Climate change, transformation challenges

2011-2020 was around 1.1°C warmer than 1850-1900

Future emissions scenarios:
- very high
- high
- intermediate
- low
- very low

Global temperature change above 1850-1900 levels

Warming continues beyond 2100

Born in 1950 70 years old in 2020
Born in 1980 70 years old in 2050
Born in 2020 70 years old in 2090

Future experiences depend on how we address climate change
Seriousness
Urgency
Action

1000 lead authors, thousands of contributors and reviewers
85,000 publications
300,000 review comments


https://www.hautconseilclimat.fr
Where are we now?
Climate action is gaining momentum

Steady decrease of greenhouse gas emissions in more than 18 countries

More than half of global greenhouse gas emissions in the scope of public policies

Progress in adaptation planning and implementation, but fragmented and incremental responses, limits, growing adaptation gaps and evidence of maladaptation

Insufficient financial flows

Public policies have prevented several billion tons of CO₂-equivalent emissions each year

Renewable energies, batteries: decrease in costs, increases in installed capacities

Energy efficiency, demand management, reduction of food waste: affordable, high acceptability

Greening of cities, slowing of global net deforestation

but the pace and scale of what has been done so far, and current plans, are insufficient to limit the escalation of climate-related risks
Greenhouse gas emissions resulting from human activities continue to increase, with unequal historical and ongoing contributions.

Unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals.

Greenhouse gas emissions from human activities cause global heating and rapid, widespread and intensifying changes

- Irreversible ocean heat uptake
- Delayed responses from glaciers, the deep ocean, and the Greenland and Antarctic ice sheets
- Acceleration of global sea-level rise
Human activities have unequivocally caused global warming.
Key indicators of global climate updated in 2022

Global surface temperature

Antarctic sea ice

Human-induced warming is increasing at the unprecedented rate of over 0.2°C per decade, the result of greenhouse gas emissions being at an all-time high over the last decade, as well as reductions in the strength of aerosol cooling.

Key greenhouse gas concentrations

<table>
<thead>
<tr>
<th>Gas</th>
<th>AR6</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>410.1 ppm</td>
<td>417.1 ppm</td>
</tr>
<tr>
<td>CH₄</td>
<td>1866.3 ppb</td>
<td>1911.9 ppb</td>
</tr>
<tr>
<td>N₂O</td>
<td>332.1 ppb</td>
<td>335.9 ppb</td>
</tr>
</tbody>
</table>

Effective radiative forcing

<table>
<thead>
<tr>
<th></th>
<th>AR6</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 GtCO₂</td>
<td>2.72 W m⁻²</td>
<td>2.91 W m⁻²</td>
</tr>
<tr>
<td>2020 GtCO₂</td>
<td>0.79 W m⁻²</td>
<td>0.89 W m⁻²</td>
</tr>
</tbody>
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Earth's energy imbalance

Human-caused climate change increases the frequency and severity of extreme events

- **Hot extremes**
- **Heavy rainfall**
- **Agricultural drought**
Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected.
Examples of recent attribution studies

- Extreme humid heat in South Asia in April 2023, largely driven by climate change, detrimental to vulnerable and disadvantaged communities.
  - During May and June 2023, record-breaking heatwaves in India and Pakistan led to widespread heat-related health impacts.
  - 22 June 2023 | World Weather Attribution

- Climate change more than doubled the likelihood of extreme fire weather conditions in Eastern Canada.
  - Extreme poverty rendering Madagascar highly vulnerable to underreported extreme heat that would not have occurred without human-induced climate change.
  - Madagascar, in particular the most populated region around the capital of Antananarivo, experienced high temperatures in October 2023.
  - 30 November 2023 | Heatwaves in Africa

