The Sense and Nonsense of remote sensing in the battle against climate change

Dr. Inge Jonckheere

Italian Academy of Advanced Studies- Columbia University, Spring 2024

The pre-paper and presentation are an attempt to provide insights into the evolution of remote sensing technology and its significant role in monitoring Earth's surface changes. It emphasizes recent advancements in satellite-based remote sensing, highlighting the deployment of advanced sensors, integration of artificial intelligence, and the emergence of small satellites. The commercial space sector, led by companies like SpaceX, has disrupted the traditional monopoly of governmental space agencies, contributing to the accessibility and affordability of satellite data.

A crucial focus of the work is on climate change, referencing the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). The paper discusses the importance of reducing greenhouse gas emissions and the role of remote sensing in supporting climate change mitigation efforts. Specific attention is given to the challenges faced in monitoring and reporting emissions from deforestation and forest degradation, with for example the UN-REDD program utilizing satellite data for land and forest monitoring.

Despite the availability of extensive satellite data, the paper highlights the paradox of insufficient progress in limiting global warming to the targeted 1.5 degrees. The global reduction in GHG emissions since the Paris Agreement is so limited, raising questions about the effectiveness of current approaches. The conclusion poses critical questions about individual, governmental, and international actions, proposing the introduction of a sustainability tax as a policy measure to incentivize behavioral change and contribute to emission reductions.

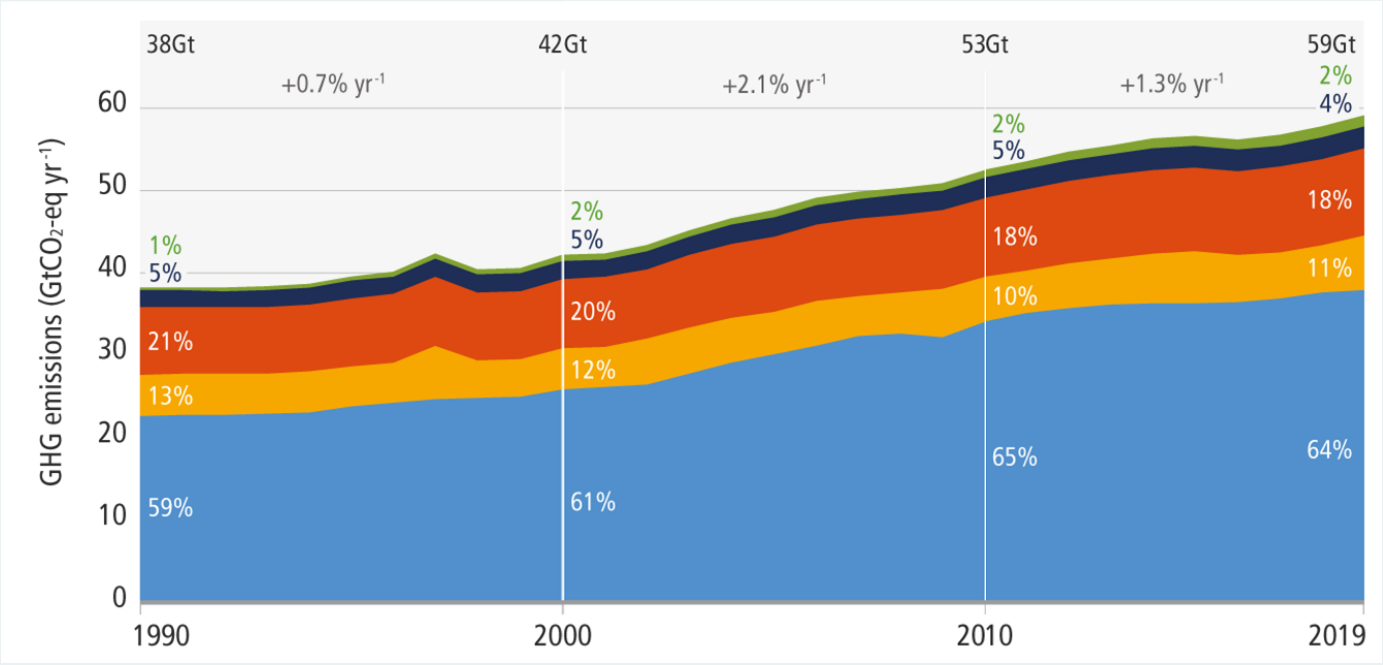
The presentation concludes by addressing the challenge of shifting the short-term perspective on climate issues, especially in the context of global crises like the pandemic and conflicts. It calls for a collective effort to instill a sense of responsibility and urgency for long-term perspectives, urging all sectors, including individuals, to consider the broader impact of their actions on the planet.

The Sense and Nonsense Remote sensing in the battle against climate

Dr. Inge JONCKHEERE
FAO Forestry Division
Forest & Climate Group

Italian Academy
Columbia University, New York (US)
24th Jan 2024

We are not on track to limit global warming to 1.5 °C.



HISTORY | EVOLUTION OF THE IPCC

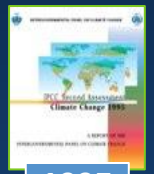
GROWTH IN SCIENTIFIC RESEARCH ON CLIMATE CHANGE

