissions and their evolution, and an examination of the climate policies enacted.

Several sets of data, presented in graph format in this document, can also be downloaded from the SDES website.

— Sylvain Moreau
HEAD OF THE DATA AND STATISTICAL STUDIES DEPARTMENT (SDES)

part 1

What is climate change?

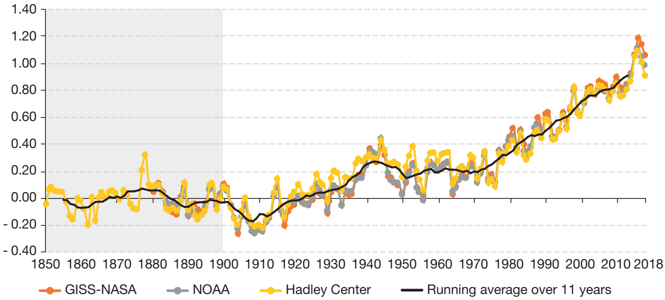
— Many indicators, such as the rising temperatures of the Earth's surface and the rising mean sea level, demonstrate a change in the climate over the last century. A selection of observations of this change and its consequences are presented here, firstly on a global scale and then for France.
The conclusions of the scientific community, synthesised in particular by the IPCC (*see glossary*), now concur as to the role of human activities in this change: the perturbation in the climate balance is primarily due to anthropogenic emissions of greenhouse gases (*see glossary*).
This section also presents projections of the consequences of climate change, based on different assumptions of future GHG emissions trajectories.

Climate change observations

EVOLUTION OF GLOBAL ANNUAL MEAN TEMPERATURE FROM 1850 TO 2018

In °C

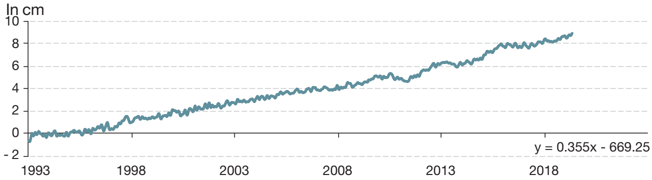
Temperature anomalies (reference 1850-1900)



Note: the shaded area represents the 1850-1900 pre-industrial period.
***Sources:** NASA; NOAA; Hadley Center*

The increase in the global mean temperature of land surface air and sea surface water is very clear. It remained relatively stable relative to the 1850-1900 pre-industrial reference period up until 1940, then the increase followed a slight upward trend until around 1980, when warming accelerated and decade averages have continued to increase since the 1980s. The decade 2001-2010 was 0.21°C warmer than the decade 1991-2000, and was 0.79°C above the 1850-1900 mean. The year 2016, with temperatures that were 1.1°C higher than in the pre-industrial period, ranks first among the hottest years since 1850. Even though 2018 was slightly cooler than 2016 and 2017, the last five years (2014 to 2018) were the five hottest years ever recorded.

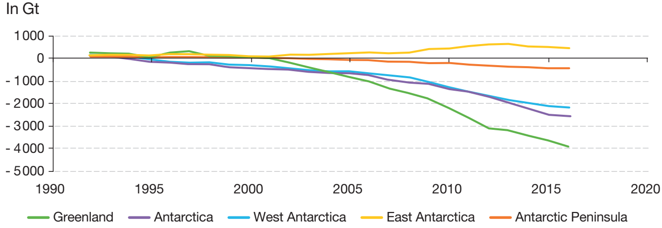
EVOLUTION OF GLOBAL MEAN SEA LEVELS SINCE 1993



Note: date of last measurement: 18 March 2019 (+ 3.36 mm/year, reference GMSL, postglacial rebound correction).
***Sources:** CNES; LEGOS; CLS*

The mean sea level has risen by 1.7 ± 0.3 mm/year over the 1901-2010 period. The rate of sea level rise has accelerated over the last decades to reach 3.4 ± 0.4 mm/year over the 1993-2018 period (satellite measurements).

MASS BALANCE OF POLAR ICE SHEETS FROM 1992 TO 2016

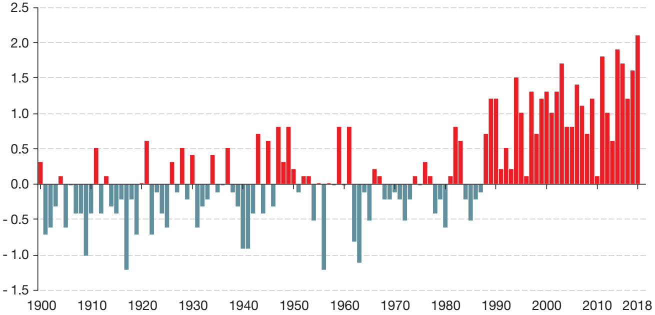


Note: Mass balance of polar ice sheets from 1992 to 2016 (from Bamber et al., 2018; The IMBIE Team, 2018).
***Source:** IPCC, SROCC 2019*

The polar regions are losing ice and this loss has intensified since around 2006. Between 2006 and 2015, the mass of the Greenland ice sheet reduced by 278 ± 11 gigatonnes per year (Gt/year) and the Antarctic ice sheet by 155 ± 19 Gt/year. These losses contribute to sea level rise by 0.77 ± 0.03 and 0.43 ± 0.05 mm/year respectively.

EVOLUTION OF THE MEAN ANNUAL TEMPERATURE IN METROPOLITAN FRANCE SINCE 1900

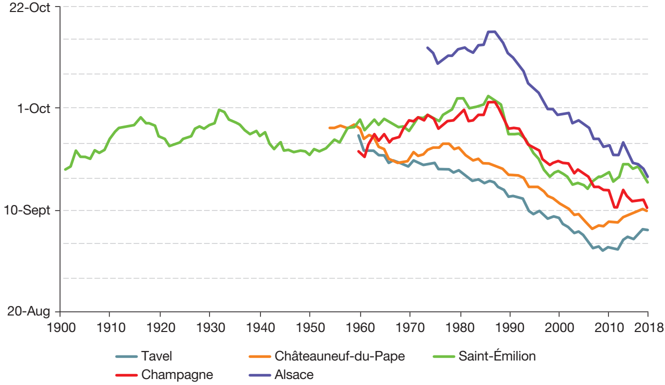
In °C



Note: the evolution of the mean annual temperature is represented in the form of the difference between it and the mean observed over the 1961-1990 period (11.8°C).
Scope: Metropolitan France.
***Source:** Météo-France*

In metropolitan France, as worldwide, the evolution of mean annual temperatures shows net warming since 1900. This warming has taken place at a variable rate, with a particularly marked rise since the 1980s. In 2018, the mean annual temperature of 13.9°C was above average (reference 1961-1990) by 2.1°C, making this year one of the hottest observed in metropolitan France.

EVOLUTION OF THE GRAPE HARVEST DATE (TEN-YEAR AVERAGES) FOR A SAMPLE GROUP OF FRENCH VINEYARDS BETWEEN 1901 AND 2018

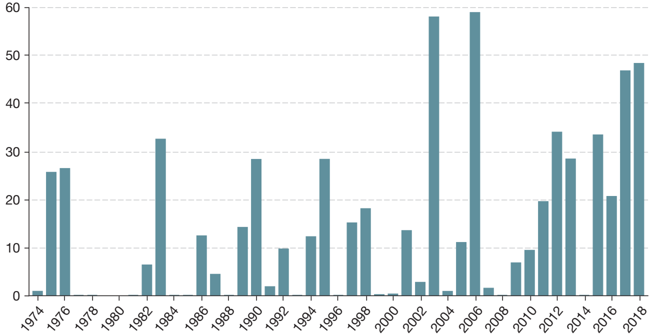


Sources: *Inter-Rhône; ENITA Bordeaux; INRA Colmar; Comité interprofessionnel du vin de Champagne.*
Data processing: Onerc

The advancement of grape harvest dates is mainly correlated with the evolution of the temperature (sum of temperatures above 10°C), in a quasi-linear manner. A trend resulting in earlier harvest dates is thus an effective marker of global warming and its impacts on vegetation.

POPULATION EXPOSED TO AT LEAST ONE SUMMER HEATWAVE IN FRANCE

In millions of inhabitants



Scope: Metropolitan France.
***Sources:** Météo-France; Insee. Data processing: Santé Publique France*

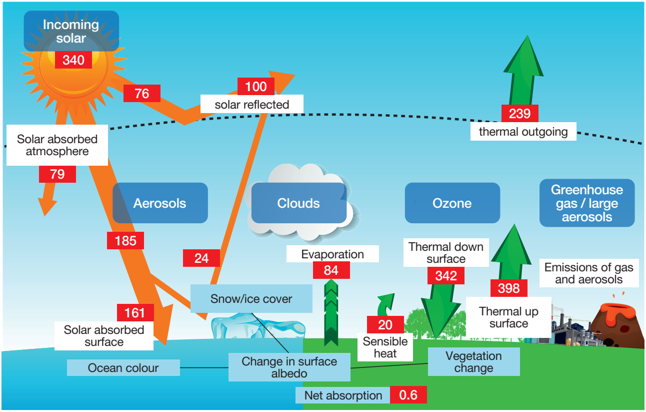
At national level, an increase in the number of heatwaves (*see glossary*) has been observed over the past decades, with, in particular, a doubling between the periods 1974-1983 and 2004-2013. Between the censuses of 1975 and 2013, the population rose by 14.3 million and the percentage of those over 75 years old has progressed from 5% (2.7 million people) to 9% (almost 6 million people). The population exposed to heat and its vulnerability linked to age has thus risen independently of the number of heatwaves.

Thus, both the number of heatwaves and the population exposed have doubled between 1974-1983 and 2004-2013 for the whole of France.

Causes of climate change

THE NATURAL GREENHOUSE EFFECT AND ITS PERTURBATIONS BY HUMAN ACTIVITIES

Current energy fluxes in W/m²



Note: the Earth constantly receives energy from the sun. The share of this energy that is not reflected by the atmosphere, notably by clouds, or the earth's surface (oceans and continents) is absorbed by the earth's surface, which heats up in the process. In return, the surfaces and the atmosphere emit infrared radiation, which is more intense when the surfaces are hot. Part of this radiation is absorbed by some gases and by the clouds then re-emitted back to the surface, which contributes to heating it. This phenomenon is known as the greenhouse effect.
Sources: *Météo-France; IPCC, Working Group I, 2013*

The growth in the atmospheric concentration of GHG due to anthropogenic emissions (*see glossary*) increases the radiation of energy towards the ground, leading to an imbalance in the Earth's radiative balance and causing a rise in the Earth's surface temperature. The change, relative to a reference year, in radiation due to a climatic factor is known as radiative forcing. A positive radiative forcing value indicates a contribution to global warming. In 2013, the total radiative forcing of anthropogenic origin was + 2.55 (± 1.1) W/m² relative to 1750.

GREENHOUSE GAS (GHG)

Excluding water vapour, GHGs make up less than 0.1% of the atmospheric volume. Water vapour, which fluctuates between 0.4% and 4%, is the main greenhouse gas. Human activities have little direct impact on the fluctuations in its concentration, but they have a strong impact on the concentrations of other GHGs.

	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NF_3
2017 atmospheric concentration (in 2005 in brackets)	406 ppm (379 ppm)	1 848 ppb (1 774 ppb)	330 ppb (319 ppb)	> 198 ppt (> 49 ppt)	> 88.9 ppt (> 4.1 ppt)	> 9.2 ppt (5.6 ppt)	1.6 ppt (> 0 ppt)
Global warming potential (total over 100 years)	1	28-30	265	< 1 to 12 400 depending on the gases	< 1 to 11 100 depending on the gases	23 500	16 100
Source of anthropogenic emissions	Fossil fuel combustion, industrial processes and tropical deforestation	Waste, agriculture, livestock and industrial processes	Agriculture, industrial processes, fertiliser use	Sprays, refrigeration, industrial processes			Manufacture of electronic components
Change in radiative forcing in 2017 since 1750 through anthropogenic emissions (W/m^2) (in 2005 in brackets)	+ 2.01 (+ 1.66)	+ 0.51 (+ 0.48)	+ 0.20 (+ 0.16)	+ 0.12 (+ 0.09)			

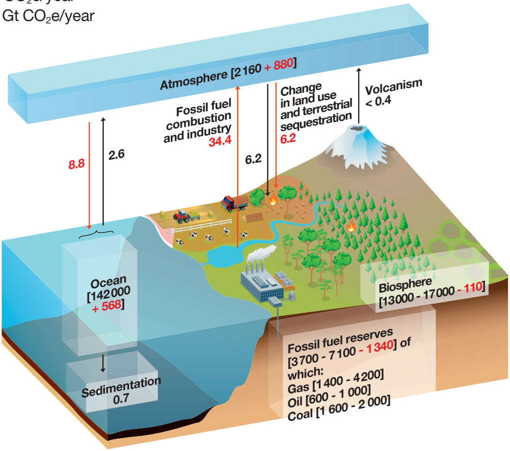
ppm: parts per million; ppb: parts per billion; ppt: parts per trillion.
***Sources:** IPCC, Working Group I, 2013; NOAA, 2019; Agage, 2019*

The global warming potential (GWP - *see glossary*) is the ratio of the energy reflected back to earth over 100 years by 1kg of a gas relative to that of 1kg of CO_2. It depends on the radiative properties and lifetime of the gases in the atmosphere. For example, 1kg of methane (CH_4) will warm the atmosphere as much as 28 to 30 kg of CO_2 over the century following their emission.

Although CO_2 is the gas with the smallest global warming potential, it is the one that has made the greatest contribution to global warming since 1750 because of the large quantities emitted.

GHG RESERVOIRS AND FLUXES: EXAMPLE OF CO_2 DURING YEARS 2008-2017

Flux in Gt CO_2e/year
Stocks in Gt CO_2e/year



Note: this graph presents: (i) in square brackets, the size of reservoirs in pre-industrial times in billions of tonnes of CO_2 in black and their variation over the 1750-2011 period in red; (ii) in the form of arrows, the carbon fluxes between the reservoirs in billions of tonnes of CO_2 equivalent per year (see glossary). The pre-industrial fluxes are in black. Those linked to anthropogenic activities between 2008 and 2017 are in red.
***Sources:** from IPCC, Working Group I, 2013 and The Global Carbon Project, Global Carbon Budget, 2018*

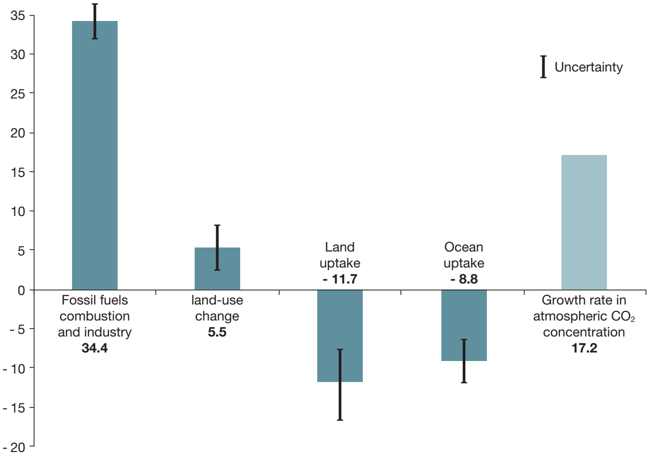
Four large reservoirs can store carbon in different forms:
- atmosphere: gaseous CO_2;
- biosphere: organic matter from living organisms including forests;
- ocean: limestone, dissolved CO_2; marine fauna and flora (plankton);
- subsoil: rocks, sediments, fossil fuels.

