Status on climate change and technical solutions

Per Alex Sørensen
PlanEnergi Denmark

ABOUT PLANENERGI

- Engineering Consultancy
- Over 40 years of experience with Renewable Energy
- +50 employees
- Offices in:

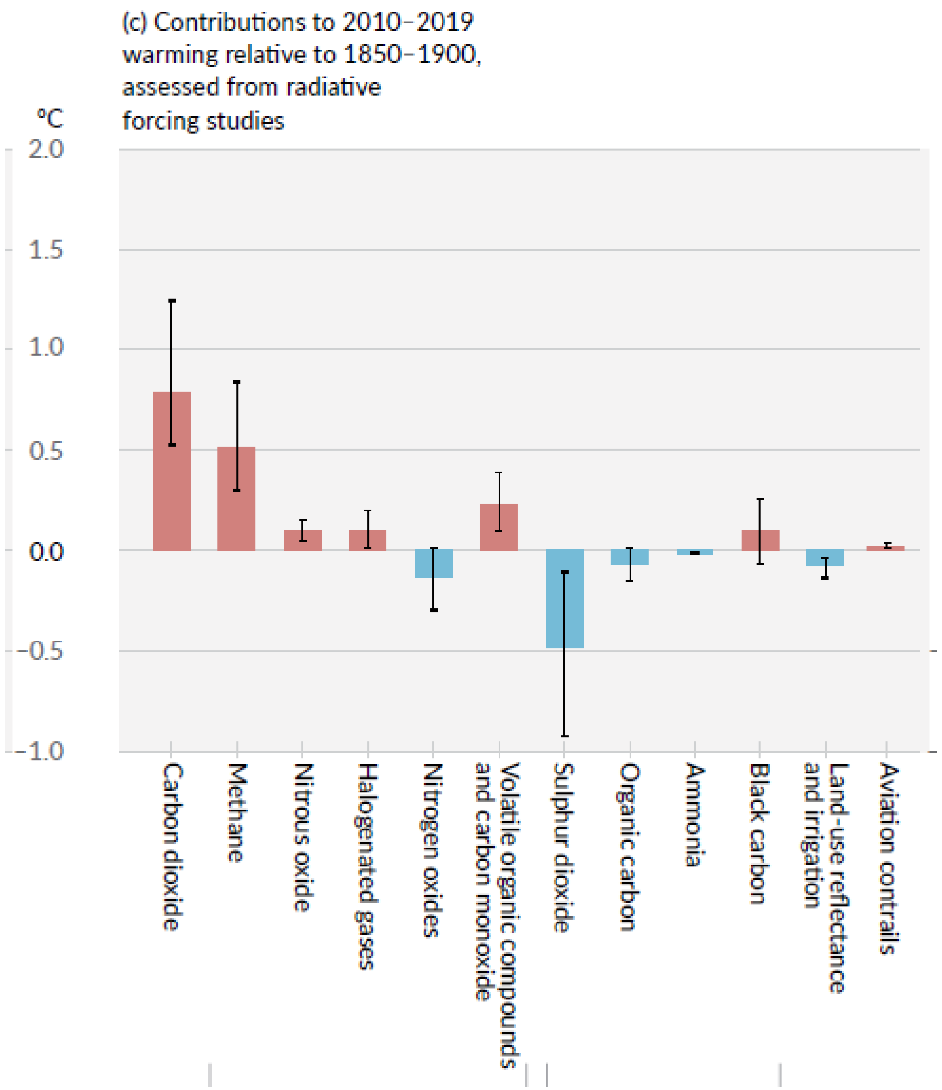
- **Strategic Climate and Energy Planning**
  - Action Plans
  - Heat Planning
- **District Heating**
  - Masterplans, feasibility studies, project proposals
  - Grid Expansions
  - Large scale heat pumps
  - (Industrial) excess heat
  - Boilers (El, biomass, gas)
  - Solar Thermal
  - Energy storages (Seasonal/pit, tanks)
  - Thermoydraulic grid simulations and -optimization
  - Termonet (LowEx Grids)
- **Biogas**
  - Project Development
  - Plant Design
  - Delivery Contracts
  - Veterinary control
  - Leakage detection (methane)
  - Counselling for operation
  - Technical Due Diligence
- **Approvals**
  - Local Plans
  - Environmental Impact Assessment
  - Environmental Approvals
- **International Research and Innovation Projects**
  - IEA, Horizon, LIFE, EUDP, etc.

Agenda

1. The current state of the climate. Greenhouse gas concentrations, global surface temperatures, global mean sea level
2. Possible climate futures. Scenarious from International Panel of Climate Change (IPCC) Sixth Assessment Report.
3. Where do climate gasses come from?
4. Technical solutions already known and in the pipeline
5. What is needed in different sectors. Examples.
6. Some conclusions

Greenhouse gas concentrations according to International Panel of Climate Change(IPPC)

- Observed increases in well-mixed GHG concentrations since around 1750 are unequivocally caused by GHG emissions from human activities over this period. Historical cumulative net CO_2 emissions from 1850 to 2019 were 2400 ± 240 $GtCO_2$ of which 58% occurred between 1850 and 1989, and about 42% occurred between 1990 and 2019.
- In 2019, atmospheric CO_2 concentrations (410 parts per million) were higher than at any time in at least 2 million years,
- and concentrations of methane (1866 parts per billion) and nitrous oxide (332 parts per billion) were higher than at any time in at least 800,000 years
- In spring 2025 the atmospheric CO_2 concentration is 429 ppm