INCREASING STAKEHOLDER INVOLVEMENT

GROWING PUBLIC AWARENESS

1988

IPCC
Jointly established by WMO and UNEP



1995

SAR
Kyoto Protocol

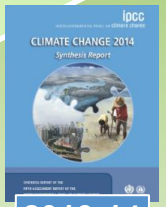
2001

TAR
Adaptation

2007

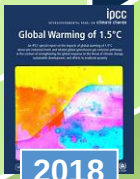
AR4
2°C limit

Nobel Peace Prize



2013-14

AR5
Paris Agreement



2018

SR15

SROCC

SRCCL

2019

2021

Sixth Assessment Report

2022

WGII

WGIII

SYR

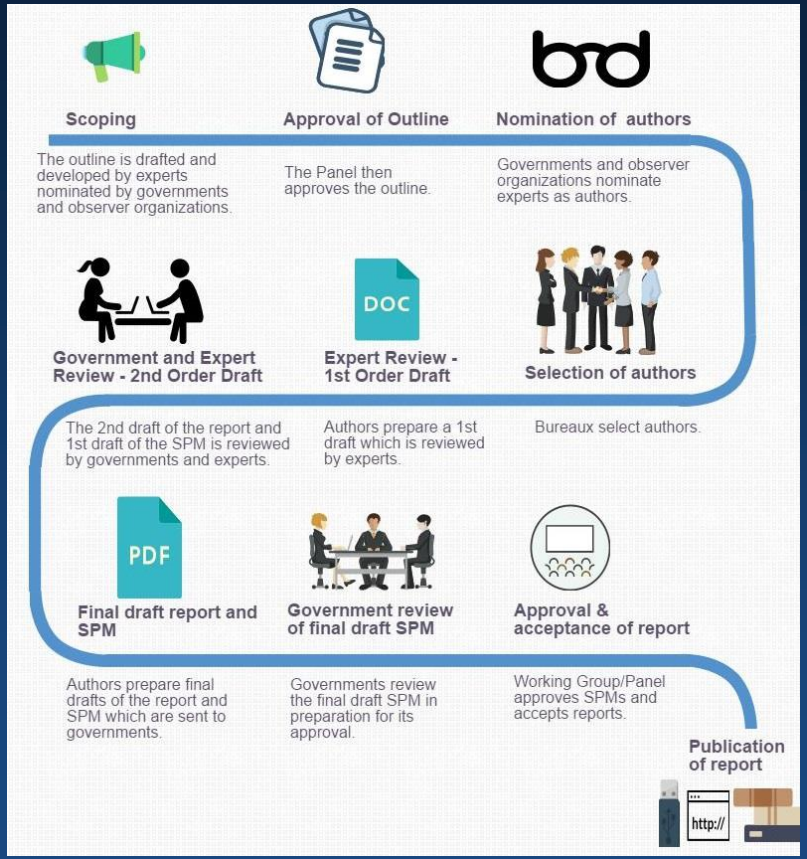
2023

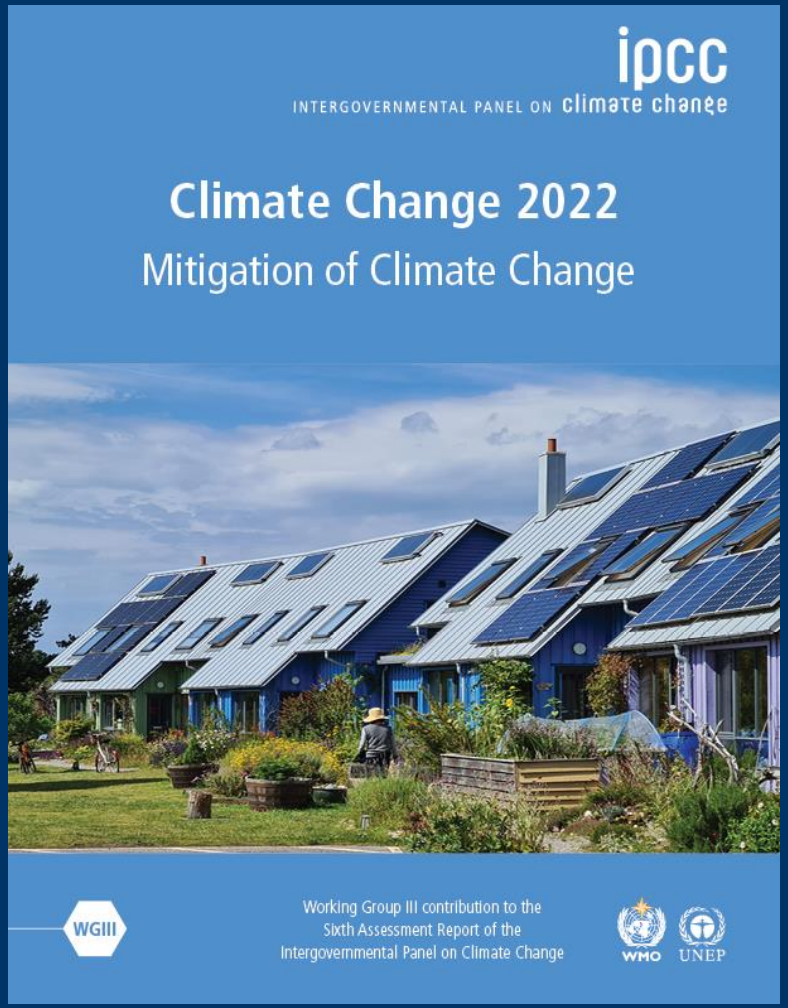
UNFCCC
Global Stock take

FAR
UNFCCC

1980 1990 2000 2010 2020 2030

How the IPCC produces its reports?





ipcc

2010-2019: Average annual greenhouse gas emissions at highest levels in human history

...but there is increased evidence of climate action

[Charlie Chesvick/IStock.com]

Background

Environmental change: climate crisis is here and now (IPCC, 2022, 2023): monitoring & forecasting land (cover/use) has become crucial more than ever to: therefore Remote sensing is used

Global scale: variety of data/data sources

National scale: global data used nationally or national data for different (international) reporting frameworks

FAO (IT)/SilvaCarbon (US) in collaboration with ESA, NASA, academia and other partners have developed tools to assist countries in measurement, reporting, and verification (MRV)

MRV support over the years

Reference levels:

- 70% of countries supported by FAO
- >90% used open foris

REDD+ results

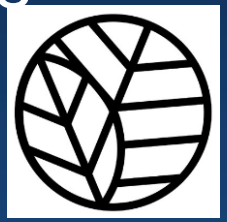
- 50% of countries supported by FAO

The complicated landscape of carbon finance opportunities

Results-based payments

Compliance markets

Voluntary carbon markets



Monitoring and policy needs (here and now)