Carbon fluxes between these reservoirs constitute the natural carbon cycle, that has been disrupted by anthropogenic emissions of CO_2 that modify the fluxes exchanged or create new ones such as the combustion of the organic fossil carbon reserves.

IMBALANCE BETWEEN EMISSIONS AND CO_2 STORAGE CAPACITY

Net annual fluxes of CO_2 to the atmosphere by source and reservoir over the 2008-2017 period

In Gt CO_2/year



Note: the uncertainty in the atmospheric CO2 growth rate is very small (± 0.07 GtCO2 /yr) and is neglected for the figure.
***Source:** The Global Carbon Project, Global Carbon Budget, 2018*

Over the last ten years, of the 39.9 Gt of CO_2 released on average per year by human activities, the atmosphere absorbed 17.2, land uptake (biosphere and soils) 11.7 and ocean uptake 8.8. The atmosphere is the reservoir that is most affected by anthropogenic activities: it absorbed almost 45% of the carbon emitted over the last fifty years.

GLOBAL ROLE OF FOREST DYNAMICS

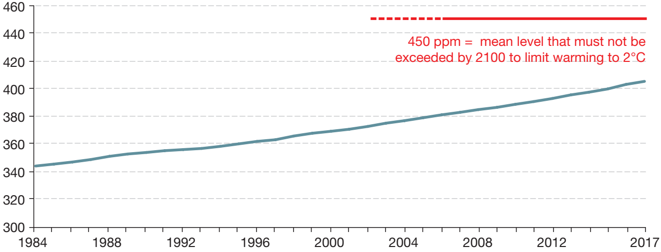
On a global scale, forests are net carbon sinks. The gross sink attributed to the biosphere - meaning mainly forests, which constitute 80% of above ground biomass and 50% of terrestrial photosynthesis (Dixon *et al.*, 1994; Beer *et al.*, 2010) - offsets 19% of annual anthropogenic GHG emissions, or approximately 10 Gt CO_2e (IPCC 2013, Canadell *et al.*, 2007).

Deforestation results in GHG emissions through the combustion and decomposition of organic matter. These gross emissions represent approximately 12% of annual anthropogenic GHG sources in the world (IPCC 2014).

In France, the net sequestration of carbon in the biomass of forests is estimated at approximately 53 Mt CO_2e for the year 2017, or approximately 15% of national CO_2 emissions, excluding land use, land-use change and forestry (LULUCF - *see glossary*) - (Citepa, 2019).

ATMOSPHERIC CO_2 CONCENTRATION

In parts per million (ppm)



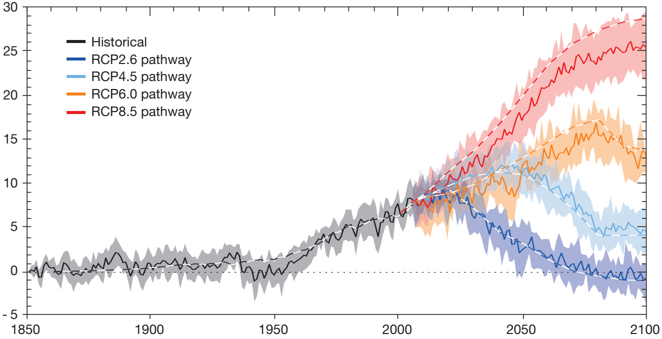
Source: *CMDGS under the aegis of WMO, 2018*

Since the development of industrial activities, land and ocean uptake has absorbed half of the anthropogenic emissions. The remaining emissions persist in the atmosphere, resulting in an increase in GHG concentrations.

Climate scenarios and projections

PROJECTIONS OF FOSSIL FUEL EMISSIONS ACCORDING TO FOUR GHG EVOLUTION PROFILES (THE IPCC's RCPs)

In GtC



Source: *IPCC, Working Group I, 2013*

The IPCC published its first report (First Assessment Report) in 1990. Its fifth report (AR5) was released in its entirety at the end of 2014. In each publication, the IPCC produces climatic projections based on GHG concentration assumptions.

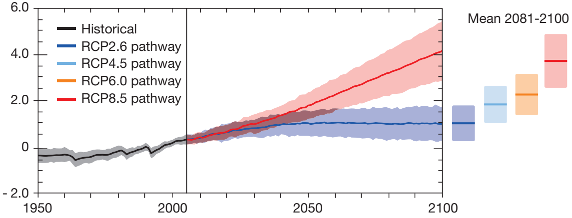
For the AR5, four GHG concentration profiles (RCP, for Representative Concentration Pathways) were defined: RCP2.6; RCP4.5; RCP6.0; RCP8.5, from the most optimistic to the most pessimistic, named after the radiative forcing value induced by 2100 (for RCP8.5, the radiative forcing amounts to 8.5 W/m²).

The scientific community has recently developed a fifth more optimistic pathway: RCP1.9. It was defined in the context of a special IPCC report published in 2018 on the consequences of a global warming of 1.5°C, and as part of the process of developing a sixth assessment report (AR6), scheduled for 2021 and 2022.

EVOLUTION OF TEMPERATURES AND SEA LEVELS IN THE DIFFERENT IPCC SCENARIOS

Projection of the variation in mean global temperature according to different scenarios

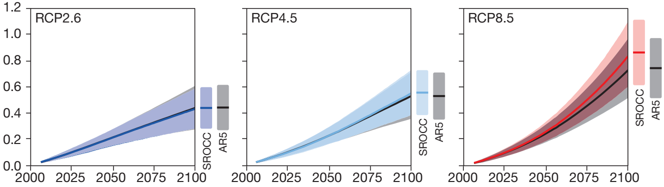
In °C



Note: temperature variation relative to the period 1986-2005.
***Source:** IPCC, Working Group I, 2013*

Projection of the global mean sea level rise relative to the 1986-2005 period

In metres



***Source:** IPCC, SROCC, 2019*

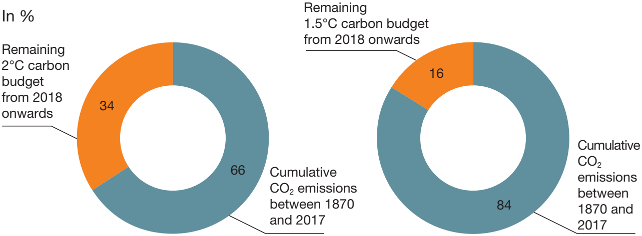
The main factors of sea level rise (*see p. 7*) are the thermal expansion of the oceans and the melting of terrestrial ice reservoirs (glaciers, polar caps, etc.). By 2100, the mean sea and ocean levels relative to 1986-2005 are likely to rise by an average of 43cm (likely range of 29 - 59 cm) in the RCP2.6 scenario, and by 84 cm (likely range 61 - 110cm) in the RCP8.5 scenario. The rise in sea levels will probably result in large population migrations, since more than one billion people live on low costal areas (less than 10 metres above sea level).

CARBON BUDGETS AND RISING TEMPERATURES

A carbon budget expresses the maximum level of CO_2 emissions for which there is a reasonable probability of avoiding a mean temperature rise above a certain level. Only the most ambitious RCPs - RCP2.6 and 1.9 - provide a probability above 50% of limiting the temperature rise to 2°C and 1.5°C respectively by 2100. The business-as-usual scenario, RCP8.5, has a probability of over 50% of resulting in a rise exceeding 4°C.

The remaining carbon budgets after 2018 allowing the mean temperature rise to be limited to 2°C and 1.5°C

In %



Note: the amounts are expressed as a percentage of the total carbon budget since the pre-industrial era, obtained by adding the cumulative emissions between 1870 and 2017 to the remaining carbon budgets from 2018 onwards. The carbon budgets are given with a 66% probability of meeting the associated climate target. The degree of uncertainty concerning the carbon budgets is high, ranging from - 670 to + 920 Gt CO_2. This is mainly due to uncertainties concerning the evolution and impact of greenhouse gases other than CO_2, the responses of the climate system to the increase in cumulative emissions and in radiative forcing and the responses of the Earth's system to the rise in temperatures.
Sources: *I4CE, from the Global Carbon Project, 2018; IPCC, Special report 1.5°C, 2018*

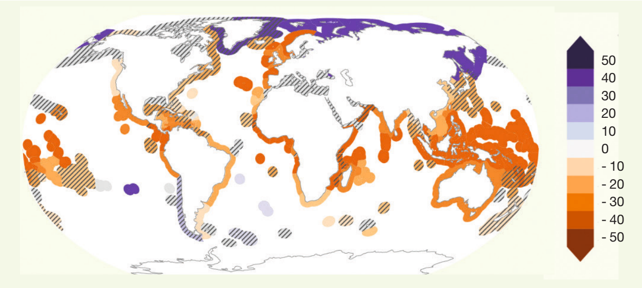
To achieve a probability over 66% of limiting the mean temperature rise to 2°C relative to the pre-industrial era, the remaining carbon budget from 2018 onwards is 1170 Gt CO_2 and only 420 Gt CO_2 to limit the rise to 1.5°C.

If CO_2 emissions continue at the same rate, the remaining carbon budget, to achieve a 66% probability of limiting the temperature rise to 2°C, will be spent before 2050, and within the next ten years to limit the rise to 1.5°C.

CONSEQUENCES ON A GLOBAL SCALE

Change to the maximum fisheries catch potential (scenario RCP8.5) by 2081-2100, in comparison to 1986-2015

In %

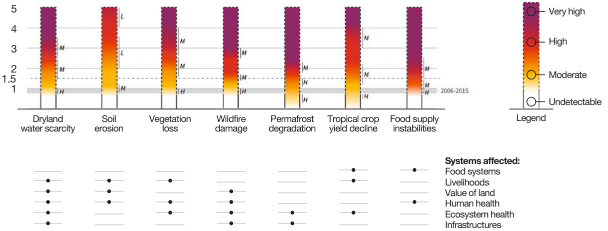


Source: *IPCC, SROCC, 2019*

Catches and their composition in many regions are already subject to the effects of warming and the evolution of primary production on the growth, reproduction and survival of fish stocks.

Impacts of the temperature rise on natural and human terrestrial systems

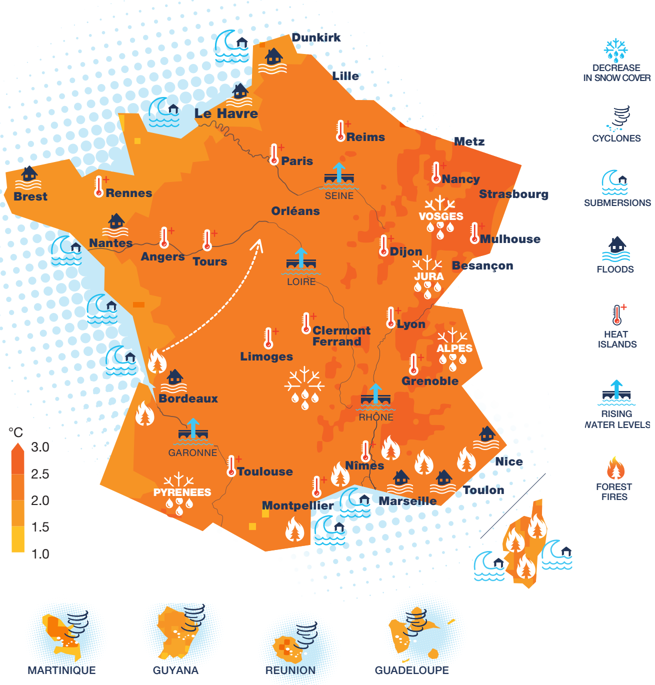
Increase in global mean temperatures relative to pre-industrial levels
In °C



Source: *IPCC, SRCCL, 2019*

CONSEQUENCES FOR FRANCE

Map of impacts observed or to come by 2050



Note: the map background is the product of simulations by "Drias, les futurs du climat" for a RCP 8.5 scenario. The temperatures correspond to the difference between the simulated temperatures by 2050 and the reference period 1976-2005. The data for Mayotte were not available at the date of publication.
Source: *Drias, les futurs du climat, 2019*

part 2

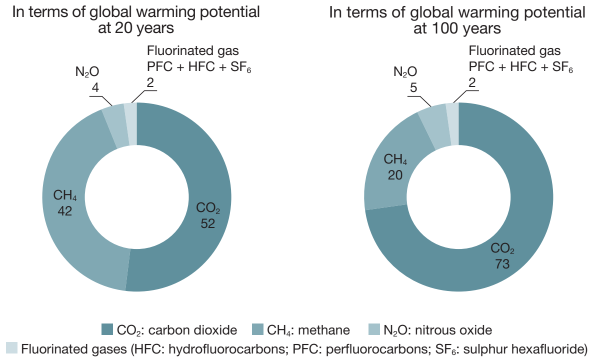
How much greenhouse gas is emitted in the world?

— In 2017, GHG emissions linked to human activities (with LULUCF) totalled the equivalent of 53.5 billions of tonnes of CO_2 ($GtCO_2e$). CO_2 alone made up three quarters of these emissions, with one quarter for the other GHGs.
In 2017, these global CO_2 emissions rose by 1.2%. They increased by over 60% between 1990 and 2017, with contrasting trends in different countries. 29% of these emissions came from China, 14% from the United States and 10% from the European Union.
As a global mean, emissions expressed in terms of population equal five tonnes of CO_2 per year and per capita, which is an additional 15% relative to 1990.

Overview of global GHG emissions

DISTRIBUTION OF GLOBAL GHG EMISSIONS (WITH LULUCF) BY GAS IN 2010

In %



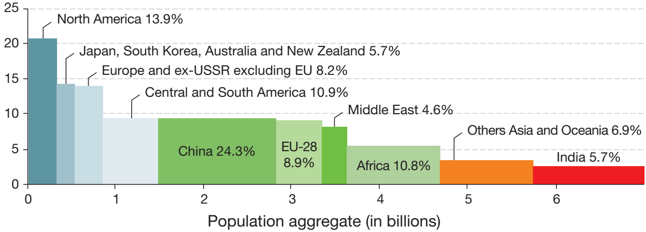
***Source:** IPCC, Working Group III, 2014*

The global warming potential (GWP) of a gas depends on the period over which it is calculated (*see p. 12*). Thus, the GWP of methane is between 28 and 30 when calculated over 100 years, and 84 when calculated over 20 years. The GHG inventories are usually expressed with a GWP at 100 years. This metric gives more weight to persistent gases than to those with a short lifetime, whereas the GWP at 20 years demonstrates the importance of methane emissions on this timescale.

Global greenhouse gas emissions have doubled since 1970 and have risen by over 40% since 1990 to reach 53.5 Gt CO_2e in 2017 (UN Environment – Emissions Gap Reports; data includes GHG emissions linked to land-use change).

REGIONAL GHG EMISSIONS PER CAPITA IN 2012

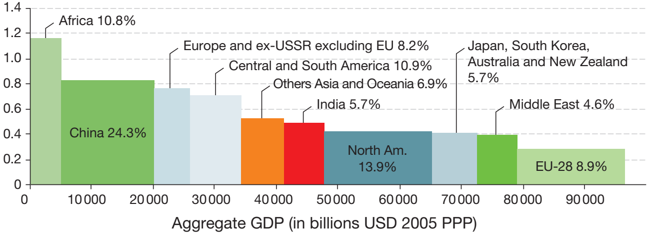
In t CO_2e/capita



In 2012, mean emissions per capita in North America were more than eight times higher than in India. However, these values do not reflect the disparities that may exist within a region (for example, in the Middle East, the emissions per head were over 50 t CO_2e/cap in Qatar and less than 2 t CO_2e/cap in Yemen), or even within the same country.

