

Role of carbon free energy in transition to climate neutral society

Aalto Energy Forum

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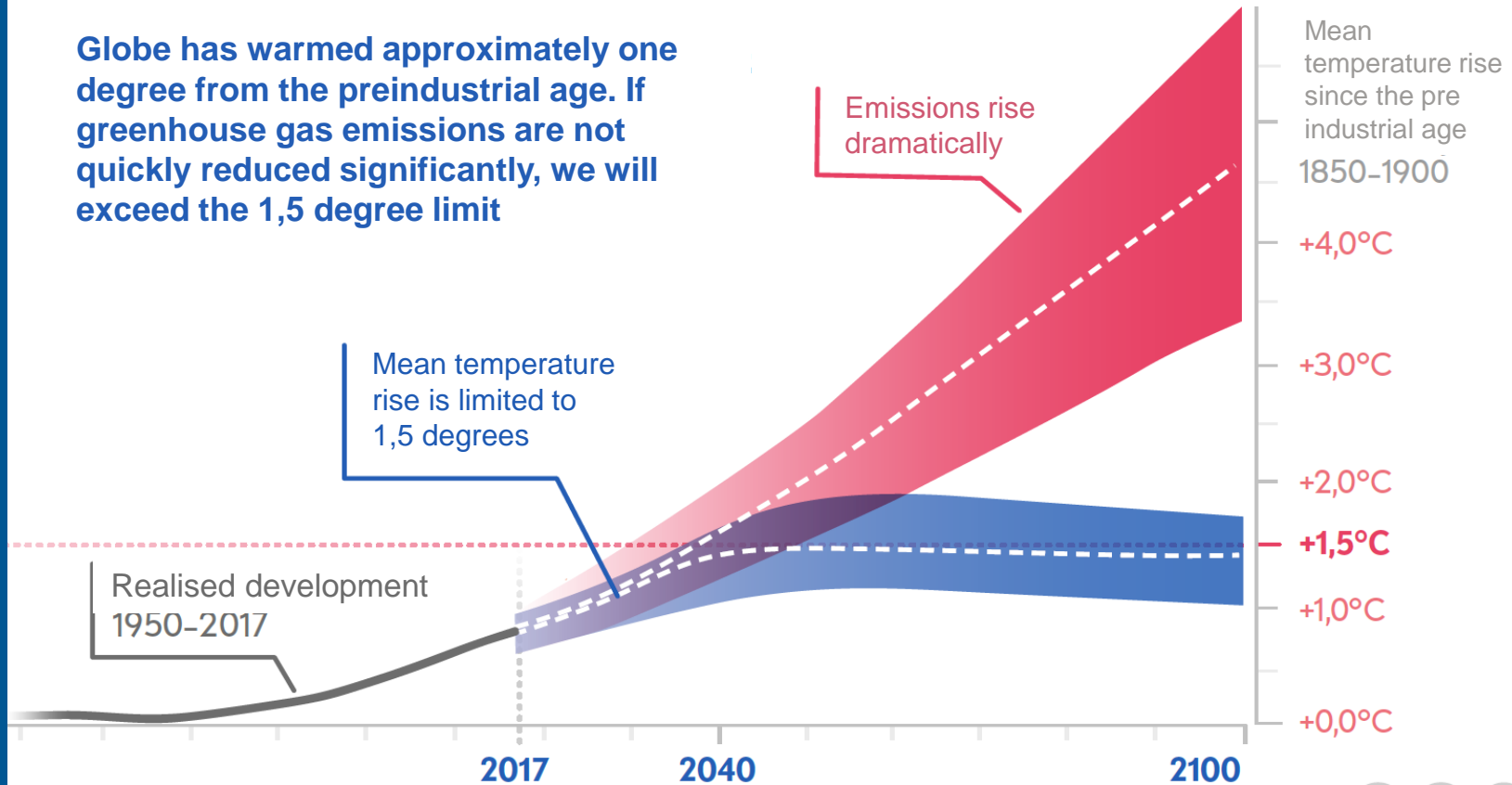
9.12.2021



