CZ-AT WINTER-SUMMER SCHOOL 2024

THE WORLD ENERGY SYSTEM – AN INTRODUCTION

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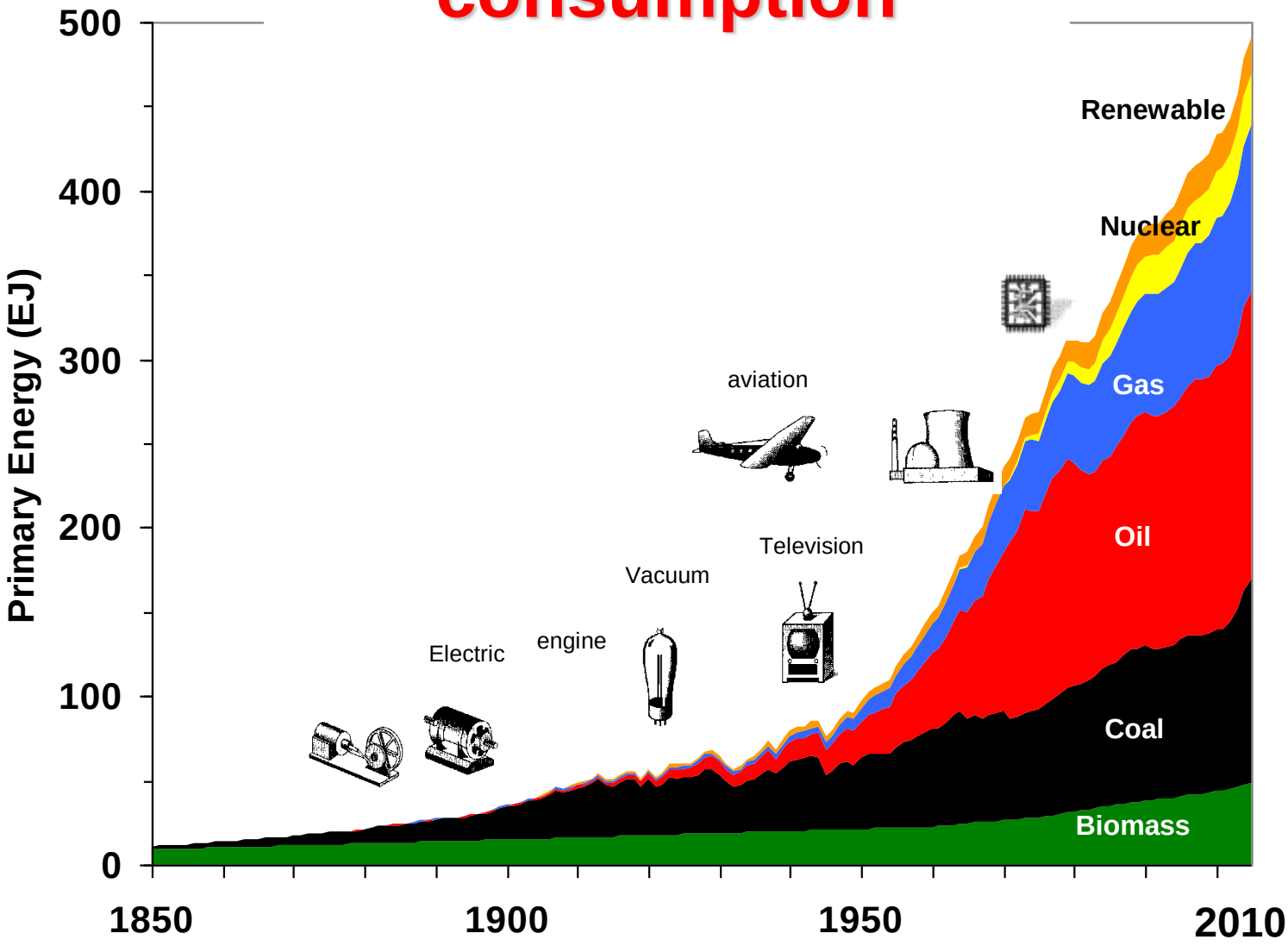
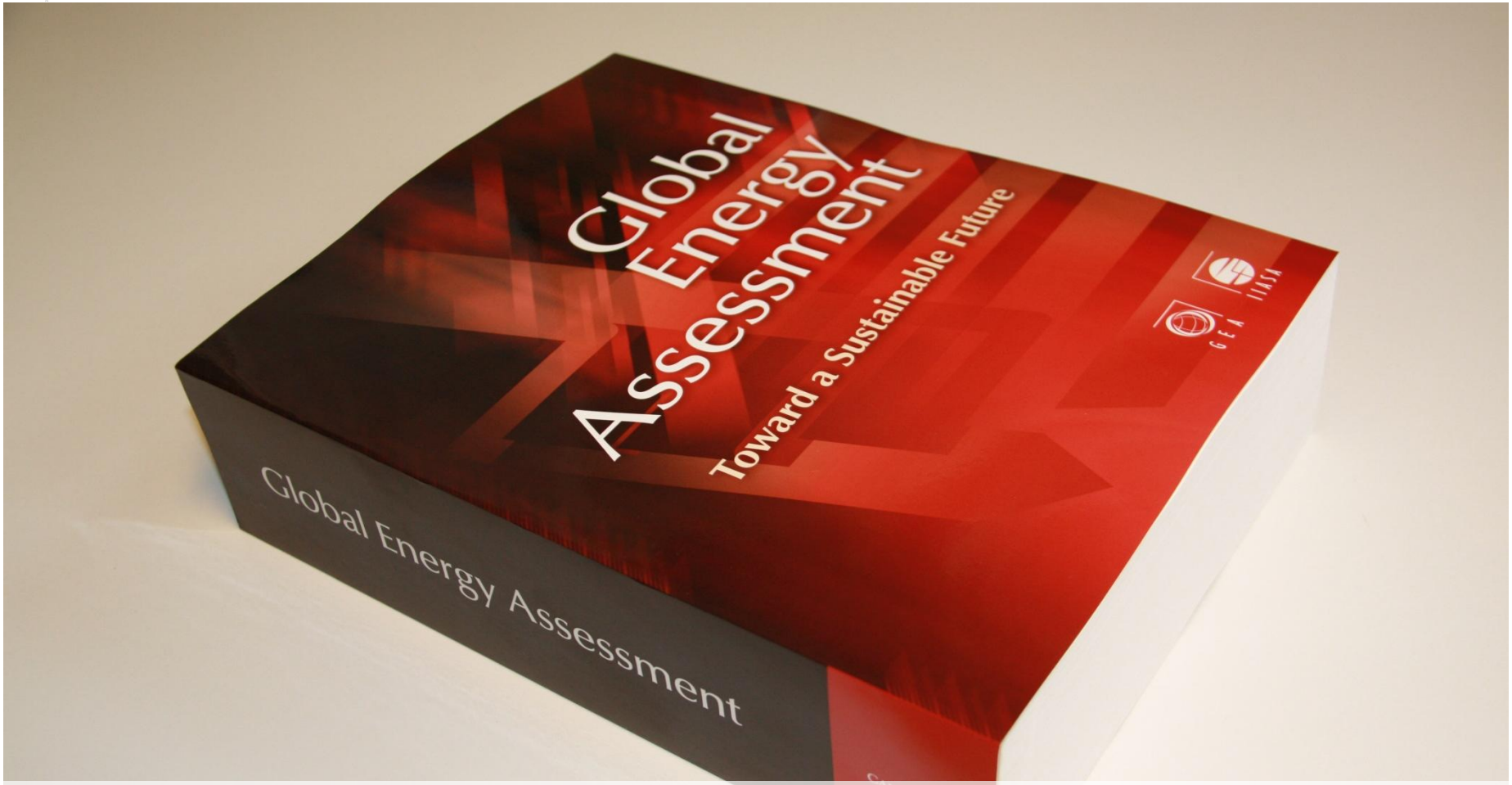
World Primary Energy consumption



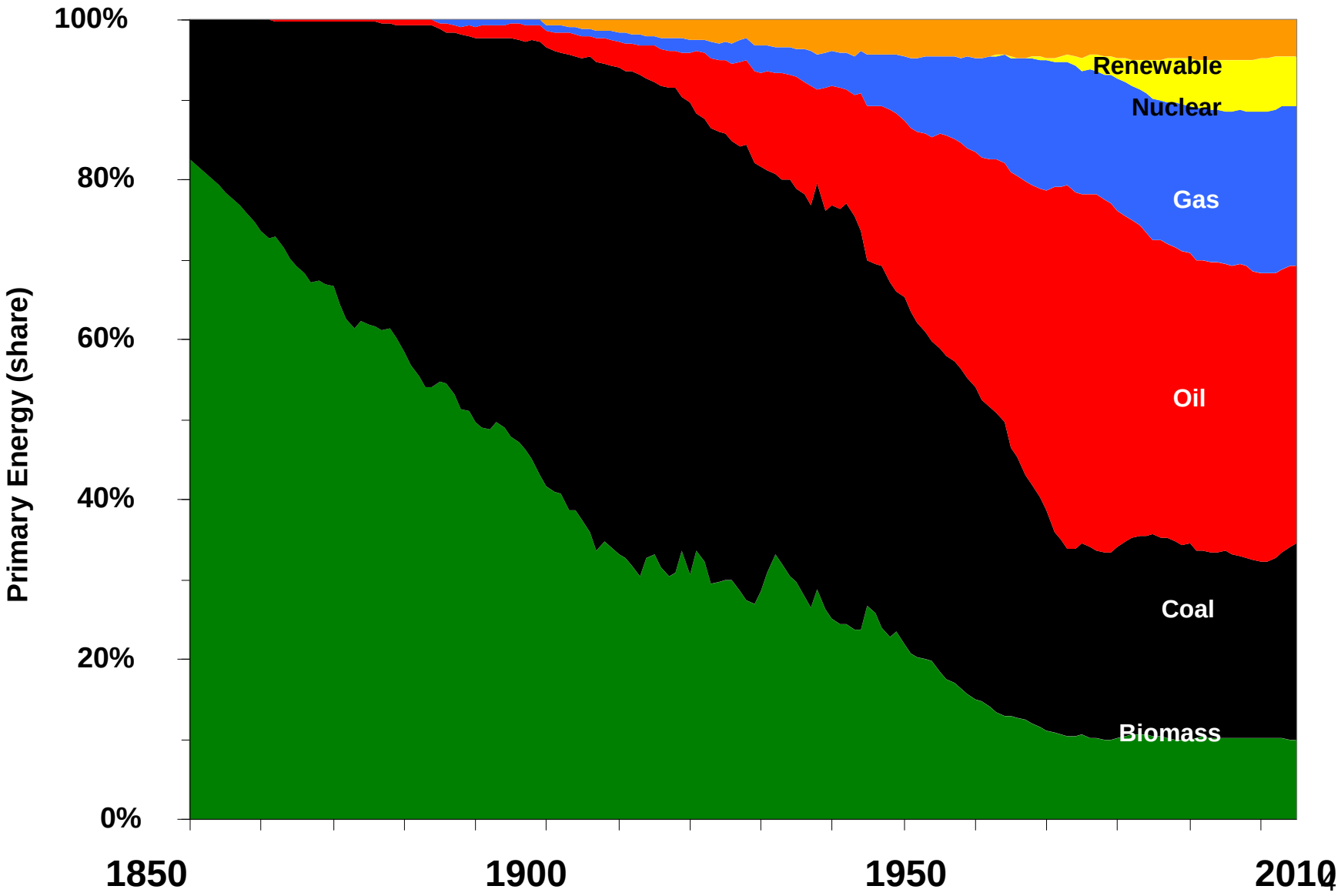
Source: GEA (2012)

www.GlobalEnergyAssessment.org

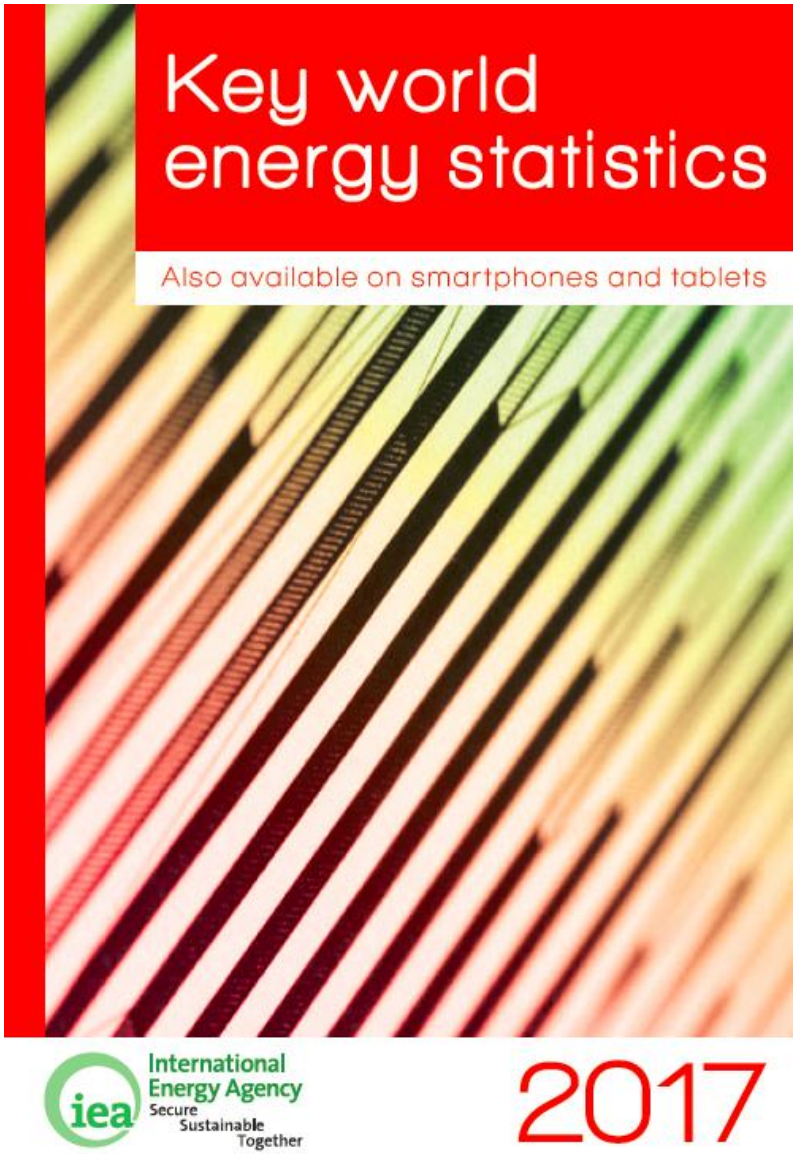


- **Total Effort: 300 Authors; 200 Reviewers**
  > 6 years >> 6m € and >> 100 p-years