REGIONAL GHG EMISSIONS PER UNIT OF GDP IN 2012

In kg CO_2e/US $ 2005 PPP



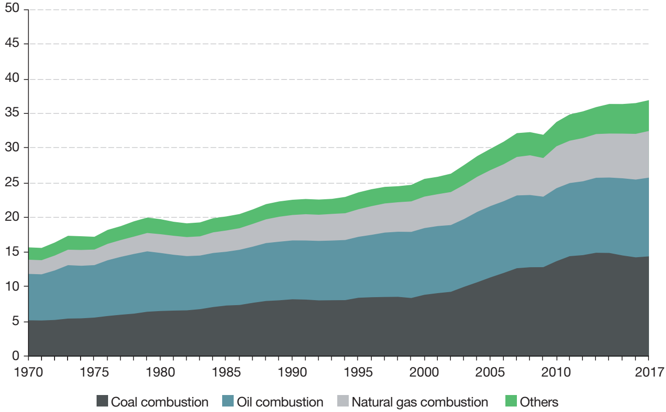
Note: the graphs below include emissions from the LULUCF sector. The percentages indicate the share of emissions from one region relative to the global total.
***Sources for graphs:** I4CE from JRC EDGAR and World Bank, 2015*

In 2012, GDP carbon intensity was four times higher in Africa than in the EU, meaning four times as much GHG were emitted there per unit of wealth produced.

Global CO_2 emissions without LULUCF

GLOBAL CO_2 EMISSIONS BY FUEL

In Gt CO_2

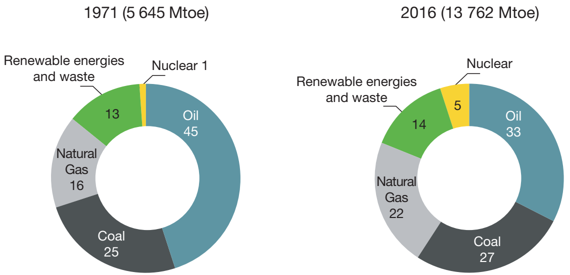


Note: the emissions recorded here are linked to fossil fuel combustion and industrial processes. This corresponds to total CO_2 emissions without LULUCF (see glossary). They account for almost 85% of global CO_2 emissions, which is approximately 65% of total GHG emissions.
***Sources:** SDES, from EDGAR, 2018; IEA, 2019*

In 2017, CO_2 emissions without LULUCF reached 37.1 billion tonnes, which is 2.4 times the level in 1970. Over 39% of these emissions were due to coal combustion, compared to 31% for oil and 18% for natural gas. The remaining 12% was from industrial processes such as cement manufacture (excluding energy combustion).

GLOBAL PRIMARY ENERGY MIX

In %



Source: *IEA, 2019*

The distribution of emissions should be compared to the global primary energy mix, which was still dominated by fossil fuels in 2016 (oil, coal and natural gas: 81% of the total). Oil is still the largest energy source in the world, despite a decrease of 13 points between 1971 and 2016, mainly offset by natural gas (+ 6 points), nuclear energy (+ 4 points) and coal (+ 1 point). Although coal is only the second largest source of energy in the global mix, it ranks first in terms of CO_2 emissions, as its emission factor is significantly higher than that of natural gas and oil (*see p. 78*). Coal consumption, which increased sharply during the early-2000s, has levelled off, or even decreased in the last few years. Although the share of renewable energies has generally been stable in the last 45 years, it has grown slightly in the last ten years to reach 14% of the mix in 2016.

GEOGRAPHICAL DISTRIBUTION OF GLOBAL CO_2 EMISSIONS (WITHOUT LULUCF)

In Mt CO_2

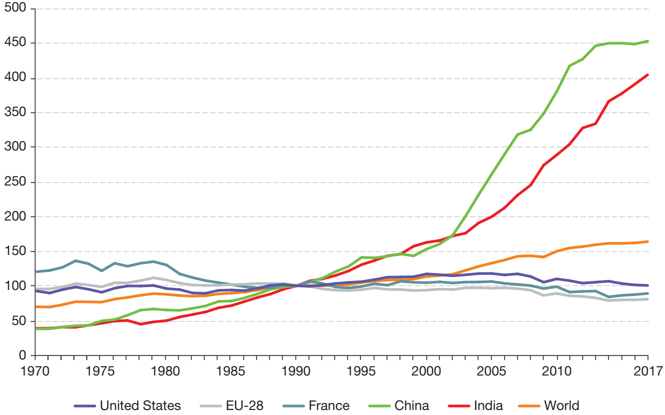
	1990	2016	2017	2017 share (%)	Evolution 2016-2017 (%)	Evolution 1990-2017 (%)
North America	**5 832**	**6 270**	**6 232**	**16.8**	**- 0.6**	**+ 6.9**
of which Canada	456	601	617	1.7	+ 2.7	+ 35.4
United States	5 086	5 146	5 107	13.8	- 0.8	+ 0.4
Central and South America	**682**	**1 354**	**1 332**	**3.6**	**- 1.6**	**+ 95.4**
of which Brazil	229	492	493	1.3	+ 0.2	+ 115.6
Europe and ex-USSR	**8 430**	**6 219**	**6 273**	**16.9**	**+ 0.9**	**- 25.6**
of which Russia	2 379	1 746	1 765	4.8	+ 1.1	- 25.8
EU - 28	4 411	3 518	3 556	9.6	+ 1.1	- 19.4
Germany	*1 018*	*799*	*797*	*2.1*	*- 0.3*	*- 21.8*
Spain	*230*	*264*	*282*	*0.8*	*+ 7.0*	*+ 22.8*
France	***390***	***340***	***347***	***0.9***	***+ 1.9***	***- 11.0***
Italy	*431*	*356*	*361*	*1.0*	*+ 1.3*	*- 16.2*
United Kingdom	*589*	*392*	*379*	*1.0*	*- 3.1*	*- 35.6*
Poland	*371*	*315*	*319*	*0.9*	*+ 1.2*	*- 14.0*
Sub-Saharan Africa	**466**	**809**	**817**	**2.2**	**+ 1.0**	**+ 75.3**
Middle East and North Africa	**1 047**	**3 054**	**3 179**	**8.6**	**+ 4.1**	**+ 203.6**
of which Saudi Arabia	166	629	639	1.7	+ 1.5	+ 284.4
Asia	**5 279**	**17 288**	**17 570**	**47.4**	**+ 1.6**	**+ 232.9**
of which China	2 397	10 777	10 877	29.3	+ 0.9	+ 353.8
South Korea	270	651	673	1.8	+ 3.5	+ 149.3
India	606	2 371	2 455	6.6	+ 3.5	+ 305.1
Japan	1 149	1 320	1 321	3.6	+ 0.1	+ 14.9
Oceania	**307**	**450**	**452**	**1.2**	**+ 0.4**	**+ 47.3**
Annex I countries	**15 010**	**13 621**	**13 624**	**36.7**	**+ 0.0**	**- 9.2**
Non-Annex I countries	**7 033**	**21 825**	**22 233**	**60.0**	**+ 1.9**	**+ 216.1**
International aviation bunkers	**259**	**538**	**543**	**1.5**	**+ 1.1**	**+ 109.8**
International marine bunkers	**372**	**668**	**677**	**1.8**	**+ 1.3**	**+ 82.2**
World	**22 674**	**36 652**	**37 077**	**100.0**	**+ 1.2**	**+ 63.5**

Note: international bunkers cover emissions from international marine and aviation transport that are not included in the national totals (see glossary).
Source: *EDGAR, 2018*

Global CO_2 emissions rose by 1.2% in 2017, at a higher rate than the preceding year (+ 0.3%). These short term trends differ across continents: the increases in Asia (+ 1.6%) and in Europe and Russia (+ 0.9%) are thus partially offset by the reduction recorded in North America (- 0.6%).

EVOLUTION OF GLOBAL CO_2 EMISSIONS BETWEEN 1970 AND 2017

Index (1990 = 100)



Source: *EDGAR, 2018*

In 2017, China was the highest CO_2 emitting country in the world (29.3%), ahead of the United States (13.8%), the European Union (9.6%) and India (6.6%). Between 1990 and 2017, emissions increased by 63.5%. Over this period, the largest contributors to this rise were China (+ 350%, or approximately 8.5 Gt CO_2), India (+ 310%, or 1.8 Gt CO_2) and the Middle East and North Africa region (+ 200%, or 2.1 Gt CO_2). Over the same period, the United States' emissions were near stable (+ 0.4%), those in the European Union decreased (- 19.4%), as did those in France (- 11.0%).

GLOBAL CO_2 EMISSIONS PER CAPITA (WITHOUT LULUCF)

In t CO_2/capita

	1990	2016	2017	Evolution 2016-2017 (%)	Evolution 1990-2017 (%)
North America	**16.1**	**12.9**	**12.7**	**- 1.5**	**- 21.1**
of which Canada	16.4	16.6	16.8	+ 1.4	+ 2.5
United States	20.4	15.9	15.7	- 1.5	- 23.0
Central and South America	**1.9**	**2.7**	**2.6**	**- 2.6**	**+ 36.5**
of which Brazil	1.5	2.4	2.4	- 0.6	+ 53.8
Europe and ex-USSR	**10.8**	**7.6**	**7.6**	**+ 0.6**	**- 29.6**
of which Russia	16.0	12.1	12.2	+ 1.0	- 23.9
EU - 28	9.2	6.9	6.9	+ 0.8	- 24.8
Germany	*12.8*	*9.7*	*9.6*	*- 0.7*	*- 24.8*
Spain	*5.9*	*5.7*	*6.1*	*+ 6.8*	*+ 2.5*
France	***6.7***	***5.1***	***5.2***	***+ 1.5***	***- 22.5***
Italy	*7.6*	*5.9*	*6.0*	*+ 1.5*	*- 21.5*
United Kingdom	*10.3*	*6.0*	*5.7*	*- 3.8*	*- 44.2*
Poland	*9.7*	*8.3*	*8.4*	*+ 1.2*	*- 13.7*
Sub-Saharan Africa	**0.9**	**0.8**	**0.8**	**- 1.7**	**- 14.9**
Middle East and North Africa	**3.4**	**5.9**	**6.1**	**+ 2.3**	**+ 79.2**
of which Saudi Arabia	10.2	19.5	19.4	- 0.6	+ 90.5
Asia	**1.8**	**4.3**	**4.3**	**+ 0.7**	**+ 139.7**
of which China	2.1	7.8	7.8	+ 0.4	+ 271.6
South Korea	6.3	12.7	13.1	+ 3.0	+ 107.7
India	0.7	1.8	1.8	+ 2.4	+ 163.2
Japan	9.3	10.4	10.4	+ 0.2	+ 12.0
Oceania	**11.8**	**11.6**	**11.5**	**- 1.3**	**- 2.9**
Annex I countries	**12.5**	**10.0**	**10.0**	**- 0.4**	**- 20.2**
Non-Annex I countries	**1.7**	**3.6**	**3.6**	**+ 0.5**	**+ 109.6**
World	**4.3**	**4.9**	**4.9**	**+ 0.0**	**+ 14.8**

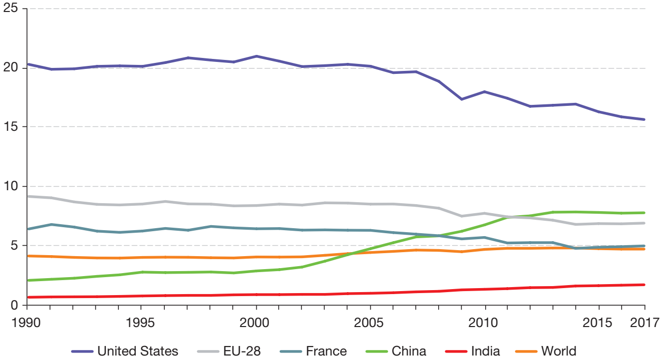
Note: this is the CO_2 emissions of a territory divided by its population. The average emissions by one person due to his/her consumption are calculated using a different approach (footprint, see p. 38).
Sources: *SDES, from EDGAR, 2018; World Bank, 2019*

Global CO_2 emissions in 2017 were, on average, 4.9 t CO_2/capita, at a comparable level to that of 2016 (+ 0.0%). The growth of global emissions (+1.2% between 2016 and 2017) is thus identical to demographic growth (+ 1.2%).

The emissions per capita data demonstrates significant geographical disparities, with distinctly low levels in Latin America (2.6), in India (1.8) and in sub-Saharan Africa (0.8). In contrast, French emissions (5.2) were slightly higher than the global average (4.9). The EU's mean emissions (6.9) were higher, close to those of China (7.8). The United States (15.7), Russia (12.2), Japan (10.4) and South Korea (13.1) had some of the highest levels.

EVOLUTION OF GLOBAL CO_2 EMISSIONS PER CAPITA BETWEEN 1990 AND 2017

In t CO_2/capita



Sources: *SDES, from EDGAR, 2018; World Bank, 2019*

Since 1990, global emissions per capita have risen by 15%. The situation differs between the Annex I countries (*see glossary*), where high levels of emissions (10.0 t CO_2/capita) have been decreasing in the last 27 years (- 20%), and the non-Annex I countries, where emission levels are almost three times lower (3.6 t CO_2/capita) but have more than doubled in 27 years (+ 110%).

In detail, emissions per capita in Asia increased by 140% between 1990 and 2017 (270% in China, 160% in India and 110% in South Korea). Over the same period, emissions per capita in Europe decreased by 30% (of which - 22% in France and - 44% in the United Kingdom), and by over 21% in North America (of which - 23% in the United States). In an intermediary position, in Japan and sub-Saharan Africa, emissions per capita only slightly changed, remaining high for the former (around 10 t CO_2/capita), and low for the latter (under 1 t CO_2/capita).

GLOBAL CO_2 EMISSIONS IN RELATION TO GDP (WITHOUT LULUCF)

In t CO_2/millions $2011 PPP

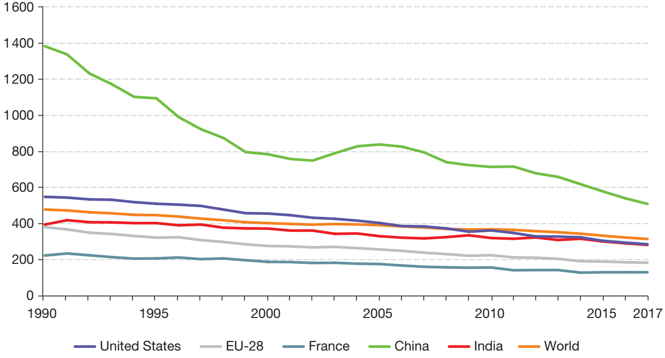
	1990	2016	2017	Evolution 2016-2017 (%)	Evolution 1990-2017 (%)
North America	**518**	**298**	**290**	**- 2.8**	**- 44.1**
of which Canada	524	383	382	- 0.4	- 27.1
United States	550	298	289	- 3.0	- 47.4
Central and South America	**213**	**213**	**206**	**- 3.3**	**- 3.5**
of which Brazil	148	168	167	- 0.8	+ 12.8
Europe and ex-USSR	**521**	**252**	**249**	**- 1.6**	**- 52.3**
of which Russia	777	487	485	- 0.4	- 37.6
EU - 28	383	189	187	- 1.5	- 51.3
Germany	*410*	*218*	*213*	*- 2.4*	*- 48.0*
Spain	*249*	*170*	*177*	*+ 3.8*	*- 29.0*
France	***226***	***134***	***134***	***+ 0.0***	***- 40.7***
Italy	*244*	*170*	*169*	*- 0.2*	*- 30.6*
United Kingdom	*384*	*152*	*145*	*- 4.8*	*- 62.3*
Poland	*948*	*318*	*307*	*- 3.4*	*- 67.6*
Sub-Saharan Africa	**356**	**228**	**225**	**- 1.3**	**- 36.8**
Middle East and North Africa	**312**	**317**	**321**	**+ 1.2**	**+ 3.0**
of which Saudi Arabia	240	387	396	+ 2.4	+ 65.1
Asia	**517**	**394**	**379**	**- 3.9**	**- 26.7**
of which China	1 383	543	512	- 5.6	- 63.0
South Korea	542	363	364	+ 0.4	- 32.8
India	397	294	285	- 3.0	- 28.2
Japan	304	271	267	- 1.6	- 12.2
Oceania	**529**	**352**	**346**	**- 1.6**	**- 34.6**
Annex I countries	**482**	**271**	**265**	**- 2.2**	**- 45.1**
Non-Annex I countries	**435**	**352**	**341**	**- 2.9**	**- 21.6**
World	**480**	**326**	**318**	**- 2.5**	**- 33.7**

Note: GDP in volume, converted into US dollars using purchasing power parity (PPP), for the year 2011 (see glossary).
***Sources:** SDES, from EDGAR, 2018; World Bank 2019*

Although less dispersed than emission levels per capita, the ratios of emissions to GDP are highly variable across the different countries, around a global mean of 318 t CO_2/million $. Some of the highest values occurred in China (512 t CO_2/million $), Russia (485) and Canada (382). Conversely, the levels are much lower in the European Union (187) and particularly in France (134).