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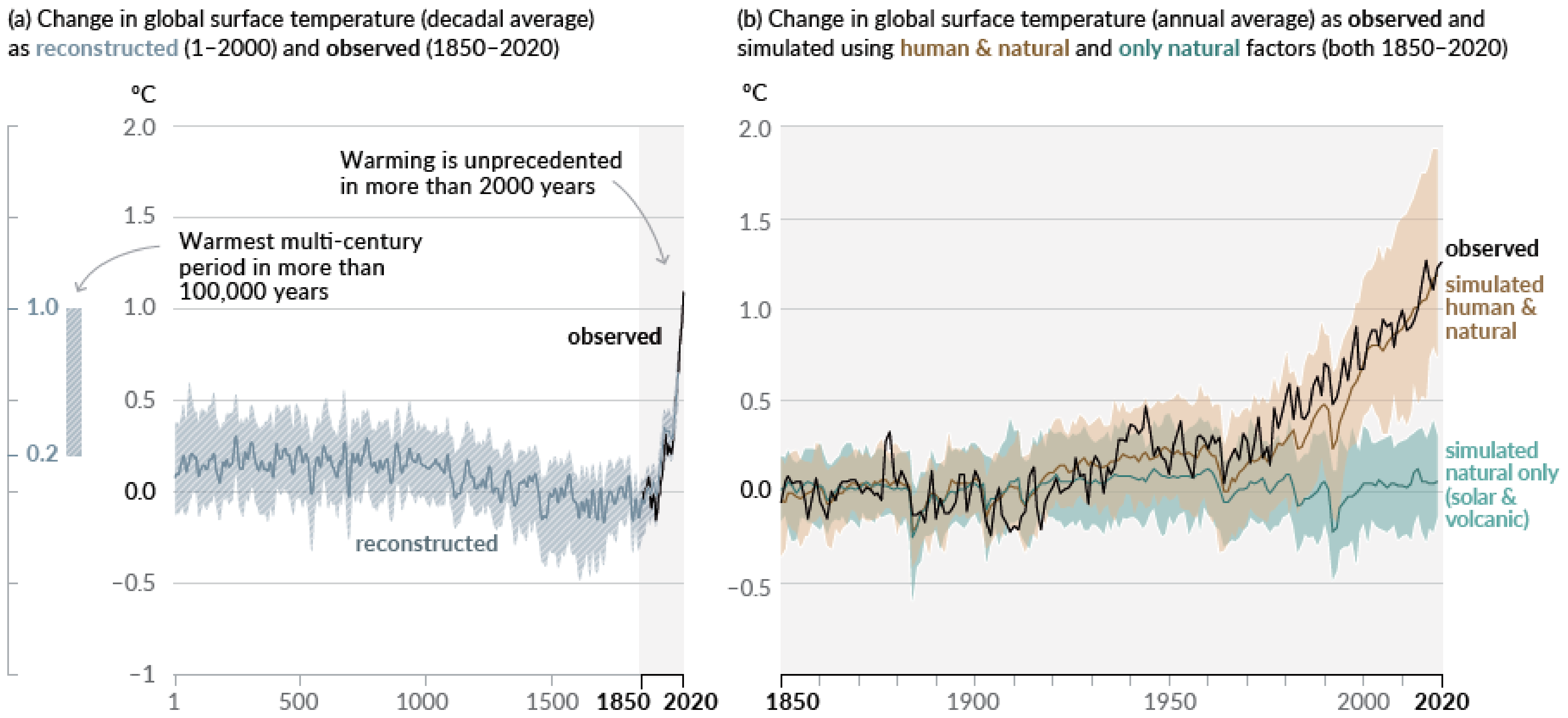
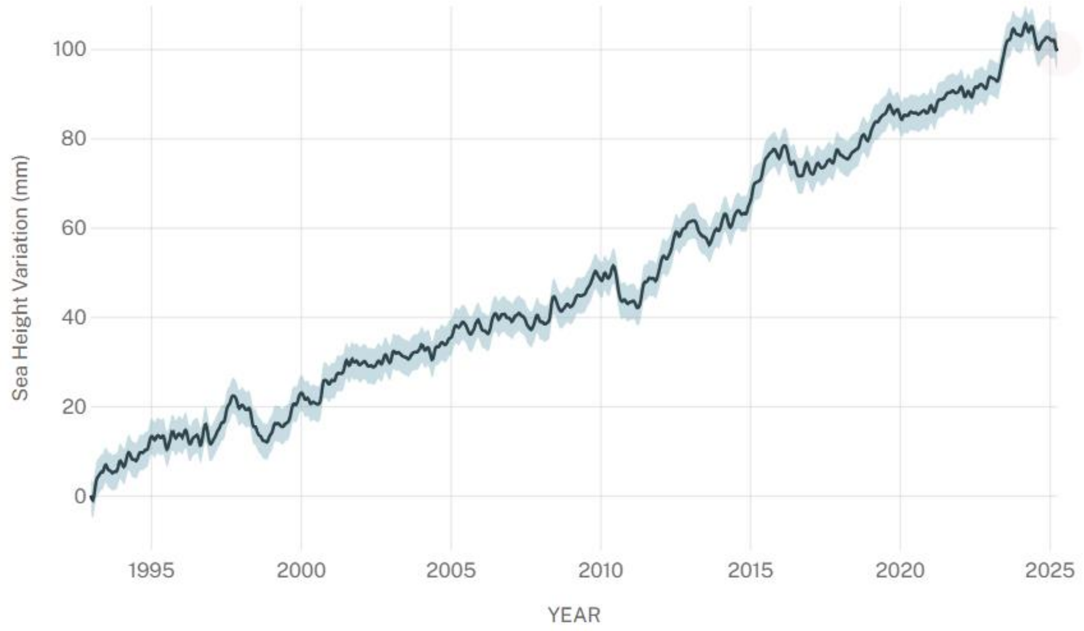
Global surface temperatures (IPCC)

- Global surface temperature was 1.09 °C higher in 2011–2020 than 1850–1900, with larger increases over land (1.59 °C) than over the ocean (0.88 °C). Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years