*Decarbonising primary energy
is the key to combat climate
change.*

Climate change 101

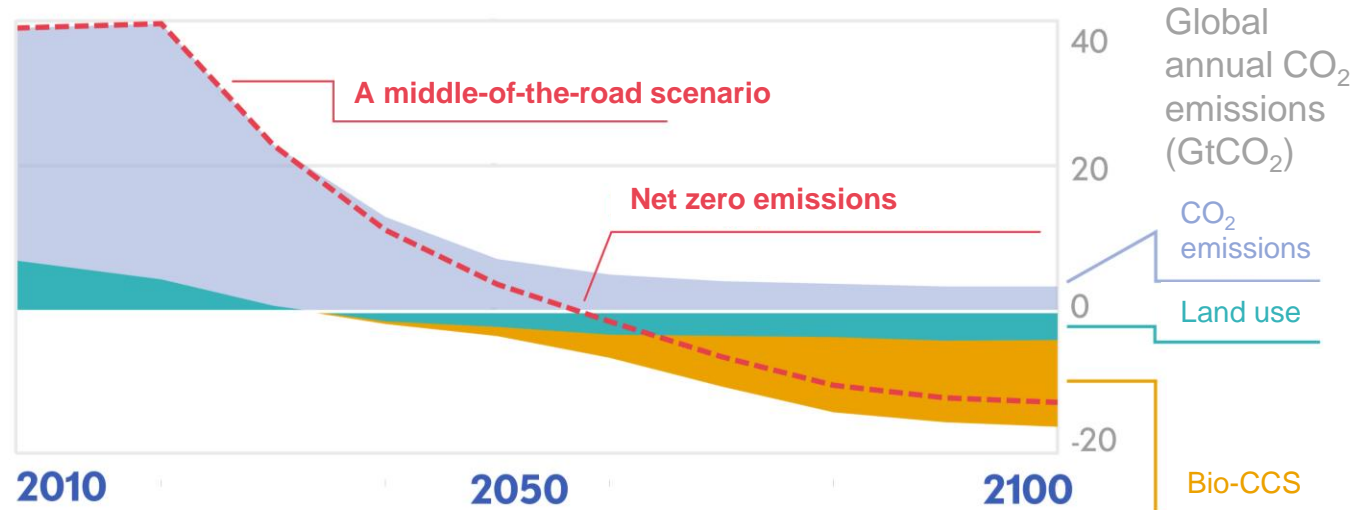
Globe has warmed approximately one degree from the preindustrial age. If greenhouse gas emissions are not quickly reduced significantly, we will exceed the 1,5 degree limit



Pohjautuu IPCC:n 1,5 asteen raportin tuloksiin. © Ilmatieteen laitos ja ympäristöministeriö, 2018. Ilmasto-opas.fi.



In order to limit the global warming to below 2dg level NET ZERO emissions should be reached by mid century



GtCO₂ = miljardia tonnia hiilidioksidia

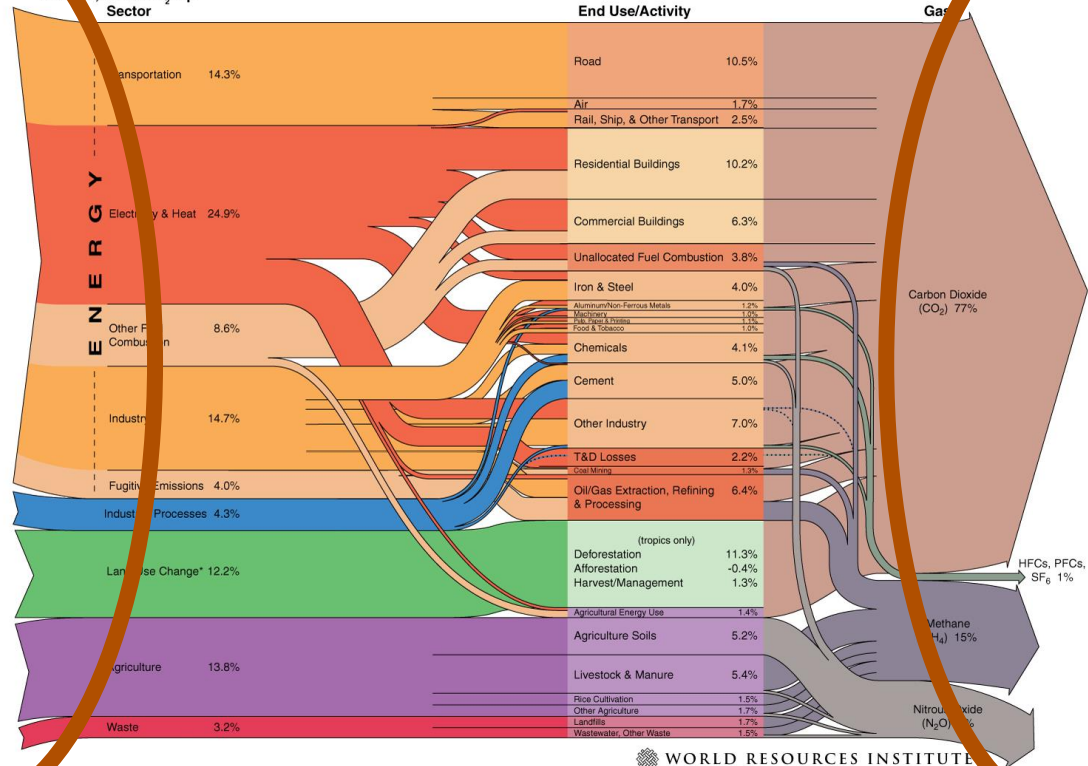
Pohjautuu IPCC:n 1,5 asteen raportin tuloksiin. © Ilmatieteen laitos ja ympäristöministeriö, 2018. Ilmasto-opas.fi.