EVOLUTION OF GLOBAL CO_2 EMISSIONS IN RELATION TO GDP BETWEEN 1990 AND 2017

In t CO_2/millions of $ 2011 PPP



Sources: *SDES, from EDGAR, 2018; World Bank 2019*

The amount of global CO_2 emitted per unit of GDP decreased by 2.5% between 2016 and 2017, which is equal to the mean rate of decrease observed over the last five years. This represents a slower growth in emissions than that of global GDP (+ 3.7% in 2017).

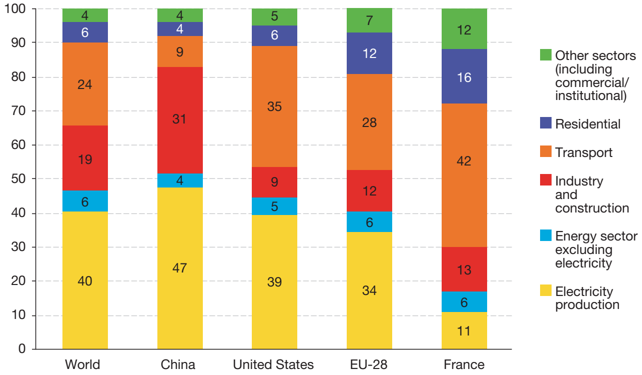
Since 1990, the amount of global CO_2 emitted per unit of GDP has decreased by a third, whereas GDP has in fact multiplied 2.5 times.

Apart from a few rare exceptions – Saudi Arabia (+ 65%), Brazil (+ 13%) – the majority of global economies are concerned by this decrease in the CO_2 intensity of wealth production. The reduction is particularly strong in China (- 63%), where historical levels have been particularly high. This intensity has also been reduced by one half in the European Union (- 51%) and the United States (- 47%).

Sectorial distribution of global CO_2 emissions

SOURCE OF CO_2 EMISSIONS FROM FUEL COMBUSTION IN 2016

In %



Source: *IEA, 2018*

In 2016, electricity production was the highest CO_2 emitting sector in the world, with 40% of total emissions due to fuel combustion. The two other large sectors in terms of emission factors are transport (24%) and industry (19% including construction). In China, industry and the energy sector (electricity and non-electricity) are responsible for a larger share in CO_2 emissions compared to the global average. Transport plays a greater role in the United States and the European Union. In the EU, emissions from the residential sector also constitute a greater share than in the rest of the world.

part 3

How much greenhouse gas is emitted in Europe and in France?

—In 2017, 4.1 Gt CO_2e of GHGs were emitted in the EU, a reduction of 25% relative to 1990 levels. Net emissions (**with LULUCF**) in France amounted to 433 Mt CO_2e, a reduction of 18% since 1990. In the EU, the highest emitting sector is the energy industry, whereas in France, the transport sector is the main contributor to French emissions. The footprint approach, which complements the territorial approach, provides an estimation of GHG emissions arising from consumption by the French population. In 2018, these were three quarters higher than national territorial emissions.

Overview of greenhouse gases in Europe

EU-28 GHG EMISSIONS IN 2017

In Mt CO_2e

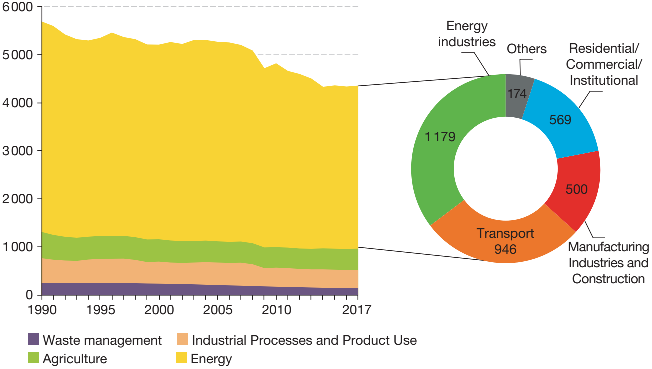
Sector	Years	CO_2	CH_4	N_2O	Fluorinated gas	Total
Energy	1990	4 123.6	195.3	29.8	0.0	4 348.7
	2017	3 253.7	85.0	29.2	0.0	3 367.8
Industrial Processes and Product Use	1990	325.5	1.7	117.9	72.0	517.2
	2017	248.3	1.6	11.1	116.5	377.5
Agriculture	1990	14.7	304.5	224.0	0.0	543.3
	2017	10.4	241.6	187.0	0.0	439.0
Waste management	1990	5.2	225.9	9.3	0.0	240.4
	2017	3.2	125.2	10.5	0.0	138.9
Total (without LULUCF)	**1990**	**4 469.1**	**727.4**	**381.0**	**72.0**	**5 649.5**
	2017	**3 515.5**	**453.4**	**237.7**	**116.5**	**4 323.2**
LULUCF	1990	- 271.6	7.4	19.2	0.0	- 245.0
	2017	- 284.3	8.0	18.3	0.0	- 258.1
Total (with LULUCF)	**1990**	**4 197.5**	**734.9**	**400.2**	**72.0**	**5 404.6**
	2017	**3 231.1**	**461.4**	**256.0**	**116.5**	**4 065.1**

Note: the waste management sector excludes incineration with energy recovery (included in "energy use").
***Source:** European Environment Agency (EEA), 2019*

In 2017, European Union GHG emissions, without LULUCF, totalled 4.3 Gt CO_2e, of which 81% were CO_2 emissions and 10% methane (CH_4). They increased by 0.5% compared to 2016 and over the longer term decreased by 23% from 1990-2017.

DISTRIBUTION BY SOURCE OF GHG EMISSIONS FROM THE EU-28 BETWEEN 1990 AND 2017

In Mt CO_2e



Source: *EEA, 2019*

In the European Union, energy use was still the man source of GHG emissions in 2017 (78.0%), followed by agriculture (10.0%). The energy industry (notably electricity production) was the highest emitting activity sector (27.3%), followed by transport (21.9%).

In 2017, total emissions rose by 0.5%. Two thirds of this increase is due to energy use. The significant decrease in the energy industry (- 1.6%) did not offset the increases in the manufacturing industry (+ 3.3%) and in transport (+ 1.4%).

This growth in transport is part of a long term trend (+ 19% since 1990). Inversely, in all the other sectors, emissions have been reduced (*see part 4*).

Overview of greenhouse gases in France

GHG EMISSIONS IN FRANCE IN 2017

In Mt CO_2e

Sector	Years	CO_2	CH_4	N_2O	Fluorinated gas	Total
Energy	1990	365.3	12.7	3.3	0.0	381.3
	2017	320.6	2.8	3.8	0.0	327.3
Industrial Processes and Product Use	1990	31.5	0.1	23.8	11.8	67.2
	2017	22.3	0.1	1.7	19.9	43.9
Agriculture (excluding energy use)	1990	1.8	42.3	38.2	0.0	82.3
	2017	1.9	38.5	35.7	0.0	76.2
Waste management	1990	2.2	14.2	0.9	0.0	17.3
	2017	1.6	14.8	0.8	0.0	17.2
Total (without LULUCF)	**1990**	**400.8**	**69.3**	**66.2**	**11.8**	**548.1**
	2017	**346.5**	**56.3**	**42.0**	**19.9**	**464.6**
LULUCF	1990	- 26.4	1.0	3.2	0.0	- 22.2
	2017	- 36.2	1.2	3.1	0.0	- 31.9
Total (with LULUCF)	**1990**	**374.4**	**70.3**	**69.4**	**11.8**	**525.9**
	2017	**310.2**	**57.5**	**45.1**	**19.9**	**432.7**

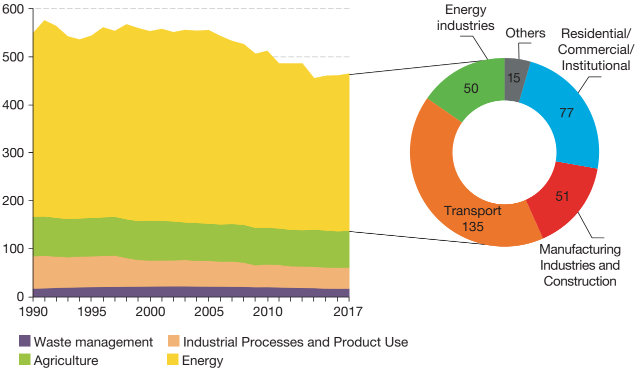
Scope: except where stated otherwise, in all of this document, emissions in "France" correspond to the scope of the Kyoto Protocol: mainland and overseas territories included in the EU (Guadeloupe, Guyana, Réunion, Martinique, Mayotte and Saint-Martin).
Source: *EEA, 2019*

In 2017, French GHG emissions, without LULUCF, represented 465 Mt CO_2e, of which 75% were of CO_2 and 12% of methane. They rose by 0.9% compared to 2016 and fell by 15% over the 1990-2017 period.

As across the whole of the European Union, energy use is the greatest source of GHG emissions in France, accounting for 327 Mt CO_2 in 2017, or 70.3% of the national total. It is followed by agriculture (16.7%), a higher level than the European average.

DISTRIBUTION BY SOURCE OF GHG EMISSIONS IN FRANCE BETWEEN 1990 AND 2017

In Mt CO_2e



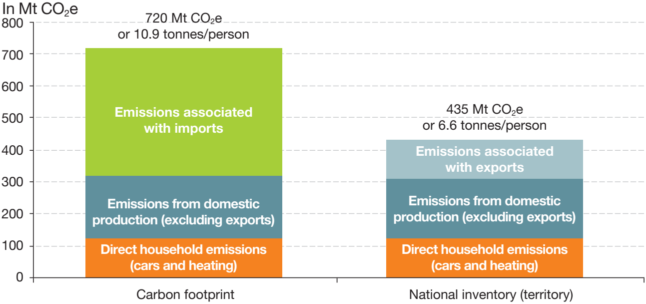
Source: *EEA, 2019*

France differs from the rest of the EU due to the low share of emissions from the energy industry, because of its large nuclear electricity production capacity. Transport is thus the largest emitting sector, with 135 Mt CO_2e, or 29% of the national total.

In 2017, total emissions (without LULUCF) rose by 0.9%. This increase was concentrated in the energy industry sector (+ 10%), since thermal power plants were put to greater use for electricity production than in 2016. Over the longer term, emissions have been reduced by 15% since 1990, with decreases in all of the sectors with the exception of transport (+ 10%).

Carbon footprint and imported emissions

COMPARISON BETWEEN THE CARBON FOOTPRINT AND THE NATIONAL INVENTORY IN 2014

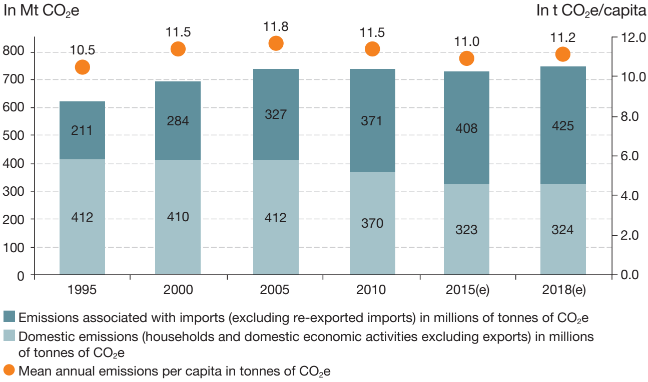


Note: the footprint and inventory (see glossary) apply to the three main greenhouse gases (CO_2, CH_4, N_2O).
Data not corrected for climatic variations.
Scope: France + Overseas Departments and Regions (Kyoto Protocol perimeter).
***Sources:** Citepa; IEA; FAO; Customs; Eurostat; Insee. Data processing: SDES, 2019*

Two complementary methods demonstrate the influence of a country on the climate:

- national inventories calculate the amount of GHGs physically emitted inside the country (**territorial approach**). These national inventories are drawn up each year following standards defined by the United Nations Framework Convention on Climate Change (UNFCCC);
- the **carbon footprint** calculates the GHGs driven by the country's domestic demand. The carbon footprint is made up of direct household emissions (housing and cars), emissions from domestic production excluding exports and emissions from the import of goods and services consumed in France (56% of the total footprint). The national inventory calculates domestic emissions only, including exported production, which represents 29% of the inventory total.

EVOLUTION OF THE CARBON FOOTPRINT

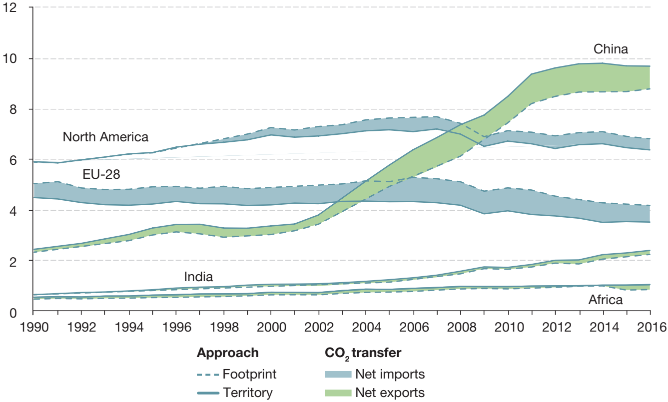


(e): estimation.
Note: the carbon footprint covers the three main greenhouse gases (CO_2, CH_4, N_2O). Data not corrected for climatic variations.
Scope: France + Overseas Departments and Regions (Kyoto Protocol perimeter).
***Sources:** Citepa; IEA; FAO; Customs; Eurostat; Insee. Data processing: SDES, 2019*

In 2018, the carbon footprint of France was estimated to be 749 Mt CO_2e. Between 1995 and 2018, the level of the footprint rose by 20% whereas, over the same period, the final domestic demand (French consumption in the broad sense, in euros, including investments) increased by 87%. Since 1995, the level of imported emissions has doubled. On the other hand, over the same period, emissions from domestic economic activities decreased by 28% and those from households (private cars and heating) decreased by 7%. After a sharp rise between 1995 and the mid-2000s, the footprint appears to have stabilised over the last decade. In 2018, the level of the carbon footprint was still much higher than that of territorial emissions (+ 76%). Per capita, the rise in the carbon footprint is less pronounced: + 7% since 1995. In 2018, a French person emitted on average 11.2 tonnes of CO_2e per year.