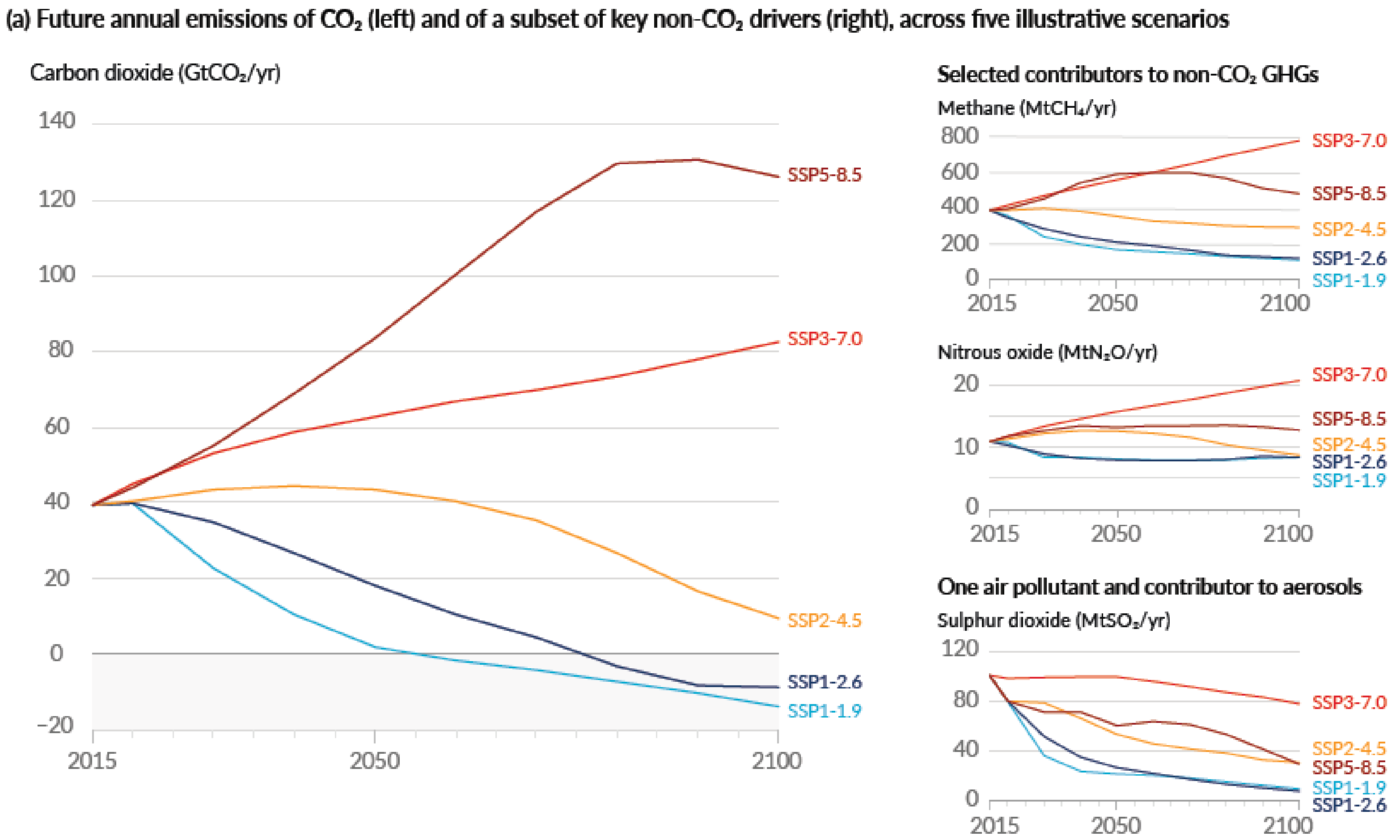
Global mean see level (IPPC)

- It is unequivocal that human influence has warmed the atmosphere, ocean and land. Global mean sea level increased by 0.20 m between 1901 and 2018.
- The average rate of sea level rise was 1.3 [0.6 to 2.1] mm yr-1 between 1901 and 1971,
- increasing to 1.9 [0.8 to 2.9] mm yr-1 between 1971 and 2006,
- and further increasing to 3.7 [3.2 to 4.2] mm yr-1 between 2006 and 2018



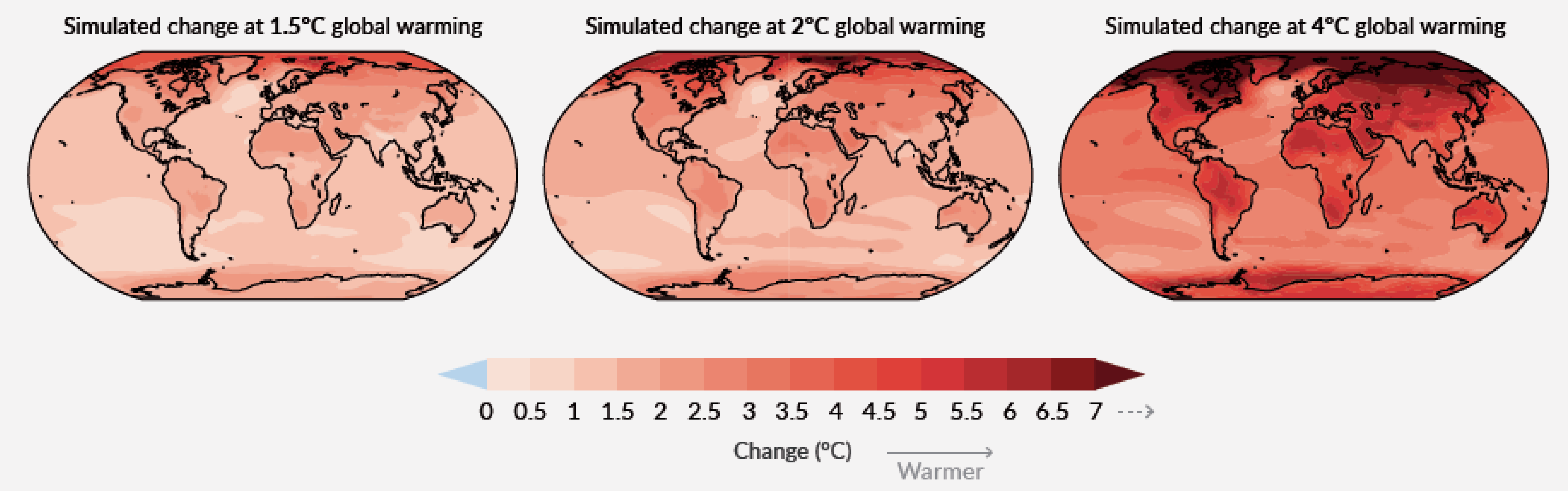
Scenarios (IPPC)