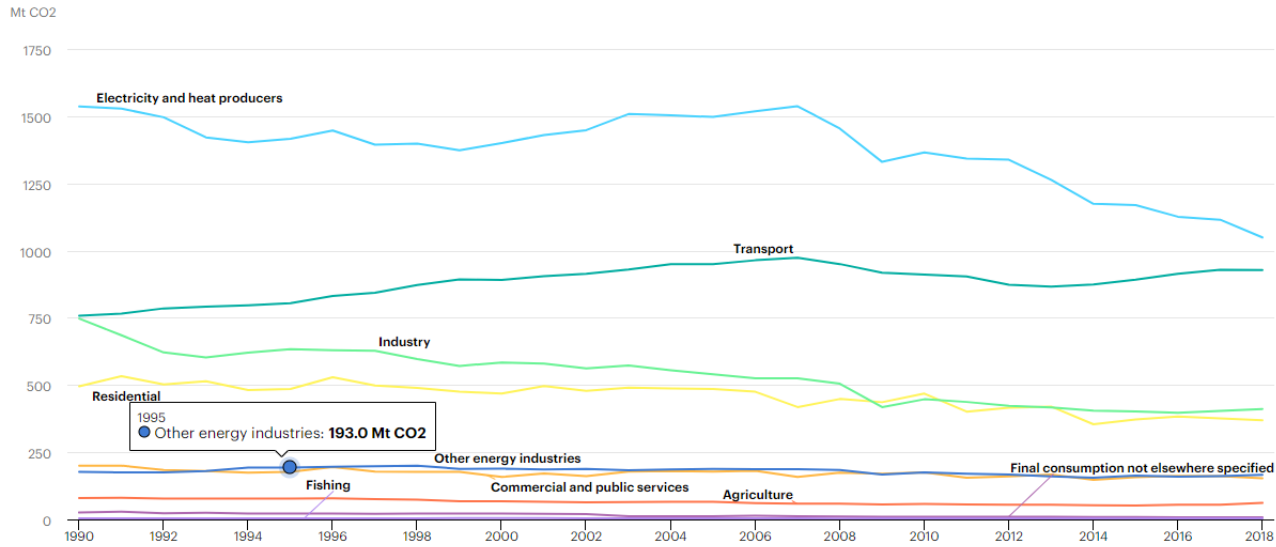
What's up CO₂?

It is the physical world that matters in this context


World Greenhouse Gas Emissions in 2005
Total: 44,153 MtCO₂ eq.



Electricity generation is decarbonising faster than other sectors

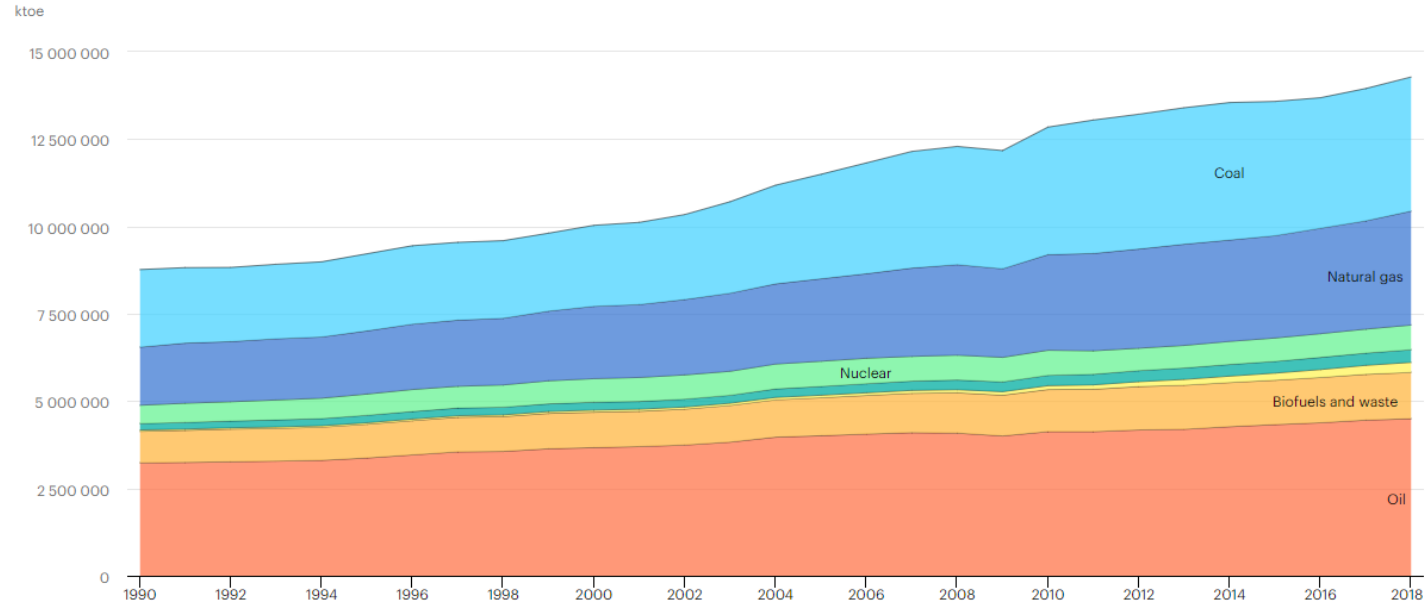


Electricity and heat producers Other energy industries Industry Transport Residential Commercial and public services Agriculture Fishing
Final consumption not elsewhere specified