INTERNATIONAL COMPARISON OF CO_2 EMISSIONS FROM FUEL COMBUSTION DEPENDING ON THE APPROACH

In Gt CO_2



Note: the footprint here covers CO_2 only.
***Source:** I4CE, 2019, from the Global Carbon Budget 2018 and World Bank, 2018*

Between 1990 and 2016, CO_2 emissions from fuel combustion in the OECD increased by 2% according to the territory approach and 7% using the footprint approach. Over this period, they decreased by 22% in the EU-28 according to the territory approach and by 17% using the footprint approach. However, they have tripled in China, whatever approach is used.

In 2016, emissions per capita in China were almost equal to those in the EU-28 according to the territory approach (approx 7 t CO_2/capita/year). On the other hand, the footprint approach gives emissions per capita as 20% lower in China than in the EU-28, and more than 40% lower than the OECD average (6 t CO_2/cap/yr in China, against 8 tCO_2/cap/yr in the EU and 11 tCO_2/cap/yr on average in the OECD.)

part 4

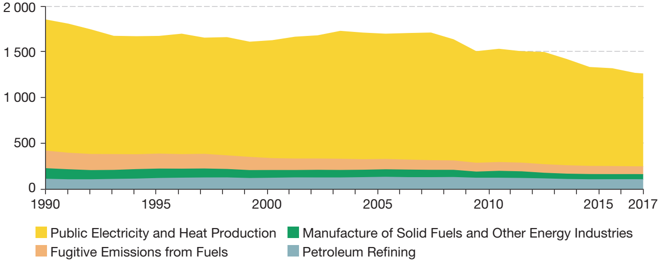
How are the GHG emissions distributed by sector in Europe and in France?

—The French and European inventories provide a breakdown of GHG emissions by sector and sub-sector. In Europe and in France, the greatest emissions reductions since 1990 can be observed in the energy sectors, particularly the manufacturing industry, and to a lesser extent, in the residential and commercial/institutional sectors. The transport sector is an exception with higher emission levels in 2017 than in 1990 in Europe and France alike, although they are now below the peak emission levels obtained in the 2000s. LULUCF *(see glossary)* produces negative emissions, corresponding to a net CO_2 sequestration by biomass and soils.

GHG emissions from the energy industry

GHG EMISSIONS FROM THE ENERGY INDUSTRY IN EU-28

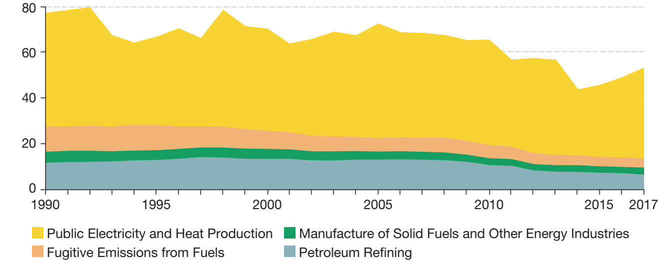
In Mt CO_2e



Note: the production of electricity and heat includes waste incineration with energy recovery, the heat here is the heat subject to a transaction.
***Source:** EEA, 2019*

GHG EMISSIONS FROM THE ENERGY INDUSTRY IN FRANCE

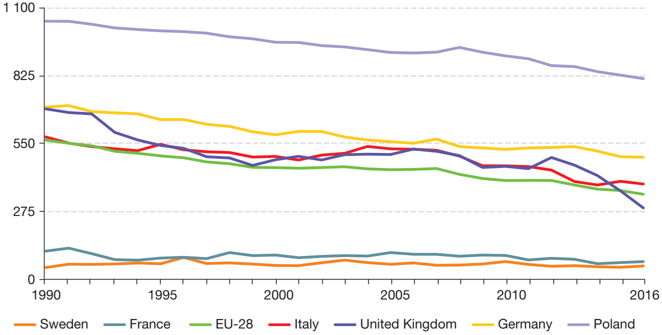
In Mt CO_2e



Note: the production of electricity and heat includes waste incineration with energy recovery, the heat here is the heat subject to a transaction.
***Source:** EEA, 2019*

CO_2 EMISSIONS FROM THE PRODUCTION OF 1 kWh OF ELECTRICITY IN THE EU

In g CO_2/kWh



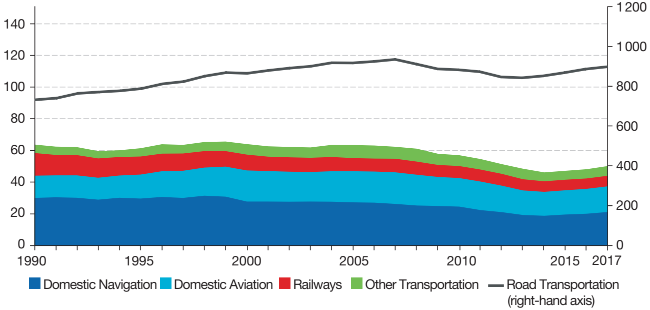
Note: cogeneration and autoproducers are included. For Poland, cogeneration from autoproducers is not included (because of breaks in historical data).
Source: *SDES, from IEA, 2019*

Since 1990, CO_2 emissions from the production of one kWh of electricity have decreased by 41% in the European Union, to reach 330 g CO_2/kWh in 2016. Although this trend is common in almost all the EU countries, emission levels are very variable between them. Emissions are highest in countries where the coal-fired production is still large, such as in Germany (480 g CO_2/kWh) and even more so in Poland (800 g CO_2/kWh). Inversely, they are lower in countries that have developed nuclear and/or renewable energies, such as France (mainly nuclear) and Sweden (mainly renewable energies).

GHG emissions from transport

GHG EMISSIONS FROM TRANSPORT IN EU-28

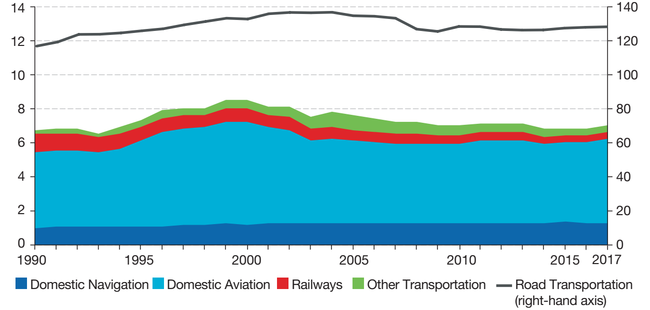
In Mt CO_2e



Note: emissions from international marine and aviation transport are not included in these totals.
***Source:** EEA, 2019*

GHG EMISSIONS FROM TRANSPORT IN FRANCE

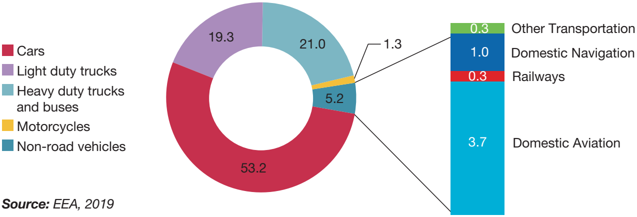
In Mt CO_2e



Note: emissions from international marine and aviation transport are not included in these totals.
***Source:** EEA, 2019*

DISTRIBUTION OF GHG EMISSIONS FROM TRANSPORT IN FRANCE IN 2017

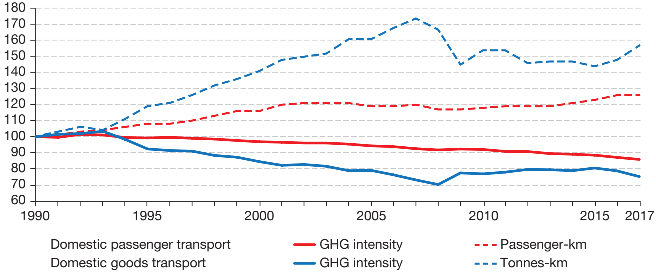
In %



Source: *EEA, 2019*

GHG INTENSITY OF ROAD TRANSPORT IN FRANCE

Index (1990 = 100)



Note: the indicators used in passenger and goods transport are, respectively, GHG emissions per passenger-km transported and GHG emissions per tonne-km transported.

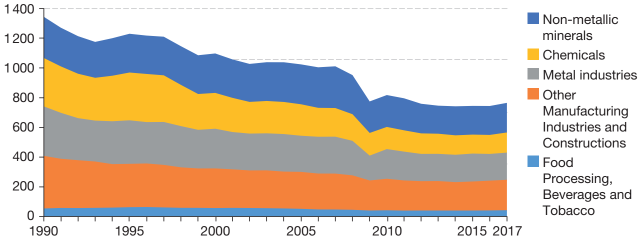
Scope: road transport in Metropolitan France.

Sources: *SDES, Comptes des transports; Citepa, Secten, April 2019*

GHG emissions from industry

GHG EMISSIONS FROM THE MANUFACTURING INDUSTRY AND CONSTRUCTION IN EU-28

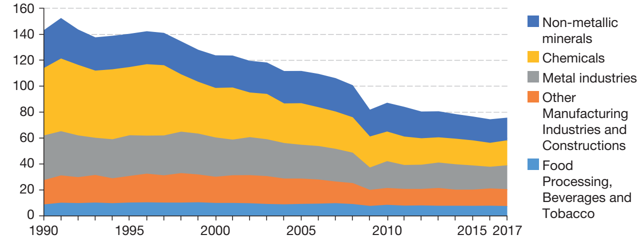
In Mt CO_2e



Note: the emissions from each sector include the emissions associated with energy usage and from industrial processes.
***Source:** EEA, 2019*

GHG EMISSIONS FROM THE MANUFACTURING INDUSTRY AND CONSTRUCTION IN FRANCE

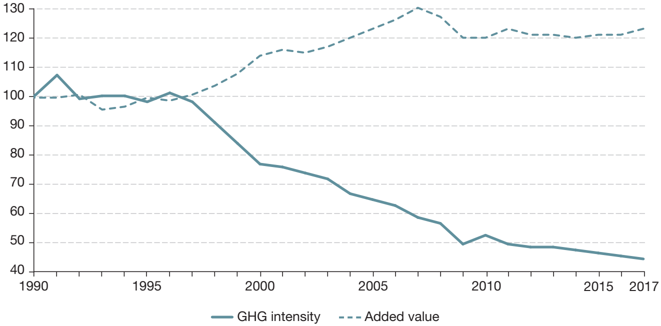
In Mt CO_2e



Note: the emissions from each sector include the emissions associated with energy usage and from industrial processes.
***Source:** EEA, 2019*

GHG INTENSITY OF THE MANUFACTURING INDUSTRY AND CONSTRUCTION IN FRANCE

Index (1990 = 100)



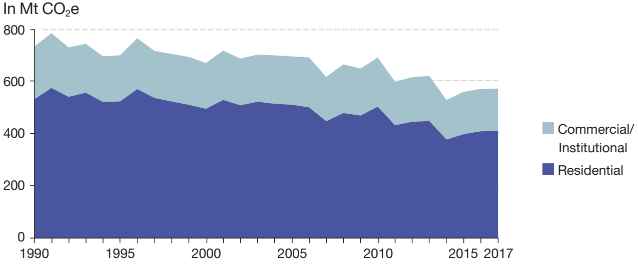
Note: the emissions are divided by the added value by the manufacturing industry and construction.
***Sources:** SDES, from Insee, 2018; Citepa, Secten, April 2019*

In the EU and in France, GHG emissions from the manufacturing industry mainly come from sectors producing CO_2-intensive primary products such as the metal and chemical industries and the manufacture of non-metallic minerals (cements, lime, glass…). In France, these three sub-sectors accounted for 73% of industry emissions in 2017, the latter contributing 18% of national emissions.

In comparison to 1990, emissions from industry (including industrial processes) are declining sharply in the EU (- 43%) and in France (- 47%), and this decrease applies to all the major industry sectors. Although the 2008-2009 economic crisis played a role, the majority of emission reductions were due to improvements in processes and energy efficiency gains. Thus, emissions from the chemical sector fell by 63% in France between 1990 and 2017, notably due to a drastic reduction in N_2O emissions (- 94%) associated with the production of adipic and nitric acids.

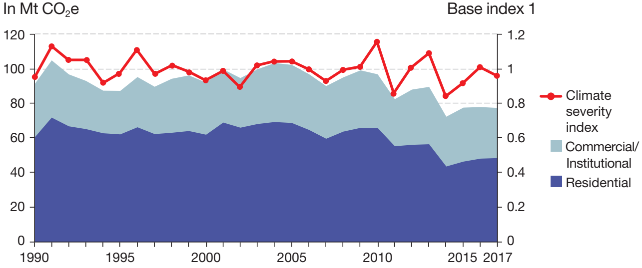
GHG emissions from residential/commercial/institutional

GHG EMISSIONS FROM RESIDENTIAL/COMMERCIAL/INSTITUTIONAL IN EU-28



Source: *EEA, 2019*

GHG EMISSIONS FROM RESIDENTIAL/COMMERCIAL/INSTITUTIONAL IN FRANCE



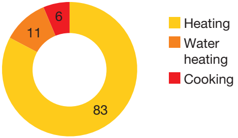
Sources: *EEA, 2019; SDES, from Météo-France*

Residential/commercial/institutional emissions are highly dependent on climate conditions. They decrease when the temperatures are mild and increase as the weather gets colder. Between the years 1990 and 2017, which were characterised by winters with similar temperatures, emissions in France decreased by 20% in residential and 6% in commercial/institutional.

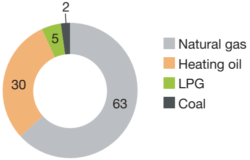
DISTRIBUTION OF CO_2 EMISSIONS FROM RESIDENTIAL BUILDINGS IN METROPOLITAN FRANCE

In %

Distribution of residential emissions in 2017 by end-use



Distribution of residential emissions in 2017 by fuel

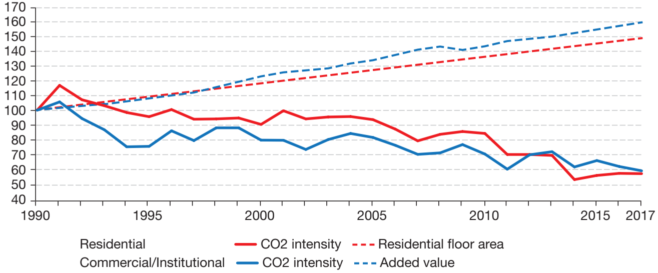


Note: only the CO_2 emissions from fossil fuel combustion are taken into account. The carbon content of bought electricity and heat is not accounted for.
***Source:** SDES, from Ceren, 2018*

Heating is still the largest CO_2 emission category in 2017 (83% of the total). Among the fossil fuels, since 1990 natural gas has displaced heating oil and coal. In 2017, it accounted for 63% of CO_2 emissions from residential buildings.