Scenarios start in 2015, and include scenarios with high and very high GHG emissions (SSP3-7.0 and SSP5-8.5) and CO_2 emissions that roughly double from current levels by 2100 and 2050, respectively, scenarios with intermediate GHG emissions (SSP2-4.5) and CO_2 emissions remaining around current levels until the middle of the century, and scenarios with very low and low GHG emissions and CO_2 emissions declining to net zero around or after 2050, followed by varying levels of net negative CO_2 emissions23 (SSP1-1.9 and SSP1-2.6).

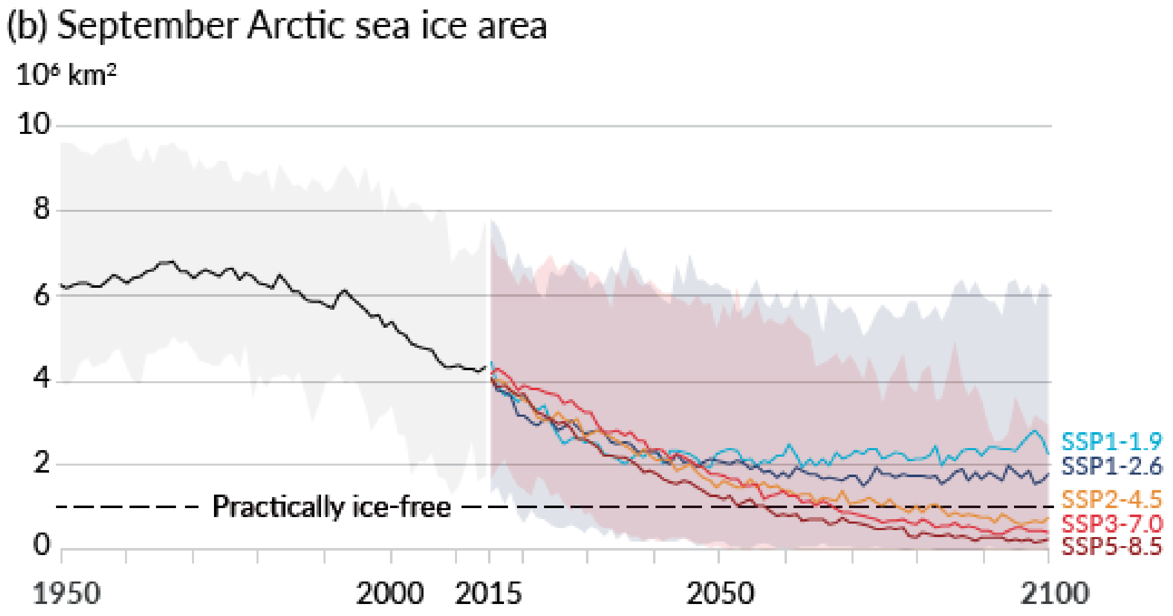


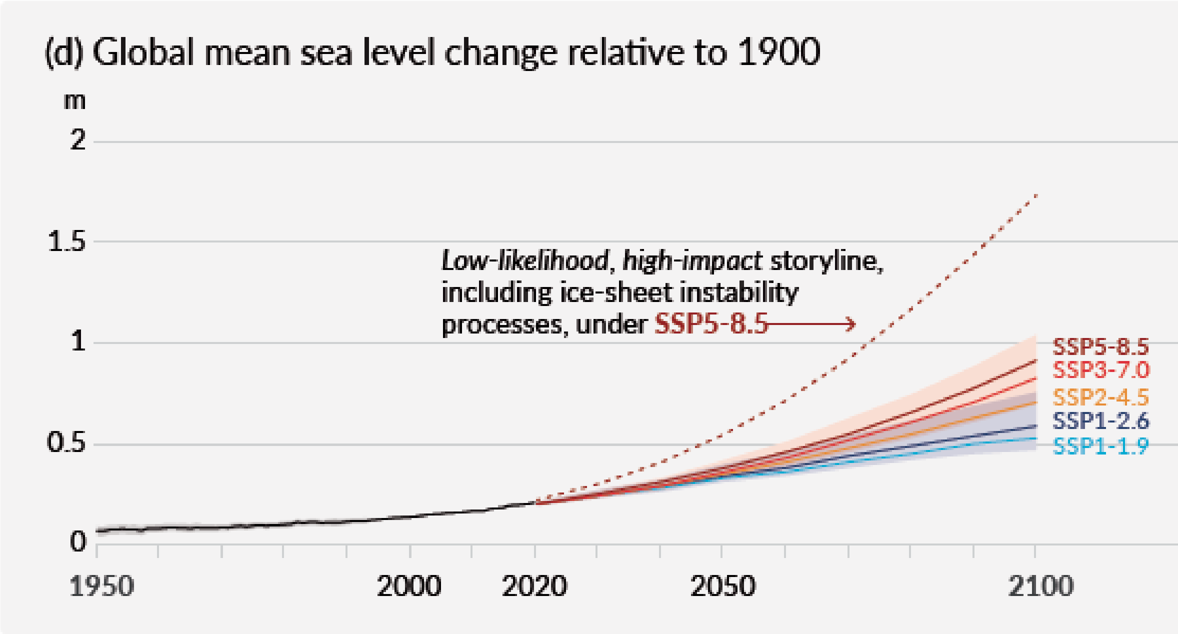
Future global warming compared to 1850-1900

