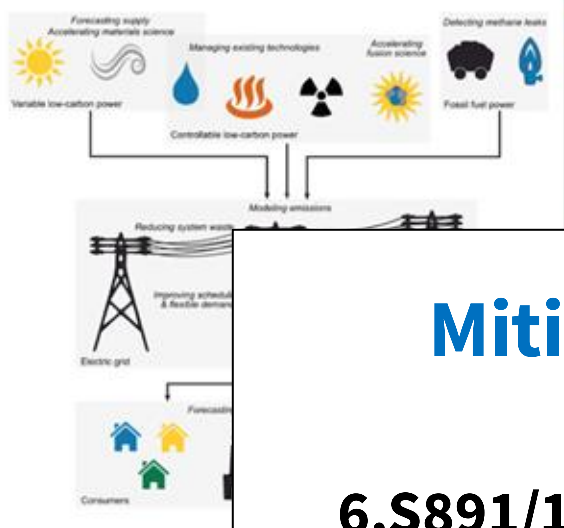
Mitigation of Climate Change

6.S891/12.S992/6.S893: AI for Climate Action

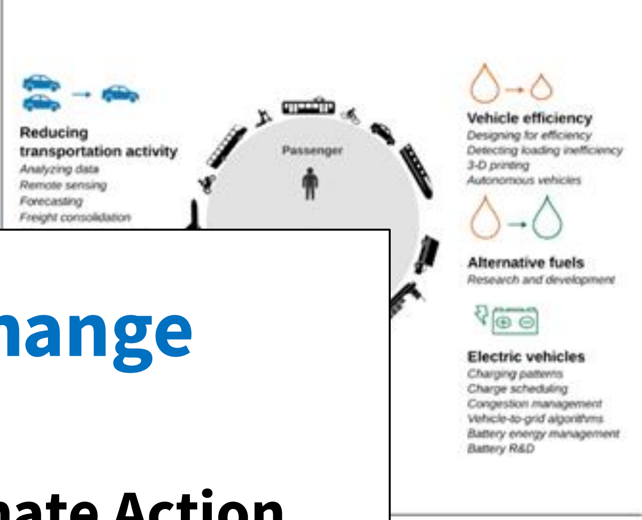
Spring 2026

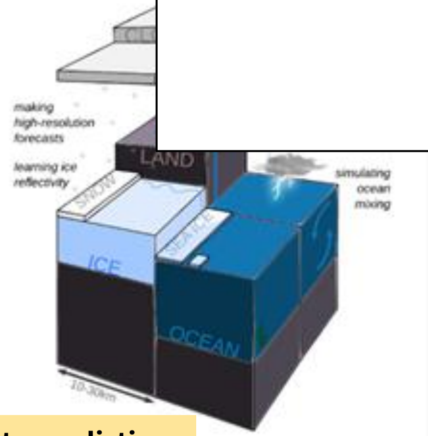
Electricity systems



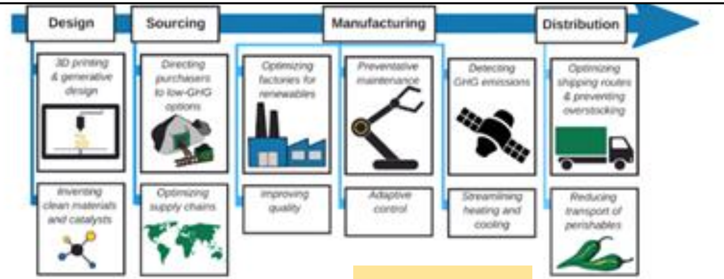
Buildings

Transportation

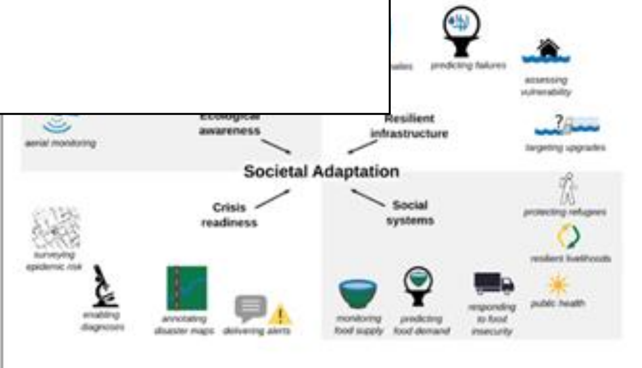




Climate prediction



Industry



Societal adaptation

Outline

Where do greenhouse gas (GHG) emissions come from?

What actions can we take in different sectors to reduce GHGs?

What macro-level strategies do we have to enable these actions?

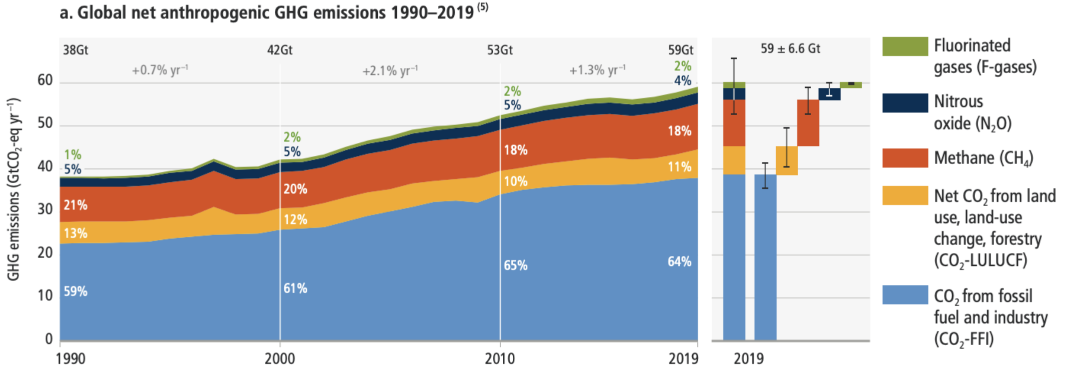
Outline

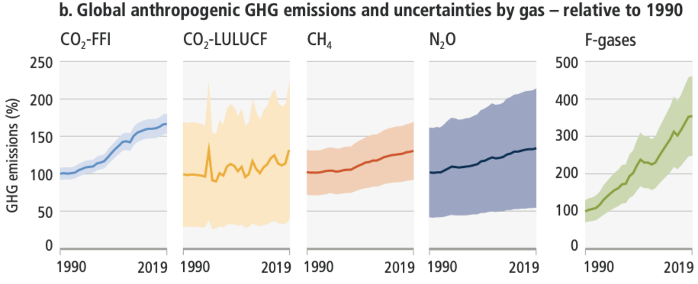
Where do greenhouse gas (GHG) emissions come from?

What actions can we take in different sectors to reduce GHGs?

What macro-level strategies do we have to enable these actions?

Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.





	2019 emissions ($GtCO_2$-eq)	1990–2019 increase ($GtCO_2$-eq)	Emissions in 2019, relative to 1990 (%)
CO_2-FFI	38 ± 3	15	167
CO_2-LULUCF	6.6 ± 4.6	1.6	133
CH_4	11 ± 3.2	2.4	129
N_2O	2.7 ± 1.6	0.65	133
F-gases	1.4 ± 0.41	0.97	354
Total	59 ± 6.6	21	154

The solid line indicates central estimate of emissions trends. The shaded area indicates the uncertainty range.

Figure SPM.1 | Global net anthropogenic GHG emissions ($GtCO_2$-eq yr^{-1}) 1990–2019. Global net anthropogenic GHG emissions include CO_2 from fossil fuel combustion and industrial processes (CO_2-FFI); net CO_2 from land use, land-use change and forestry (CO_2-LULUCF)[9]; methane (CH_4); nitrous oxide (N_2O); and fluorinated gases (HFCs, PFCs, SF_6, NF_3).[6] **Panel a** shows aggregate annual global net anthropogenic GHG emissions by groups of gases from 1990 to 2019 reported in $GtCO_2$-eq converted based on global warming potentials with a 100-year time horizon (GWP100-AR6) from the IPCC Sixth Assessment Report Working Group I (Chapter 7). The fraction of global emissions for each gas is shown for 1990, 2000, 2010 and 2019; as well as the aggregate average annual growth rate between these decades. At the right side of Panel a, GHG emissions in 2019 are broken down into individual components with the associated uncertainties (90% confidence interval) indicated by the error bars: CO_2-FFI ±8%; CO_2-LULUCF ±70%; CH_4 ±30%; N_2O ±60%; F-gases ±30%; GHG ±11%. Uncertainties in GHG emissions are assessed in Supplementary Material 2.2. The single-year peak of emissions in 1997 was due to higher CO_2-LULUCF emissions from a forest and peat fire event in South East Asia. **Panel b** shows global anthropogenic CO_2-FFI, net CO_2-LULUCF, CH_4, N_2O and F-gas emissions individually for the period 1990–2019, normalised relative to 100 in 1990. Note the different scale for the included F-gas emissions compared to other gases, highlighting its rapid growth from a low base. Shaded areas indicate the uncertainty range. Uncertainty ranges as shown here are specific for individual groups of greenhouse gases and cannot be compared. The table shows the central estimate for: absolute emissions in 2019; the absolute change in emissions between 1990 and 2019; and emissions in 2019 expressed as a percentage of 1990 emissions. {2.2, Figure 2.5, Supplementary Material 2.2, Figure TS.2}

Source: [IPCC AR6 WG3 SPM 2022]