CO_2 INTENSITY OF RESIDENTIAL/COMMERCIAL/INSTITUTIONAL IN FRANCE

Index (1990 = 100)

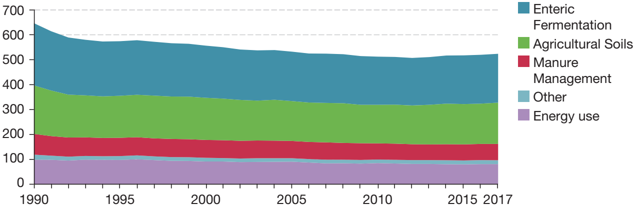


Note: the commercial/institutional emissions are divided by added value of the commercial/institutional sector (excluding transport), and residential emissions are divided by residential floor area, m^2.
***Sources:** SDES, Comptes du logement; Insee, Valeur ajoutée; Citepa, Émissions de CO_2, 2019*

GHG emissions from agriculture, forestry and land use

GHG EMISSIONS FROM AGRICULTURE IN EU-28

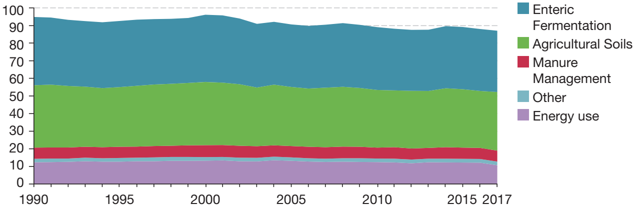
In Mt CO_2e



Source: *EEA, 2019*

GHG EMISSIONS FROM AGRICULTURE IN FRANCE

In Mt CO_2e

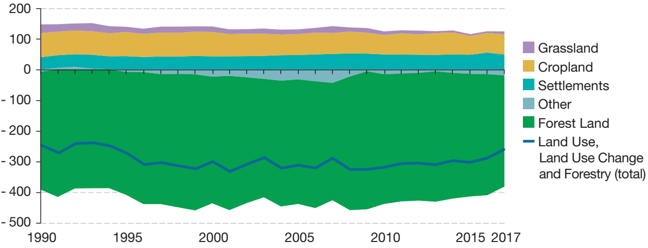


Source: *EEA, 2019*

Agriculture differs from other sectors by its low share of emissions from energy combustion. The main sources of emissions are methane (CH_4), primarily emitted by animals (enteric fermentation), and N_2O, from the transformation of nitrogen products (agricultural soils: fertiliser, manure, slurry etc.).

GHG EMISSIONS FROM LULUCF IN EU-28

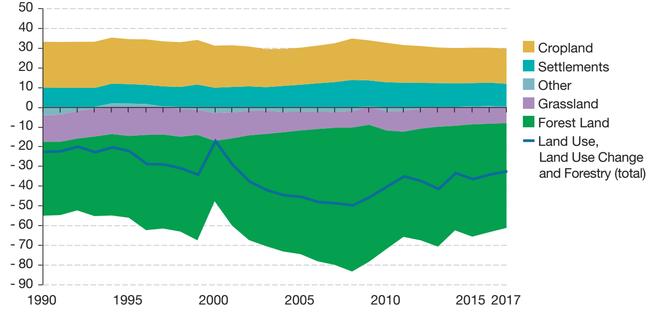
In Mt CO_2e



Source: *EEA, 2019*

GHG EMISSIONS FROM LULUCF IN FRANCE

In Mt CO_2e



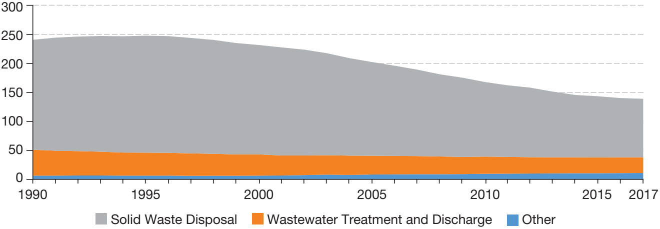
Source: *EEA, 2019*

The total emissions associated with land use, land use change and forestry (LULUCF) are negative both in the EU and in France. This means that GHG removals by LULUCF exceed its emissions. This is mainly due to forest growth, while the artificialisation of soils and the conversion of grassland to cropland contribute to increasing emissions.

GHG emissions from waste management

GHG EMISSIONS FROM WASTE MANAGEMENT IN EU-28

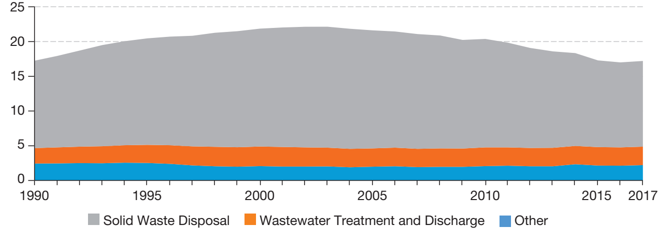
In Mt CO_2e



Note: waste incineration with energy recovery is not included (it is accounted for in "energy industry").
***Source:** EEA, 2019*

GHG EMISSIONS FROM WASTE MANAGEMENT IN FRANCE

In Mt CO_2e



Note: waste incineration with energy recovery is not included (it is accounted for in "energy industry").
***Source:** EEA, 2019*

Waste management-related emissions are mainly methane emitted during the decomposition of waste in landfill. These emissions have been falling since the mid-1990s in the EU and since the mid-2000s in France.

part 5

What climate policies are implemented at the global level, in Europe and in France?

—COP21 in December 2015 concluded with the adoption of the Paris Agreement, where both developed and developing countries pledged to limit their GHG emissions. The European Union set a target of a 40% reduction in emissions by 2030 compared to 1990 levels. Climate policies rely in particular on an emission allowance trading system *(see glossary)*. Carbon pricing policies have been introduced in Europe and across the world, notably to redirect investment flows. France has produced a Climate Plan, a low-carbon strategy and carbon budgets in order to drive the transition to a low GHG economy.

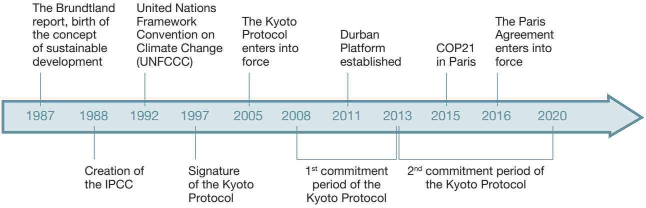
International negotiations

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)

The UNFCCC was the first international treaty aiming to prevent harmful anthropogenic impacts for the climate. It was adopted in 1992 in Rio de Janeiro. It enshrines three principles:

- the precautionary principle: lack of scientific certainty on the impacts of climate change should not be used as a reason for postponing action;
- the principle of common but differentiated responsibility: all emissions have an impact on climate change, but the most industrialised countries have a greater responsibility for current GHG concentration levels;
- the right to economic development principle: the actions to combat climate change should not have a harmful effect on priority needs in developing countries, which include, among others, sustainable economic growth and the eradication of poverty.

The members states of the UNFCCC meet every year for the Conference of the Parties (COP). All key decisions on the UNFCCC are taken during these conferences. The 25th COP will take place in Madrid (Spain) from the 2 to 13 December 2019, under the Presidency of Chile.



KYOTO PROTOCOL

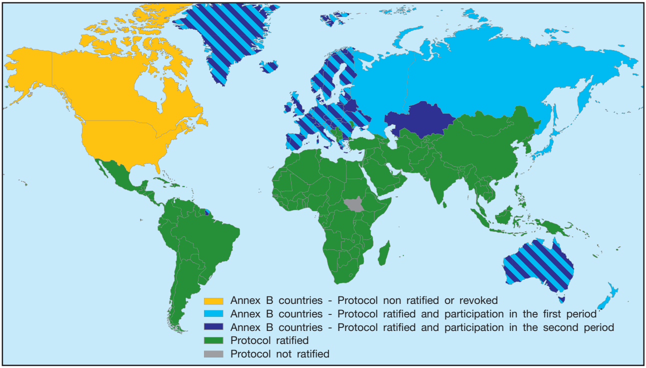
The Kyoto Protocol was the first outcome of international climate negotiations. It was signed in 1997 and entered into force in 2005 after Russia's ratification made a quorum of 55 States representing 55% of emissions from the most industrialised countries in 1990 (listed in annex B of the protocol - *see glossary*).

Applying a top-down approach, the protocol set a target for Annex B countries to reduce GHG emissions by around 5% between 2008 and 2012 relative to 1990 levels. The targets were binding and varied between countries, but did not apply to non-Annex B countries.

In 2012, during COP18 in Doha (Qatar), the parties agreed to extend the protocol to cover a second commitment period from 2013 to 2020. The countries that announced a commitment for this period represented 13% of global emissions in 2010.

Of the countries in Annex B, only the United States did not ratify the protocol and Canada pulled out in December 2011.

Signatory countries of the Kyoto protocol



Source: *UNFCCC, September 2016*

The Paris Agreement

THE APPROACH TAKEN IN THE AGREEMENT

In contrast to the Kyoto Protocol, the Paris Agreement relies on a bottom-up approach, mainly based on cooperation to encourage all types of stakeholders, both public and private, to commit to acting in favour of the climate. The basis of this approach relies on seeking benefits and co-benefits associated with climate action rather than on sharing the effort of reducing greenhouse gas emissions.

Through the three long-term objectives, the agreement sets a global trajectory, but allows some flexibility so that the parties can determine their own climate commitments, in the form of contributions determined at a national level (NDC, for Nationally Determined Contributions - *see glossary*). The NDCs describe the national efforts planned in terms of mitigation and potentially adaptation, based on their national circumstances. By guaranteeing a consideration of the different national circumstances, this approach has succeeded in attracting an unprecedented number of commitments from all of the countries in the world. The approach also contributed to obtaining a final consensus at COP21.

Additionally, efforts by non-state actors (cities, regions, companies, investors, civil society, etc.) are recognised in the Decision of COP21, so as to emphasise their role in the dynamic known as the “Action Agenda”. The dialogue established between the non-state actors and the negotiating process relies in particular on the NAZCA portal (non-state actors zone for climate action) that lists actions by non-state actors and should in future also assess their progress.

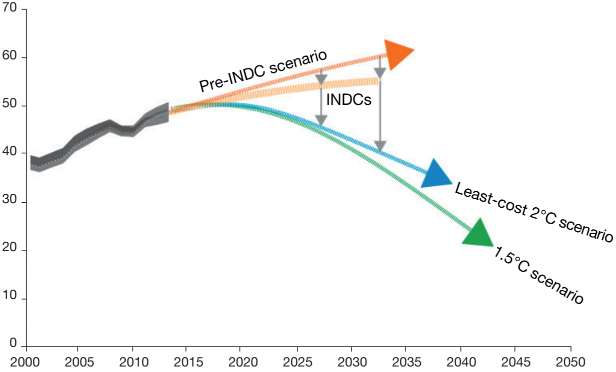
RESULTS OF COP21

On 12 December 2015 at COP21, the Paris Agreement was adopted by the UNFCCC. It entered into force on 4 November 2016. On 1st June 2019, 185 parties (including the European Union) ratified the Paris Agreement, and 184 parties (including the European Union) submitted their contributions (NDCs).

IMPACT OF INDCs ON GLOBAL GHG EMISSIONS

Comparison between emission levels in 2025 and 2030 resulting from the introduction of INDCs and other scenarios

In Gt CO_2e



Note: these scenarios represent a mean of the estimated uncertainty range, taking into account the uncertainties surrounding the impacts of climate change and the implementation of the national contributions; the 2°C scenario is a least-cost scenario with a 66% chance of remaining below 2°C; the 1.5°C scenario is a least-cost scenario with a 50% chance of remaining under 1.5°C.
Source:UNFCCC synthesis report, 2016*

A UNFCCC report dated May 2016 concludes, by taking into account the implementation of INDCs (Intended Nationally Determined Contributions, which determine the parties' contributions before the agreement enters into force), that global GHG emissions are set to rise between 34-53% by 2030 relative to 1990 levels. On the other hand, emissions per capita are set to decrease by 10% between 1990 and 2030. In their current form, these contributions appear insufficient to limit climate change to 1.5-2°C. It is still possible to meet the target, but this would require a significant and rapid strengthening of ambitions in the future, as foreseen in the Paris Agreement with the ambition-raising mechanism.

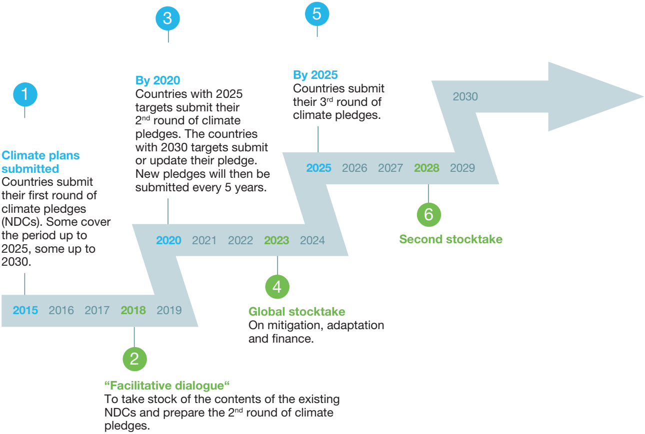
OBJECTIVES OF THE AGREEMENT

The objectives of the Paris Agreement can be divided into three key pillars:

- mitigation: maintain the increase in global temperatures "well below" 2°C by 2100 relative to pre-industrial levels and pursue efforts to limit this rise to 1.5°C;
- adaptation: strengthen countries' capacity to respond to the impacts of climate change and recover from them;
- finance: make financial flows compatible with climate goals and mobilise $100 billion a year of North-South climate funding by 2020.

Moreover, the Paris Agreement introduced a formal review mechanism to increase national commitments, the NDCs, every five years.

NDC Ambition-raising "ratchet" mechanism



Source: *I4CE, from Carbon Brief, How countries plan to raise the ambition of their climate pledges, 2016*

European Union commitments

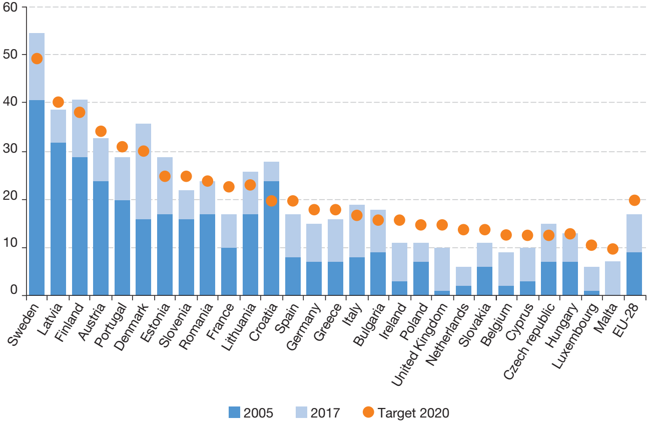
ENERGY-CLIMATE PACKAGE 2020

The energy-climate package defines three goals to achieve by 2020, known as "3 x 20":

- a 20% reduction in GHG emissions from 1990 levels;
- a 20% increase in the share of renewables in gross final energy consumption. This goal translates into national targets in the different Member States;
- a 20% improvement in energy efficiency This objective corresponds to a 20% decrease in primary energy consumption compared to a baseline scenario established in 2007, the 2007 *Baseline* scenario (*see glossary*).

Share of renewables in Member States' gross final energy consumption

In %



Source: *I4CE, from Eurostat, 2019*

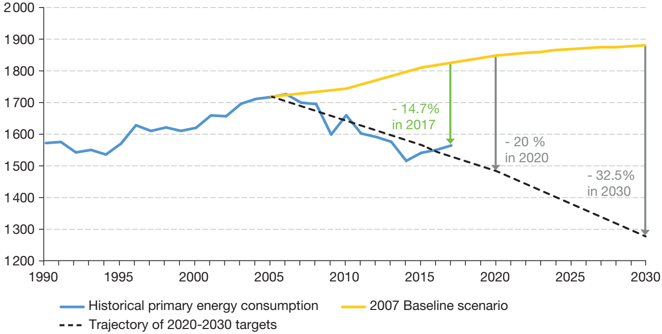
ENERGY-CLIMATE PACKAGE 2030

The European institutions have agreed on the following goals for 2030:

- a reduction of at least 40% in GHG emissions from 1990 levels;
- a 32% increase in the share of renewable energy in gross final energy consumption.
- a 32.5% increase in energy efficiency - which means a 32.5% decrease in energy consumption compared to the 2007 Baseline scenario (*see glossary*).