	Near term, 2021–2040		Mid-term, 2041–2060		Long term, 2081–2100	
Scenario	Best estimate (°C)	*Very likely* range (°C)	Best estimate (°C)	*Very likely* range (°C)	Best estimate (°C)	*Very likely* range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

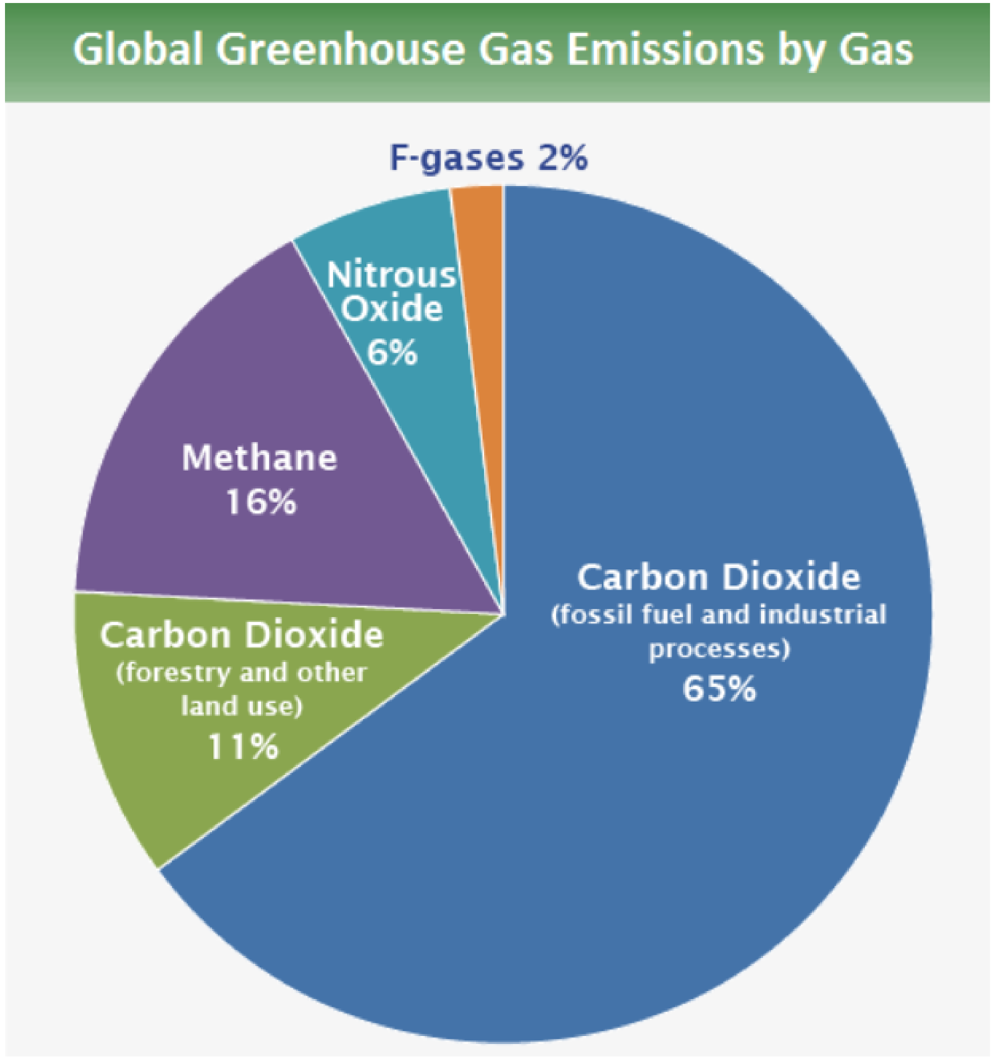


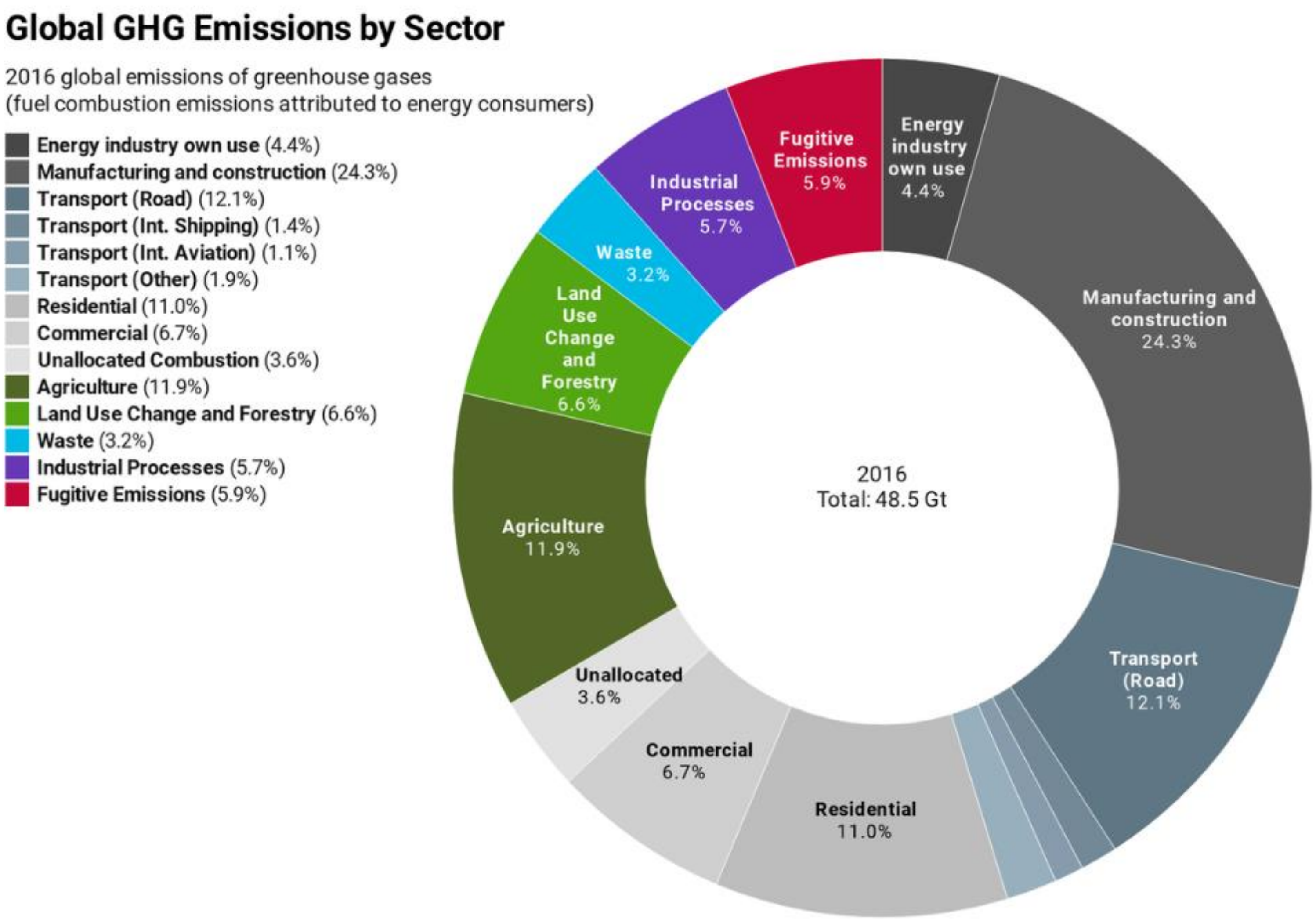
Future sea level (IPPC)