Shares of PE world-wide



Source: GEA (2012)

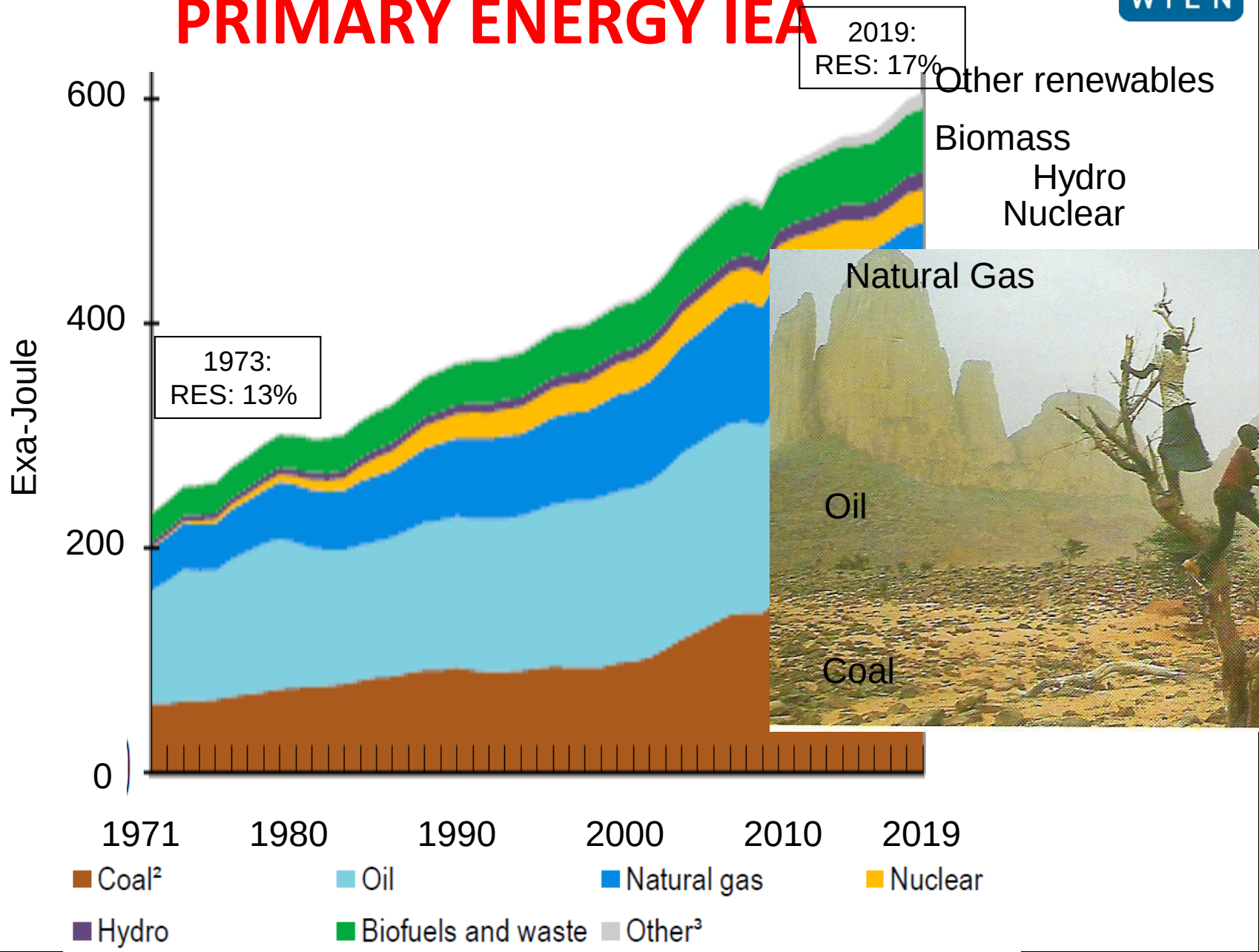


Statistics report

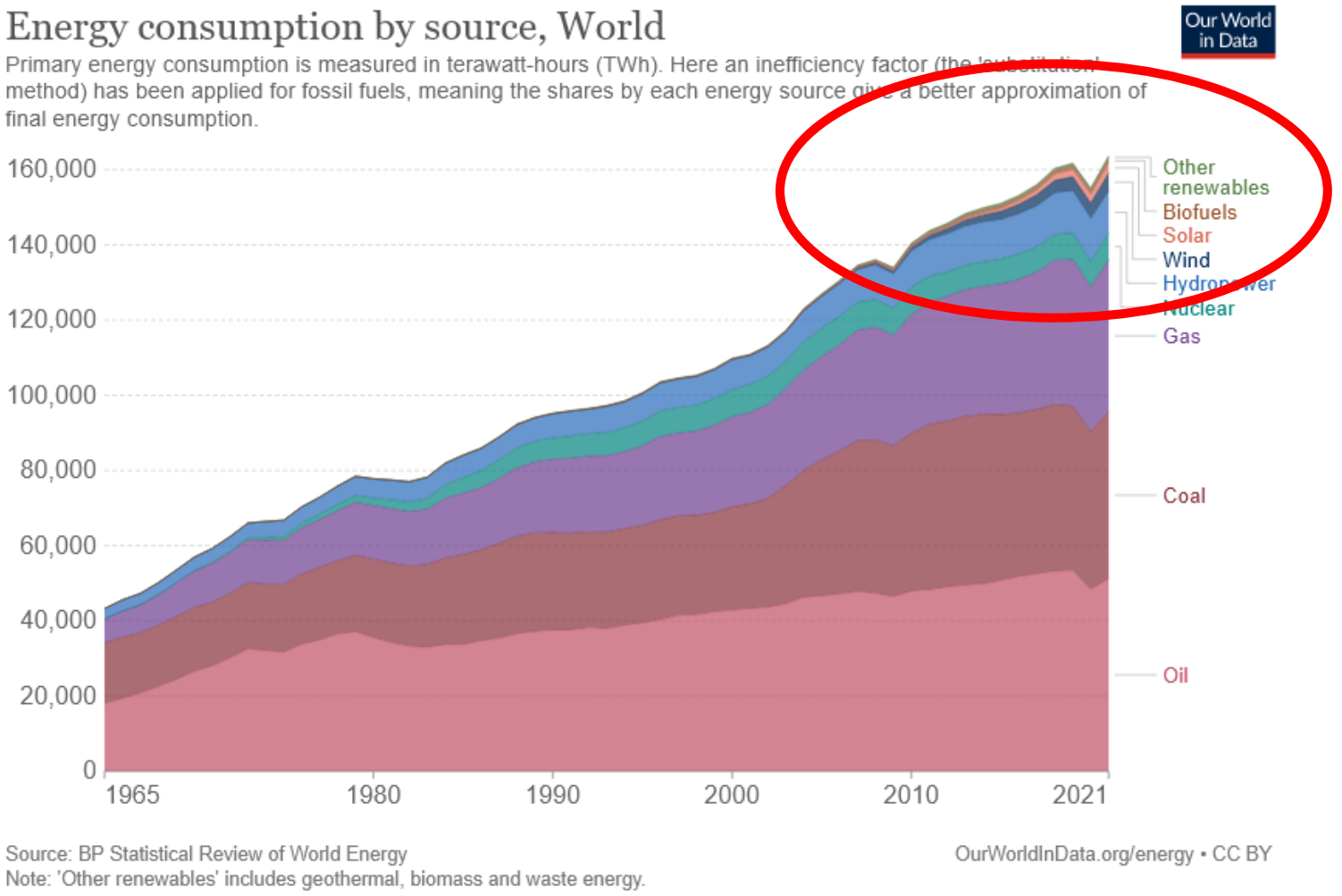
Key World Energy Statistics 2021

September 2021

WORLD-WIDE TREND IN PRIMARY ENERGY IEA



WORLD-WIDE TREND IN PRIMARY ENERGY



Energy Economics

TU

Our World in Data

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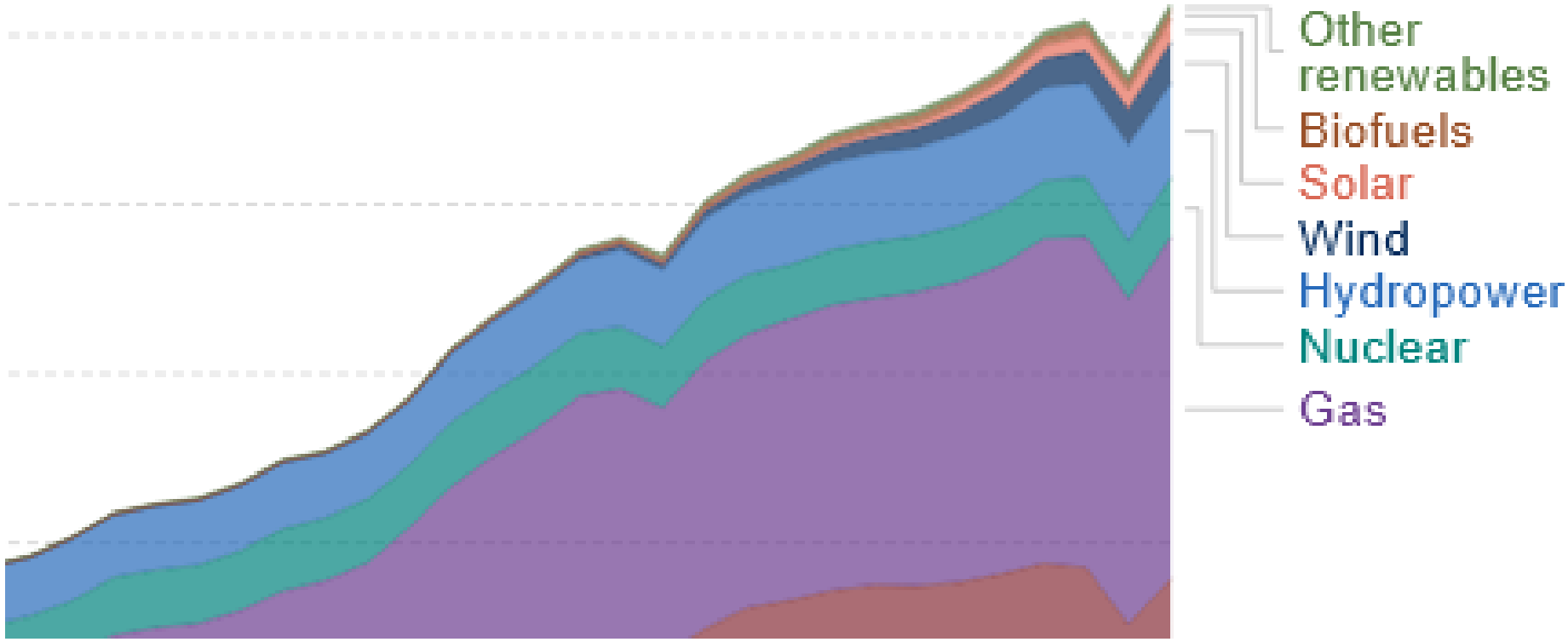
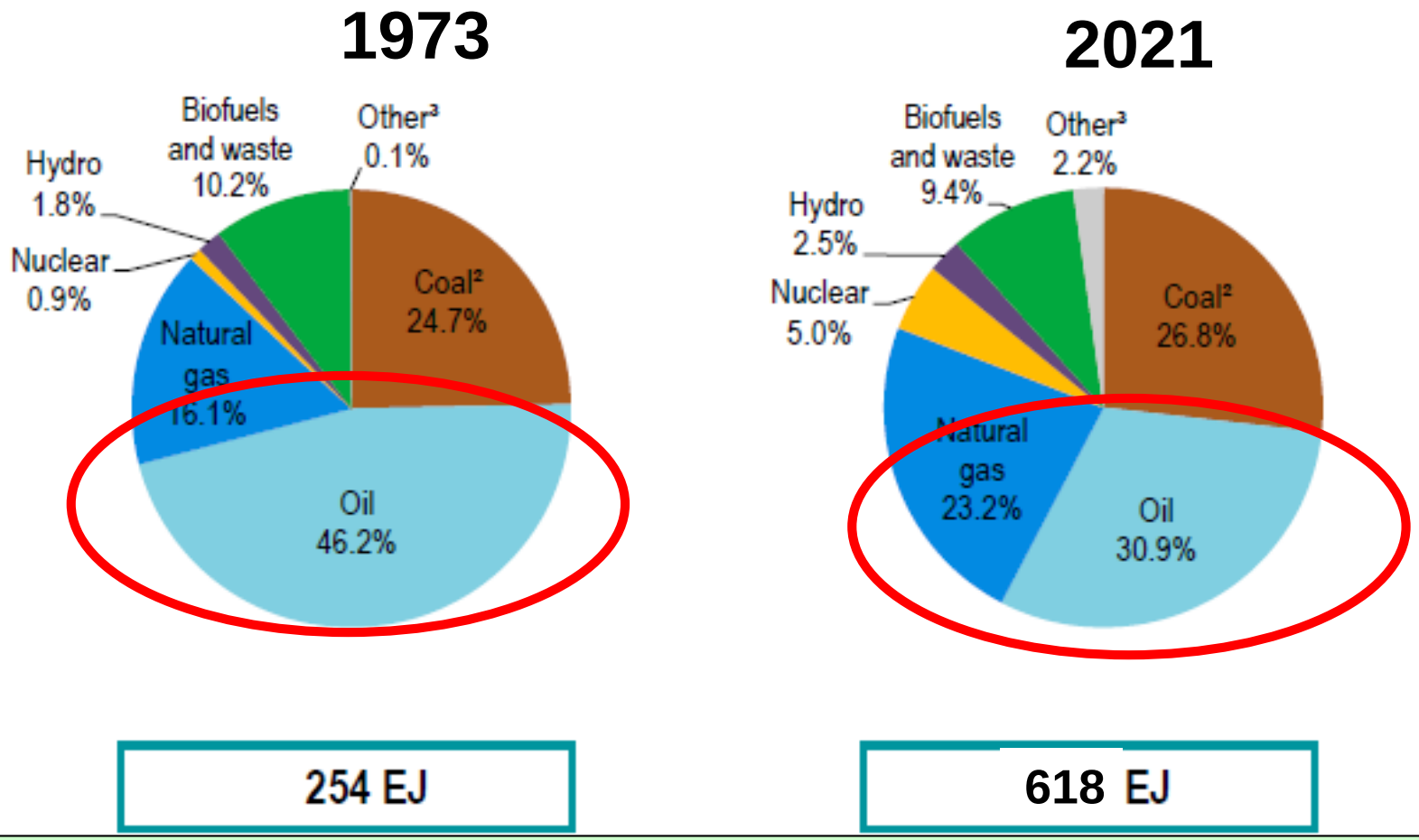
Wh). Here an inefficiency factor (the 'substitution'
by each energy source give a better approximation of