Evolution of primary energy consumption in EU-28 and trajectory of 2020 and 2030 targets

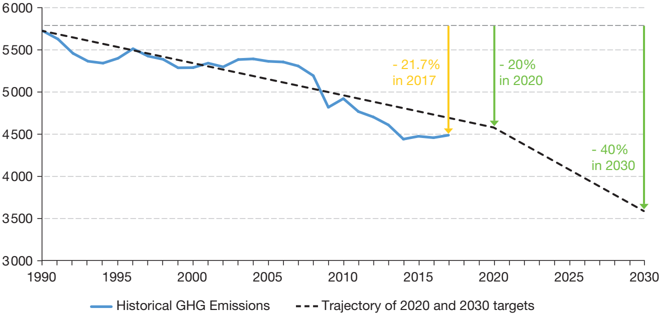
In Mtoe



Source: *I4CE, from Eurostat and European Commission, 2019*

Evolution of GHG emissions in EU-28 and trajectory of 2020 and 2030 targets

In Mt CO_2e



Source: *I4CE, from Eurostat and European Commission, 2018*

EFFORT SHARING

The two instruments that cover the EU's GHG emissions are the Emissions Trading System (EU ETS, *see p. 62*) and the Effort Sharing Decision (ESD) which defines the national reduction goals for sectors not covered by the EU ETS.

The 2020 goal of a 20% reduction in GHG emissions relative to 1990 levels translates into a target of a 21% reduction from 2005 levels for the EU ETS, and a 10% reduction from 2005 levels for the other sectors.

The 2030 goal of at least 40% reduction in GHG emissions relative to 1990 levels translates into a target of a 43% reduction from 2005 levels for the EU ETS, and 30% reduction from 2005 levels for the other sectors.

In 2018, the European institutions adopted a regulation on sharing the 2030 target between Member States for sectors not covered by the EU ETS.

The European Emission Trading System

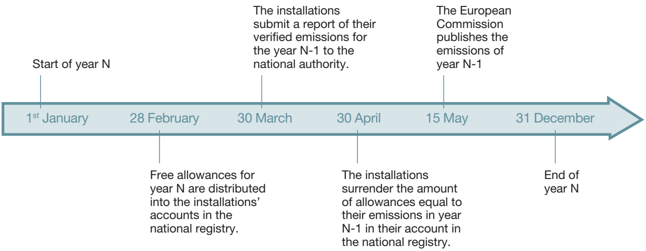
OPERATING PRINCIPLES

The EU ETS (*see glossary*) was created in 2005 with the aim of setting an emissions cap on high emitting sectors in the EU. It is currently in its third operating phase (2013-2020).

Under this cap, installations receive or buy emission allowances which they can trade with each other. Each year, these installations must surrender an amount of allowances (1 allowance = 1 tonne of CO_2) equal to the previous year's verified emissions.

In 2013, the scope of the EU ETS was widened to include new sectors and new greenhouse gases. It now covers more than 11 000 industrial installations and electricity plants in the EU and in countries in the European Economic Area (Norway, Liechtenstein and Iceland) as well as flights within this area, which represents around 45% of GHG emissions.

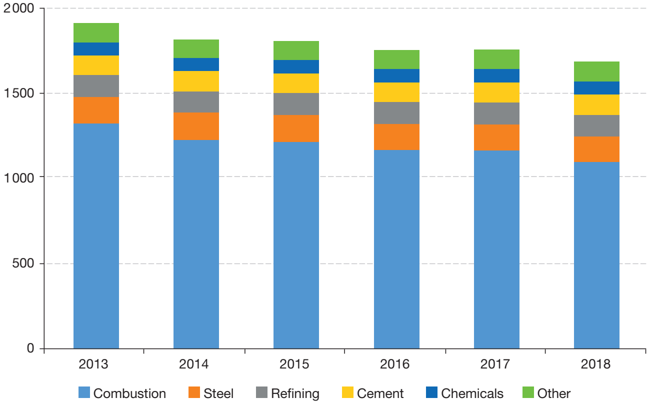
EU ETS annual calendar



Source: *I4CE*

GHG emissions from stationary installations covered by the EU ETS per sector (2013-2018)

In Mt CO_2e



Note: "Other" includes the production of glass, lime, paper, ceramic and non-ferrous metals.
***Source:** I4CE, from European Environment Agency data, 2019*

ALLOWANCE CAP AND ALLOCATION

-During the first two phases of the EU ETS (the pilot phase in 2005-2007, and a second phase in 2008-2012 which coincided with the first commitment period of the Kyoto Protocol), the emissions cap was established using a decentralised and bottom-up process. Each Member State established a National Allocation Plan (NAP) to share out the allowances between the installations covered, and the sum of the NAPs formed the overall cap.

In 2013, a cap was established at European level. This cap decreases in a linear manner each year, to achieve a 21% reduction by 2020 compared to 2005 levels, which corresponds to an approximate annual reduction of 38 million tonnes of CO_2e.

FEWER AND FEWER FREE ALLOCATIONS

The majority of the allowances were allocated free of charge in phases 1 and 2. From 2013 onwards, fewer and fewer allowances are allocated free of charge:

- power plants have not received free allowances since 2013, except for temporary exemptions for eight Central and Eastern European countries;
- the manufacturing industry continues to receive some of its allowances free of charge, reduced from 80% in 2013 to 30% in 2020, except for the industrial sectors recorded by the European Commissions as running a high risk of carbon leakage (relocation in order to escape carbon restrictions), who benefit from 100% free allowances until 2020.

The free allowances are established in relation to the carbon intensity benchmarks established per sector and per product and to the activity data.

The other allowances are sold at auction. The auctions can be pooled, but the revenues are managed by the States, who are obliged to use at least half for climate and energy purposes.

ALLOWANCE TRADING

The allowances can be traded: an installation that emits more than its allowance can buy allowances on the market; an installation that reduces its emissions can resell its unused allowances.

The trading of allowances between suppliers and buyers is either done by mutual agreement, i.e. through bilateral contracts between the industry players, or on the markets using digital portals that publish the prices and amounts traded.

ALLOWANCE SURPLUS

Allowance surpluses have built up in the EU ETS since 2009, resulting in a depreciation of its price signal up until 2018. This surplus was primarily caused by the economic crisis, by the effect of other European energy and climate policies aimed at reducing emissions, and by the increase in the supply of allowances through the use of international credits.

HISTORY OF ALLOWANCE PRICES

In €/tCO_2e

Source: *Sandbag Carbon price viewer, 2019*

REFORMS OF THE EU ETS

Several measures have been introduced to try to reabsorb the allowance surplus accumulated in the EU ETS. A first measure consisted of postponing the auctioning of 900 million allowances between 2014 and 2016 to 2019-2020 (backloading).

A second step was the introduction of the Market Stability Reserve (MSR) in January 2019, that aimed to regulate the long-term surplus by applying caps to the number of allowances in circulation.

Finally in 2018, the operating rules of the EU ETS were reviewed for the post-2020 period. In particular, this revision foresees an increase in the rate of annual reductions of emissions caps, which will go from around 38 million tonnes of CO_2e to 48 million tonnes of CO_2e after 2021.

The rising price of allowances since 2018 is the result of actors anticipating a greater scarcity of allowances due to the introduction of the MSR in 2019, as well as a rise in credibility of the EU ETS in the medium term due to the adoption of a revised directive for the 2021-2030 period. The price fluctuated between 20 and 30 €/tCO_2e during the first six months of 2019.

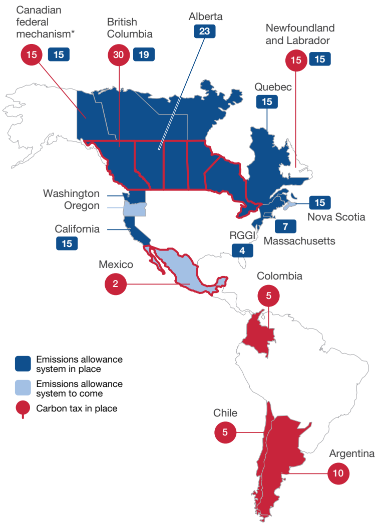
CARBON PRICING AROUND THE WORLD

Some states have decided to assign an economic value to the emission of a tonne of CO_2 to encourage economic decision-makers to invest more heavily in clean energies or in low-carbon technologies and less in technologies that emit GHG.

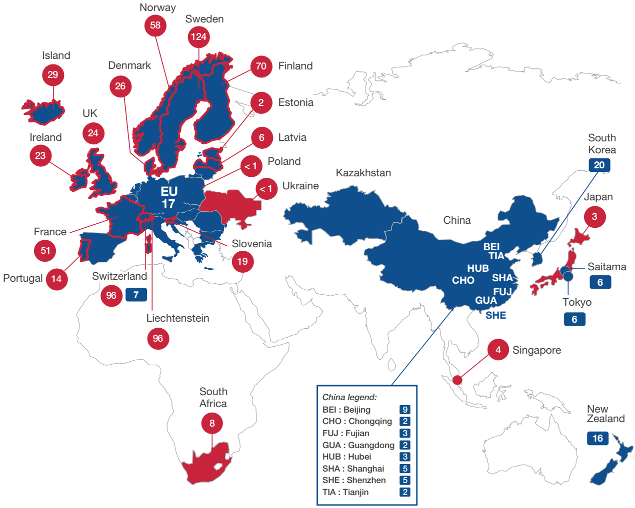
Two instruments give an explicit price to carbon: the carbon tax sets a price per tonne of CO_2 and the emissions allowance trading scheme (ETS) sets a maximum amount of permitted emissions.

Global overview of carbon prices in May 2019

In US \$/t CO_2e



On 1st May 2019, 25 carbon taxes and 26 tradable emission allowance markets were operating across the world. The jurisdictions covered by one or several explicit carbon prices represented approximately 60% of global GDP. Among these feature the big emitters such as China, South Korea, Europe, South Africa, Japan and Mexico.



** The federal mechanism applies in the provinces that do not have their own pricing scheme in place.*
***Source:** I4CE, Global Carbon Account, May 2019*

REVENUES FROM CARBON PRICING AROUND THE WORLD

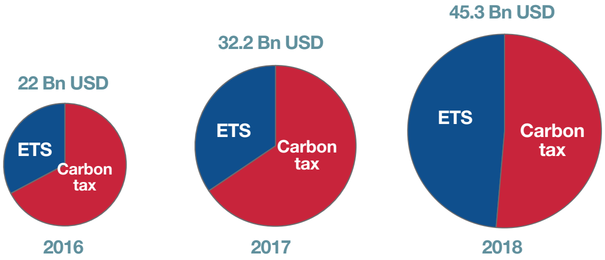
Revenues from carbon pricing in the G20 countries

Carbon pricing instruments generated 45 billion dollars (40 billion euros) of revenues in 2018, compared to 32 billion in 2017. This rise is mainly due to increased prices on the European market, which rose from less than 10 before 2018 to over 25 dollars more recently.

In 2018, 52% of carbon revenues were generated through taxes, totalling 23 billion dollars, and 48% were through the allowance markets, totalling 22 billion dollars. Over 75% of the revenues from carbon pricing came from European Union Member States.

Evolution of the proceeds of the different carbon pricing instruments

In billions of dollars

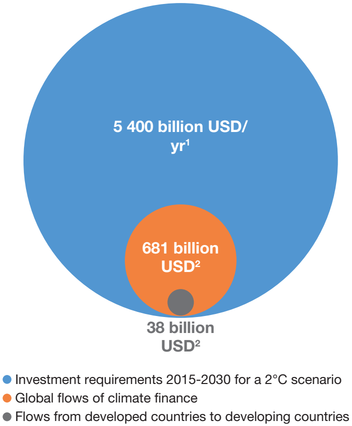


Source: *I4CE, Global Carbon Account, May 2019*

On a global scale, 54% of revenues were used for projects linked to the low-carbon transition, 37% were allocated in the general public budget, 6% financed tax exemptions and 3% were directly transferred to businesses and households.

Funding the combat against climate change

ANNUAL CLIMATE FINANCE FLOWS (2016) IN TERMS OF GLOBAL INVESTMENT REQUIREMENTS FOR A 2°C SCENARIO



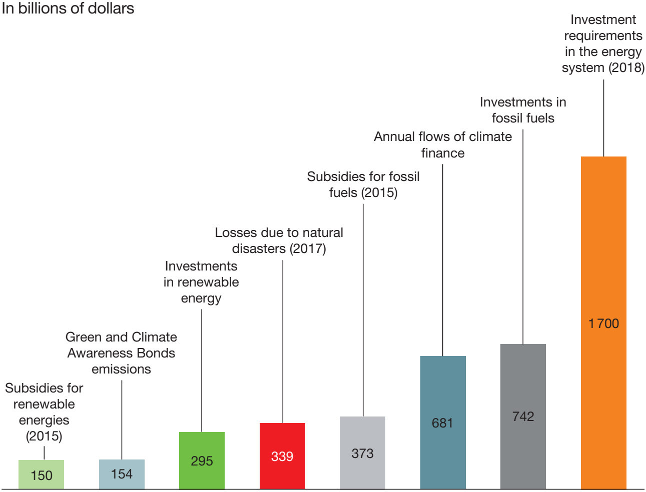
Sources: *Better Growth, Better Climate, The New Climate Economy, 2014 [(1)]; Biennial Assessment Report of Climate Finance Flows, UNFCCC, 2018 [(2)]*

The climate finances bring together all of the finance flows that make it possible to implement actions with a positive impact in terms of mitigation (reduction of GHG emissions) or adaptation to climate change. Depending on the organisations and the definitions, distinctions may exist in the level of impact and whether it is a co-benefit or the main objective of the action financed.

In 2016, climate finance flows totalled 681 billion USD.

COMPARISON BETWEEN ANNUAL CLIMATE FINANCE FLOWS AND OTHER KEY FINANCE FLOWS

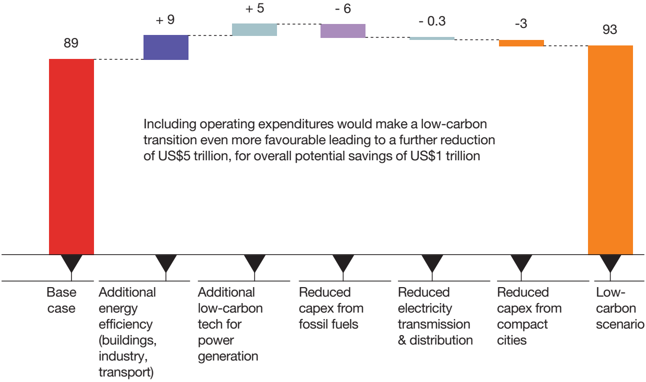
In billions of dollars



Note: the flows are global and annual for the year 2016 (except where indicated otherwise). The investment requirements in the energy system have been calculated so as to adhere to the 2°C scenario.
***Source:** I4CE, 2018, from the Biennial Assessment Report of Climate Finance Flows, UNFCCC, 2018*

GLOBAL INVESTMENT REQUIREMENTS FOR THE CLIMATE OVER THE 2015-2030 PERIOD

Indicative figures, in trillions of US dollars 2010



Note: moving from the baseline scenario to a low-carbon scenario requires, among other investments, an additional US$9 trillion in the field of energy efficiency over the 2015-2030 period; however, there is a high degree of uncertainty about the amounts required.
Source: *The New Climate Economy, 2014*

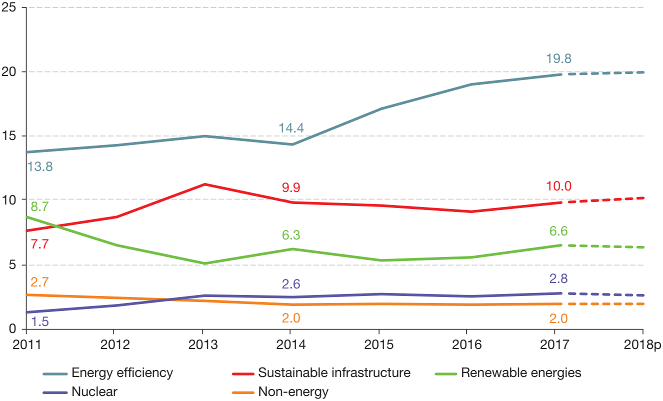
To meet the 2°C goal, significant sums must be mobilised – in the order of several trillion dollars per year by 2030 – for all of the sectors. This mobilisation applies to both the production and use of energy. However, a scenario based on the continuity of current requirements requires investments of the same order of magnitude, whatever the level of the climate constraint.