Systemic approach to CO₂ mitigation and what to do

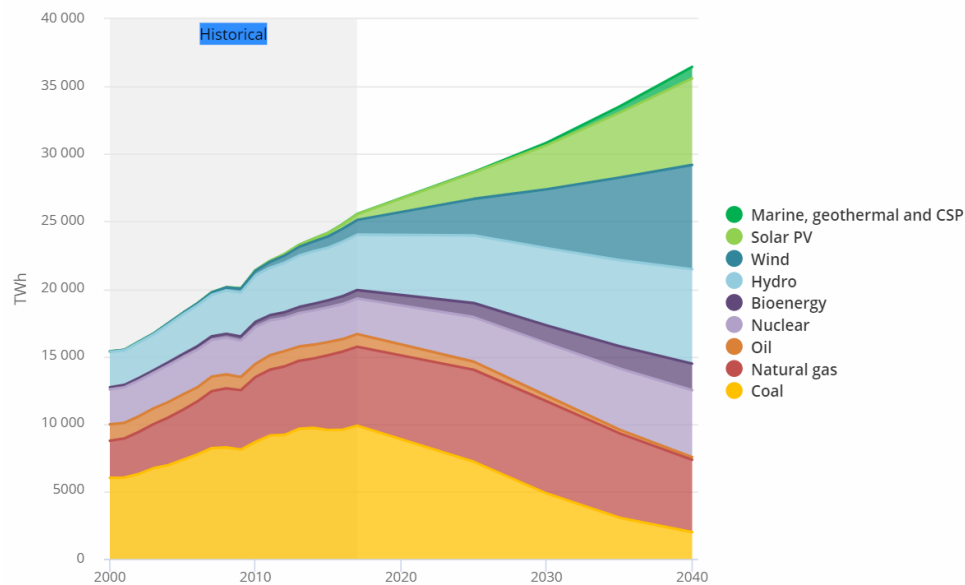
Total world energy supply



IEA 2020

● Coal ● Natural gas ● Nuclear ● Hydro ● Wind, solar, etc. ● Biofuels and waste ● Oil

Sustainable Development Scenario (SDS)



IEA/World Energy Outlook 2018

Sustainable Development Scenario (SDS)

Outlines an integrated approach to achieving internationally agreed objectives on climate change, air quality and universal access to modern energy.

What's on track?

Tracking Power

Not on track

Decarbonising the power sector is a fundamental step to reduce emissions, especially in an increasingly electrified world.

Tracking Power 2021 report

- Renewable Power
- Nuclear Power

- Natural Gas-Fired Power
- Coal-Fired Power
- CCUS in Power

Tracking Fuel Supply

Not on track

A rapid step-change in policy and industry action is needed to cut flaring and methane emissions in the oil and gas sector.

Tracking Fuel Supply 2021 report

- Methane Emissions from Oil and Gas
- Flaring Emissions

Tracking Industry

Not on track

Industry processes that can't be easily electrified must cut emissions through efficiency, aggressive innovation and carbon capture.

Tracking Industry 2021 report

- Chemicals
- Iron and Steel
- Cement

- Pulp and Paper
- Aluminium
- CCUS in Industry and Transformation

Tracking Transport

Not on track

The transport sector will need to undergo a major transformation, including vastly improving efficiency and shifting from oil to electricity and other low-carbon fuels.

Tracking Transport 2021 report

- Electric Vehicles
- BAI
- Low-Carbon Fuels for Cars and Trucks
- Aviation Fuels

- Decarboned Bunkers
- Aviation
- International Shipping

Tracking Buildings

Not on track

Unprecedented efficiency improvements are required in buildings, addressing growing demand from cooling, heating and powered devices.

Tracking Buildings 2021 report

- Building Envelopes
- Heating
- Cooling
- Lighting
- Appliances and Equipment

- Smart Buildings
- District Heating
- Data Centres and Data Transmission Networks

Tracking Energy Integration

Not on track

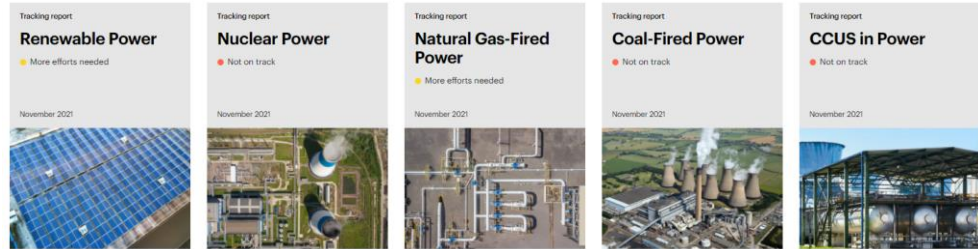
Energy integration technologies will become increasingly important, especially as shares of variable renewables rise.