Greenhouse gas emissions by sector

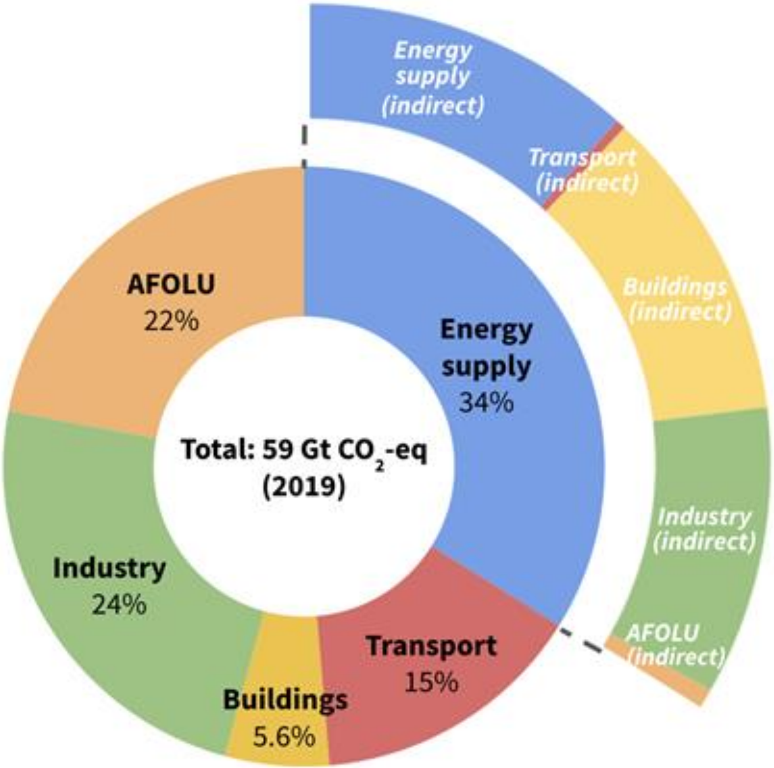
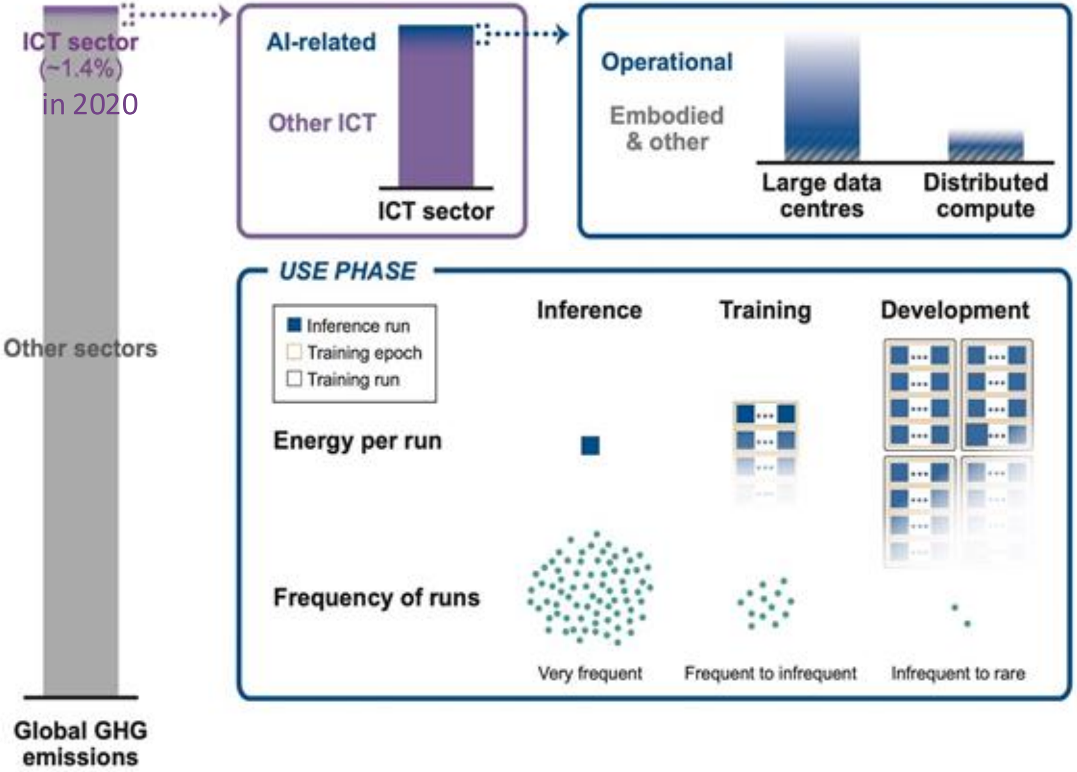


Figure data based on [IPCC AR6 WG3 SPM 2022]. Percentages shown do not add to exactly 100% due to rounding to two significant figures.

A new sector?
Impacts from AI computation & hardware

Operational impacts from energy & water consumed during computation

Embodied emissions & materials impacts from production, transport, and disposal of hardware

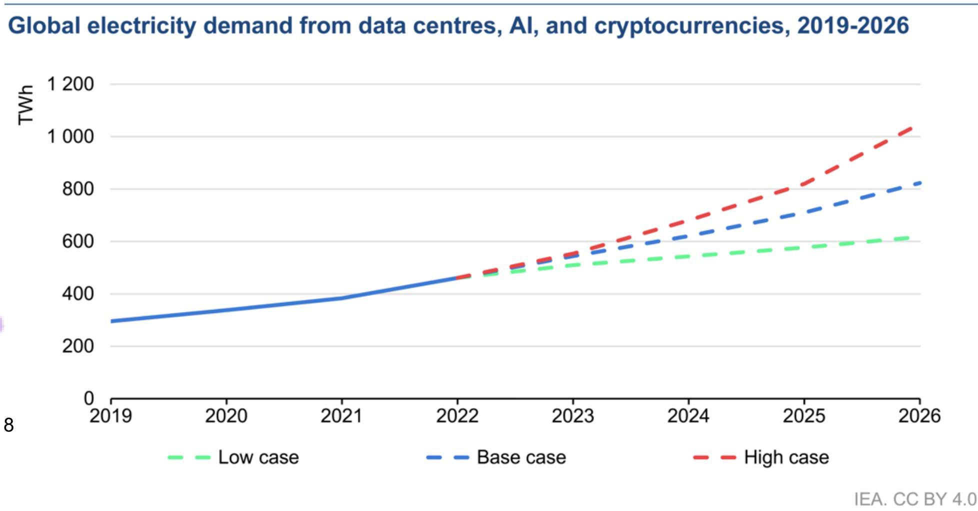


Kaack, L. H., Donti, P. L., Strubell, E., Kamiya, G., Creutzig, F., & Rolnick, D. (2022). Aligning artificial intelligence with climate change mitigation. *Nature Climate Change*, 1-10.

Data center electricity demand is rapidly growing

6% increase
btwn 2010 and 2018

(despite 5.5x increase in compute instances)



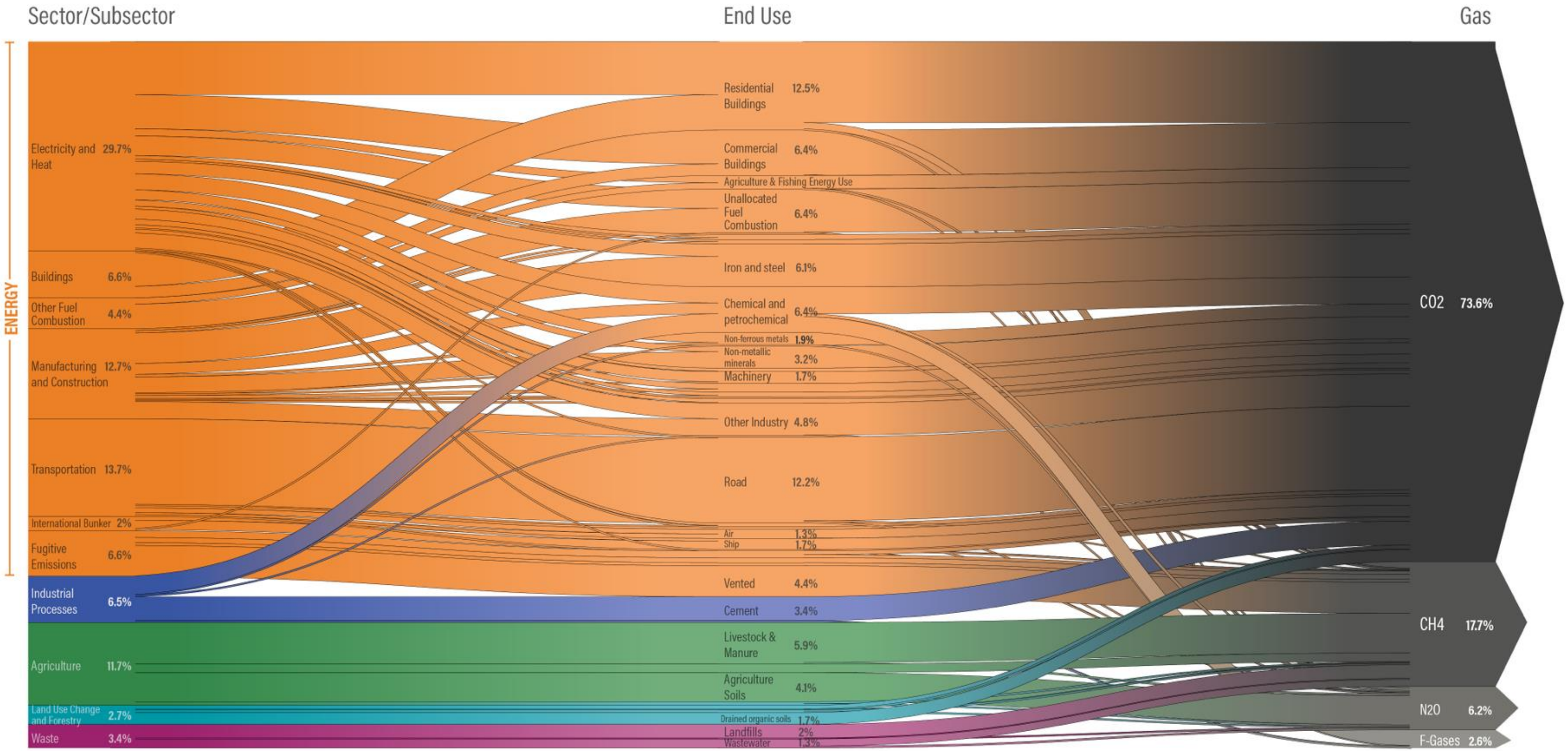
> 2x increase
btwn 2019 and 2026

[left] Rough estimates, based on:
Masanet, Eric, et al. "Recalibrating global data center energy-use estimates." Science (2020)

[right] Source: IEA, "Electricity 2024: Analysis and forecast to 2026"

World Greenhouse Gas Emissions in 2021 (Sector | End Use | Gas)

Total: 50 GtCO2e



Source: Climate Watch, based on raw data from IEA (2022), GHG Emissions from Fuel Combustion; modified by WRI.

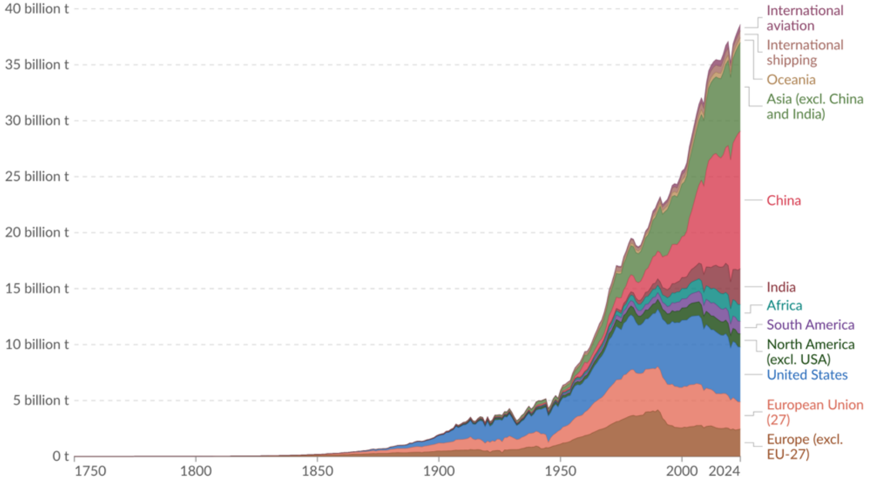
WORLD RESOURCES INSTITUTE

Source: https://www.wri.org/data/world-greenhouse-gas-emissions-2021

Annual CO_2 emissions by world region

Our World in Data

Emissions from fossil fuels and industry[1] are included, but not land-use change emissions[2]. International aviation and shipping are included as separate entities, as they are not included in any country's emissions.