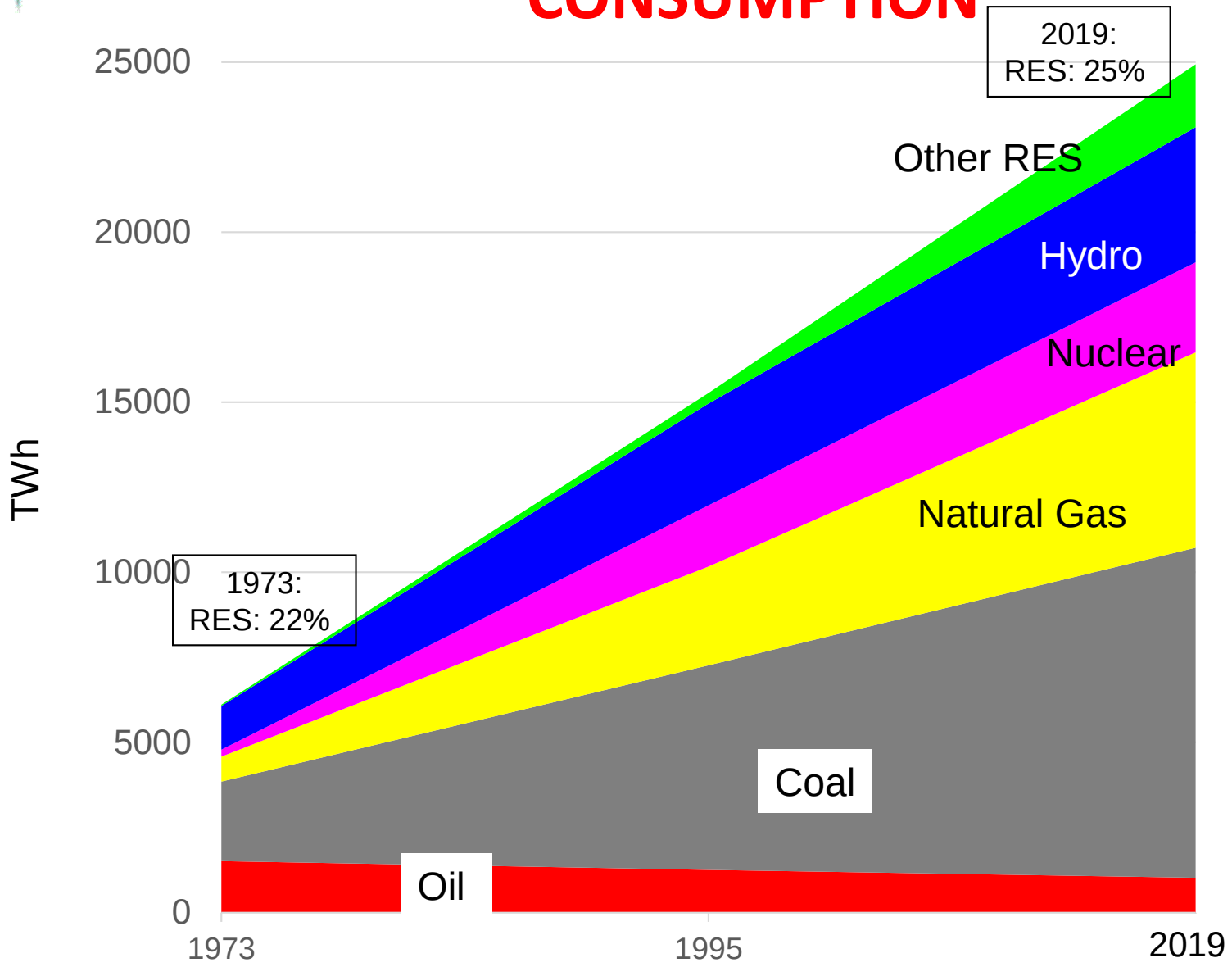
World: Primary energy



Source: IEA 2023

- ***Total primary energy demand more than doubled between 1973 and 2021;***
- ***Share Oil down (more than -30%!), Gas up, Coal up!***

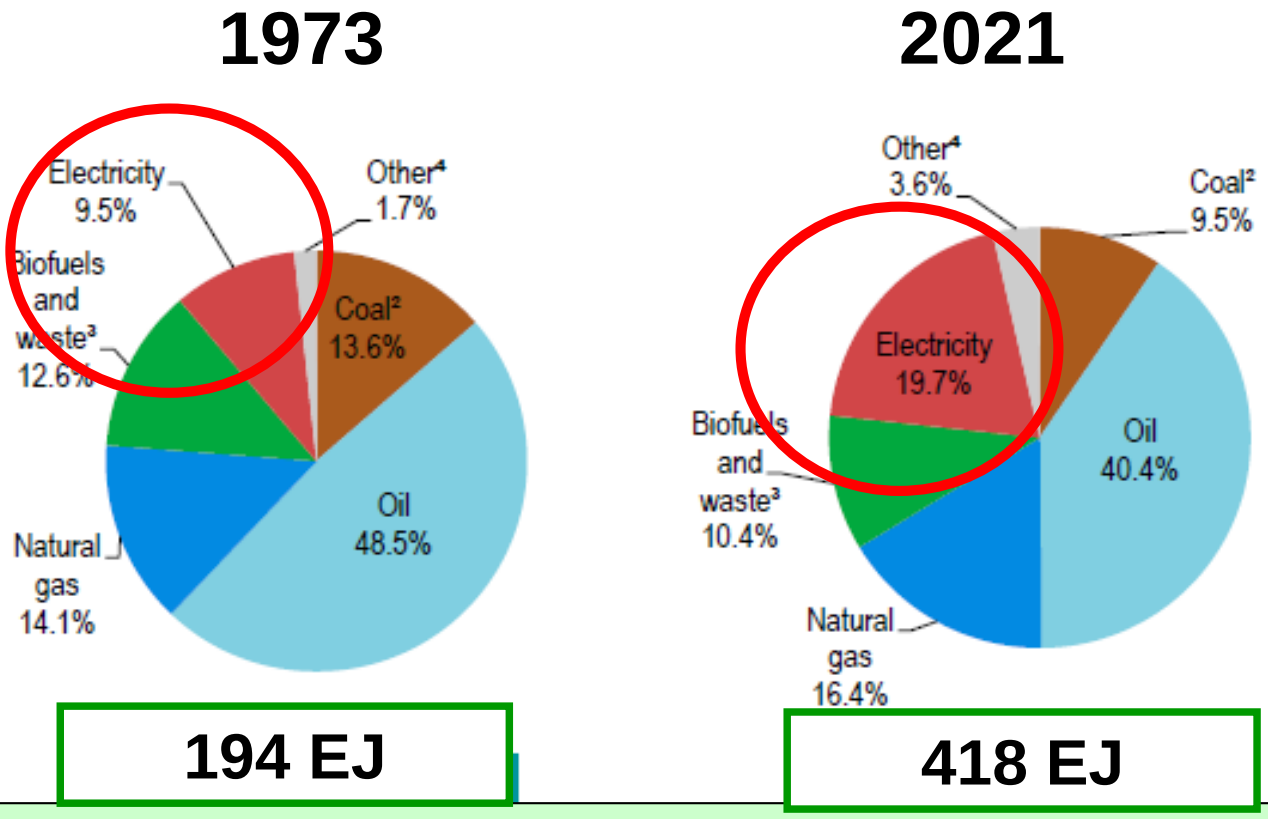
WORLD-WIDE TREND IN ELECTRICITY CONSUMPTION



Source: IEA (2020)

World: Final energy

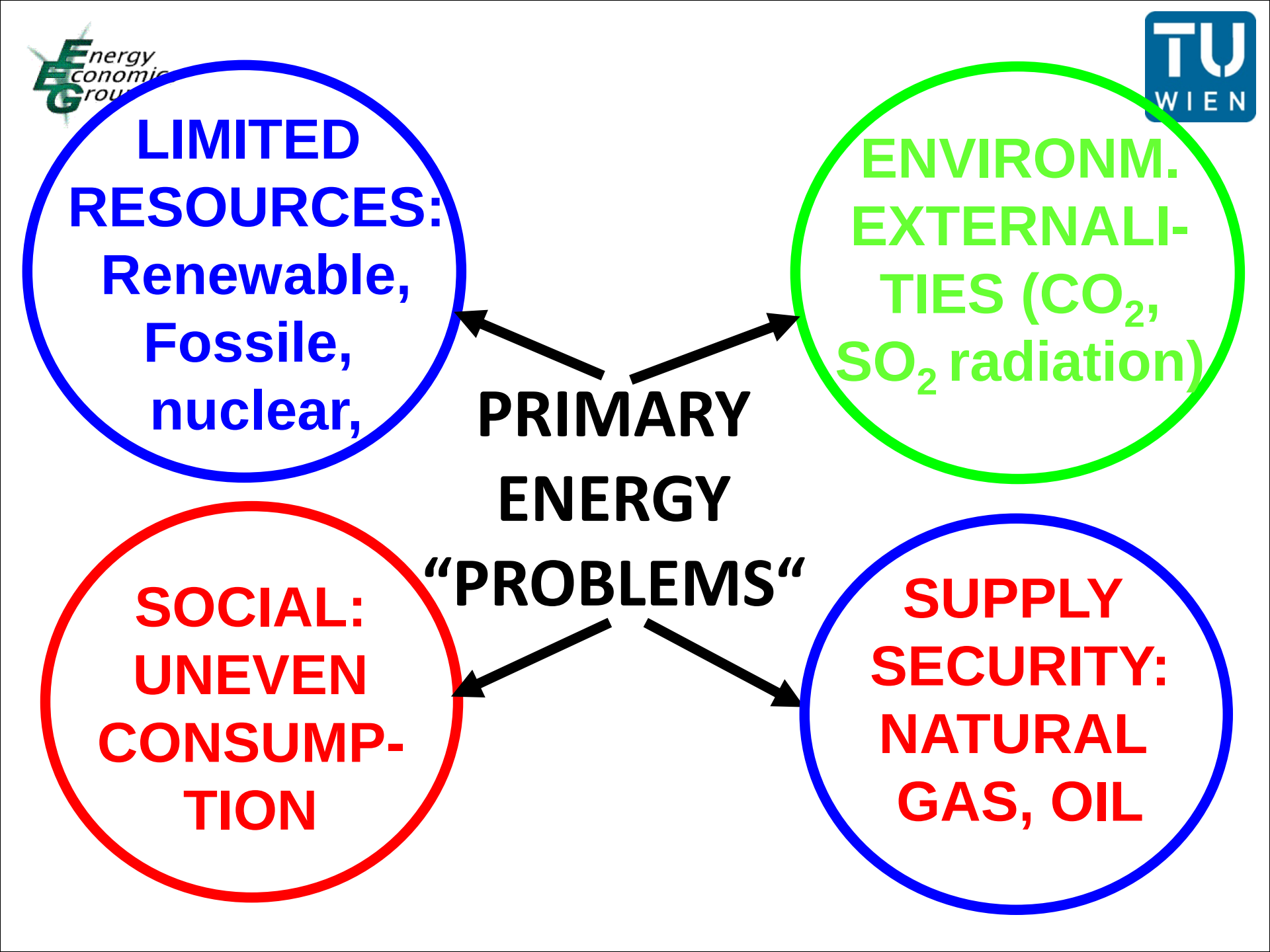
Share of world total final consumption by source, 1973 and 2019



Source: IEA 2021

- ***The share of electricity increases continuously: In 2021 twice of 1973***
- ***Share of oil decreased from 48% to 40%***

** Other includes Solar, Geothermal, Wind


LIMITED RESOURCES: Renewable, Fossile, nuclear,
ENVIRONM. EXTERNALI-TIES (CO_2, SO_2 radiation)
PRIMARY ENERGY "PROBLEMS"
SOCIAL: UNEVEN CONSUMP-TION
SUPPLY SECURITY: NATURAL GAS, OIL