Tracking Energy Integration 2021 report

- Renewable Storage
- Hydrogen

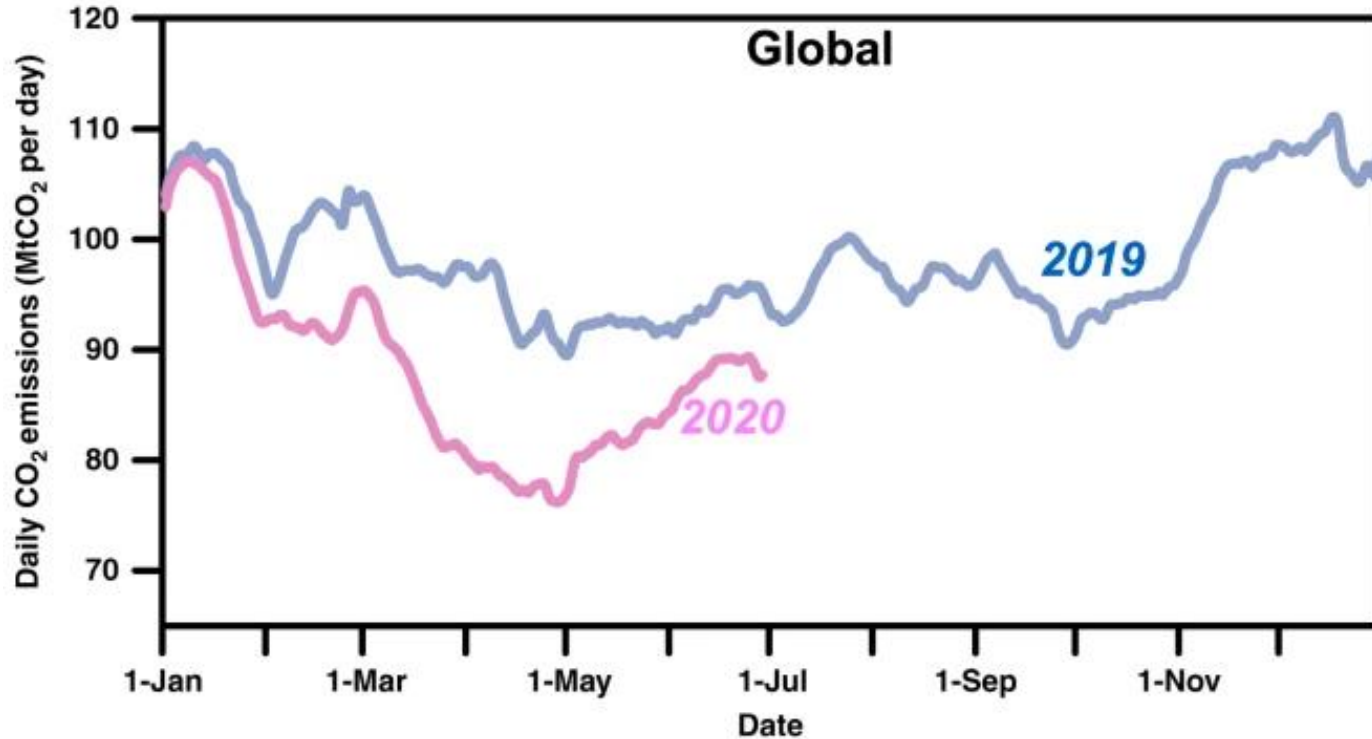
- Smart Grids
- Decarbon Resilience
- Smart Air Conditioners