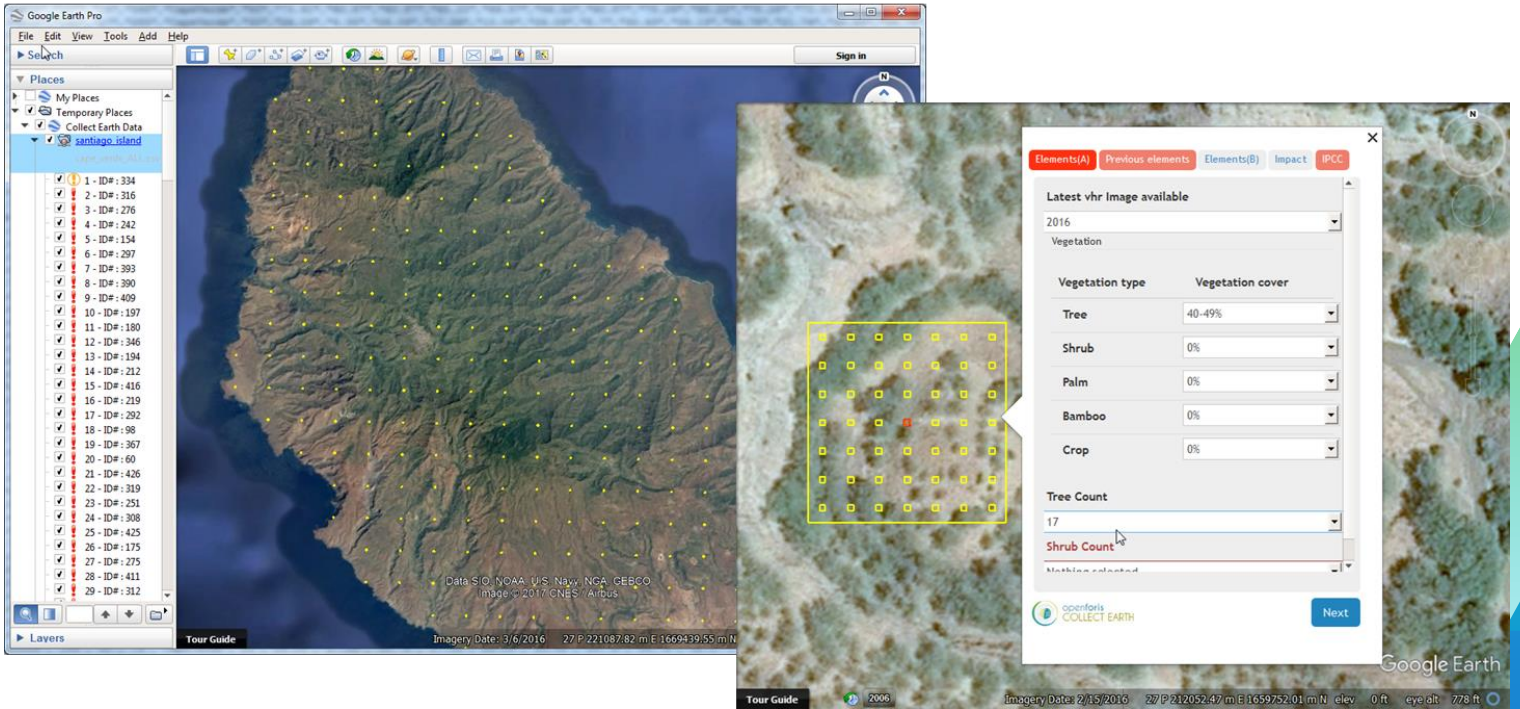
- Better data, better decisions? E.g. 10 years of UN-REDD
- Need for (better) integration of measurable field, airborne and space borne RS parameters with practical land/forest (monitoring) solutions and policy implementation
- Support research needed in the domains of agriculture, food security, raw materials, soils, biodiversity, environmental degradation and hazards, inland and coastal waters, and forestry
- **Mitigation** efforts versus **adaptation**: f. e. agricultural practices/management through Chl, N in soils

Augmented Visual Interpretation

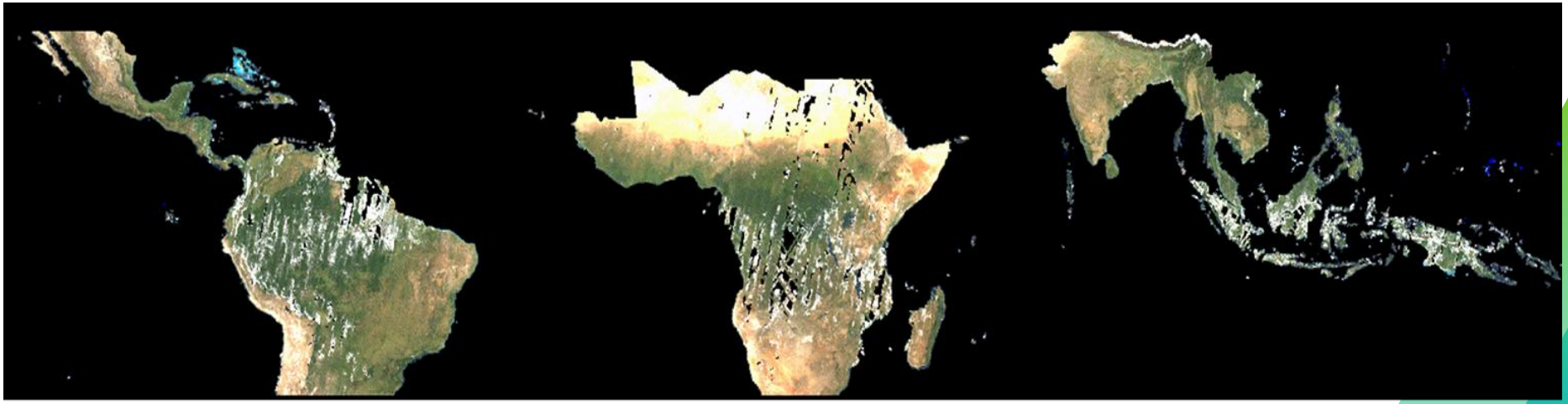
Data Collection tool integrated in Google Earth.