Data source: Global Carbon Budget (2025)

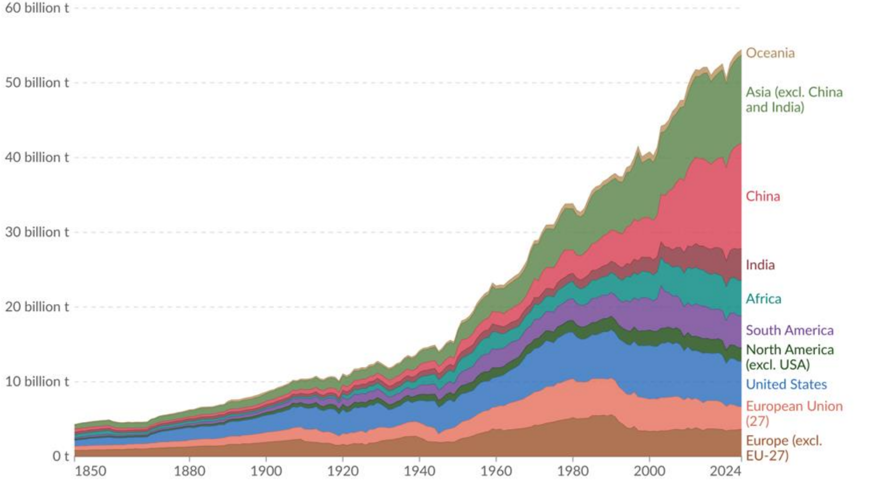
1. Fossil CO_2 emissions This refers to the carbon dioxide released when burning fossil fuels or from certain industrial activities.
Burning fossil fuels — coal, oil, and gas — produces CO_2 during transport (cars, trucks, planes), electricity generation, heating, and energy use in industry. This also includes flaring, which is the burning of extra gas during oil and gas extraction.
Some industrial processes also release CO_2. This happens especially in cement and steel production, where chemical reactions (unrelated to burning fuel) produce carbon dioxide.
These figures don't include CO_2 emissions from changes in land use, like deforestation or reforestation.

2. Land-use change emissions Land-use change emissions are the carbon dioxide (CO_2) released or removed when land use changes.
They mostly come from deforestation, forest degradation, turning forests or other ecosystems into cropland or pasture, and draining peatlands. When vegetation is cleared or burned, the carbon stored in plants and soil is released as CO_2.
Land-use change can also remove CO_2 from the atmosphere when vegetation grows back, for example, when forests regrow. This can lead to negative emissions in the data.
In scientific and policy discussions, these emissions are sometimes grouped under the broader term "LULUCF" (land use, land-use change, and forestry).
These estimates are uncertain because they depend on limited data and assumptions about land cover, how much carbon is stored in ecosystems, and how land is managed.
They are separate from fossil CO_2 emissions from burning fossil fuels and certain industrial processes.

Annual greenhouse gas emissions by world region, 1850 to 2024

Our World in Data

Greenhouse gas emissions[1] include carbon dioxide, methane and nitrous oxide from all sources, including land-use change[2]. They are measured in tonnes of carbon dioxide-equivalents[3] over a 100-year timescale.



Data source: Jones et al. (2025)

1. Greenhouse gas emissions A greenhouse gas (GHG) is a gas that causes the atmosphere to warm by absorbing and emitting radiant energy.
Greenhouse gases absorb radiation that is radiated by Earth, preventing this heat from escaping to space.
Carbon dioxide (CO_2) is the most well-known greenhouse gas, but there are others including methane, nitrous oxide, and in fact, water vapor.
Human-made emissions of greenhouse gases from fossil fuels, industry, and agriculture are the leading cause of global climate change.
Greenhouse gas emissions measure the total amount of all greenhouse gases that are emitted. These are often quantified in carbon dioxide equivalents (CO_2eq) which take account of the amount of warming that each molecule of different gases creates.

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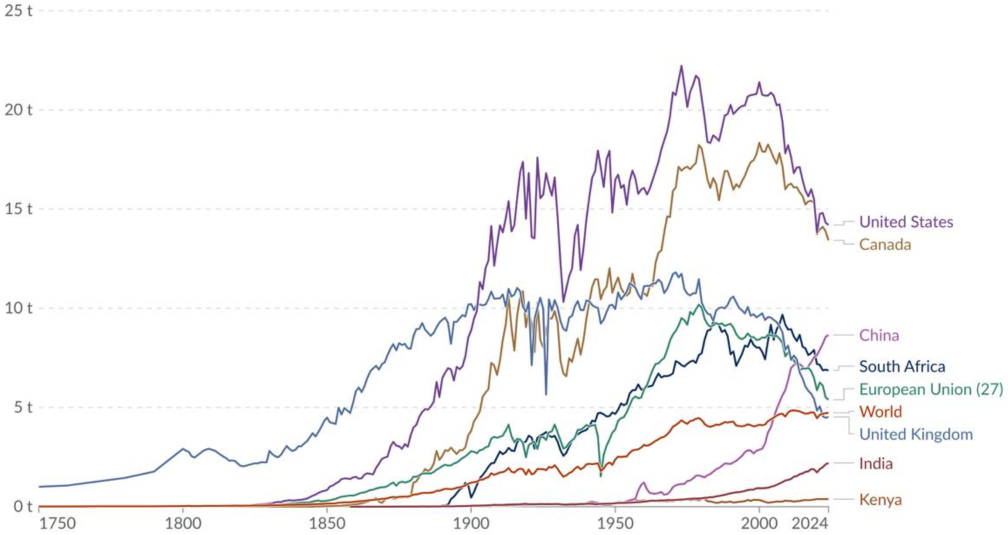
3. Carbon dioxide equivalents (CO_2eq) Carbon dioxide is the most important greenhouse gas, but not the only one. To capture all greenhouse gas emissions, researchers express them in "carbon dioxide equivalents" (CO_2eq). This takes all greenhouse gases into account, not just CO_2.
To express all greenhouse gases in carbon dioxide equivalents (CO_2eq), each one is weighted by its global warming potential (GWP) value. GWP measures the amount of warming a gas creates compared to CO_2. CO_2 is given a GWP value of one. If a gas had a GWP of 10 then one kilogram of that gas would generate ten times the warming effect as one kilogram of CO_2.
Carbon dioxide equivalents are calculated for each gas by multiplying the mass of emissions of a specific greenhouse gas by its GWP factor.
This warming can be stated over different timescales. To calculate CO_2eq over 100 years, we'd multiply each gas by its GWP over a 100-year timescale (GWP100).
Total greenhouse gas emissions – measured in CO_2eq – are then calculated by summing each gas' CO_2eq value.

Source: https://ourworldindata.org/co2-and-greenhouse-gas-emissions

CO_2 emissions per capita

Our World in Data

Carbon dioxide (CO_2) emissions from burning fossil fuels and industrial processes[1]. This includes emissions from transport, electricity generation, and heating, but not land-use change[2].



Data source: Global Carbon Budget (2025); Population based on various sources (2024)

OurWorldinData.org/co2-and-greenhouse-gas-emissions |

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Source:
https://ourworldindata.org/co2-and-greenhouse-gas-emissions

Importance of sustainable development

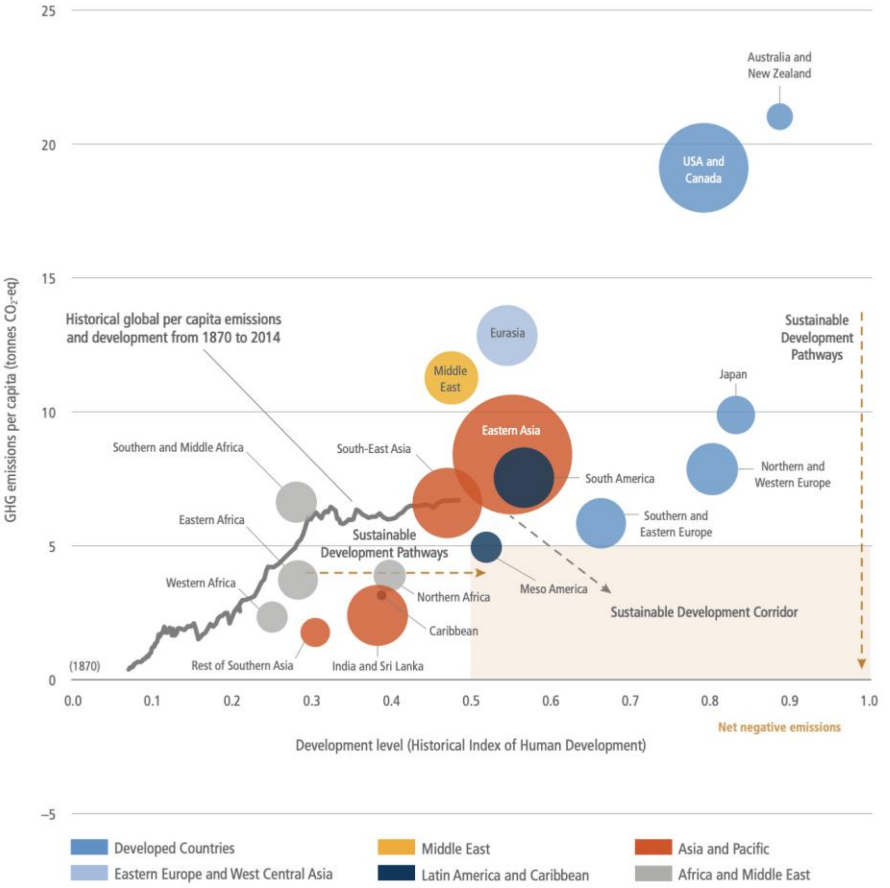


Figure TS.1 | Sustainable development pathways towards fulfilling the Sustainable Development Goals. The graph shows global average per-capita GHG emissions (vertical axis) and relative 'Historic Index of Human Development' (HIHD) levels (horizonal) have increased globally since the industrial revolution (grey line). The bubbles on the graph show regional per-capita GHG emissions and human development levels in the year 2015, illustrating large disparities. Pathways towards fulfilling the Paris Agreement (and SDG 13) involve global average per-capita GHG emissions below about 5 tCO_2-eq by 2030. Likewise, to fulfil SDGs 3, 4 and 8, HIHD levels (see footnote 7 in Chapter 1) need to be at least 0.5 or greater. This suggests a 'sustainable development zone' for year 2030 (in pale brown); the in-figure text also suggests a 'sustainable development corridor', where countries limit per-capita GHG emissions while improving levels of human development over time. The emphasis of pathways into the sustainable development zone differ (dashed brown arrows), but in each case transformations are needed in how human development is attained while limiting GHG emissions.