Tracking clean energy progress



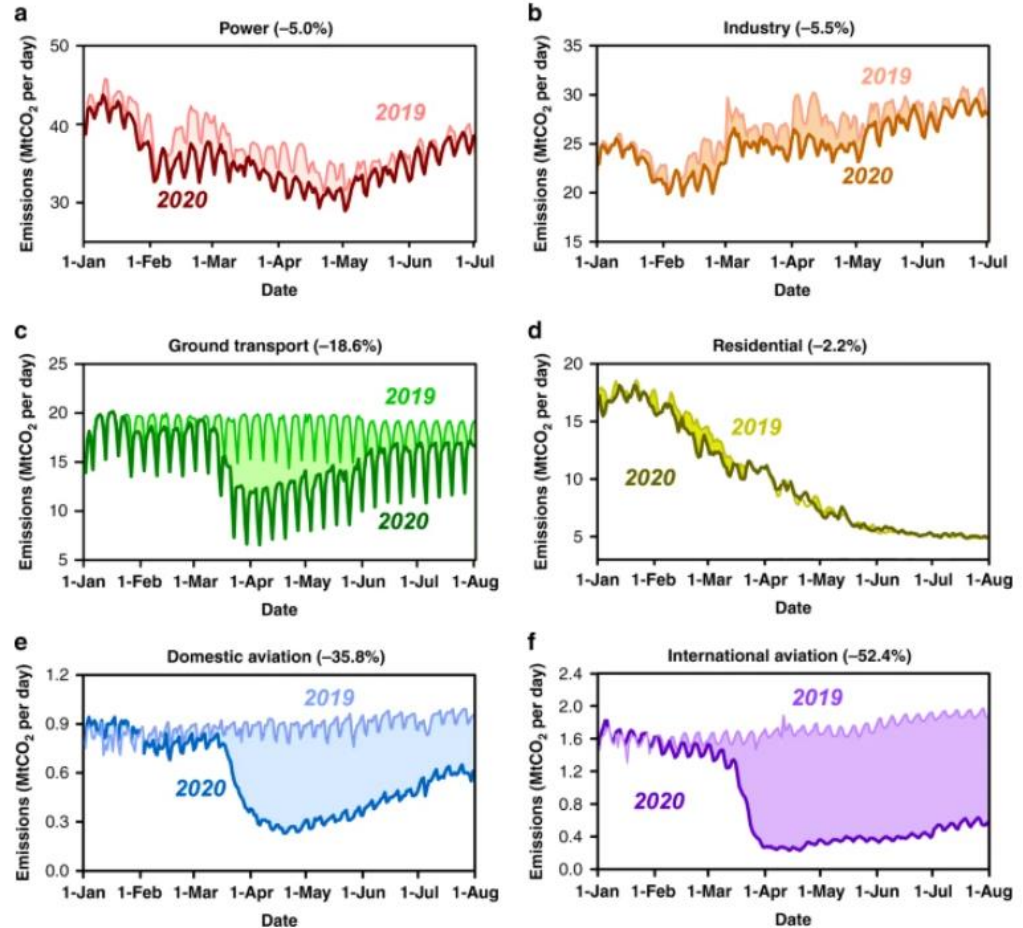
Covid-19

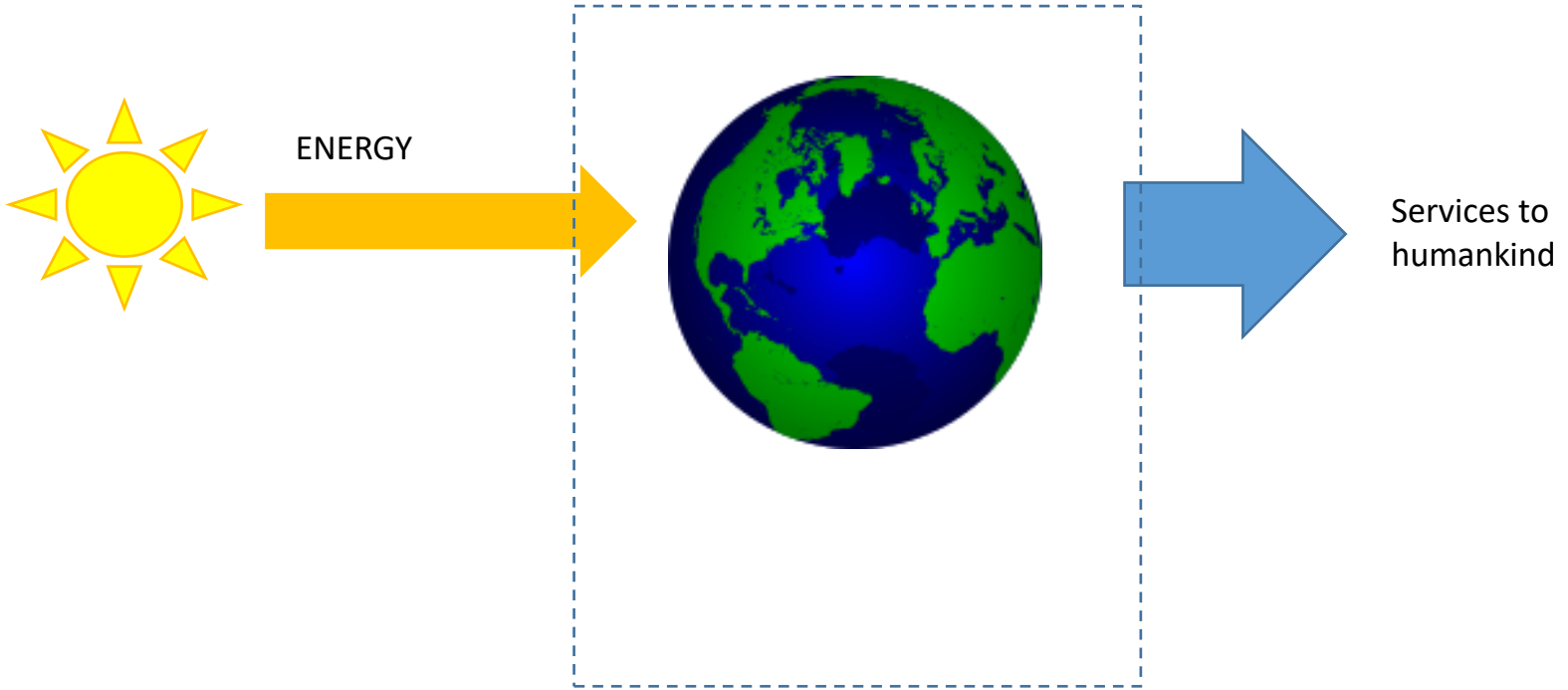
Effects of COVID-19 on global CO₂ emissions