Free access to Very High Resolution imagery.

Multitemporal imagery thanks to Google Earth, Bing Maps and High Resolution



Planet data

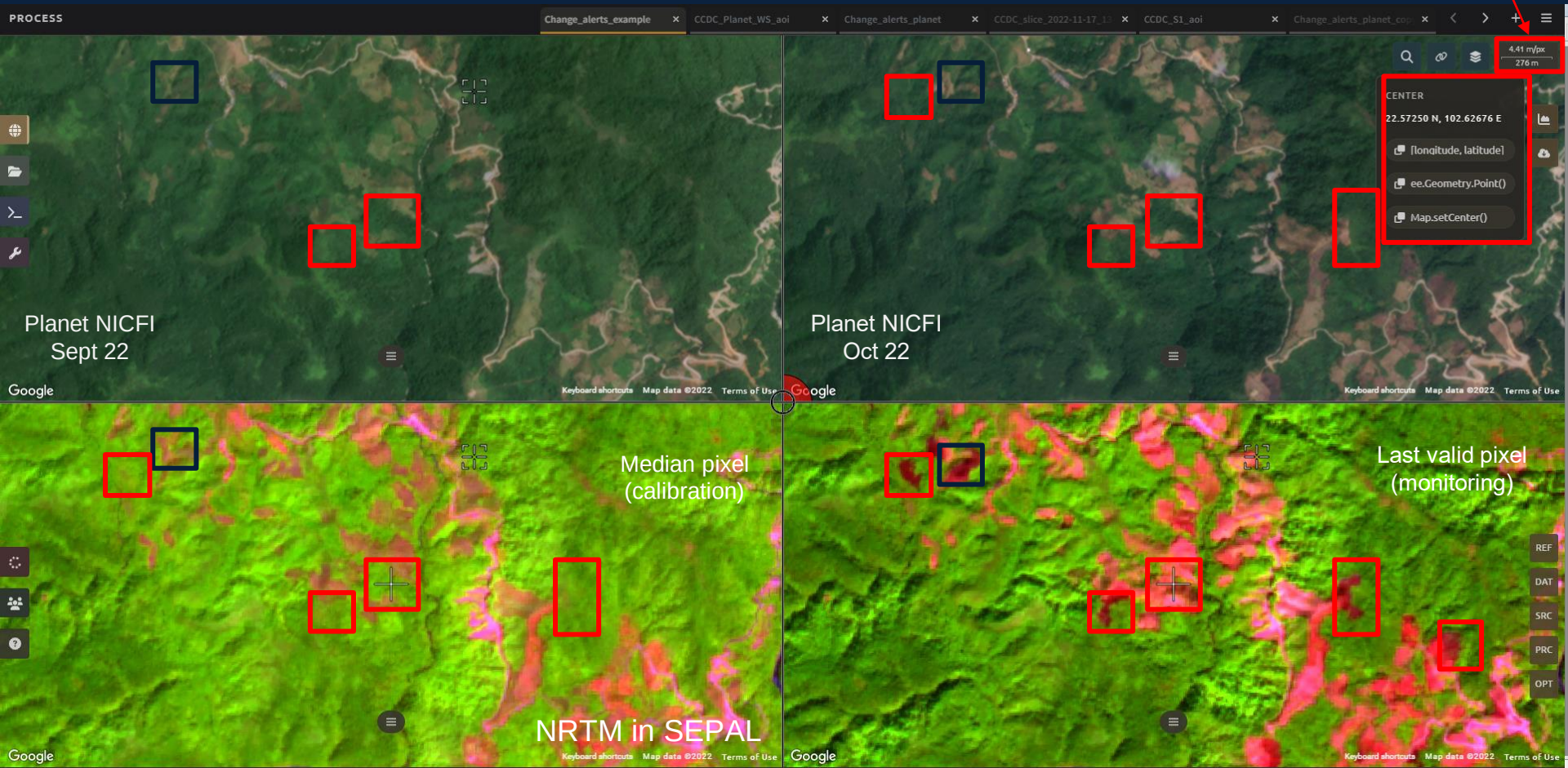


Pan-tropical, high-resolution data offer amazing opportunities

(Slides courtesy of R. D'Annunzio)

SEPAL/ Planet Module

Change Alert Instant verification



CAFI validation data

explore the validation data by country, change type driver and view Planet mosaics

Filter Change Type

Select Change Type

- All -

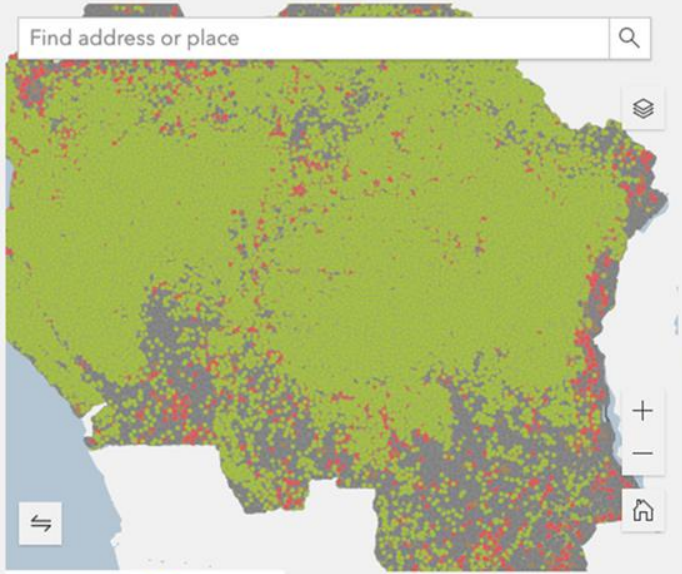
Filter Country

Select Country Code

Select Driver(s)

- Artisanal Agriculture
- Settlements
- Infrastruture
- Artisanal Mine
- Industrial Mine
- Artisanal Forestry
- Industrial Forestry
- Industrial Agriculture
- Other

Total points: 359,978



Add additional information

Comment on validation data

To enter information on a plot, select it in the map

< 1 of 359984 >

Validation Plot: 1

ISO	COG
LON	15.667202
LAT	-0.916955
CUSUM Code	203
CUSUM date	2019.5369873

Validation data

Planet Data

Planet Medres Normalized Analytic 2020-12 Mosaic

Planet Medres Normalized Analytic 2020-11 Mosaic

Different frameworks, similar indicators, same data?