Source: [IPCC AR6 WG3 TS 2022]

Outline

Where do greenhouse gas (GHG) emissions come from?

What actions can we take in different sectors to reduce GHGs?

What macro-level strategies do we have to enable these actions?

Climate change mitigation

Mitigation: Reducing or preventing GHG emissions

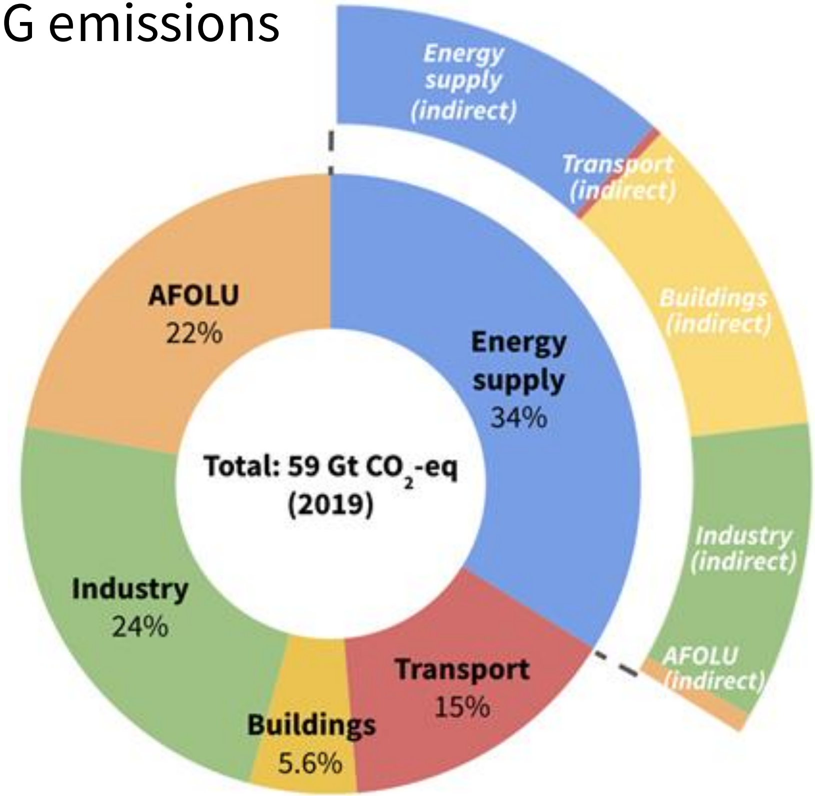


Figure data based on IPCC AR6 WG3 Report (2022). Percentages shown do not add to exactly 100% due to rounding to two significant figures.

Climate change mitigation

Mitigation: Reducing or preventing GHG emissions

Sectors

Energy supply
Transportation
Buildings
Industry
Agriculture
Forestry
Other land use
CO_2 removal

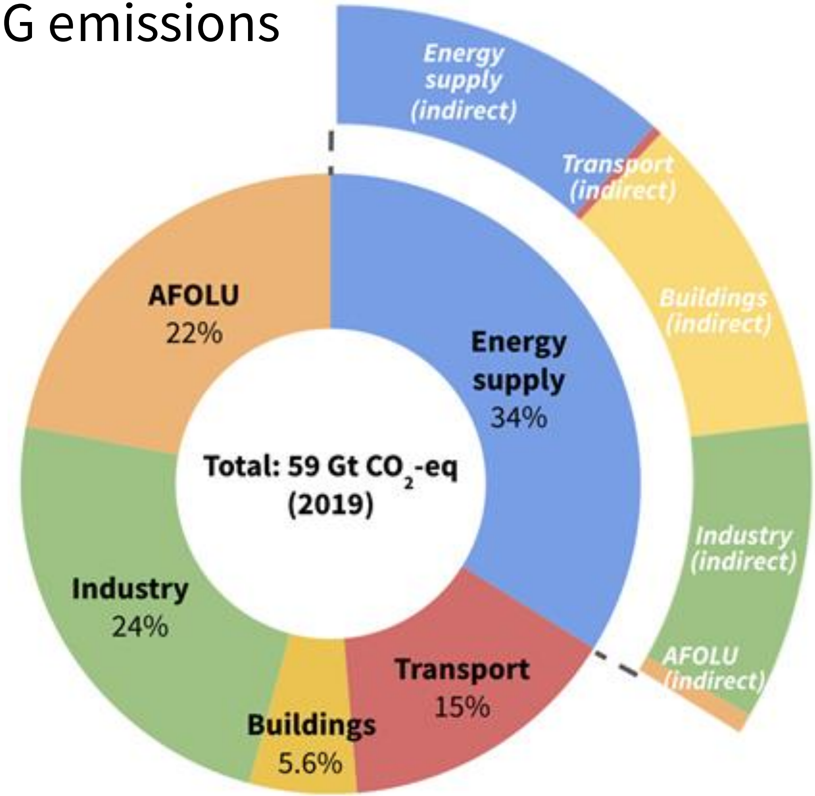


Figure data based on IPCC AR6 WG3 Report (2022). Percentages shown do not add to exactly 100% due to rounding to two significant figures.

Climate change mitigation

Mitigation: Reducing or preventing GHG emissions

Sectors

Energy supply
Transportation
Buildings
Industry
Agriculture
Forestry
Other land use
CO_2 removal

Energy-related emissions

Mitigation: Energy-related emissions

Conceptual framework based on **Kaya identity:**

$$\left(\text{GHG emissions} = \text{population} \times \frac{\text{service}}{\text{population}} \times \frac{\text{energy}}{\text{service}} \times \frac{\text{GHG emissions}}{\text{energy}} \right)$$

Mitigation: Energy-related emissions

Conceptual framework based on **Kaya identity:**

$$\left(\text{GHG emissions} = \text{population} \times \frac{\text{service}}{\text{population}} \times \frac{\text{energy}}{\text{service}} \times \frac{\text{GHG emissions}}{\text{energy}} \right)$$

Reducing consumption

Example: Passenger cars *Service = vehicle-kilometers* 	Reduce number of miles driven ▸ Individual change: Move closer to work ▸ Systemic change: Dense urban areas Increase passengers per trip and vehicle
General energy-related sectors	Individual behavior changes Systemic changes & structural improvements

Mitigation: Energy-related emissions

Conceptual framework based on **Kaya identity:**

$$\text{GHG emissions} = \text{population} \times \frac{\text{service}}{\text{population}} \times \boxed{\frac{\text{energy}}{\text{service}}} \times \frac{\text{GHG emissions}}{\text{energy}}$$

Improving efficiency

Example: Passenger cars

Service = vehicle-kilometers

Improve vehicle efficiency (e.g., fuel economy)

Drive more efficiently

Switch to other transport modes (e.g., bikes)

General energy-related sectors

Efficient end-use technologies

Efficient generation technologies

Mitigation: Energy-related emissions

Conceptual framework based on **Kaya identity:**

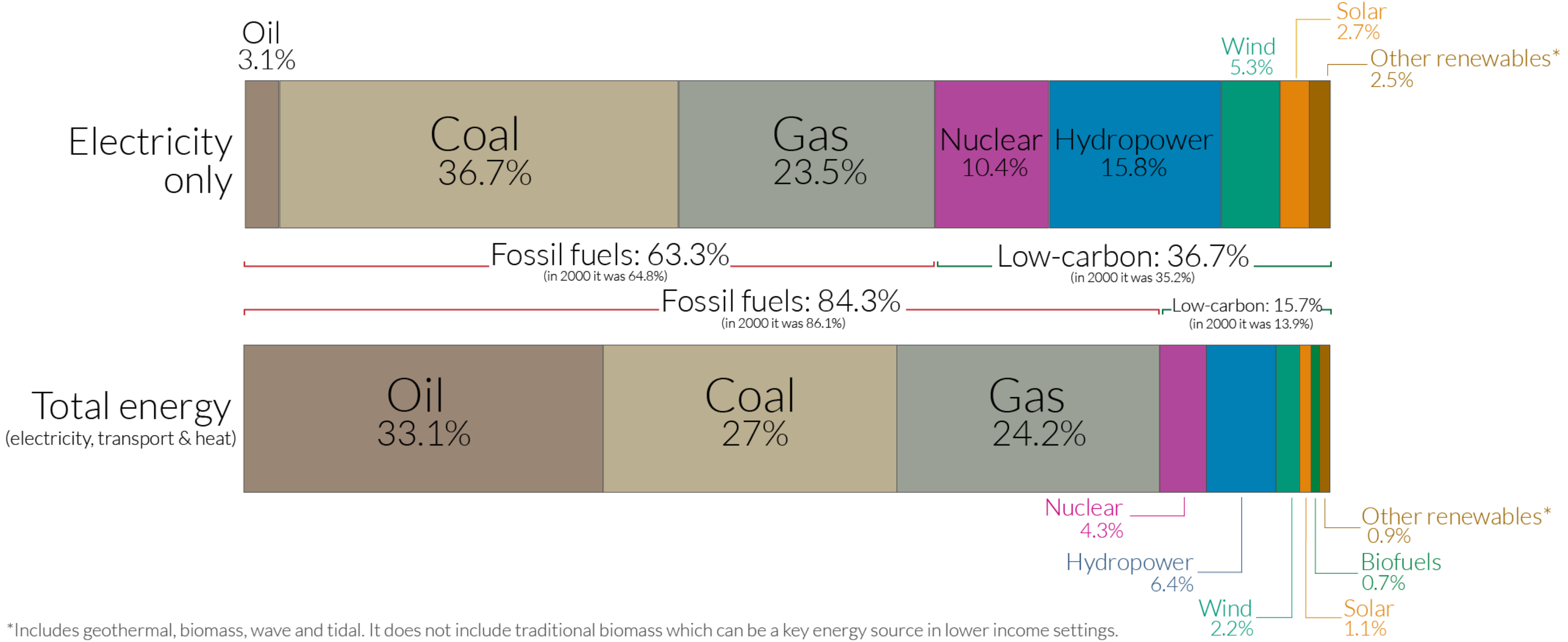
$$\left(\text{GHG emissions} = \text{population} \times \frac{\text{service}}{\text{population}} \times \frac{\text{energy}}{\text{service}} \times \frac{\text{GHG emissions}}{\text{energy}} \right)$$

Switching to clean energy

Example: Passenger cars *Service = vehicle-kilometers* 	Switch to battery electric vehicles (powered by a clean grid) Switch to alternative clean fuels (e.g., electrofuels, solar fuels, hydrogen)
General energy-related sectors	Electrify & switch to low-carbon power Replace fossil fuels with clean alternative fuels

More than one-third of global electricity comes from low-carbon sources; but a lot less of total energy does

Our World in Data



*Includes geothermal, biomass, wave and tidal. It does not include traditional biomass which can be a key energy source in lower income settings.