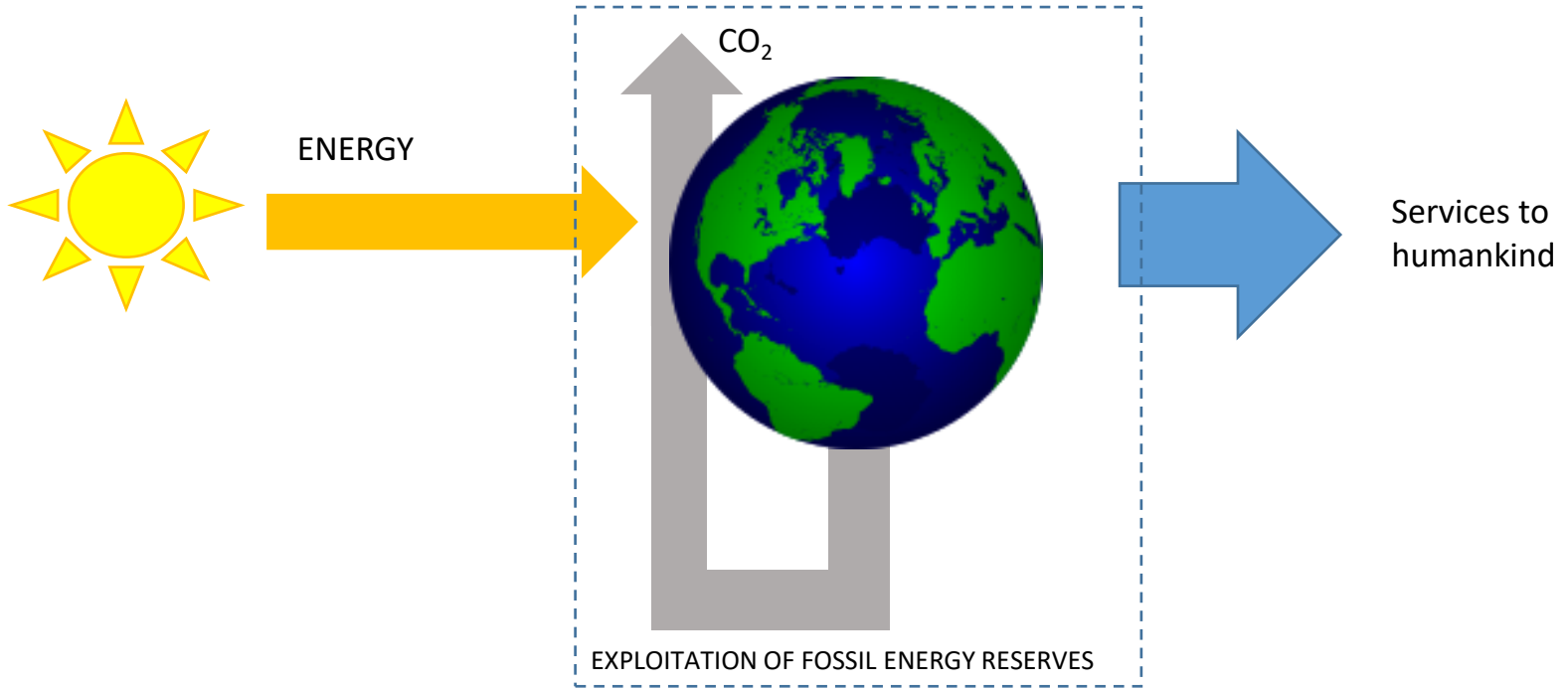


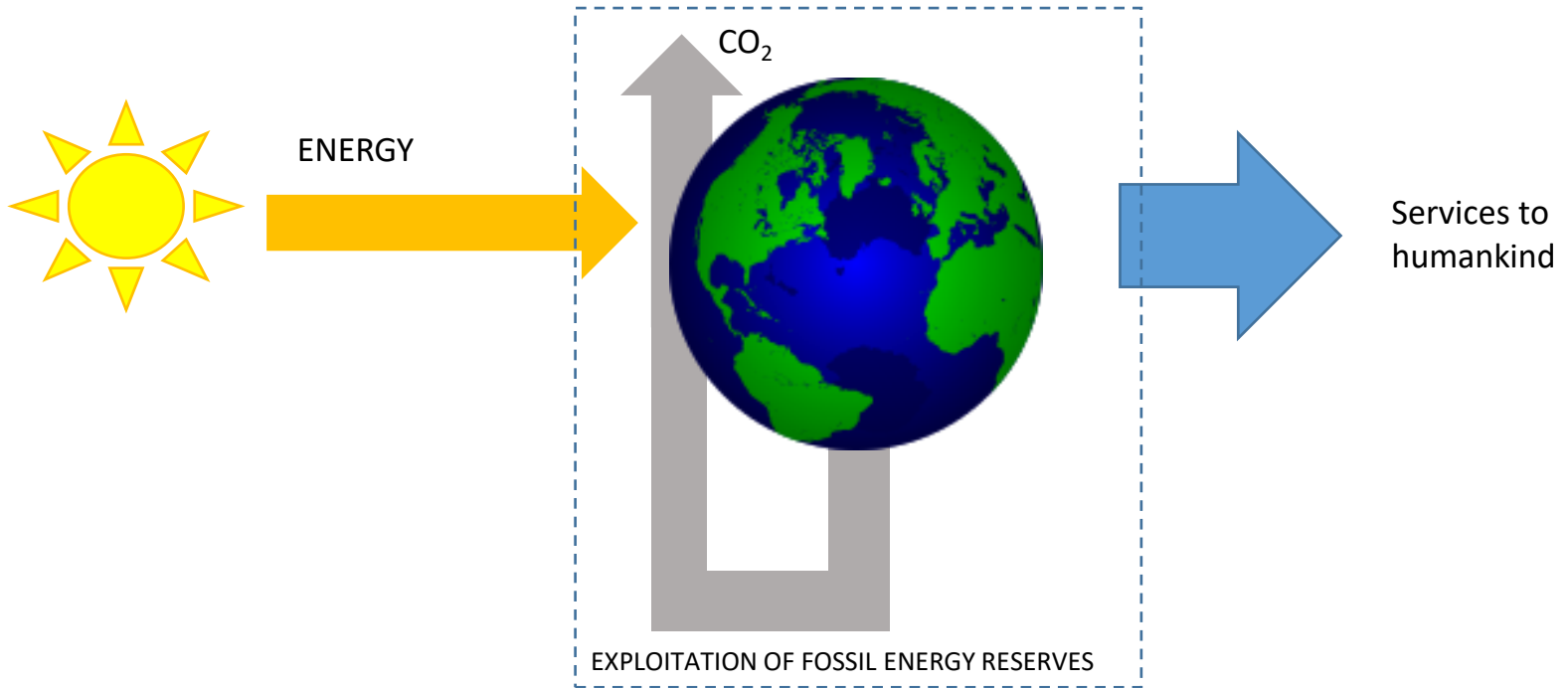
Liu, Z., Ciais, P., Deng, Z. *et al.* Near-real-time monitoring of global CO₂ emissions reveals the effects of the COVID-19 pandemic. *Nat Commun* 11, 5172 (2020). <https://doi.org/10.1038/s41467-020-18922-7>