Convention on Biological Diversity

United Nations Framework Convention on Climate Change

United Nations Convention to Combat Desertification

United Nations Statistics Division

And others

We map frameworks related to ecosystem restoration and develop a database which contains the data, indicators, criteria, targets, etc.

RS for global climate change : our wish list from policy side

- Support in mapping **changes in land cover/use** and help sustainable forest management and agricultural practices: ADAPTATION
- Detect **soil properties** for action on improving soil health
- Support **forest management** and assessments on biodiversity, ecosystem sustainability and environmental degradation, and to monitor lake and coastal ecosystems including water quality.
- New products and services in the domain of agriculture, food security, raw materials, soils, biodiversity, environmental degradation and hazards, inland and coastal waters, and forestry.

Way forward interlinking end users and scientific community

- Taking into account **user requirements** in the domains of land and forest monitoring
- **User inclusion** from the concrete (project) start
- **Data ownership** for end users
- Important **policy frameworks**, among others

UN SDGs [(Sustainable Development Goals], SDGs 2, 12 and 15], the EU Common Agricultural Policy (CAP), the EU Raw Materials Initiative, the UN Convention for Combating Desertification and Land Degradation, the Soil Thematic Strategy and the Soil Framework Directive, the EU Water Framework Directive and the UN Convention on Biodiversity (Aichi Targets).

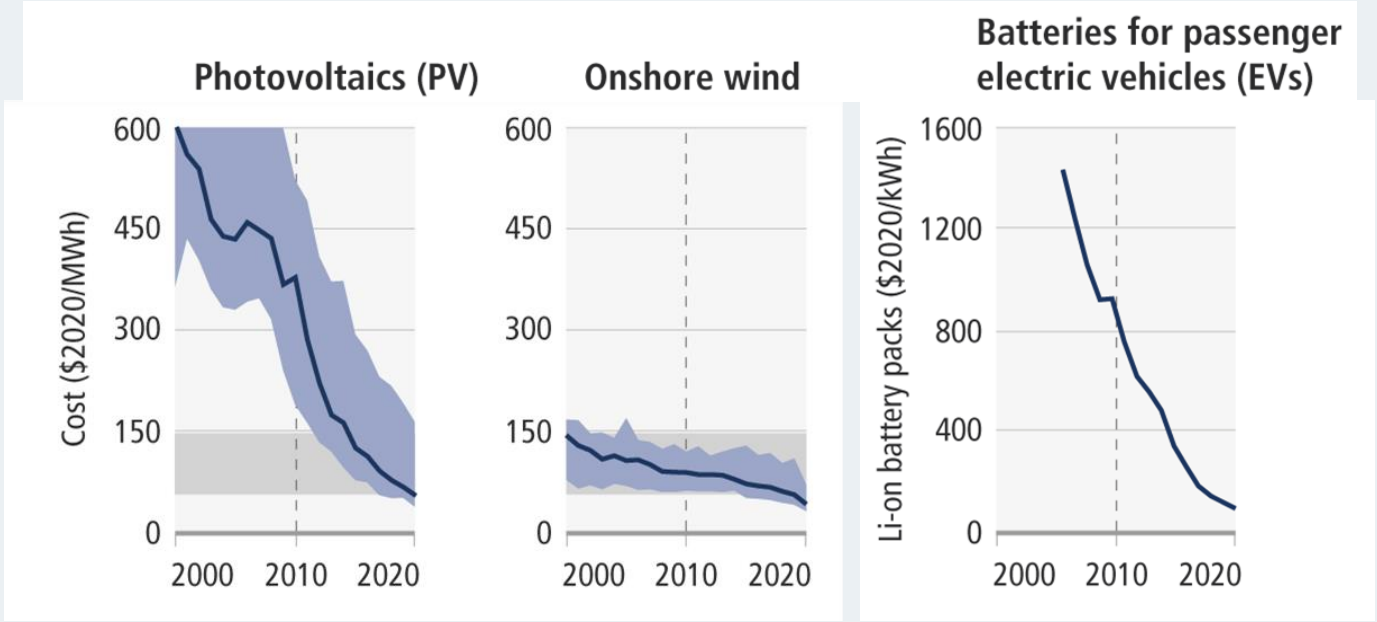
ipcc

> **Unless there are immediate and deep emissions reductions across all sectors, 1.5°C is beyond reach.**