The difference between a business-as-usual scenario and a low-carbon scenario is thus mainly in the distribution of investments. Indeed, in the low-carbon scenario, higher levels of investment are needed in low-carbon technologies and in energy efficiency, but lower levels are needed for the production of fossil fuels for example.

OVERVIEW OF CLIMATE FINANCES IN 2017

Climate investments in France per field of contribution to the low-carbon transition

In billions of euros



p: provisional.

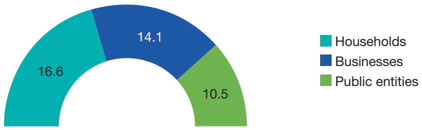
Source: *I4CE, Landscape of Climate Finance, 2018 edition*

The Landscape of Climate Finance surveys the investment spending in favour of the climate in France and analyses the way in which this spending is funded. Climate investments reached 41.2 billion euros in 2017.

France spent nearly 20 billion euros on energy efficiency, 6.6 billion euros for the deployment of renewable energies and 10 billion euros on building sustainable transport and network infrastructure. Investments to develop and renew nuclear plants totalled 2.8 billion euros. For forests and non-energy industrial processes investments amounted to 2 billion euros.

Climate investments in France per project developer in 2017

In billions of euros current

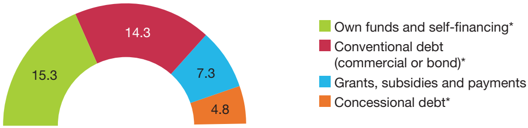


Source: *I4CE, Landscape of Climate Finance, 2018 edition*

Households are the main project developers. They accounted for 40% of climate investments, or 16.6 billion euros in 2017 (excluding reduced rate VAT, estimated at 0.5 billion euros in 2017). This is followed by the public entities, meaning the State, local authorities, social landlords and infrastructures managers, who accounted for 14.1 billion euros of investment. Businesses invested 10.5 billion euros in the climate.

The finance instruments for investments in France in 2017

In billions of euros current



** Including financing from business accounts.*
Source: *I4CE, Landscape of Climate Finance, edition 2018*

To fund their investments, project developers mobilise finance from four main types of instrument: grants, subsidies or transfers, concessional loans, conventional debt, and capital or equity injection. Businesses rely on funding from their corporate balance sheet that combines debt and equity.

State policies to combat climate change: the example of France

France has committed to a 40% reduction in its greenhouse gas emissions by 2030 relative to 1990 levels. The Energy and Climate bill, adopted in 2019, sets the objective of carbon neutrality by 2050, through a more than six-fold reduction in emissions relative to 1990 levels.

The revised national low-carbon strategy (SNBC), which is due to be adopted by decree in 2019, integrates this new long-term objective.

The SNBC provides guidelines for implementing the transition to a low-carbon economy in all sectors of activity, for reducing territorial emissions and the carbon footprint of France more generally.

The carbon budgets set greenhouse gas emissions caps on the national territory and define the target trajectories for emissions reduction for successive periods of five years, in line with the goal of carbon neutrality by 2050.

Mean annual emissions (in Mt CO_2e)	**2015**	**1st carbon budget (2015-2018)**	**2nd carbon budget (2019-2023)**	**3rd carbon budget (2024-2028)**	**4th carbon budget (2029-2033)**
All sectors together	458	440	421	357	299

Source:*revised national low-carbon strategy project (https://www.ecologique-solidaire.gouv.fr/sites/default/files/Projet%20strategie%20nationale%20bas%20carbone.pdf)*

The revised Multi-Annual Energy Plan project (PPE in French), which is due to be adopted by decree in 2019, establishes the priorities for action for public authorities to manage all types of energy, in coherence with the National Low Carbon Strategy (SNBC).

To ensure these commitments are respected and to limit deviations from the trajectory, France has reinforced its governance of climate policies with the creation of the *Haut conseil pour le climat* (HCC, High Council for the Climate). This body is independent, following the example of the British Committee on Climate Change. Its primary mission is to assess the implementation of the SNBC and compliance with the trajectory, and to sound the alarm in the event of discrepancies.

Key data

+ 1.0°C

Rise in global temperatures between the period 1850-1900 and 2018

+ 20 %

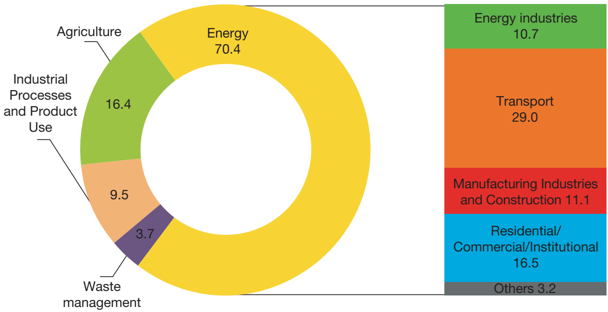
Rise in the carbon footprint of the French population between 1995 and 2018[1]

€41 Bn

Investments in favour of the climate in France in 2017

DISTRIBUTION OF GREENHOUSE GAS EMISSIONS IN FRANCE IN 2017[2]

In %



+ 64 %

of global emissions of CO_2 between 1990 and 2017[2]

- 25 %

of GHG emissions in the EU between 1990 and 2017[3]

- 18%

of GHG emissions in France between 1990 and 2017[3]

[1] For the three main greenhouse gases: CO_2, CH_4, N_2O.
[2] Without LULUCF.
[3] With LULUCF.

Annexes

— Some emissions factors
— Glossary
— Useful websites

Some emissions factors

CO_2 EMISSIONS FACTORS OF THE MAIN FOSSIL FUELS

Coal (coking, sub-bituminous or other bituminous)	4.0 t CO_2/toe	Lignite (low energy coal)	4.2 t CO_2/toe
Diesel or crude oil	3.1 t CO_2/toe	Liquefied petroleum gas (LPG)	2.6 t CO_2/toe
Gasoline	2.9 t CO_2/toe	Natural gas (methane)	2.3 t CO_2/toe

Source: *IPCC, 2006*

The CO_2 emissions factors indicate the amount of CO_2 emitted during the combustion of a given fuel and for a unit of energy (here in toe). The case of biomass is not covered here: it is considered that the direct CO_2 emissions linked to the combustion of biomass are offset by the absorption of CO_2 during the growth of the plant. If this is not the case, the non-offset emissions are recorded in the LULUCF sector.

EMISSIONS FACTORS FROM COMMON PRODUCTION ACTIVITIES

It is possible to extend the concept of emissions factors to business activities by dividing the GHG emissions directly emitted by an activity by a measure of this activity.

Sector	Emissions factors	Comments
Electricity production	0.87 t CO_2/MWh for a coal power plant	40% efficiency rate
	0.36 t CO_2/MWh for a gas power plant	55% efficiency rate
Industry	1.8 t CO_2/tonne of steel	Traditional sector (non-recycled crude steel)
	0.62 t CO_2/ tonne of cement	EU-28 average in 2016, per tonne cement-equivalent
Agriculture and forests	5.2 t CO_2e/dairy cow and per year	Emissions linked to enteric fermentation and to manure management
	580 t CO_2e/ha of deforested tropical forest	Global mean, emissions related to the combustion and decomposition of organic material

Sources: *Ademe (French Environment and Energy Management Agency); Cement Sustainability Initiative; Citepa; SDES*

CARBON CONTENT OF DAILY OBJECTS AND ACTIONS

The GHG balance is built using a "lifecycle" approach. It includes several different phases linked to the activity associated with the emissions factor. For example, for one kilometre in a car, the GHG balance includes the direct emissions from gasoline or diesel combustion, but also the emissions from the extraction and refining of the fuel, its transport and distribution as well as those linked to the manufacture of the car.

TRANSPORT

- Aeroplane (passenger) - 180-250 seats, journey of 0-1000 km: **293 g CO_2e/passenger.km**
- Private car - average fiscal rating, petrol engine: **259 g CO_2e/km**
- TGV, High Speed Train (France): **3.69 g CO_2e/passenger.km**
- Underground (Paris): **5.70 g CO_2e/passenger.km**

FOOD

- Meal - traditional (with beef): **6.29 kg CO_2e/meal**
- Meal - traditional (with chicken): **1.35 kg CO_2e/meal**
- Meal - vegetarian: **0.51 kg CO_2e/meal**

ELECTRONICS

- Desktop computer - with flat screen: **1 280 kg CO_2e/device**
- Laptop computer - 14.1 inches: **202 kg CO_2e/device**
- Smartphone: **30 kg CO_2e/device**

COMMUNICATION

- 1 email with attachment: **35 g CO_2e/unit**
- 1 internet search: **6.65 g CO_2e/unit**
- 1 email: **4 g CO_2e/unit**
- 1 tweet: **0.02 g CO_2e/unit**

Source: *Ademe (French Environment and Energy Management Agency), Bilan GES, 2018*

Glossary

Annex I countries and Annex B countries: the UNFCCC's Annex I countries are developed countries and those transitioning to a market economy. Apart from few exceptions, these countries correspond to the Annex B countries of the Kyoto Protocol, which aims to state the quantified commitments to which they must adhere.

Anthropogenic: relating to human activities (industry, agriculture etc.).

Baseline Scenario 2007: developed for the European Commission by the E3M laboratory of the *Institute of Communication and Computer Systems at the National Technical University* of Athens, it presents projections for the EU's energy system by 2030. It takes into account the policies implemented in the Member States up to the end of 2006.

CO_2 equivalence (CO_2e): method of measuring greenhouse gas emissions based on the warming effect of each gas relative to that of CO_2.

Emission allowance: unit of account of the market system. Represents one tonne of CO_2.

ETS: *Emissions Trading System*. Trading system for CO_2 emissions allowances

Fossil fuel reserves: quantities of oil, gas and coal resources recoverable from known reserves, under existing economic conditions and technology.

GDP: gross domestic product. A measurement of the wealth generated by a country over a given period. It is measured using purchasing power parity (PPP) to allow for comparisons between countries.

GHG: greenhouse gases are the gaseous components of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.

GWP: global warming potential. Allows a comparison, over a given period, of the contributions of different greenhouse gases to global warming.

Heatwave: period when the three-day running average of minimum and maximum temperatures reaches departmental alert thresholds.

International bunkers: emissions related to international aviation and marine transport.

Inventory: the greenhouse gas inventory for a given country is a table presenting the emissions of major sectors in a simple, useable form for anyone seeking an objective overview. The inventories are drawn up by applying the methodological principles defined by the IPCC.
The inventories are published on the UNFCCC website.

IPCC : Intergovernmental Panel on Climate Change, a research group created by the World Meteorological Organization and the United Nations Environment Programme, responsible for surveying and synthesising scientific work on climate change.

LULUCF: *Land Use, Land Use Change and Forestry*.

NDC: *Nationally Determined Contribution*. NDCs describe the national efforts planned in the context of the combat against climate deregulation, in the form of mitigation and/or adaptation objectives.

Solid fuels: coal and its derivatives. Emissions associated with the transformation of solid fuels are mainly from coking plant activities.

Toe: tonne of oil equivalent. Measurement unit for energy.

UNFCCC: *United Nations Framework Convention on Climate Change*.

Useful websites

Ademe - *Agence de l'environnement et de la maîtrise de l'énergie* / French Environment and Energy Management Agency
www.ademe.fr
Ademe's GHG balance (French Environment and Energy Management Agency)
www.bilans-ges.ademe.fr

Citepa - *Centre interprofessionnel technique d'études de la pollution atmosphérique* / Inter-professional Technical Centre for Studies on Atmospheric Pollution
www.citepa.org

Drias les futurs du climat - Météo-France, IPSL, CERFACS
www.drias-climat.fr

EEA - European Environment Agency
www.eea.europa.eu

European Commission / Directorate-General for Climate Action
ec.europa.eu/clima/index
EUTL - *European Union Transaction Log*
ec.europa.eu/environment/ets

I4CE - Institute for Climate Economics
www.i4ce.org

IEA - International Energy Agency
www.iea.org

IPCC - Intergovernmental Panel on Climate Change
www.ipcc.ch

Météo-France Climat HD
www.meteofrance.fr/climat-passe-et-futur/climathd

MTES - *Ministère de la Transition écologique et solidaire* / French Ministry for an Ecological and Inclusive Transition
www.ecologique-solidaire.gouv.fr
SDES - *Commissariat général au développement durable* / General Commission for Sustainable Development
www.statistiques.developpement-durable.gouv.fr
Climate Plan
www.gouvernement.fr/action/plan-climat

Stratégie nationale bas-carbone (SNBC) / National Low-Carbon Strategy
www.ecologique-solidaire.gouv.fr/index.php/strategie-nationale-bas-carbone
Programmation pluriannuelle de l'énergie (PPE) / Multi-Annual Energy Plan
www.ecologique-solidaire.gouv.fr/programmations-pluriannuelles-lenergie-ppe
Deuxième Plan national d'adaptation au changement climatique (PNACC) / Second nation plan for adaptation to climate change
www.ecologique-solidaire.gouv.fr/sites/default/files/2018.12.20_PNACC2.pdf

NOAA - *National Oceanic and Atmospheric Administration*
www.noaa.gov

Onerc - *Observatoire national sur les effets du réchauffement climatique* / National observatory of the effects of global warming
www.ecologique-solidaire.gouv.fr/observatoire-national-sur-effets-du-rechauffement-climatique-onerc

UNFCCC: United Nations Framework Convention on Climate Change
unfccc.int

Université Paris-Dauphine - CGEMP - *Centre de géopolitique de l'énergie et des matières premières* / Centre of Energy Geopolitics and Raw Materials
www.cgemp.dauphine.fr
Climate Economics Chair
www.chaireeconomieduclimat.org

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This publication, in its organisation and choice of themes addressed, aims to inform as wide a public as possible about climate change, its mechanisms, causes and effects as well as about the measures introduced to limit the risks, at the international, European and national level.

In particular, it provides detailed statistics on greenhouse gas emissions in the world, in Europe and in France.

Key figures on climate

France, Europe and Worldwide

General Commission for Sustainable Development

Data and Statistical Studies Department (SDES)
Tour Séquoia – 92055 La Défense cedex
Contact: diffusion.sdes.cgdd@developpement-durable.gouv.fr

Directorate General for Energy and Climate (DGEC)
Tour Séquoia – 92055 La Défense Cedex
Contact: scee.dgec@developpement-durable.gouv.fr

Institute for Climate Economics (I4CE)
24 avenue Marceau – 75008 Paris
Contact: contact@i4ce.org

www.statistiques.developpement-durable.gouv.fr

PUBLIC STATISTICS

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