OurWorldinData.org – Research and data to make progress against the world's largest problems.

Source: Our World in Data based on BP Statistical Review of World Energy (2020). Based on the primary energy and electricity mix in 2019.

Source: https://ourworldindata.org/low-carbon-electricity

Mitigation: Energy-related emissions

Conceptual framework based on **Kaya identity:**

$$\left(\text{GHG emissions} = \text{population} \times \frac{\text{service}}{\text{population}} \times \frac{\text{energy}}{\text{service}} \times \frac{\text{GHG emissions}}{\text{energy}} \right)$$

Reducing consumption

Improving efficiency

Switching to clean energy

Climate change mitigation

Mitigation: Reducing or preventing GHG emissions

Sectors

Energy supply Transportation Buildings Industry	**Energy-related emissions**
Agriculture Forestry Other land use	**Land use (AFOLU) emissions**
CO_2 removal	

Mitigation: Land use emissions

GHG emissions result from (e.g.)

- Land use changes (forests, peatlands, etc.)
- Livestock
- Fertilizer use
- Crop cultivation practices

Complex to assess effects of interventions

- Natural systems are in complex carbon cycle
- Interactions between climate system, natural factors, socioeconomic factors

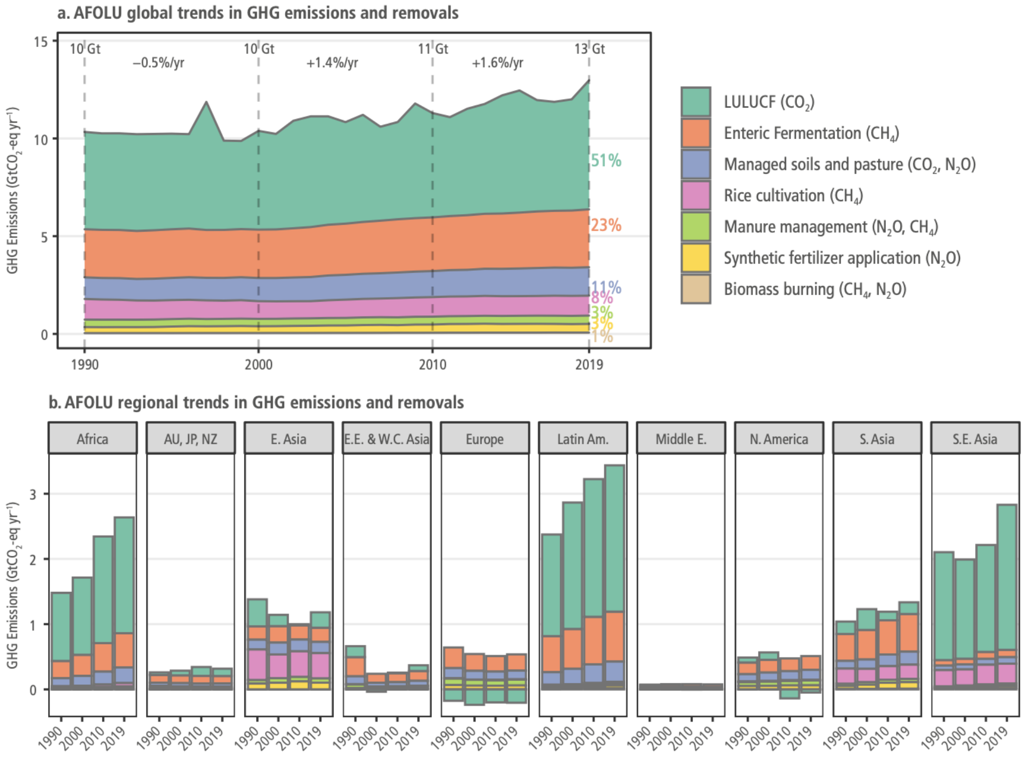


Figure 7.3 | Subdivision of the total AFOLU emissions from Table 7.1 by activity and gas for the period 1990 to 2019. Positive values are emissions from land to atmosphere, negative values are removals. Panel A shows emissions divided into major activity and gases. Note that 'biomass burning' is only the burning of agriculture residues in the fields. The indicated growth rates between 1990–2000, 2000–2010, 2010–2019 are annualised across each time period. Panel B illustrates regional emissions in the years 1990, 2000, 2010, 2019 AFOLU CO_2 (green shading) represents all AFOLU CO_2 emissions. It is the mean from three bookkeeping models (Hansis et al. 2015; Houghton and Nassikas 2017; Gasser et al. 2020) as presented in the Global Carbon Budget (Friedlingstein et al. 2020) and is *not directly comparable to LULUCF in NGHGIs* (Section 7.2.2). Data on CH_4 and N_2O emissions are from the EDGAR database (Crippa et al. 2021). See Sections 7.2.2 and 7.2.3 for comparison of different datasets. All values expressed are as CO_2-eq with GWP100 values: CH_4 = 27, N_2O = 273.

Figure source: [IPCC AR6 WG3 AFOLU 2022]

Example mitigation strategies: Land use

Natural systems	Agriculture	Demand-side measures
Prevent deforestation Preserve peatlands and coastal wetlands Protect biodiversity Protect indigenous rights	Improve land mgmt. Reduce fertilizer use Reduce cows & ruminants Improve cultivation practices	Reduce losses in food supply chain Dietary change Change wood procurement practices

Monitoring: E.g., via remote sensing

See also: [IPCC AR6 WG3 AFOLU 2022]

Climate change mitigation

Mitigation: Reducing or preventing GHG emissions

Sectors

Sectors	
Energy supply Transportation Buildings Industry	**Energy-related emissions**
Agriculture Forestry Other land use	**Land use (AFOLU) emissions**
CO_2 removal	**“Negative emissions”**

Mitigation: Negative emissions strategies

Negative emissions strategies remove CO_2 from the atmosphere

- **Carbon capture and storage** (CCS): Use sorbents to capture CO_2 from exhaust or directly from air
  - Related: Bioenergy with carbon capture and storage (BECCS)
- **Enhancing natural sinks:** Afforestation, reforestation, soil carbon restoration, peatland restoration, etc.
- **Biochar:** Pyrolize plant materials & store underground

Climate change mitigation

Mitigation: Reducing or preventing GHG emissions

Sectors

Energy supply
Transportation
Buildings
Industry

Energy-related emissions

Agriculture
Forestry
Other land use

Land use (AFOLU) emissions

CO_2 removal

“Negative emissions”

Many options available now in all sectors are estimated to offer substantial potential to reduce net emissions by 2030. Relative potentials and costs will vary across countries and in the longer term compared to 2030.

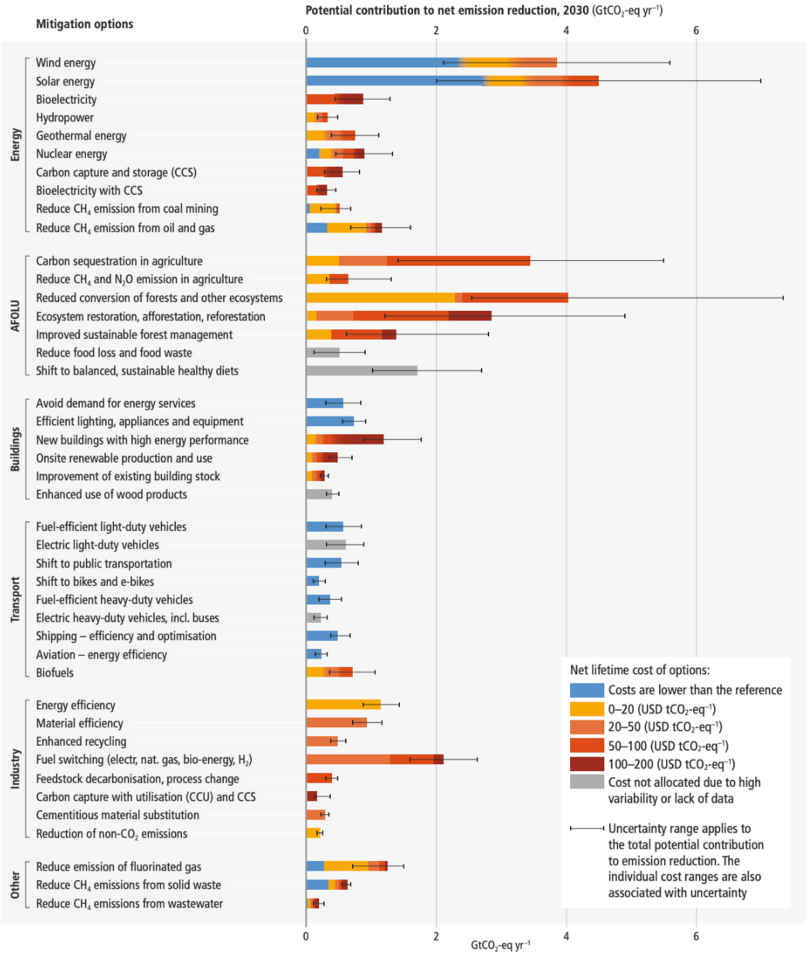


Figure SPM.7 | Overview of mitigation options and their estimated ranges of costs and potentials in 2030.