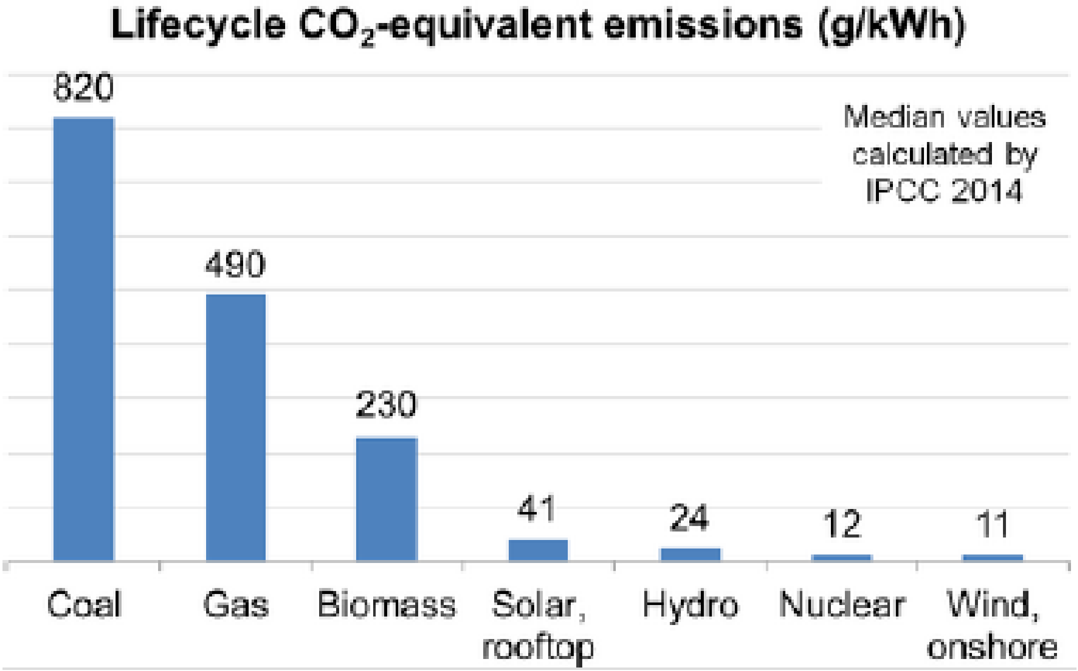


Where do climate gasses come from?