- Climate change increased heavy rainfall, hitting vulnerable communities in Eastern Northeast Brazil.
  - Climate change likely increased extreme monsoon rainfall, flooding highly vulnerable communities in Pakistan.
  - Climate change exacerbated heavy rainfall leading to large scale flooding in highly vulnerable communities in West Africa.
  - From May until October 2022, large parts of West Africa experienced large-scale flooding.
  - Interplay of climate change-exacerbated rainfall, exposure and vulnerability led to widespread impacts in the Mediterranean region.
  - During the first two weeks of September 2023, torrential rains fell in several countries across the Mediterranean, causing by low pressure systems forming around a blocking high centered over the Netherlands.
  - 19 September 2023 | Extreme Rainfall | Africa, Europe, Mediterranean

- Vulnerability and high temperatures exacerbate impacts of ongoing drought in Central South America.

- Human-Induced climate change increased drought severity in Horn of Africa.

- Human-Induced climate change compounded by socio-economic water stressors increased severity of drought in Syria, Iraq and Iran.

CO₂ emissions due to wildfires in Canada in 2023

https://www.worldweatherattribution.org

https://www.climameter.org/
Widespread and substantial impacts and related losses and damages are attributed to human-caused climate change.
Impacts are caused by changes in physical climate conditions, attributed to human influence, which will increase with every further increment of global warming.

Adverse impacts from human-caused climate change will continue to intensify with every increment of global warming.
France is strongly exposed to the consequences of climate change, including for food production, and not ready to face them.

2022, cost for insurance companies: 2,9Mrđ€

- Second hottest year after 2022
- Exceptional heatwave 17-24 August
- Hottest fall on record
- Record monthly precipitation in fall and floods in Northern France – severe drought in the South
- Oversea territories: record heat, historical drought (Guyane, Mayotte)

(Météo France, state of climate for 2023)
New loss and damage fund

the adverse effects of climate change, such as climate-related emergencies, sea level rise, displacement, relocation, migration, insufficient climate information and data, and the need for climate-resilient reconstruction and recovery.

Expected needs by 2030:
- at least 100 and up to 400 billion US $ per year

2023 pledges: 0.77 billion US $

What are possible futures?
Every ton of CO₂ adds to global warming

Cumulative CO₂ emissions and warming until 2050

these emissions determine how much warming we will experience

different emissions scenarios and their ranges of warming

Historical global warming

Cumulative CO₂ emissions (GtCO₂) since 1850
Future emissions will cause future warming
Global warming of 1.5°C will be reached in the early 2030s

Emissions scenarios and pathways

Global surface temperature change

+ emissions of short-lived compounds
+ modulation by natural variability

In the case of sharp emission reductions, discernable effects within 20 years on global surface temperature
Projections by 2300 in the context of past climate variations

Atmospheric CO₂ concentration (ppm)

Change in global mean surface temperature compared to 1850-1900 (°C)
With every increment of global warming, regional changes in mean climate become more widespread and pronounced.

https://interactive-atlas.ipcc.ch/
With every increment of global warming, regional changes in mean climate and extremes become more widespread and pronounced.
Future climate change is projected to increase the severity of impacts across natural and human systems and will increase regional differences. Examples of impacts without additional adaptation.

Risk of species losses
Percentage of animal species and seagrasses exposed to potentially dangerous temperature conditions\(^1,2\)

\(^1\)Includes 30,652 species of birds, mammals, reptiles, amphibians, marine fish, benthic marine invertebrates, krill, cephalopods, corals, and seagrasses.

Conservation, protection and restauration of ecosystems
Future climate change is projected to increase the severity of impacts across natural and human systems and will increase regional differences.

Examples of impacts without additional adaptation:

Risks differ by system

Land-based systems:
- Wildfire damage
- Permafrost degradation
- Biodiversity loss
- Dryland water scarcity
- Tree mortality
- Carbon loss

Ocean/coastal ecosystems:
- Warm-water corals
- Kelp forests
- Seagrass meadows
- Epipelagic
- Rocky shores
- Salt marshes

- e.g. over 100 million additional people exposed
- e.g. increase in the length of fire season
- e.g. coral reefs decline >99%
- e.g. coral reefs decline by 70–90%
Future climate change is projected to increase the severity of impacts across natural and human systems and will increase regional differences.