Some mitigation options are already more cost-effective than the prior alternative(s)

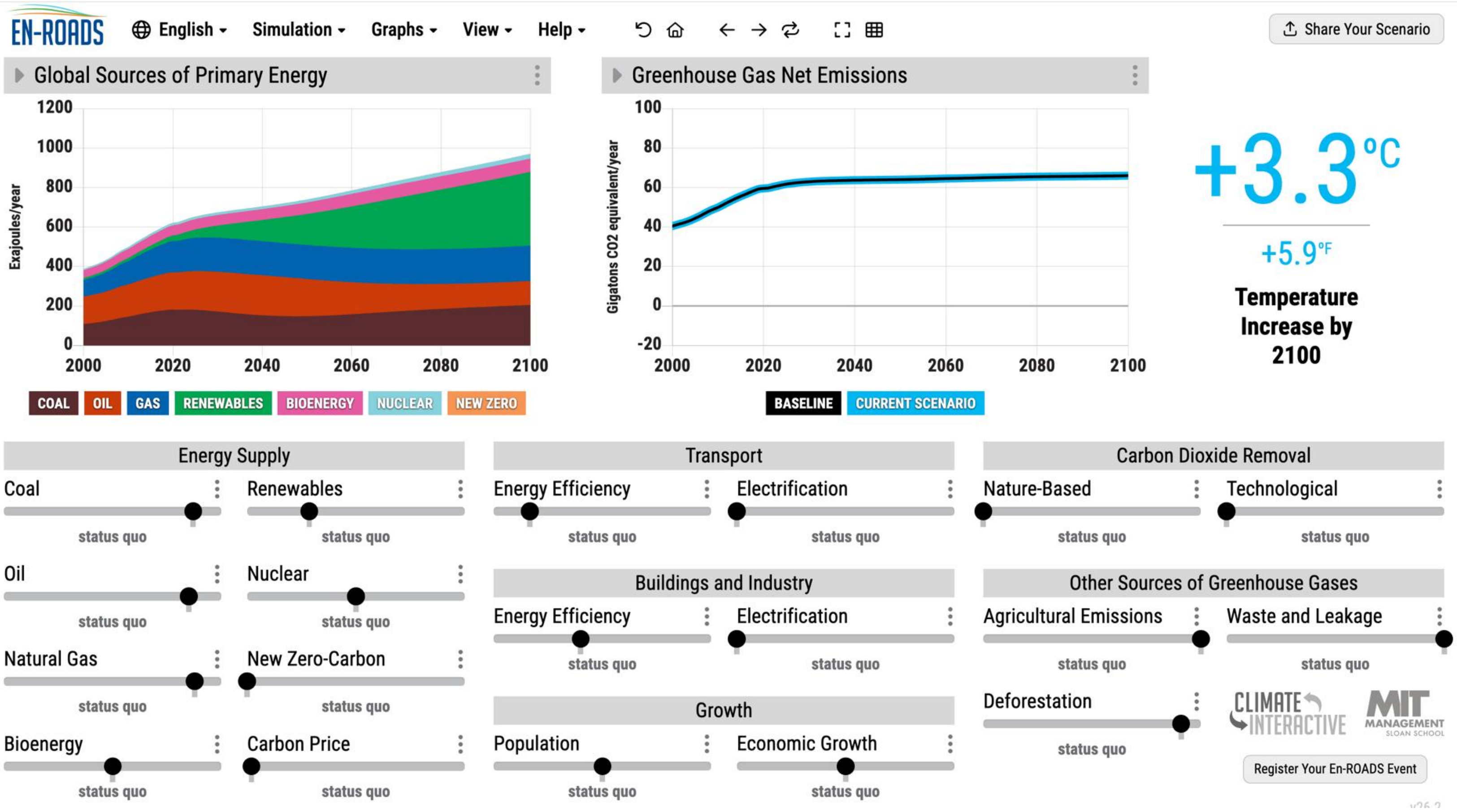
Others require policy, regulation, and innovation support

Figure SPM.7 (continued): Overview of mitigation options and their estimated ranges of costs and potentials in 2030. Costs shown are net lifetime costs of avoided greenhouse gas emissions. Costs are calculated relative to a reference technology. The assessments per sector were carried out using a common methodology, including definition of potentials, target year, reference scenarios, and cost definitions. The mitigation potential (shown in the horizontal axis) is the quantity of net GHG emission reductions that can be achieved by a given mitigation option relative to a specified emission baseline. Net GHG emission reductions are the sum of reduced emissions and/or enhanced sinks. The baseline used consists of current policy (around 2019) reference scenarios from the AR6 scenarios database (25/75 percentile values). The assessment relies on approximately 175 underlying sources, that together give a fair representation of emission reduction potentials across all regions. The mitigation potentials are assessed independently for each option and are not necessarily additive. {12.2.1, 12.2.2} The length of the solid bars represents the mitigation potential of an option. The error bars display the full ranges of the estimates for the total mitigation potentials. Sources of uncertainty for the cost estimates include assumptions on the rate of technological advancement, regional differences, and economies of scale, among others. Those uncertainties are not displayed in the figure. Potentials are broken down into cost categories, indicated by different colours (see legend). Only discounted lifetime monetary costs are considered. Where a gradual colour transition is shown, the breakdown of the potential into cost categories is not well known or depends heavily on factors such as geographical location, resource availability, and regional circumstances, and the colours indicate the range of estimates. Costs were taken directly from the underlying studies (mostly in the period 2015–2020) or recent datasets. No correction for inflation was applied, given the wide cost ranges used. The cost of the reference technologies were also taken from the underlying studies and recent datasets. Cost reductions through technological learning are taken into account.[69]

- When interpreting this figure, the following should be taken into account:
- The mitigation potential is uncertain, as it will depend on the reference technology (and emissions) being displaced, the rate of new technology adoption, and several other factors.
- Cost and mitigation potential estimates were extrapolated from available sectoral studies. Actual costs and potentials would vary by place, context and time.
- Beyond 2030, the relative importance of the assessed mitigation options is expected to change, in particular while pursuing long-term mitigation goals, recognising also that the emphasis for particular options will vary across regions (for specific mitigation options see SPM Sections C4.1, C5.2, C7.3, C8.3 and C9.1).
- Different options have different feasibilities beyond the cost aspects, which are not reflected in the figure (compare with SPM Section E.1).
- The potentials in the cost range USD100–200 tCO_2-eq^{-1} may be underestimated for some options.
- Costs for accommodating the integration of variable renewable energy sources in electricity systems are expected to be modest until 2030, and are not included because of complexities in attributing such costs to individual technology options.
- Cost range categories are ordered from low to high. This order does not imply any sequence of implementation.
- Externalities are not taken into account. {12.2, Table 12.3, 6.4, Table 7.3, Supplementary Material Table 9.SM.2, Supplementary Material Table 9.SM.3, 10.6, 11.4, Figure 11.13, Supplementary Material 12.SM.1.2.3}

Source: [IPCC AR6 WG3 SPM 2022]

En-ROADS: Test out the impacts of different strategies!



https://www.climateinteractive.org/en-roads/

Outline

Where do greenhouse gas (GHG) emissions come from?

What actions can we take in different sectors to reduce GHGs?

What macro-level strategies do we have to enable these actions?

Routes for action

Public policy & regulation (international, national, sub-national)

Markets & finance

Technology & innovation

Corporate action

Individual action

Policy levers to reduce/limit GHG emissions

Targets (mandatory or voluntary)

- International: UNFCCC and COP (Kyoto Protocol, Paris Agreement)
- At national or sub-national levels

Regulation, **standards**, and **investments**

Carbon pricing

- Carbon tax: Tax per unit of CO_2 or CO_2-eq emissions
- Carbon markets: Emissions trading under some agreed-upon CO_2-eq cap (i.e., cap-and-trade or emissions trading system)

UN Framework Convention on Climate Change (UNFCCC)

UNFCCC international treaty signed in 1992 as “as a framework for international cooperation to combat climate change”

- Established annual forum, called the Conference of Parties (COP)

Kyoto Protocol (adopted 1997, into force 2005) legally binds developed countries to emissions reduction targets

Paris Agreement (2015) requires *all* countries to set emissions pledges, called Nationally Determined Contributions (NDCs)

See: https://unfccc.int/process/the-convention/history-of-the-convention

Analysis of NDCs

New NDCs are more ambitious than previous, but are still not sufficiently ambitious to meet 1.5°C or 2°C targets

Figure ES.5 Global GHG emissions under different scenarios and the emissions gap in 2030 and 2035

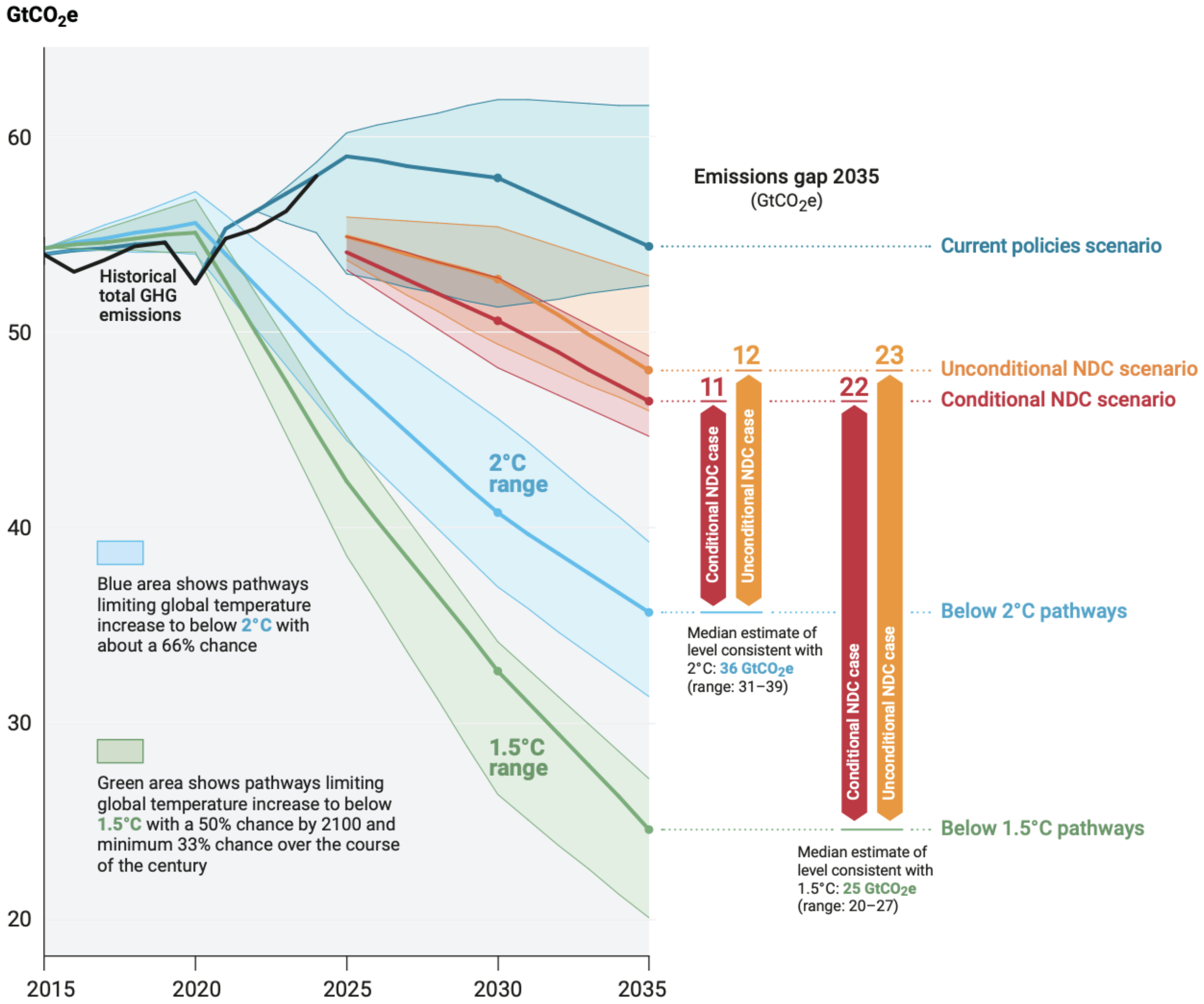


Figure source: [UNEP 2025]