The Key Energy Challenges

Energy Access

Climate Change

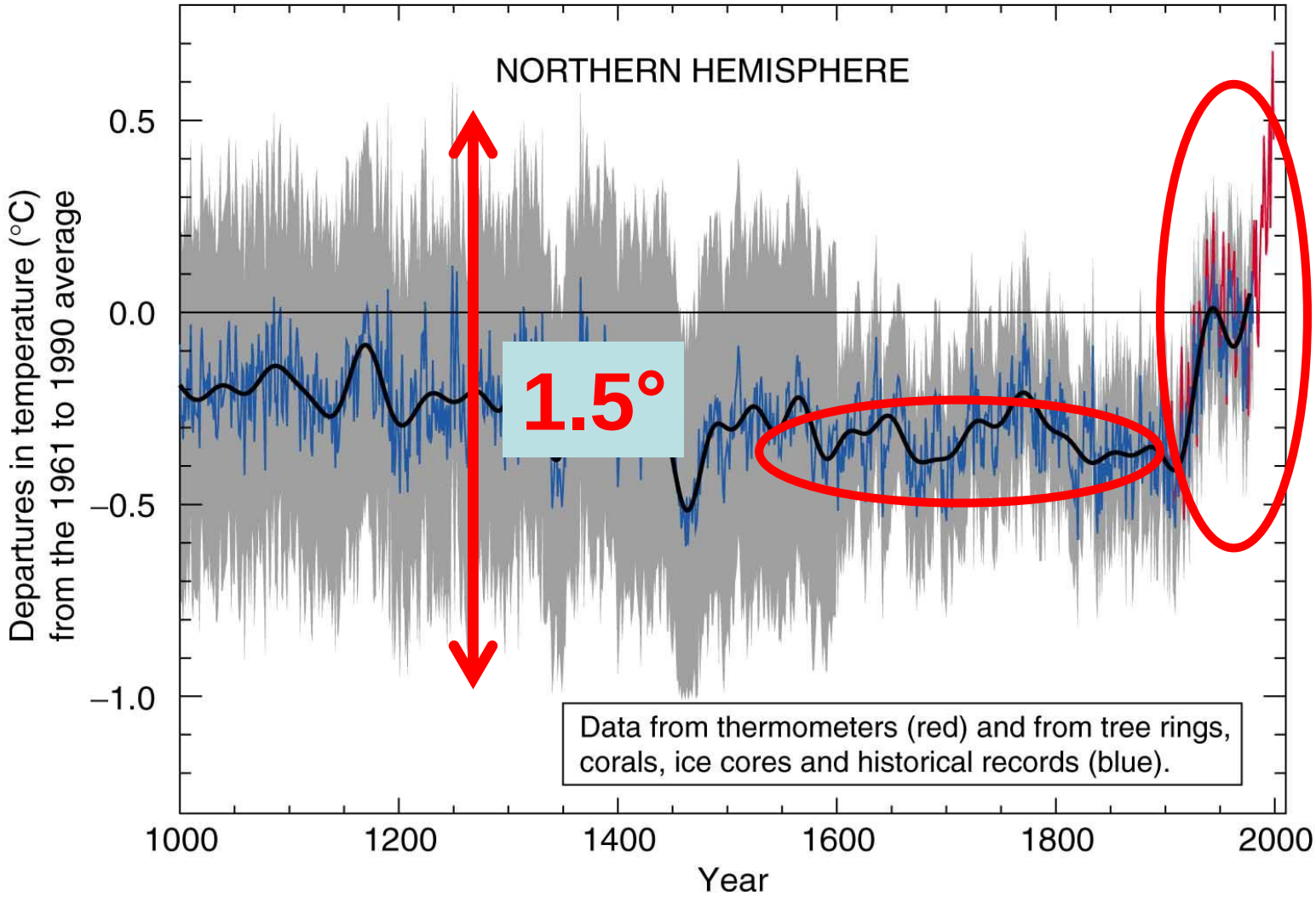
Air Pollution Health Impacts

Energy Security

Wood for Cooking

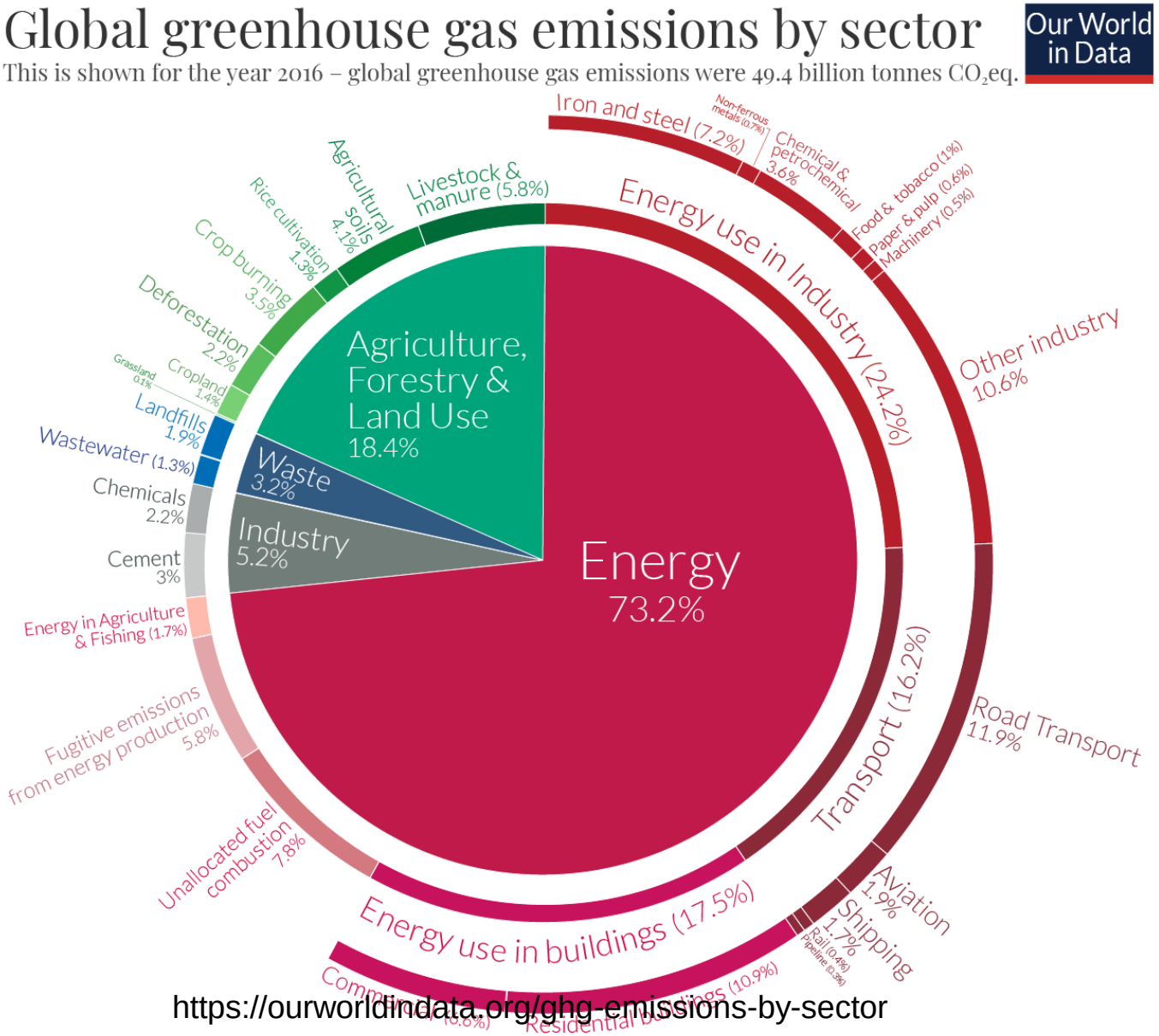
Source: Modi, 2011 and Yumkella, 2013

Long-term Variations of Earth's Surface temperature in the past 1000 years



Source: IPCC, 2001a

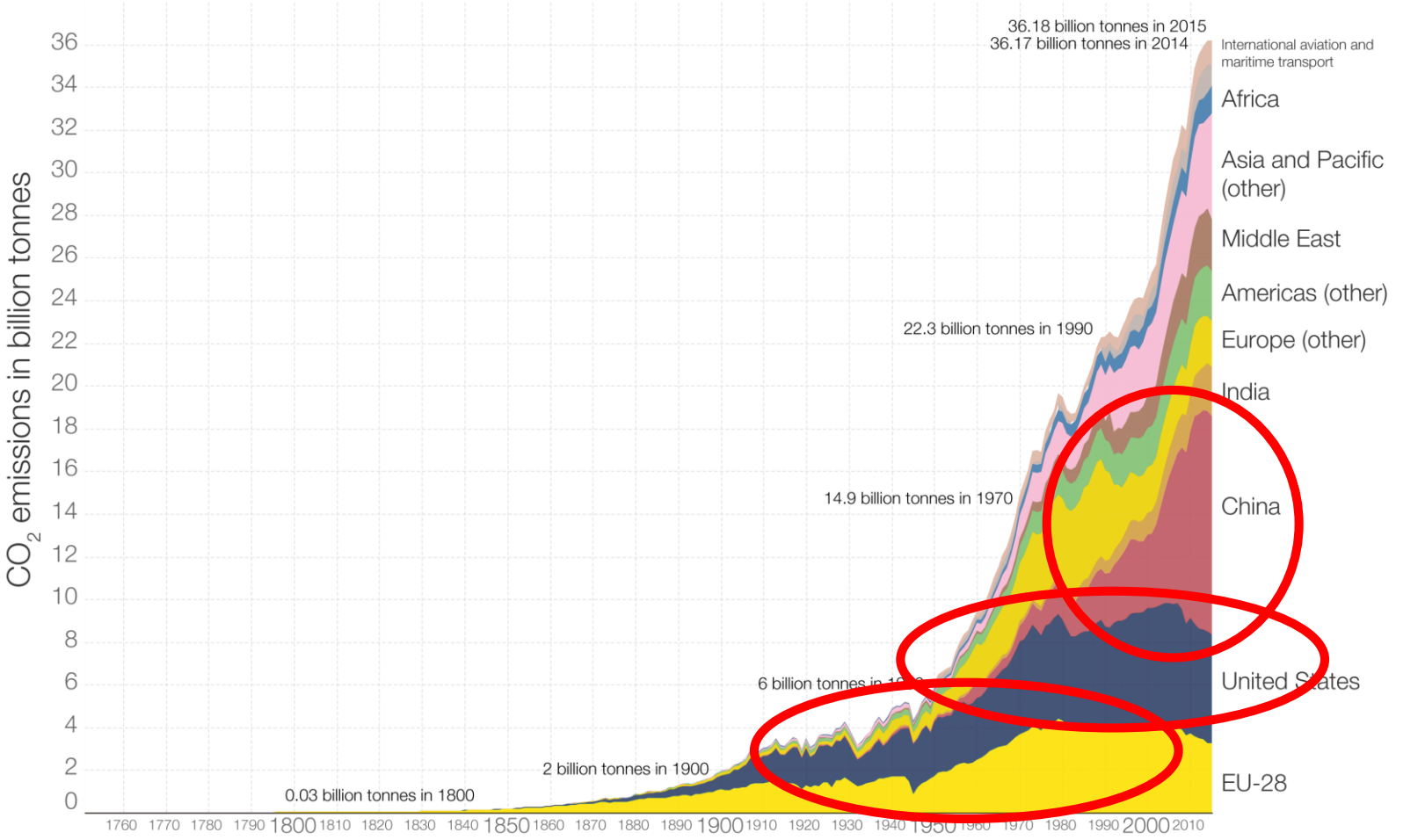
What does energy contribute to Global Warming?



https://ourworldindata.org/ghg-emissions-by-sector

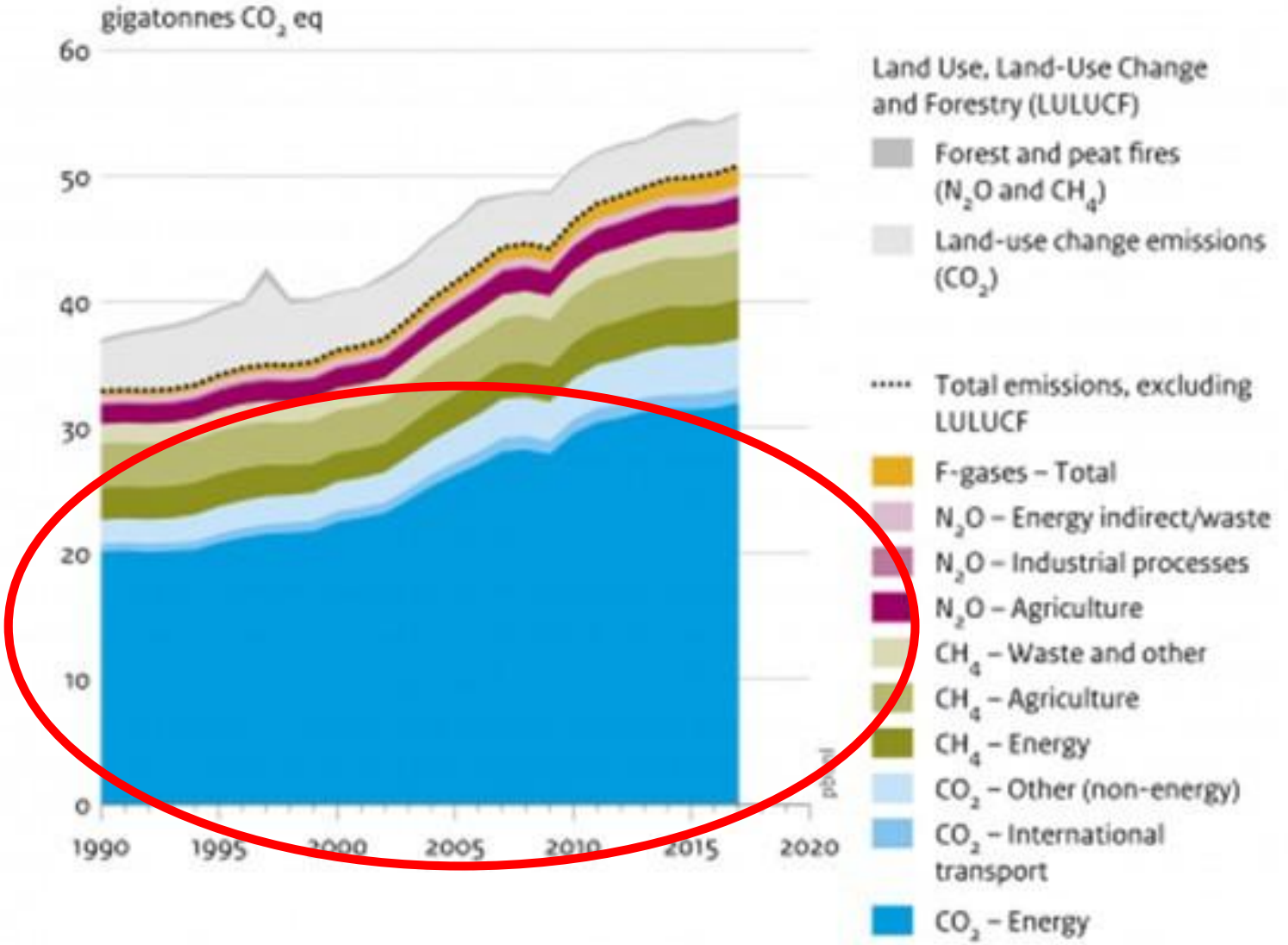
Global CO_2 emissions by world region, 1751 to 2015

Annual carbon dioxide emissions in billion tonnes (Gt).