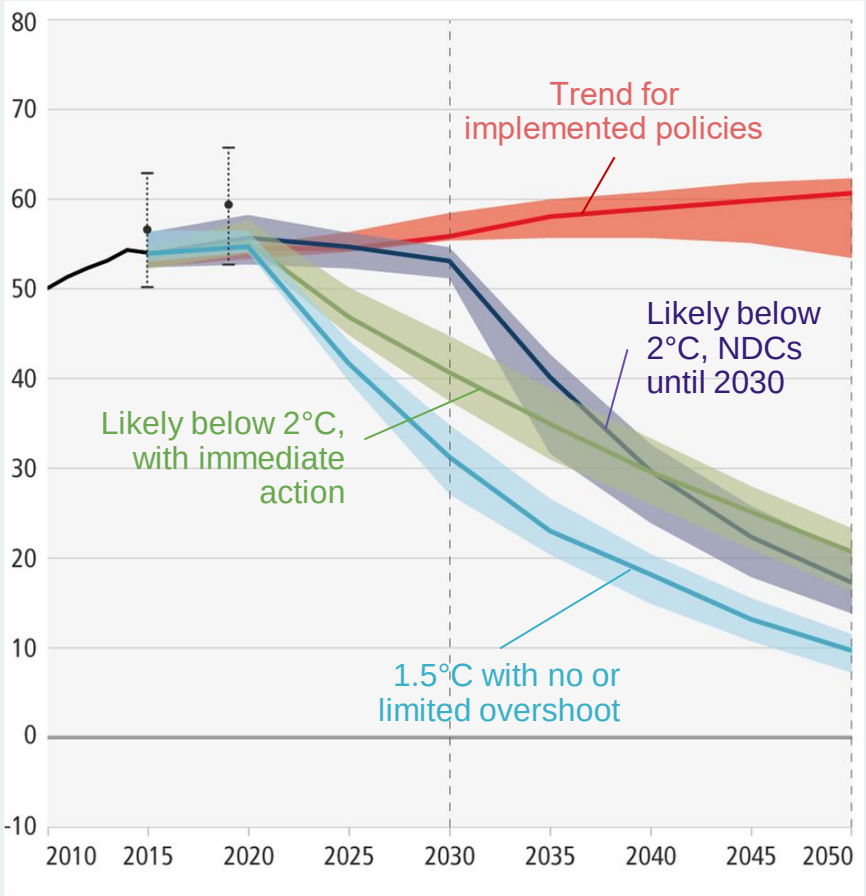
Increased evidence of climate action

Some countries have achieved a **steady decrease** in emissions **consistent** with limiting warming to **2°C.**

Zero emissions targets have been adopted by at least **826 cities and 103 regions**



In some cases, costs for renewables have fallen below those of fossil fuels.



Limiting warming to 1.5 °C

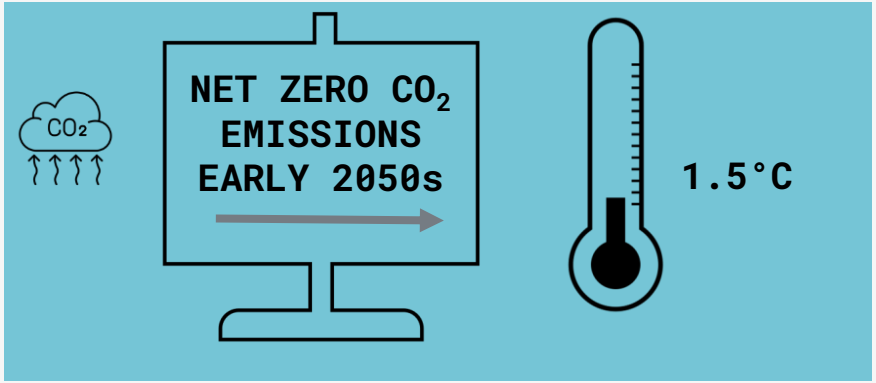
- Global GHG emissions peak before 2025, reduced by 43% by 2030.
- Methane reduced by 34% by 2030

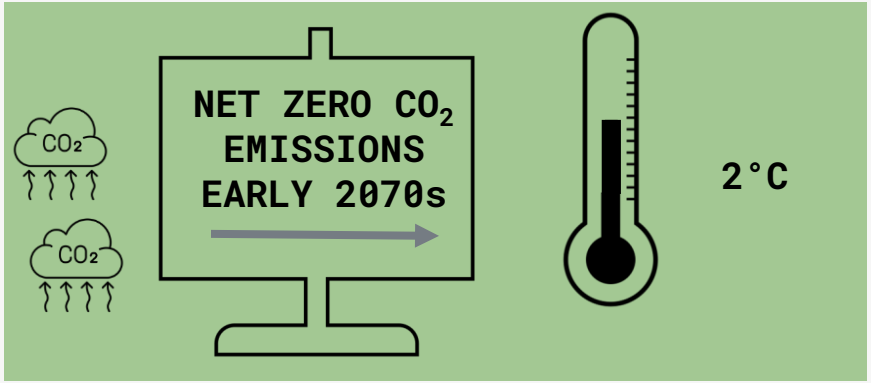
Limiting warming to around 2°C

- Global GHG emissions peak before 2025, reduced by 27% by 2030.

(based on IPCC-assessed scenarios)

The temperature will stabilise when we reach net zero carbon dioxide emissions





(based on IPCC-assessed scenarios)

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

There are options available **now** in every sector that can at least **halve** emissions by 2030

Demand and services

Energy

Land use

Industry

Urban

Buildings

Transport

Energy

- **major transitions** are required to limit global warming
- reduction in fossil fuel use and use of carbon capture and storage
- low- or **no-carbon** energy systems
- widespread **electrification** and improved energy **efficiency**
- **alternative fuels**: e.g. hydrogen and sustainable biofuels

[Portland General Electric CC BY-ND 2.0, Harry Cunningham/Unsplash, Stéphane Bellerose/UNDP in Mauritius and Seychelles CC BY-NC 2.0, IMF Photo/Lisa Marie David, Tamara Merino CC BY-NC-ND 2.0]

Demand and services

- potential to **bring down** global **emissions** by **40-70%** by 2050
- walking and cycling, electrified transport, reducing air travel, and adapting houses make large contributions
- **lifestyle changes** require **systemic changes** across all of society
- **some** people require additional **housing**, **energy** and **resources** for human wellbeing

[Bosch, Unsplash/Yoav Aziz, Adam Bartoszewicz, Victor Hernandez]

Transport

- **reducing demand** and **low-carbon** technologies are key to reducing emissions
- **electric vehicles**: greatest potential
- **battery technology**: advances could assist electric rail, trucks
- **aviation** and **shipping**: alternative fuels (low-emission **hydrogen** and **biofuels**) needed
- Overall, substantial potential but depends on **decarbonising the power sector**.