The power of local action

GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY

EVERY DAY A NEW CITY JOINS GCOM

ONE IN EVERY 7
PEOPLE ON EARTH
IS PART OF A GCOM CITY

13,830
CITIES AND LOCAL GOVERNMENTS

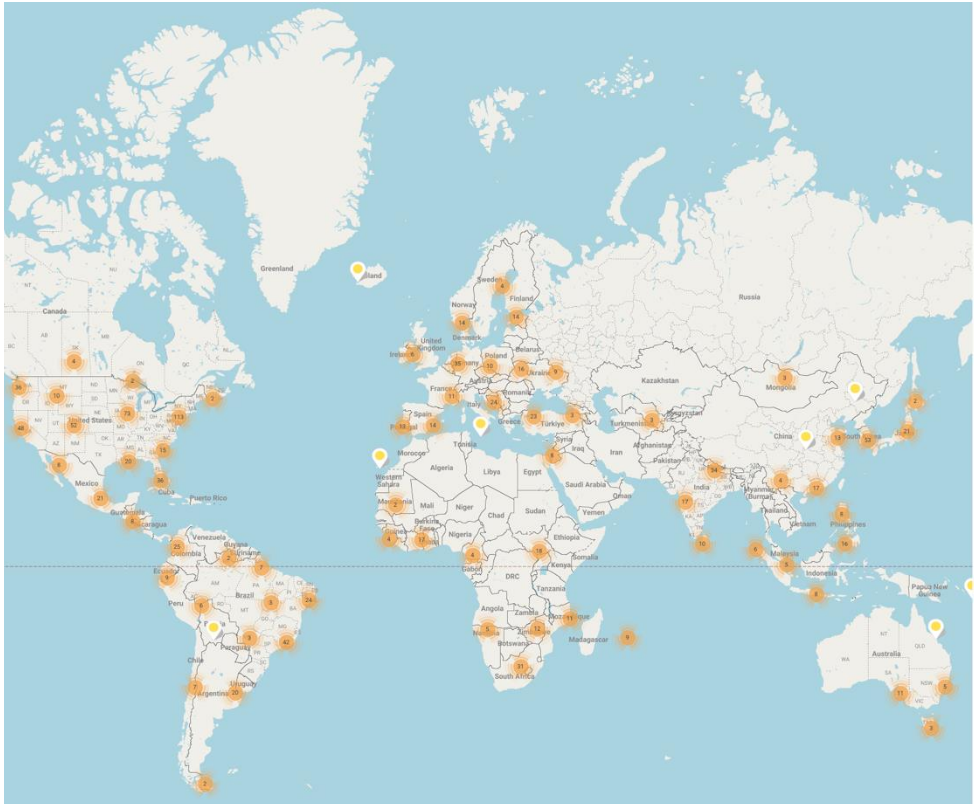
1.246
BILLION PEOPLE

148
COUNTRIES

Source: 2025 Global Covenant of Mayers Impact Report (https://www.globalcovenantofmayors.org/impact2025/)

The power of local action, ctd.

ICLEI
Local Governments for Sustainability



2500+
Cities towns & regions

25+
% Global urban population

125+
Countries worldwide

20+
% Global population

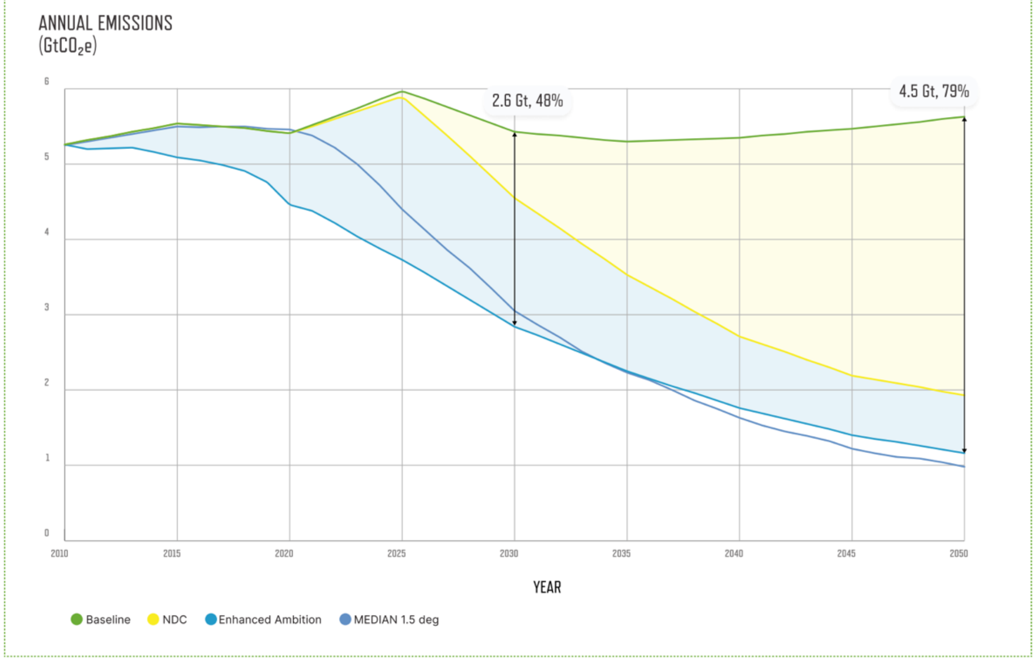
Source: https://iclei.org/our_network/

The power of local action, ctd.

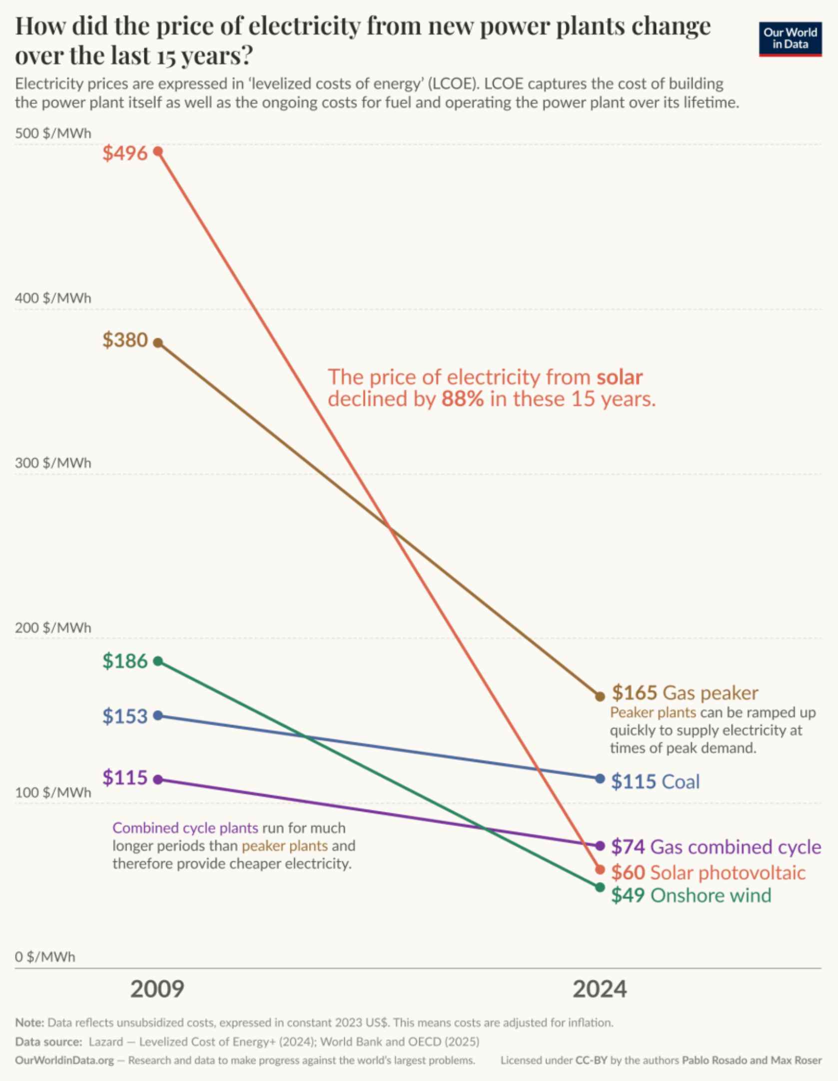
CITIES COULD REDUCE EMISSIONS BY 4.5 $GtCO_2e$ ANNUALLY BY 2050

Our data shows that GCoM signatories alone could deliver the equivalent of 4.5 $GtCO_2$ in annual reductions by 2050. Cities committed to climate action could make up the difference between NDCs and the emission reduction needed to keep the planet below 1.5°C of warming. These projections by GCoM are based upon current targets and NDCs.

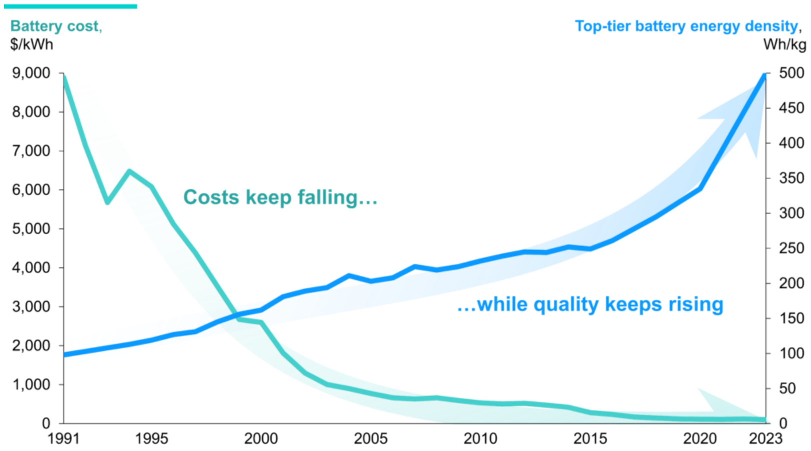
This ambition can only become a reality if local governments are empowered to deliver on the projects that they have planned. This graph compares projected global emissions under four scenarios: a business-as-usual trajectory (baseline), current Nationally Determined Contributions (NDCs), GCoM signatories' collective targets, and the pathway needed to limit warming to 1.5°C.