Data source: Carbon Dioxide Information Analysis Center (CDIAC); aggregation by world region by Our World In Data.
The interactive data visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic.

Global greenhouse gas emissions, per type of gas and source, including LULUCF

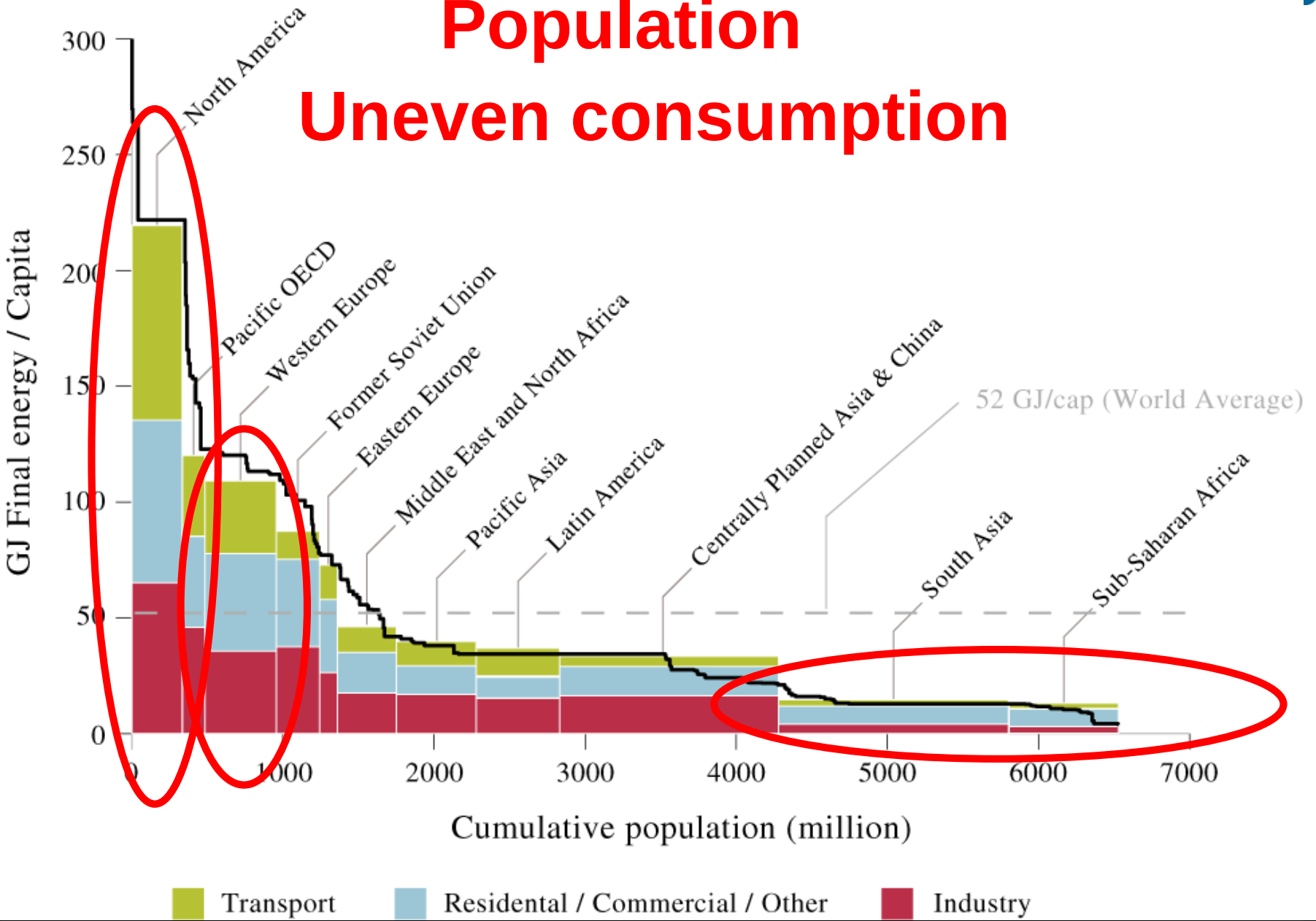


https://www.pbl.nl/en/publications/trends-in-global-co2-and-total-greenhouse-gas-emissions-2018-report

Source: EDGAR v5.0/v4.3.2 FT 2017 (EC-JRC/PBL, 2018); Houghton and Nassikas (2017)

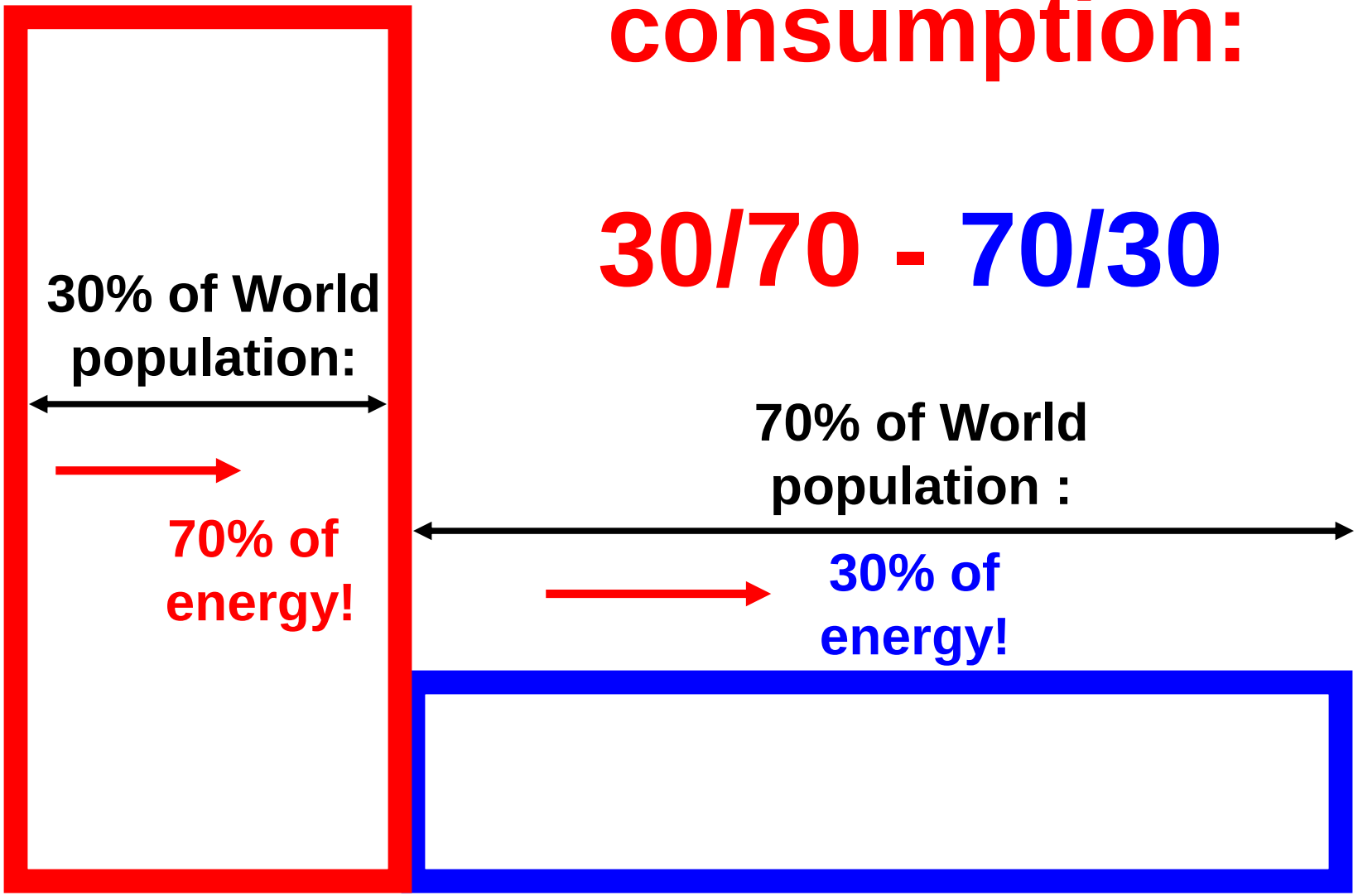
Per Capita Final Energy & Population

Uneven consumption



Uneven consumption:

30/70 - 70/30

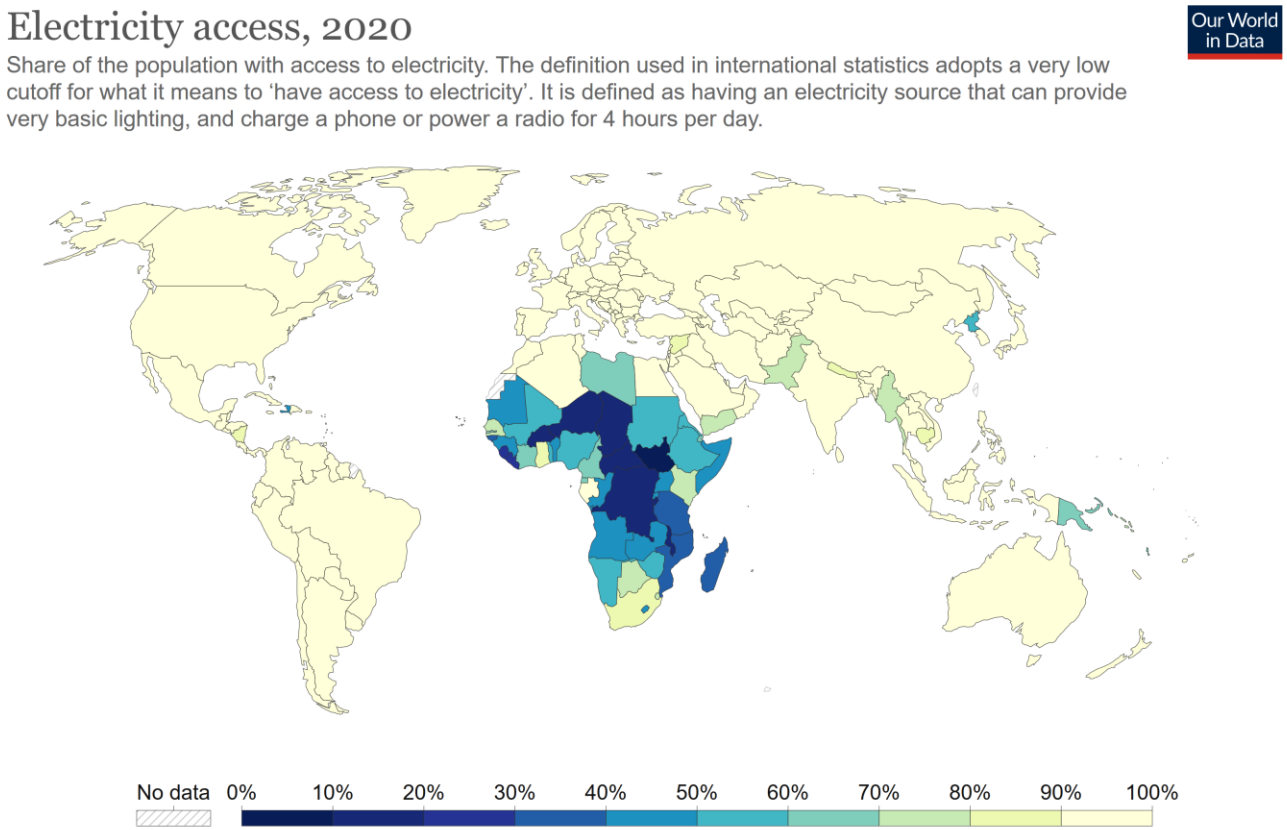


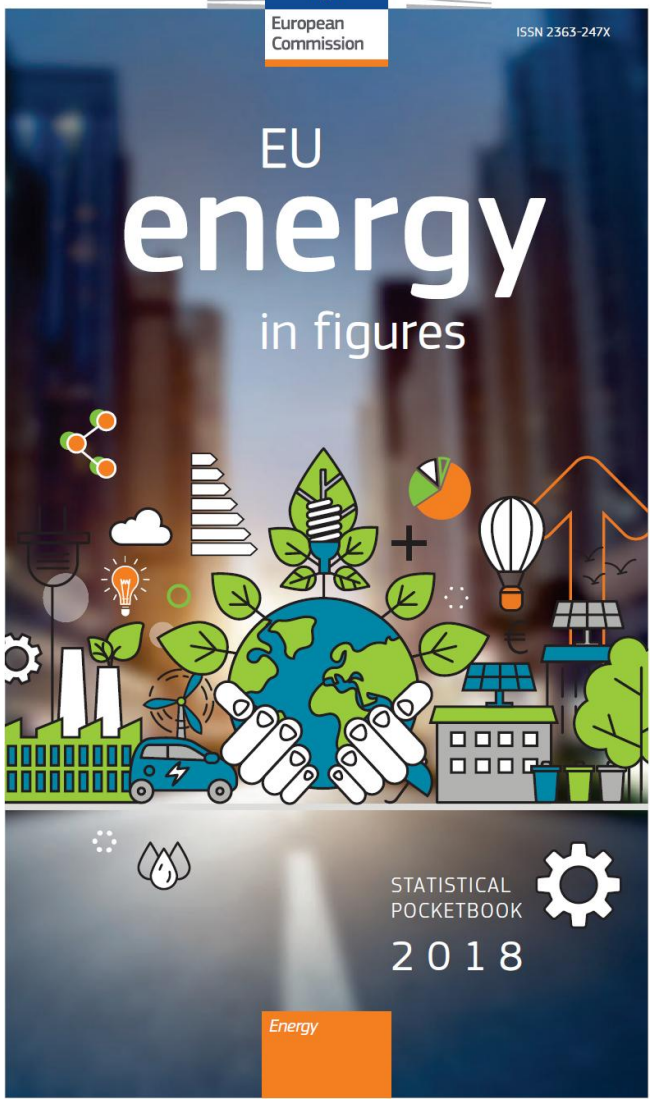
- **What are secondary energy problems?**