[United Airlines, Jeremy Segrott CC BY 2.0, Andreas160578/Pixabay]

Cities and urban areas

- better urban planning, as well as:
- sustainable production and consumption of goods and services,
- **electrification** (low-emission energy),
- enhancing **carbon uptake and storage** (e.g. green spaces, ponds, trees)

There are options for existing, rapidly growing *and* new cities.

[Pelargoniums for Europe/Unsplash, City of St Pete CC BY-ND 2.0, Victor/Unsplash, EThekwini Municipality, Arne Müseler/arne-mueseler.com, CC BY-SA 3.0 de]

Buildings

- buildings: possible to reach net zero emissions in 2050
- action in this decade is critical to fully capture this potential
- involves retrofitting existing buildings and effective mitigation techniques in new buildings
- requires ambitious policy packages
- zero energy and **zero-carbon** buildings exist in new builds **and retrofits**

[Pelargoniums for Europe/Unsplash, City of St Pete CC BY-ND 2.0, Victor/Unsplash, EThekwini Municipality, Arne Müseler/arne-mueseler.com, CC BY-SA 3.0 de]

Land use

- can provide large-scale emissions reductions **and** remove and store CO_2 at scale
- protecting and restoring **natural ecosystems** to remove carbon: forests, peatlands, coastal wetlands, savannas and grasslands
- competing demands have to be **carefully managed**
- **cannot compensate** for **delayed** emission **reductions** in other sectors

Technology and Innovation

- investment and policies **push forward low emissions** technological **innovation**
- **effective decision making** requires assessing potential benefits, barriers and risks
- **some options** are technically **viable**, rapidly becoming **cost-effective**, and have relatively **high public support**. Other options face barriers

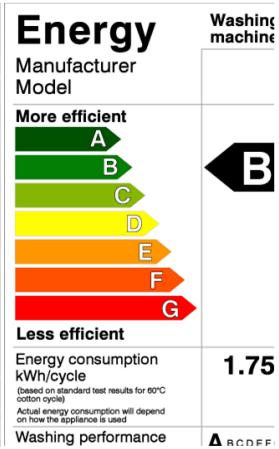
Adoption of low-emission technologies is slower in most developing countries, particularly the least developed ones.

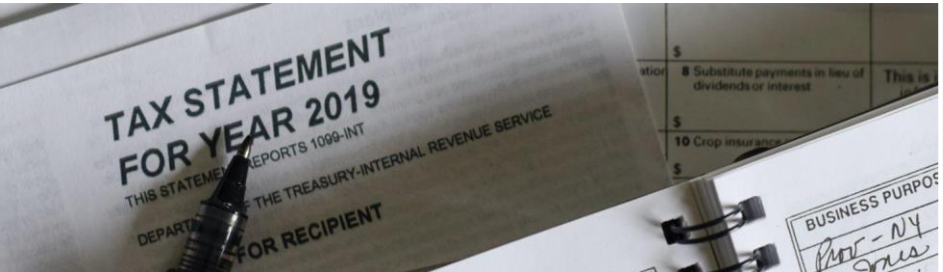
Carbon Dioxide Removal

- required to **counterbalance hard-to-eliminate** emissions
- through **biological** methods: reforestation, and soil carbon sequestration
- **new technologies** require more **research**, up-front **investment**, and proof of concept at **larger scales**
- **essential** to **achieve net zero**
- **agreed methods** for measuring, reporting and verification required

[Forest Service Northern Region CC BY 2.0, Fiston Wasanga/CIFOR CC BY-NC-ND 2.0, Climeworks]







Policies, regulatory and economic instruments

- regulatory and economic instruments have **already proven effective** in reducing emissions
- **policy packages** and **economy-wide packages** are able to achieve **systemic change**
- ambitious and effective mitigation requires **coordination across government** and society

[World Bank/Simone D. McCourtie, Dominic Chavez CC BY-NC-ND 2.0, Trent Reeves/MTA Construction & Development CC BY 2.0, IMF Photo/Tamara Merino CC BY-NC-ND 2.0, Olga Delawrence/Unsplash.]

Closing investment gaps

- financial flows: **3-6x lower** than levels needed **by 2030** to limit warming to below 1.5°C or 2°C
- there is **sufficient global capital** and liquidity to close investment gaps
- challenge of closing gaps is widest for developing countries

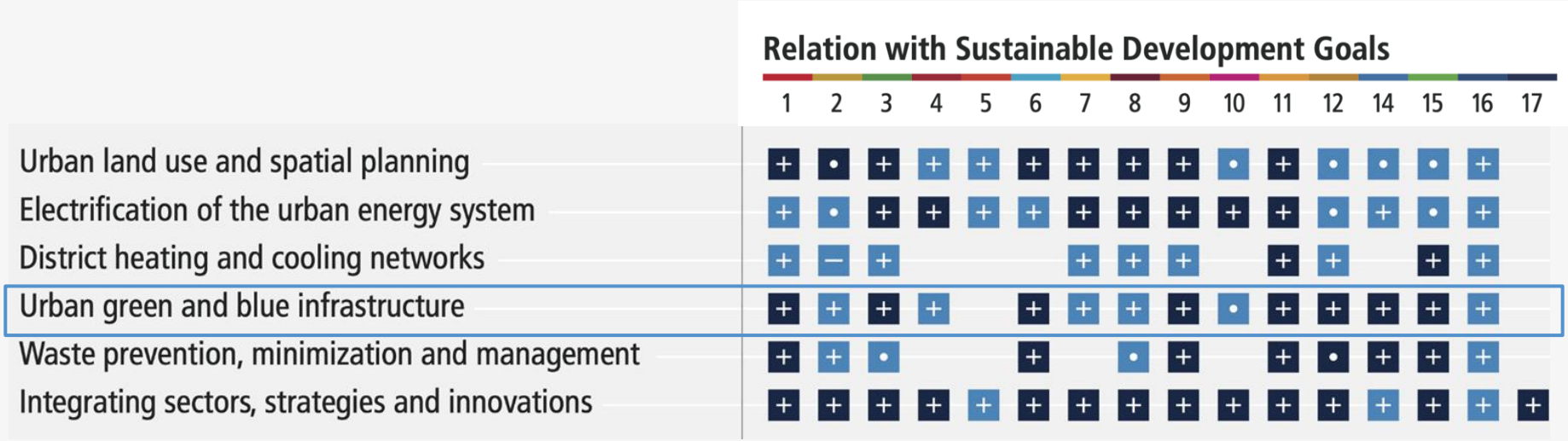
[Tobias/Unsplash, Rwanda Green Fund /CC BY-SA 2.0]