Global daily CO₂ emissions

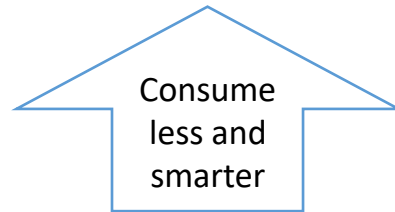
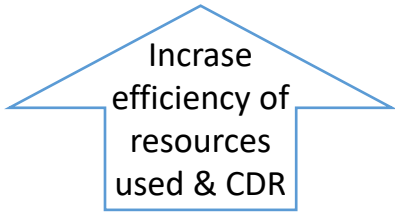
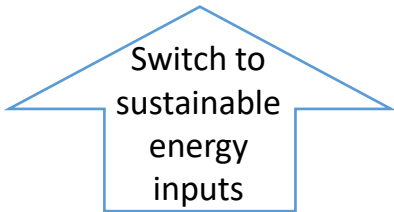








How to reduce GHG emissions



A decorative pattern on the left side of the slide, featuring a repeating grid of white and grey cubes. Each cube has a green semi-circle on its top face, creating a 3D effect.

Solutions

Low carbon energy sources

Conversions

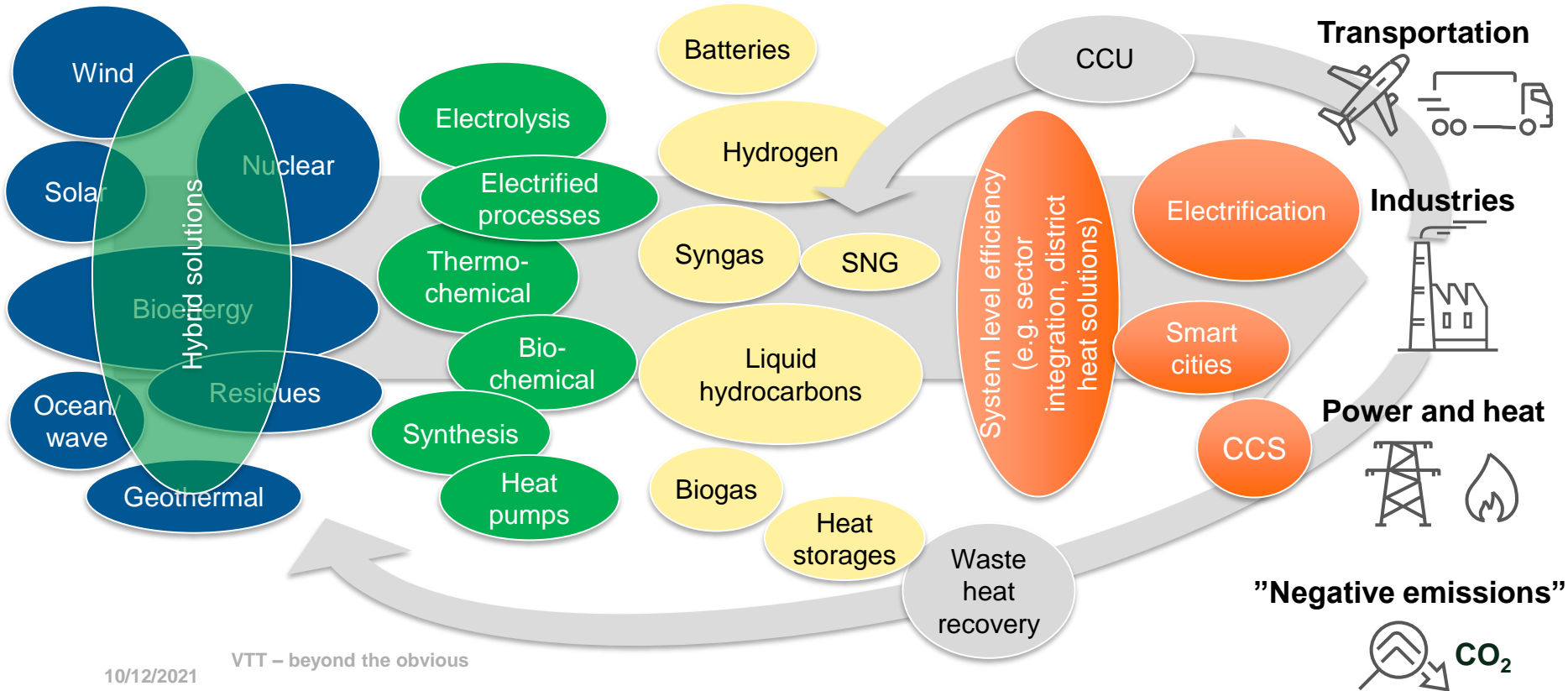
Storages

Smart systems & solutions

VTT

Renewables

Adjustables



Conclusions

- Decarbonisation of primary energy
- Decarbonisation of primary energy and systemic change

- Energy carriers to enable penetration of low carbon electricity to hard to decarbonize parts of the system
- Carbon dioxide removal

- Decarbonisation of primary energy

bey⁰nd

the obvious

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