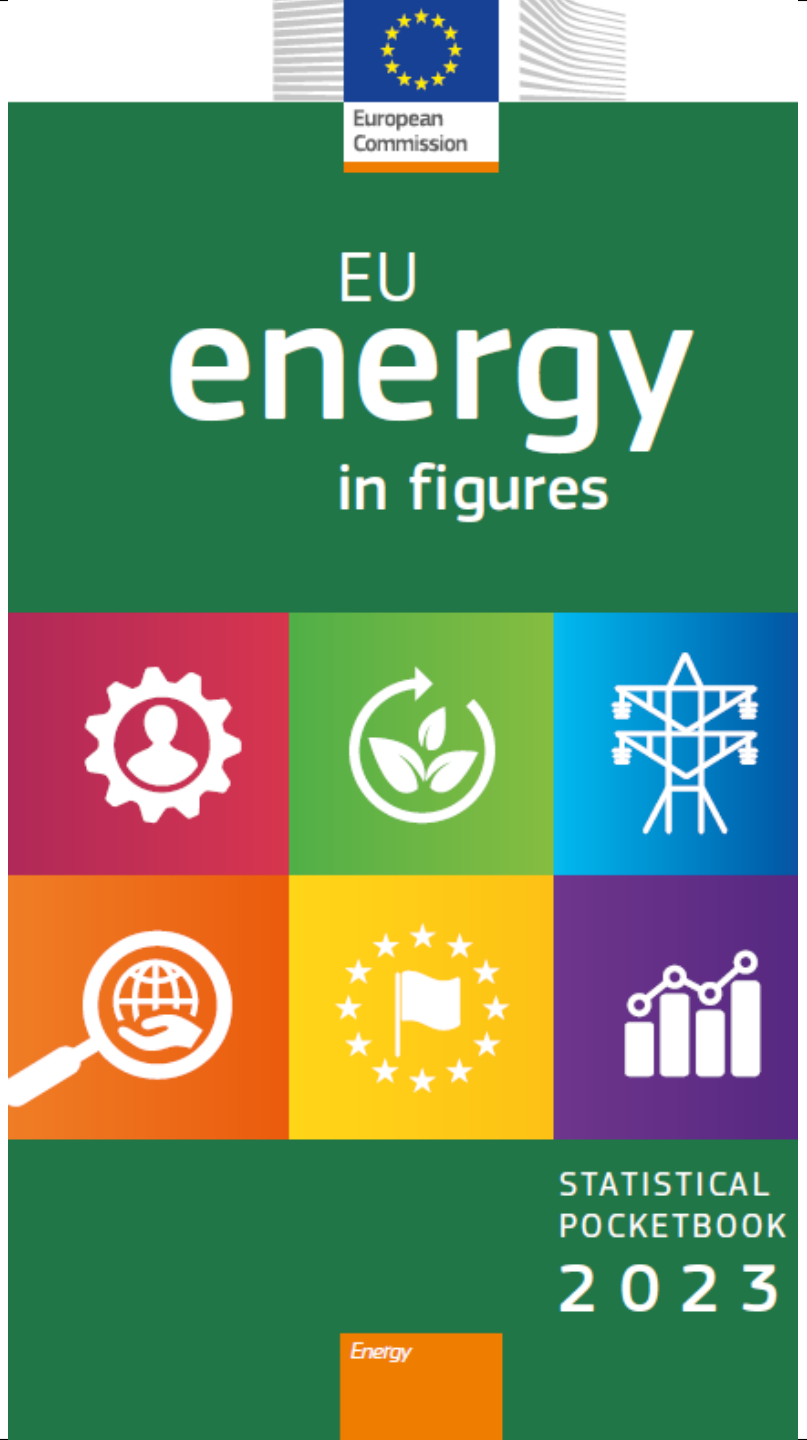
- **What are secondary energy problems?**
- **BANANA**

- **How just is energy consumption/are CO2 emissions distributed?**

- **The issue of SEA: Sustainable energy access for all ? SDG … ?**




European Commission
ISSN 2363-247X
EU
energy
in figures
STATISTICAL
POCKETBOOK
2018
Energy


European Commission
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energy
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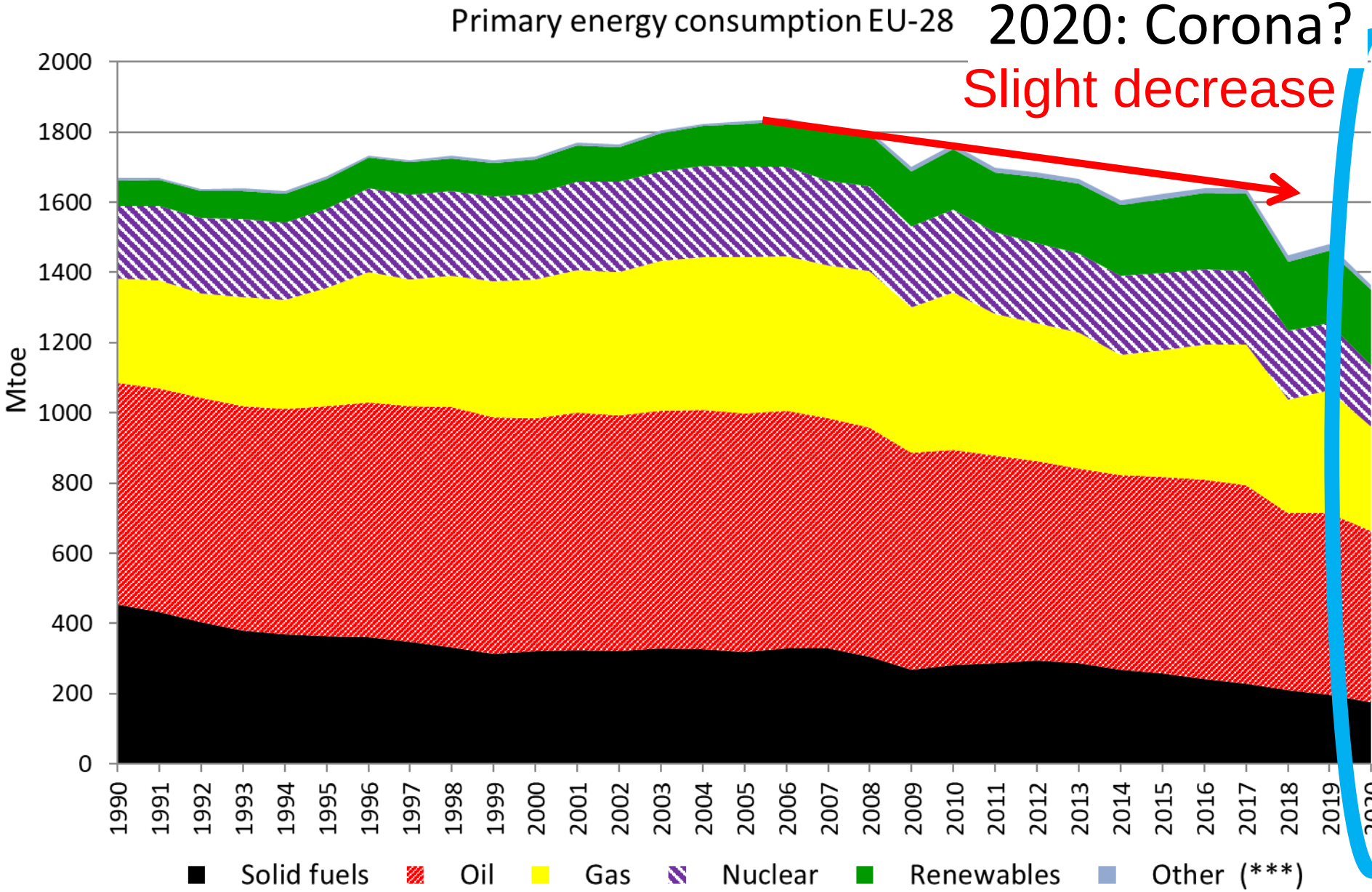
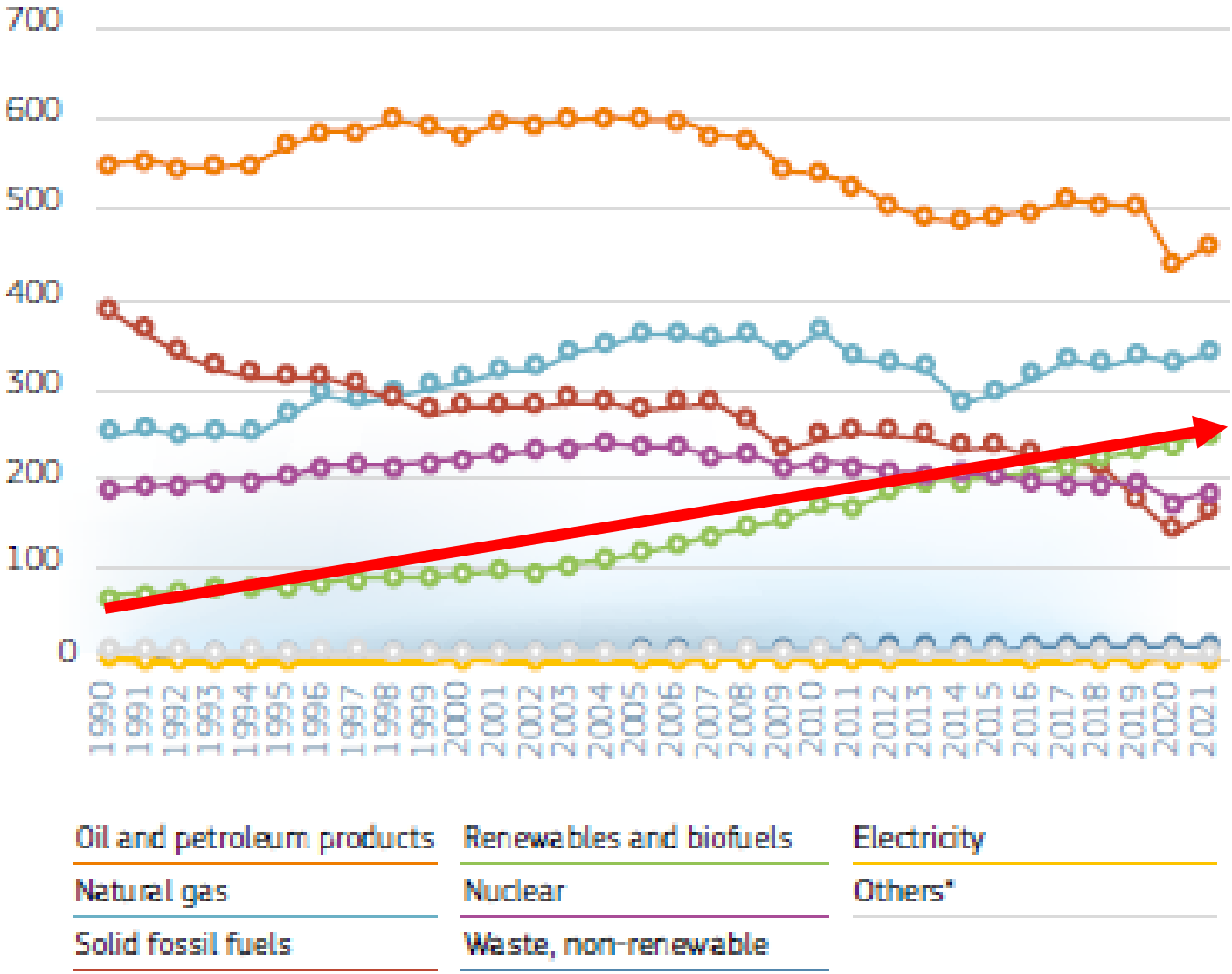
STATISTICAL
POCKETBOOK
2023
Energy