Accelerated climate action is critical to sustainable development

[Duy Pham/Unsplash]


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

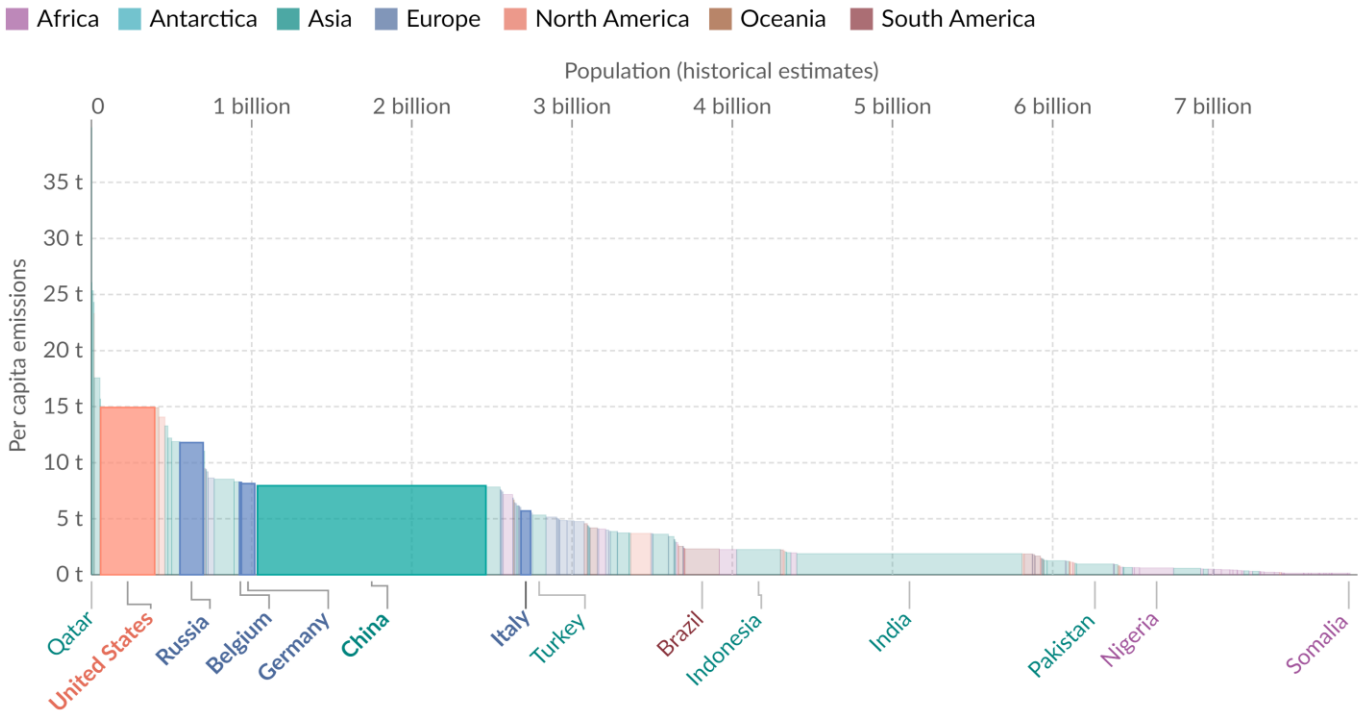
Mitigation options in urban areas



CO_2 emissions per capita, 2021

Our World in Data

The width of each bar shows countries scaled by population size. The height of each bar measures tonnes of per capita carbon dioxide (CO_2) emissions from fossil fuels and industry[1].



Data source: Global Carbon Budget (2023); Population based on various sources (2023)
OurWorldInData.org/co2-and-greenhouse-gas-emissions | CC BY

1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Key questions

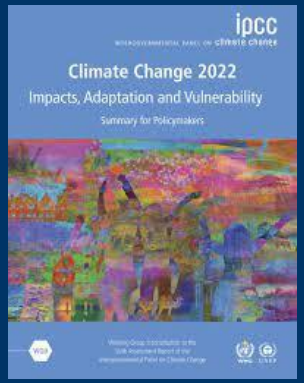
- What do we do wrong: why can we not **reduce more emissions** and have less footprint? As
  - Individual
  - Development aid agency
  - Government

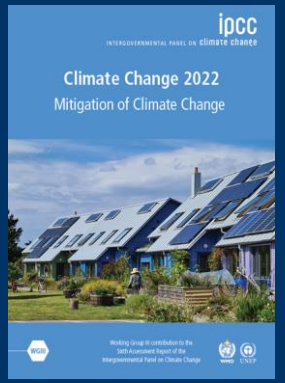
- How can an individual be **persuaded that his contribution is of interest** for the wider community/world?

- **Sustainability tax**?

- How can we change the **short-term perspective views** (war, crisis) vs **long-term perspective** of climate change?

Sixth Assessment Report
WORKING GROUP II & III – ADAPTATION & MITIGATION OF CLIMATE CHANGE





“ **The evidence is clear:**

The time for action is now

Thanks for your attention!

More info on www.fao.org

@FAOForestry

@FAOClimatechange

inge.Jonckheere@fao.org