Examples of impacts without additional adaptation:

**Heat-humidity risks to human health**

**Historical 1991–2005**

**Days per year where combined temperature and humidity conditions pose a risk of mortality to individuals**

- 1.7 – 2.3°C
- 2.4 – 3.1°C
- 4.2 – 5.4°C
Future climate change is projected to increase the severity of impacts across natural and human systems and will increase regional differences.

Examples of impacts without additional adaptation:

**Food production impacts**

- Maize yield:
  - Changes (%) in yield
  - 1.6 – 2.4°C
  - 3.3 – 4.8°C
  - 3.9 – 6.0°C

- Fisheries yield:
  - Changes (%) in maximum catch potential
  - 0.9 – 2.0°C
  - 3.4 – 5.2°C

Areas with little or no production, or not assessed
Areas with model disagreement
Climate-related risks are increasingly complex and difficult to manage.
Losses and damages are part of our future, hitting the most vulnerable ecosystems and people especially hard, but the actions we take now will make a difference.

Adaptation and socio-economic pathways affect levels of climate related risks

Limited adaptation (failure to proactively adapt; low investment in health systems); incomplete adaptation (incomplete adaptation planning; moderate investment in health systems); proactive adaptation (proactive adaptation management; higher investment in health systems).

The SSP1 pathway illustrates a world with low population growth, high income, and reduced inequalities, food produced in low GHG emission systems, effective land use regulation and high adaptive capacity (i.e., low challenges to adaptation). The SSP3 pathway has the opposite trends.
Responding to sea level rise requires long-term planning.

The probability of abrupt / irreversible changes increases with the level of global warming.

Sea level rise will continue for millennia, but how fast and how much depends on future emissions.
Every increment of global warming intensifies key risks in every region

Africa

- Food production from crops, fisheries and livestock in Africa
- Biodiversity and ecosystems in Africa
- Mortality and morbidity from heat and infectious disease in Africa
- Delayed impacts of sea level rise in the Mediterranean

Risk levels:
- Very high
- High
- Moderate
- Undetectable

Migrations
Cultural heritage
Reduced economic growth
Every increment of global warming intensifies key risks in every region

Key risks for Europe under low to medium adaptation

- Human heat stress, mortality and morbidity
- Marine ecosystems disruptions
- Terrestrial ecosystems disruptions
- Losses in crop production
- Water scarcity in Southern Europe (SEU)
- Water scarcity in Western and Central Europe (WCE)
- River and pluvial flooding
- Coastal flooding
- Delayed risks for cultural heritage and long-living infrastructure

Niveau de risque:
- Très élevé
- Élevé
- Modéré
- Indétectable

Small islands
- Ecosystem degradation
- Resources
- Coral reefs
- Water stress
- Food insecurity
- Flooding (health, heritage)
- Habitability
- Losses and damages
• By 2050-2060, 2°C of global warming imply 3°C warming for France (= record temperature in 2022)
• By 2100, 3°C of global warming imply around 4°C for France
• Reference framework for adaptation including low likelihood, high impact eventualities
• Adaptation must shift from the current prevalent mode today to become transformative, building on scientific knowledge and anticipating costs
How to accelerate climate action?
France greenhouse gas emissions

Raw emissions
2021-2022 : -2.7%
2022-2023 : -4.6% (partial estimate)

Conjunctural factors (energy, inflation)

The second carbon budget (2019-2023) could be exceeded when accounting for the weaker managed forest sink

Rates of emission reductions should almost double in 2023-2030 compared to 2019-2022 to be compliant with targets

Accelerated efforts are needed in each sector supported by just transition economical policies

Food system, 22% of the French carbon footprint (including 46% from imported emissions)
Remaining carbon budgets to limit warming to 1.5°C could soon be exhausted, and those for 2°C largely depleted.