Primary energy in Europe

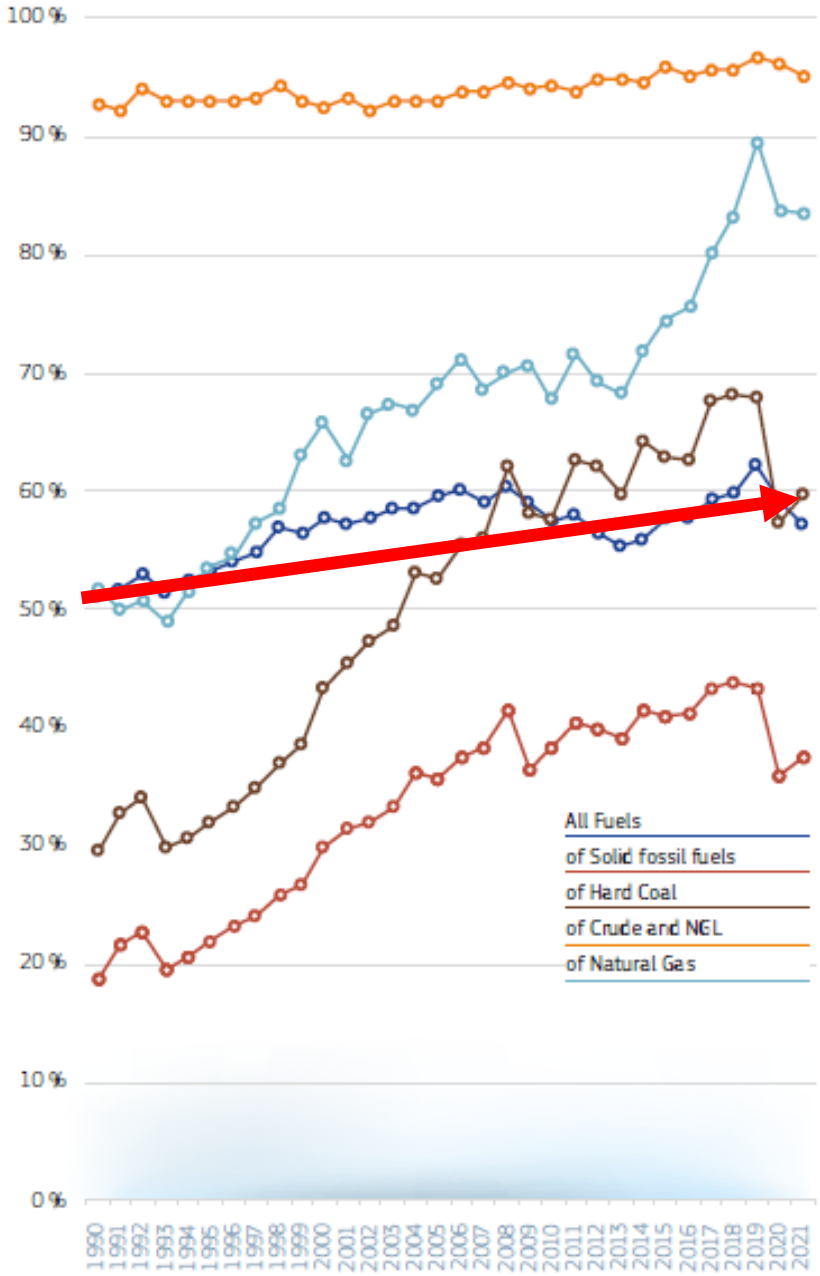


EU-27: Gross inland energy consumption

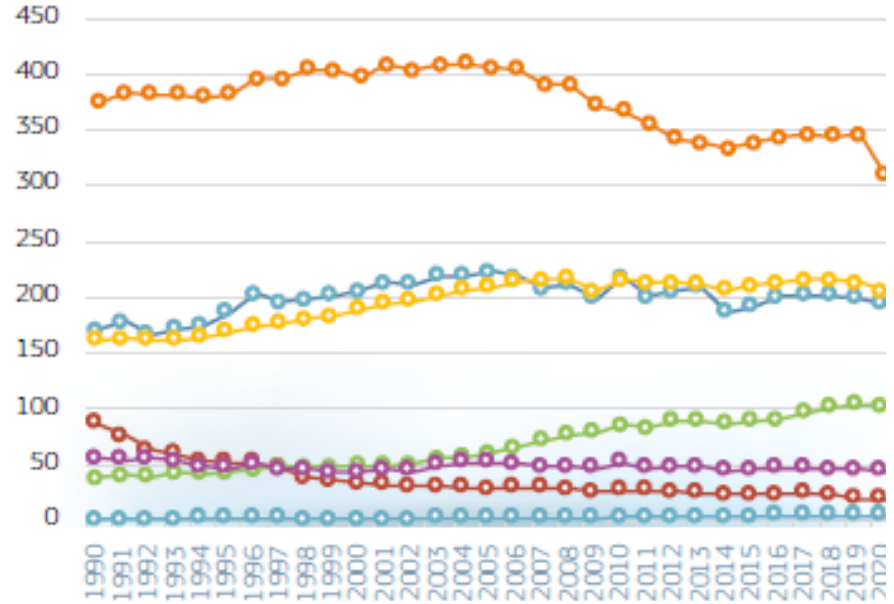


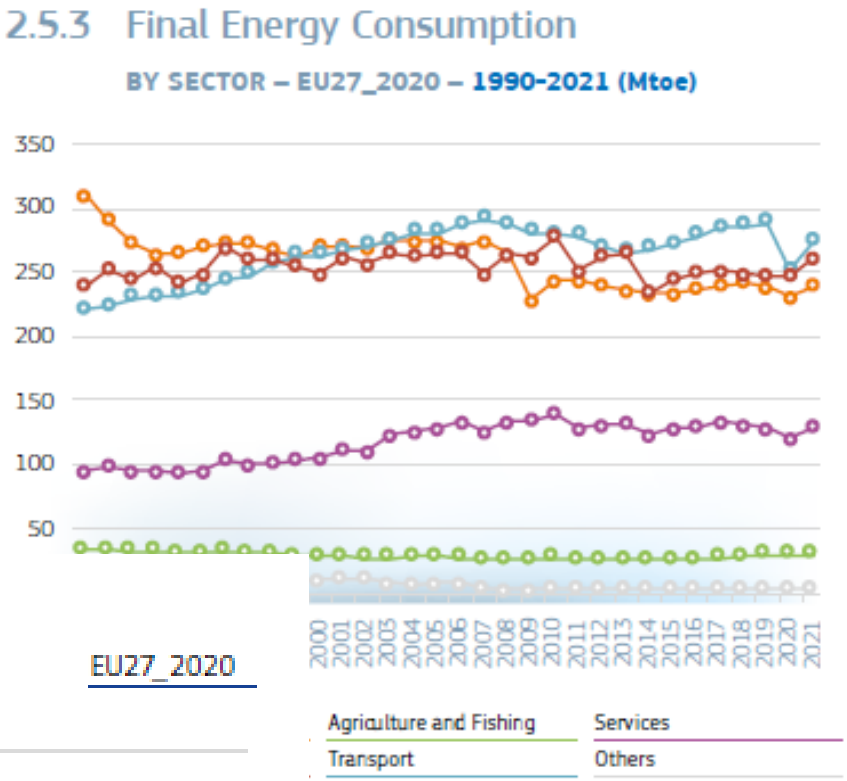
2.3.2 Import Dependency by Fuel

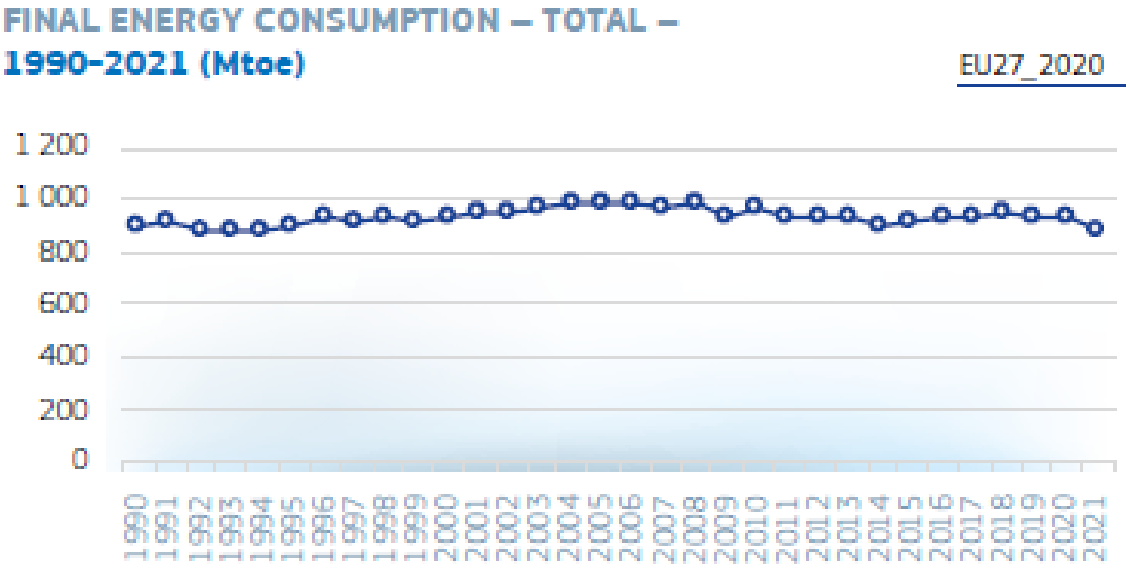
EU27_2020 – IMPORTS FROM EXTRA-EU – 1990-2021 (%)



Final energy EU-27

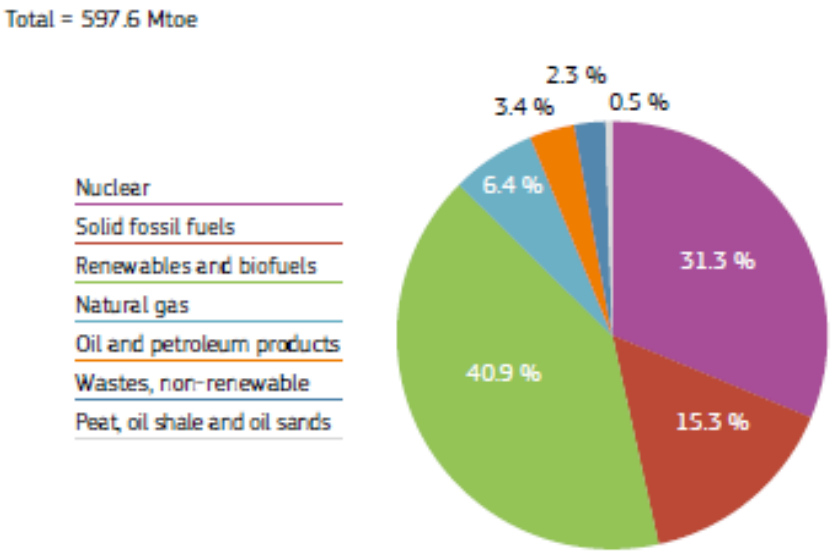






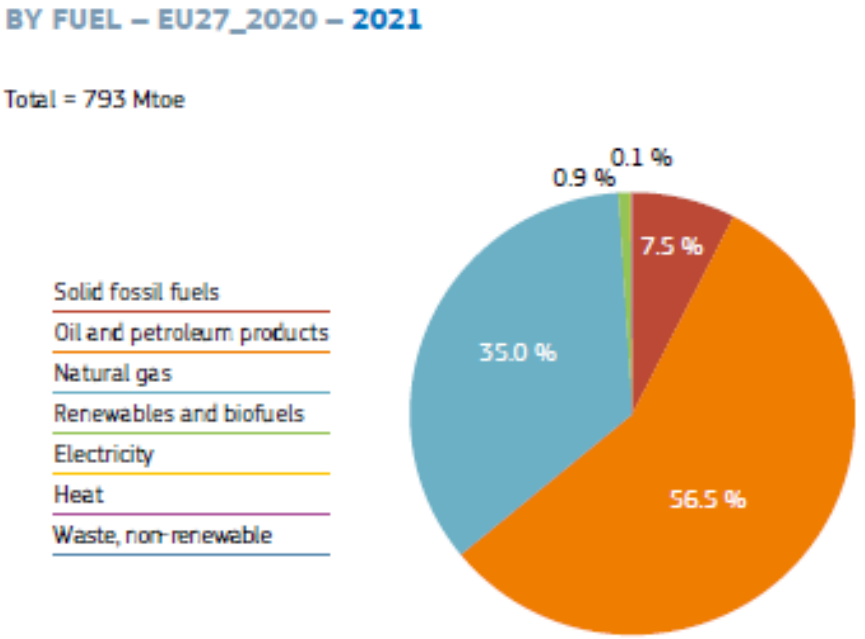
Primary Energy EU-28: origin of resources

Indigenous:



Total 2021: ca. 600 Mtoe

Imports:

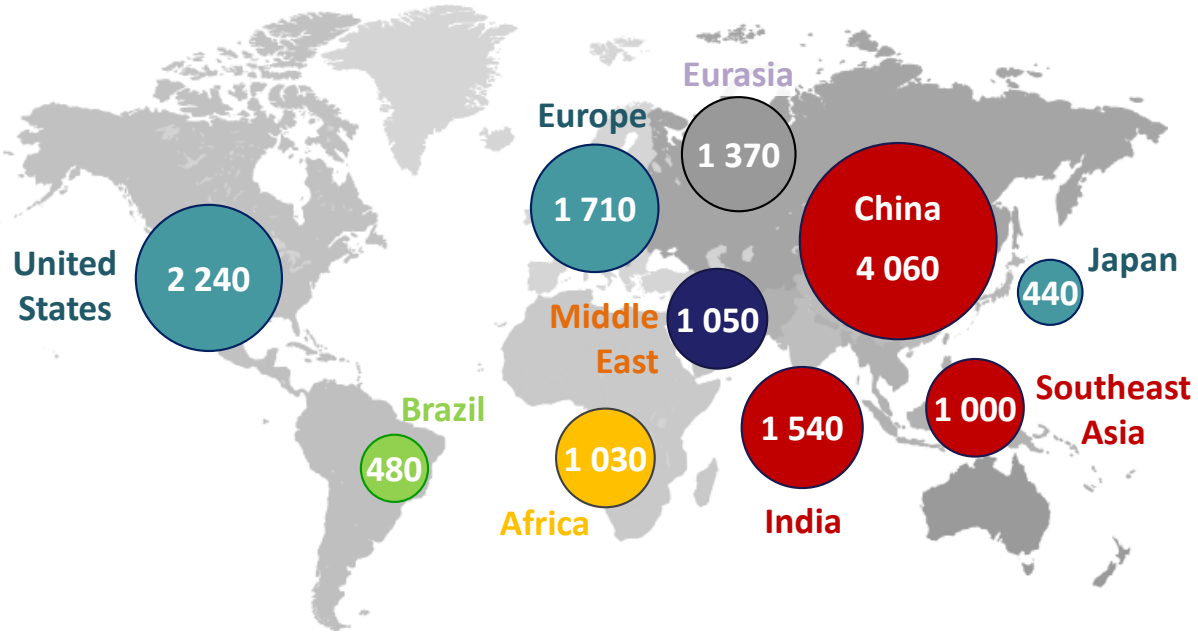


Total 2021: ca. 800 Mtoe

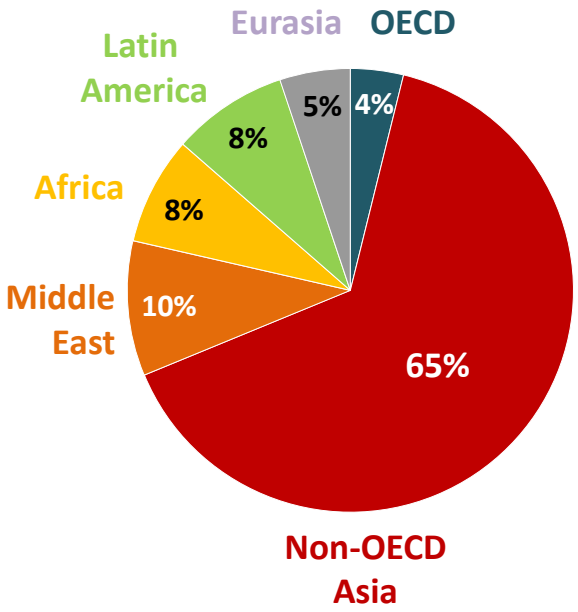
Source: EUROSTAT (2023)