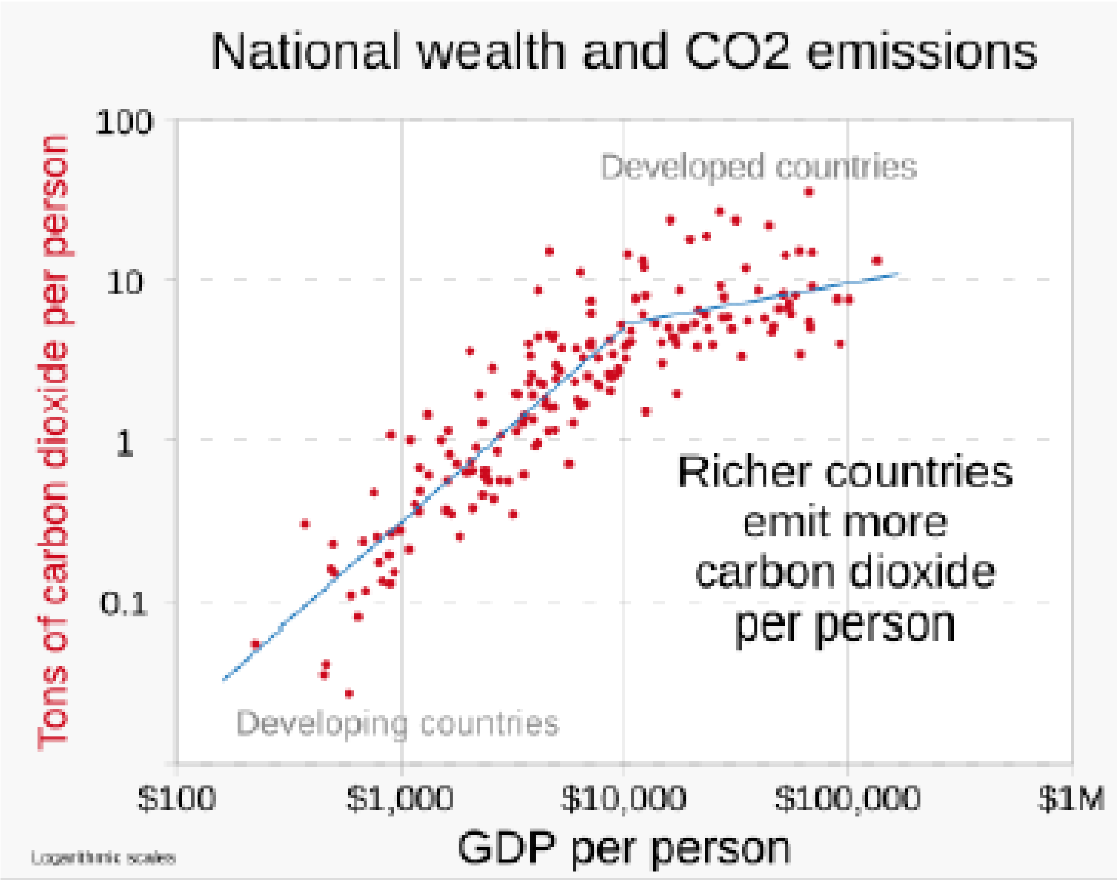




Fuel sources and wealth influence



Life-cycle greenhouse gas emissions of electricity supply technologies, median values calculated by IPCC[202]



Costs and matureness of renewable energy technologies

Matureness:

Hydropower: mature

Wind power onshore: mature

Wind power offshore: mature

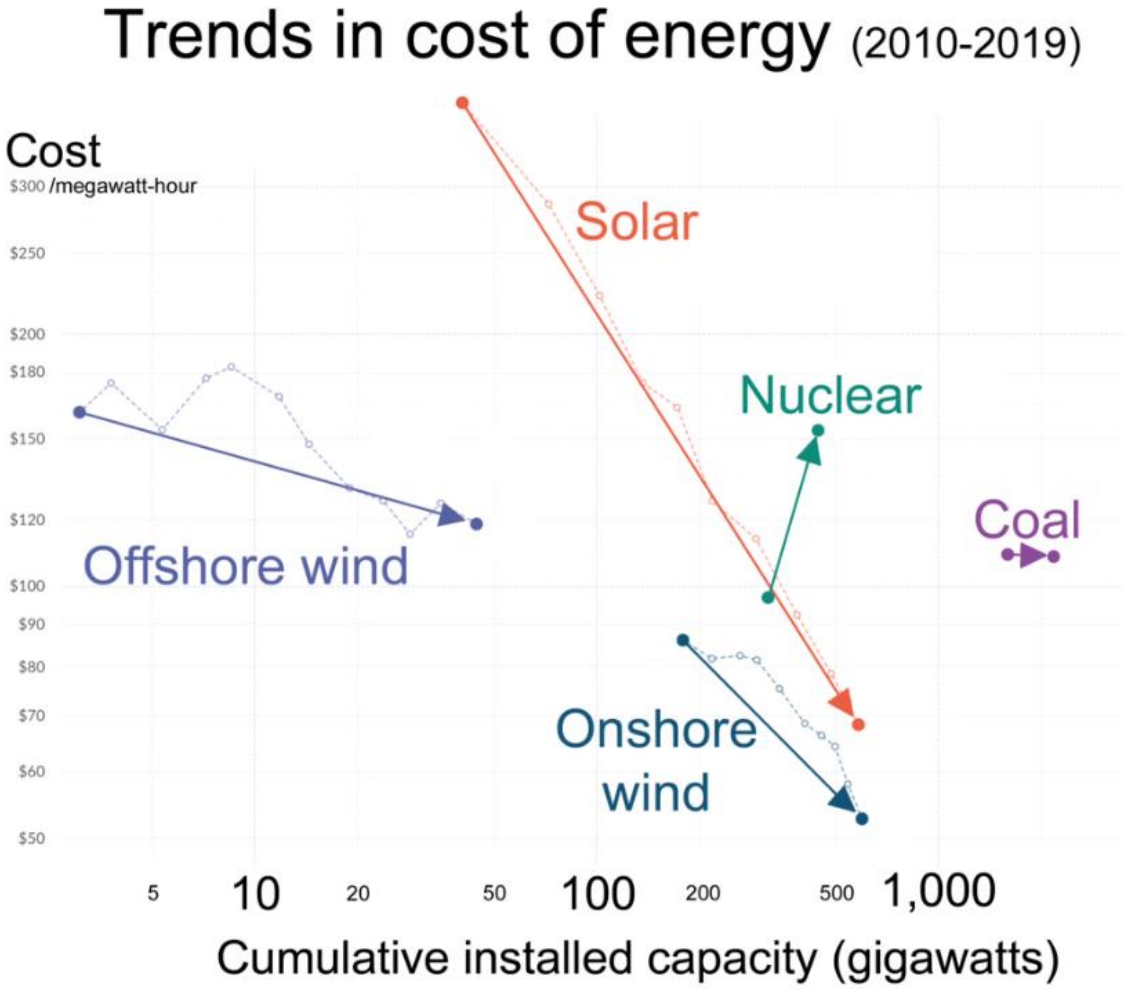
PV on fields: mature

PV on roofs: mature

Biogas: mature

Biomass combustion: mature

Storage technologies: under development



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Cost and matureness of PtX and CCS (Carbon Capture and Storage)

Matureness:

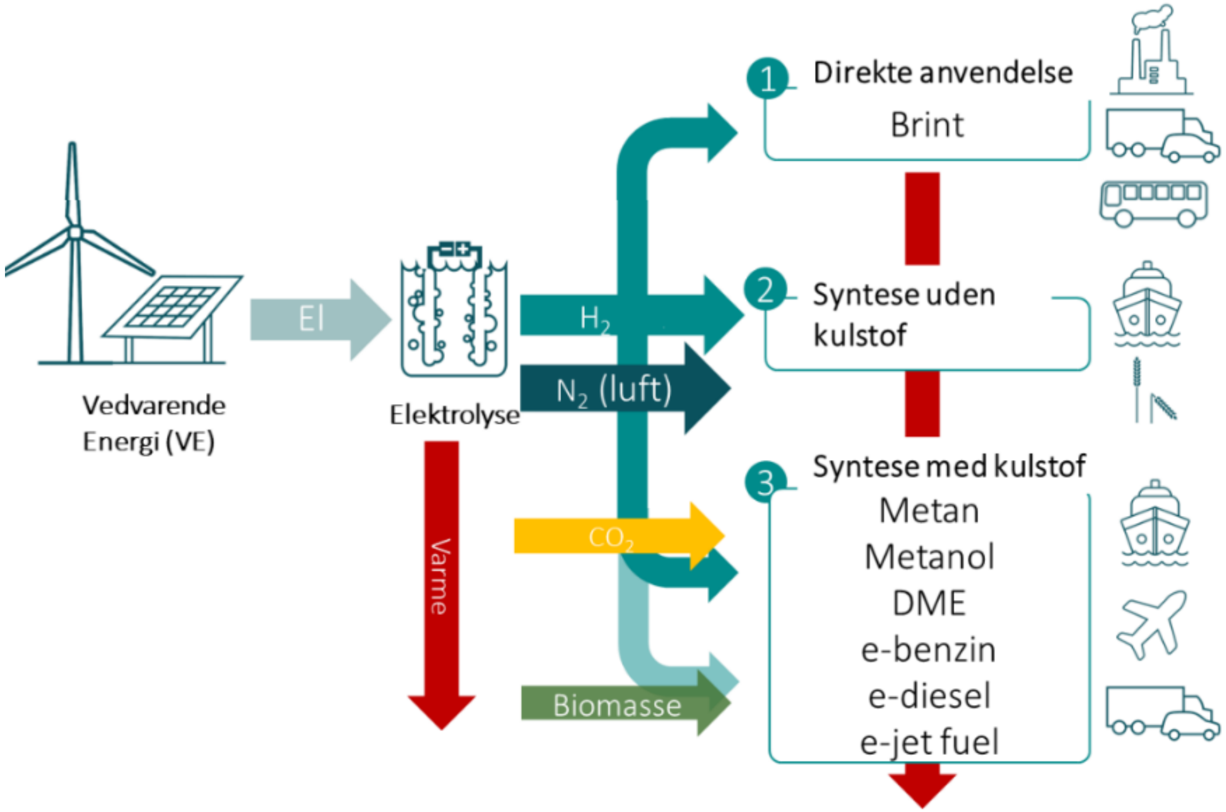
Hydrogen production: Large plants implemented, but still under development

Ammonia production: Pilot plant implemented

Metanation: Pilot plants implemented

Metanol: Pilot plants implemented

DME, e-gasoline, e-diesel, e-jet fuel: under development



What can we do. Sector by sector I

Electricity generation:

Coal-fired power stations emitted in 2018 over 20% of global greenhouse gas emissions (app 50 Gt per year). Gas-fired power plants 5%. In 2024 the International Energy Agency (IEA) reported that in 2023 the global CO_2 emission from energy sources was 37.4 billion tonnes. This was a growth from 2022 despite of PV and wind implementation.

Needed: PV and wind electricity.

Agriculture:

Agriculture, forestry and land use sectors contribute between 13% and 21% of global greenhouse gas emissions. Rice production contributes with 10% of methane and livestock with 28% of methane. Indirect emissions come from conversion of forests into agricultural land.

Needed: biogas, carbon and nitrogen management plans, production of biochar, change from cattle to poultry, rabbits, pigs, limitation of food waste, ”climate-smart agriculture”…

Deforestation:

Tropical deforestation has doubled during the last to decades.

Needed: Political action and forestation in other countries

What can we do. Sector by sector II

Transport:

Transport counts for 15% of emissions worldwide. Over a quarter from road freigt. Maritime transport counts for 3.5 to 4% of greenhouse gas emissions. Jet airliners generated 3.5% of all human impact on climate in 2020.

Needed: electrification of land transport, renewable fuels in maritime transport (Ammonia, methanol with carbon capture)

Renewable fuels in air transport and/or reduction in air transport

Buildings and construction:

In 2019 the building sector was responsible for 12 Gt CO_2eq-emissions. 49% is from electricity for use in buildings. 28% are produced during the manufacturing proces.

Needed: renewable electricity, retrofitting of existing buildings, use of renewable electricity in buildings and renewable electricity and hydrogen/biogas in the production sector, use of less emitting materials as wood, cellulose fiber insulation..

What can we do. Sector by sector III

Mining:

In 2010 the World Bank estimated that 134 billion m^3 of natural gas was flared or wented annually. Enough to supply the entire world gas for 16 days.

Needed: Political action

Plastics:

Between 3% and 4% of global GHG emissions are related to plastic production. Plastic emits CO_2 when it degrades.

Needed: reduced use of plastic

Digital services:

The sector produced in 2020 2% to 4% of GHG emissions. By the end of 2021 bitcoin was estimated to produce 65.4 million tonnes of CO_2 or as much as Greece annually. AI is expected to be a future large scale contributor

Needed: renewable electricity and political regulation

Some conclusions

We are included in a full scale experiment where one of the consequenses can be 3-5 degrees higher temperatures, and 0.5 – 1 meter higher sea level in 2100

- We have and can develop many technical solutions, but it is not enough
- More efficient energy systems are needed. Flexibility and sector coupling is needed, As an example combinations between production of biofuels and heating/cooling of buildings using excess heat from the production
- Reduction in consumption of plastics, avaiation, goods and more recycling is needed
- Change in farming is needed
- Foresting is needed

And when introducing the tasks necessary to control or reduce climate changes we will have also to be aware of reduction in biodiversity, pollution from chemicals and other irreversible changes

It is not imposssible. Technical solutions can do a part of the change. Change of habits and consumption can do another part of the change.

Thank you for listening
Questions?

pas@planenergi.dk
www.planenergi.eu