2023 update: divided by 2
Limiting global warming well below 2°C and close to 1.5°C requires immediate, rapid and deep reductions in greenhouse gas emissions.

Technical potential to divide emissions by a factor of 2 by 2030 when combining technological innovation, demand management and ecosystem-based responses.
COP28 outcomes

- Global framework for adaptation
- Energy transition

Estimating the impact of COP28 initiatives
What is overlap, what is achievable and what needs work?

- Historical: incl. LULUCF
- Current policies
- Pledges & targets
- 1.5°C Paris Agreement compatible
- Target gap 19–22 GtCO₂e
- Implementation gap 24–27 GtCO₂e
- 1.5°C emissions gaps in 2030

Overlap
- Reductions already contained within current NDCs

Achievable
- Potential reductions on top of current NDCs based on current signatories

Needs work
- Theoretical further reductions that could be achieved if all countries sign and implement

Global greenhouse gas emissions (GtCO₂e/year)

Dec 2023 update
There are multiple opportunities for scaling up climate action. Feasibility of climate responses and adaptation, and potential of mitigation options in the near-term.

**Climate responses and adaptation options**

- Improved air quality
- Healthy diets
- Ecosystem health

**Mitigation options**

- Solar
- Wind
- Reduce methane from coal, oil and gas
- Bioelectricity (includes BECCS)
- Geothermal and hydropower
- Nuclear
- Fossil Carbon Capture and Storage (CCS)

**Feasibility level and synergies with mitigation**

- High
- Medium
- Low
- Insufficient evidence

**Confidence level in potential feasibility and in synergies with mitigation**

- *** High
- ** Medium
- * Low

**Net lifetime cost of options**

- Costs are lower than the reference
- 0–20 (USD per tCO2-eq)
- 20–50 (USD per tCO2-eq)
- 50–100 (USD per tCO2-eq)
- 100–200 (USD per tCO2-eq)
- Cost not allocated due to high variability or lack of data
There are multiple opportunities for scaling up climate action.

Feasibility of climate responses and adaptation, and potential of mitigation options in the near-term.

- **Climate responses and adaptation options**
  - Sustainable urban water management
  - Sustainable land use and urban planning
  - Green infrastructure and ecosystem services
  - Enhanced health services (e.g., WASH, nutrition and diets)

- **Mitigation options**
  - Efficient buildings
  - Fuel efficient vehicles
  - Electric vehicles
  - Efficient lighting, appliances, and equipment
  - Public transport and bicycling
  - Biofuels for transport
  - Efficient shipping and aviation
  - Avoid demand for energy services
  - Onsite renewables

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- **High**
- **Medium**
- **Low**
- **Insufficient evidence**

**Confidence level in potential feasibility and in synergies with mitigation**
- **High**
- **Medium**
- **Low**

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- 100–200 (USD per tCO₂-eq)
- 20–50 (USD per tCO₂-eq)
- Cost not allocated due to high variability or lack of data

**Options costing 100 USD tCO₂-eq or less could reduce global emissions by at least half of the 2019 level by 2030.**

- **Thermal comfort**
- **Air quality**
- **Active mobilities**

**Health systems**

**Solidarity**
Strategies and infrastructures to enable low-carbon lifestyles

Demand-side options (efficiency, sufficiency):
40 - 70% of global greenhouse gas emission reduction potential by 2050

Equity and just transition

Quality of life, well-being and health benefits

Sufficiency: set of measures and daily practices that avoid demand for energy, materials, land and water while delivering human well-being for all within planetary boundaries.
Scaling-up adaptation and mitigation actions is critical for sustainable development

Their implementation needs to account for co-benefits and possible trade-offs with each sustainable development goal
With rapid action, it is possible to build a liveable and sustainable future for all through climate resilient development.