Source: 2025 Global Covenant of Mayers Impact Report (https://www.globalcovenantofmayors.org/impact2025/)



Clean technologies are often less expensive



Ziegler and Trancik (2021) before 2018 (end of data), BNEF *Long-Term Electric Vehicle Outlook* (2023) since 2018, BNEF *Lithium-Ion Battery Price Survey* (2023) for 2015-2023, RMI analysis.

Corporate climate action

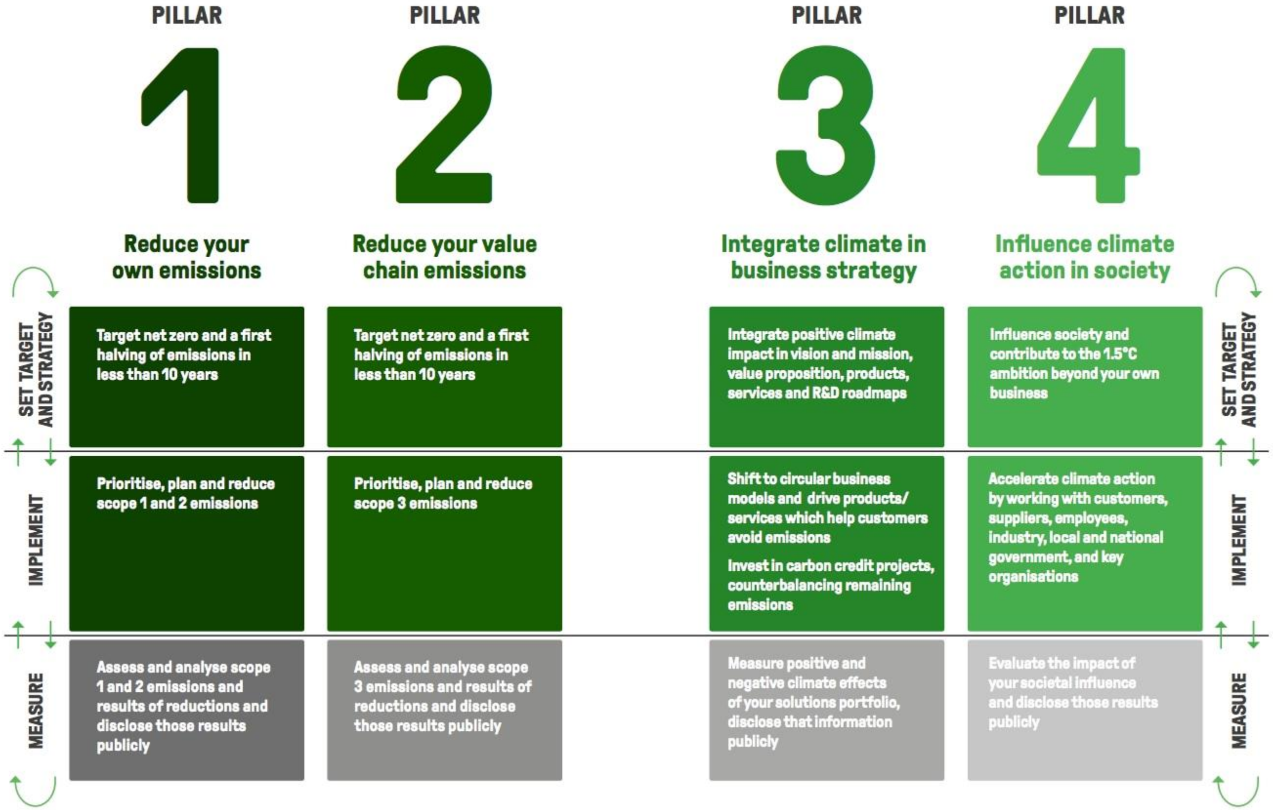


Figure source: The 1.5°C Business Playbook

Corporate climate action, ctd.

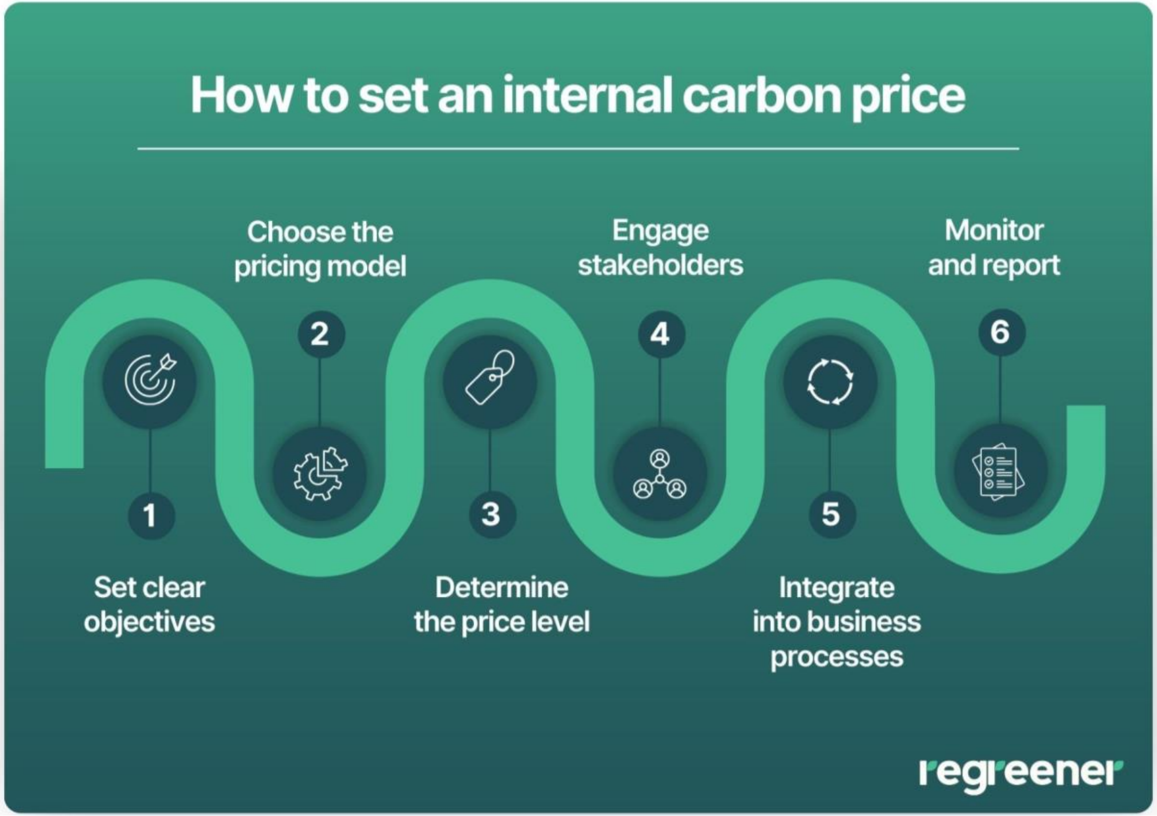


Figure source: regreener.earth

Individual action

Combined with action from governments & businesses, and with other systemic change, individual behavior can play a role

Individuals can also help drive systemic action, e.g.:

- Speaking up to drive policy, corporate, & collective action
- Leveraging their skills through their careers or through volunteer engagement

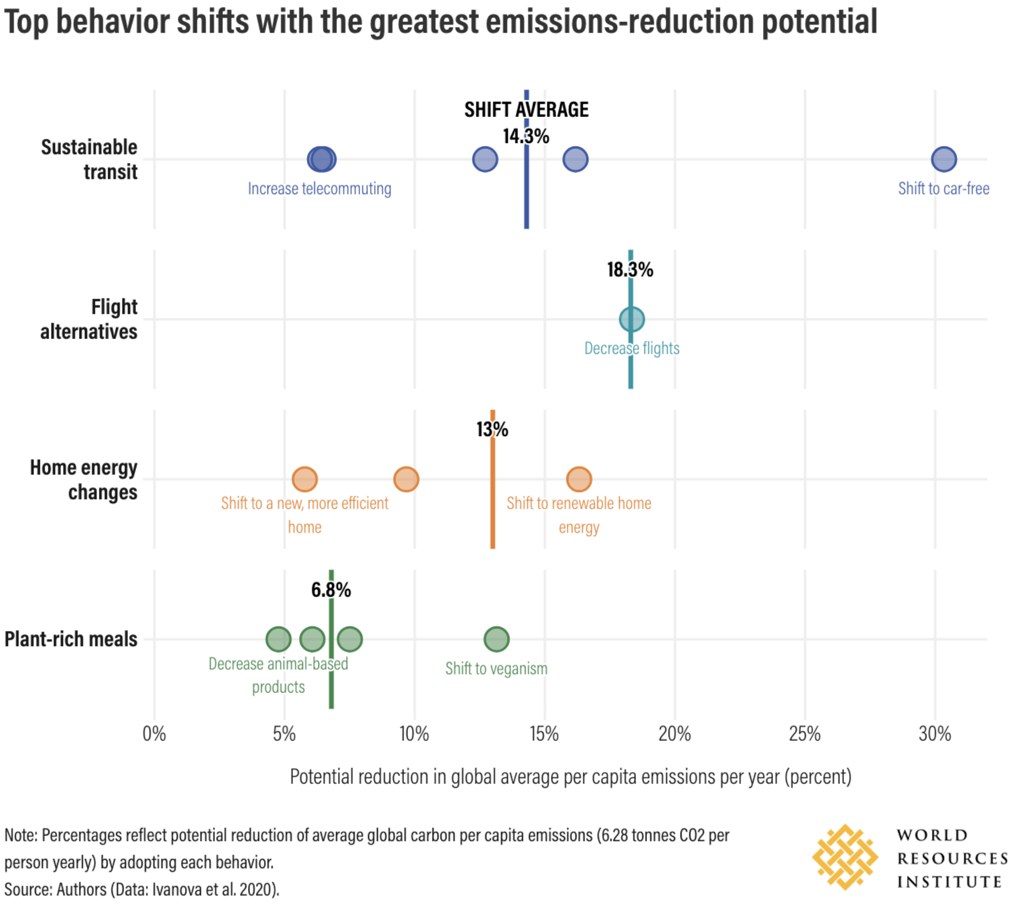


Figure source: https://www.wri.org/insights/climate-impact-behavior-shifts

How do I pick which (mitigation) strategy to work on?

Recognize that diverse actions are needed – no one “right” answer

Be guided by an order-of-magnitude estimate of impact

Ask:

- Where might my skills and interests have additionality?
- Do I have buddies or networks with relevant complementary skillsets and/or that can help shape pathways to deployment?
- What do I enjoy doing on a day-to-day basis? What brings me joy?

Abbreviated References

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