WEO: The engine of energy demand growth moves to South Asia

Primary energy demand, 2035 (Mtoe)



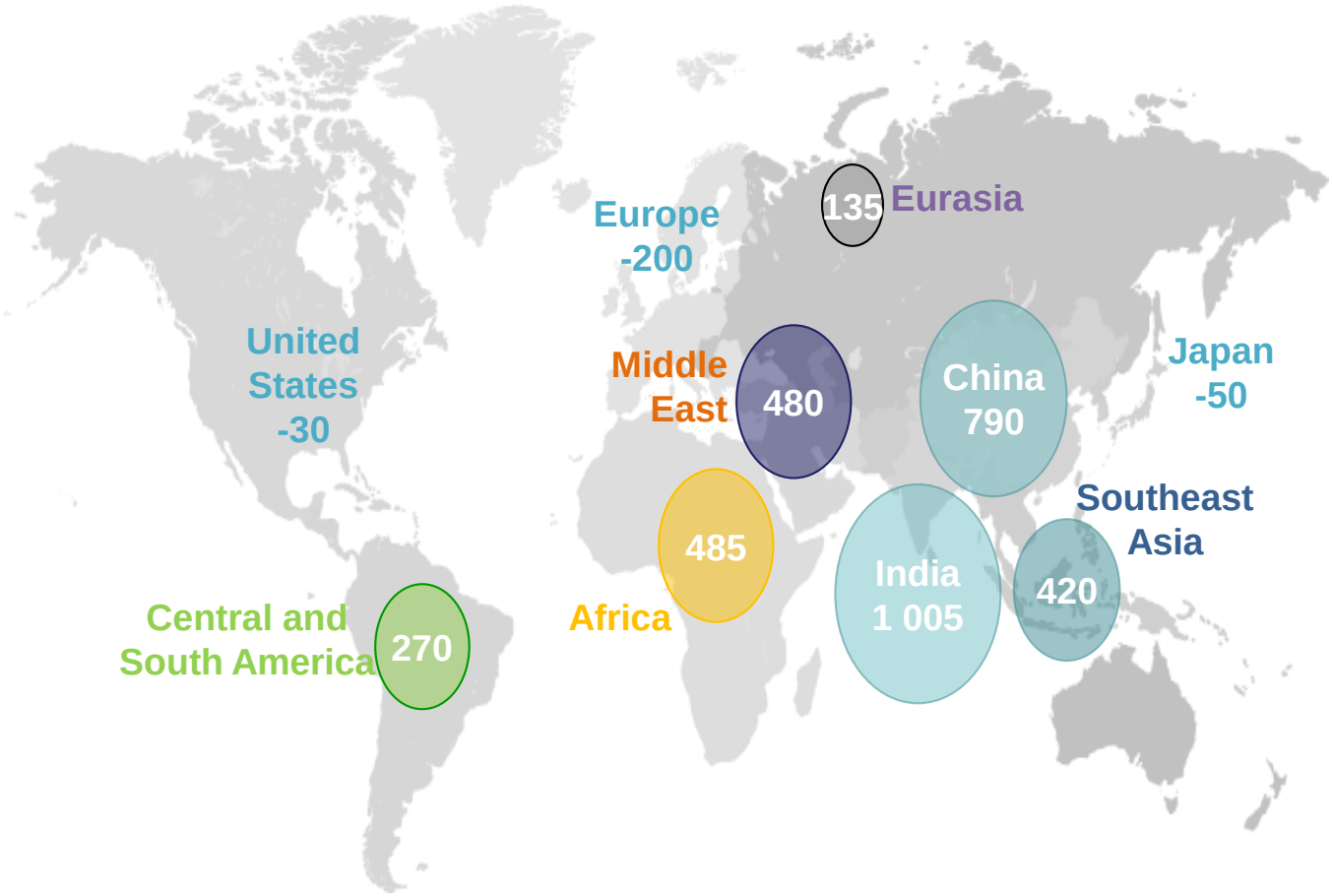
Share of global growth 2012-2035



China is the main driver of increasing energy demand in the current decade, but India takes over in the 2020s as the principal source of growth

WEO 2017: India takes the lead, as China energy growth slows

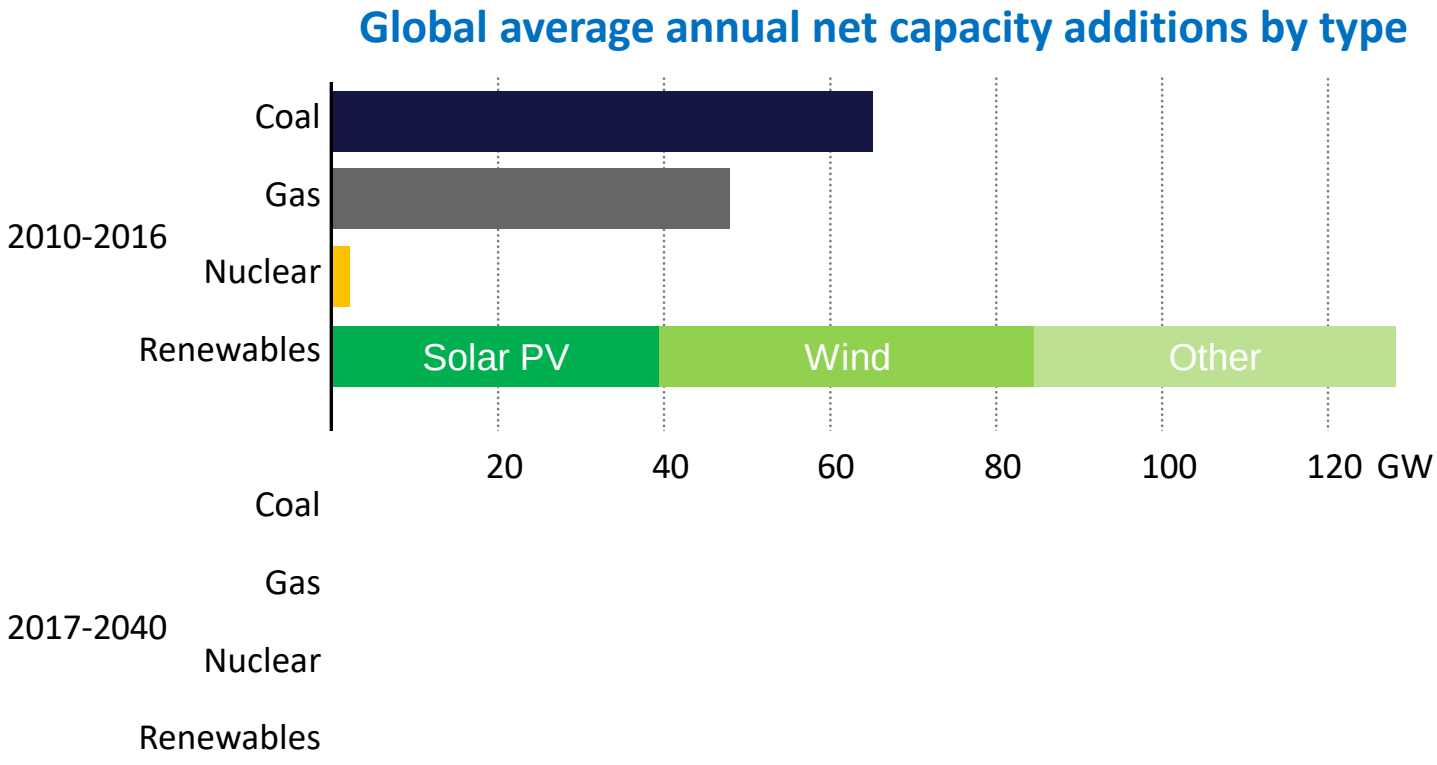
Change in energy demand, 2016-40 (Mtoe)



Old ways of understanding the world of energy are losing value as countries change roles:

the Middle East is fast becoming a major energy consumer & the United States a major exporter

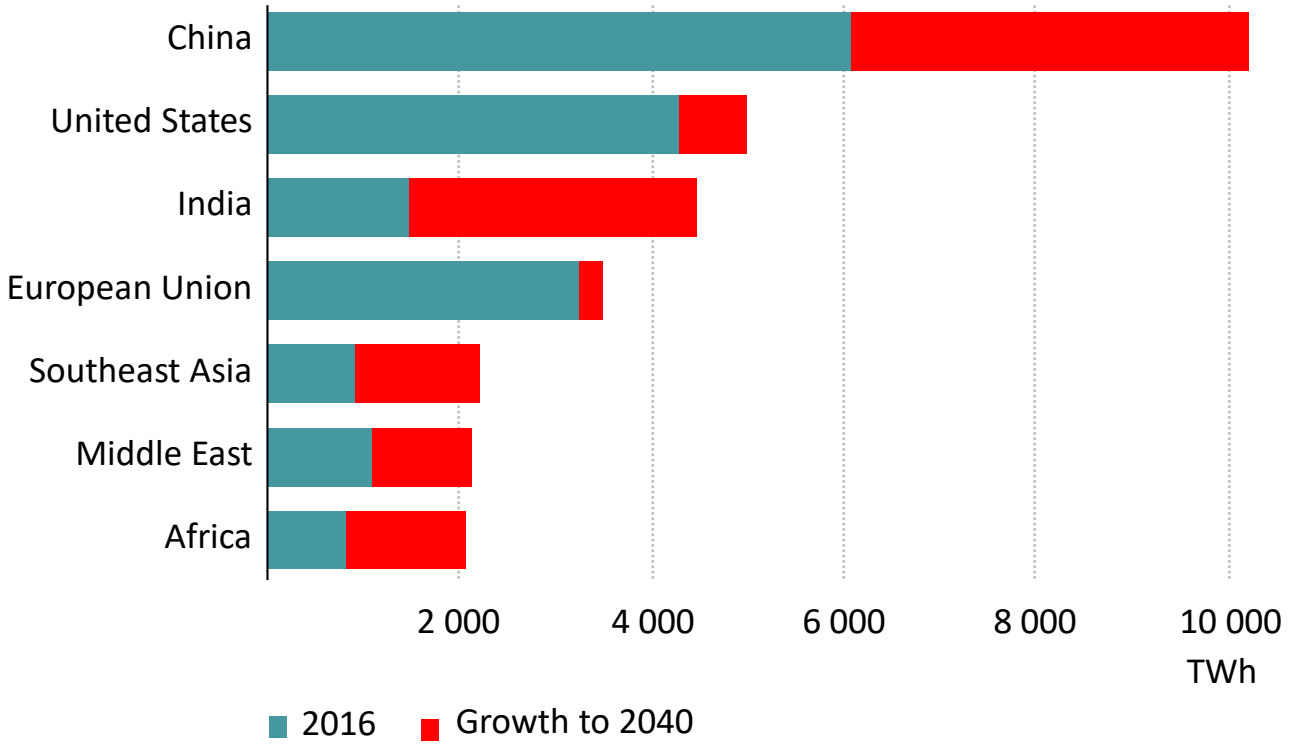
Solar PV forges ahead in the global power mix



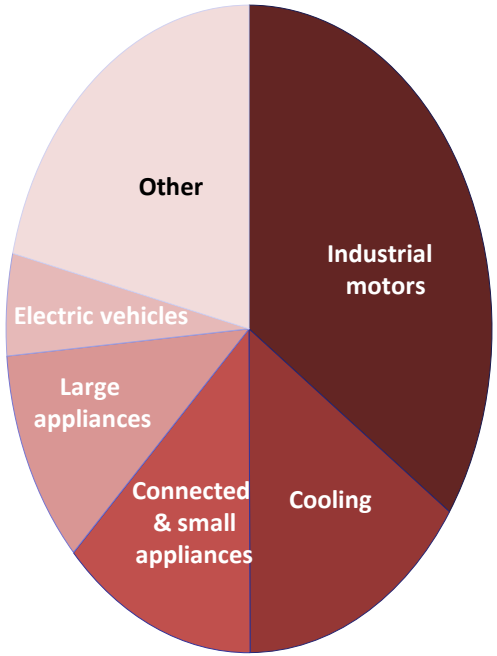
China, India & the US lead the charge for solar PV, while Europe is a frontrunner for onshore & offshore wind: rising shares of solar & wind require more flexibility to match power demand & supply

The future is electrifying

Electricity generation by selected region

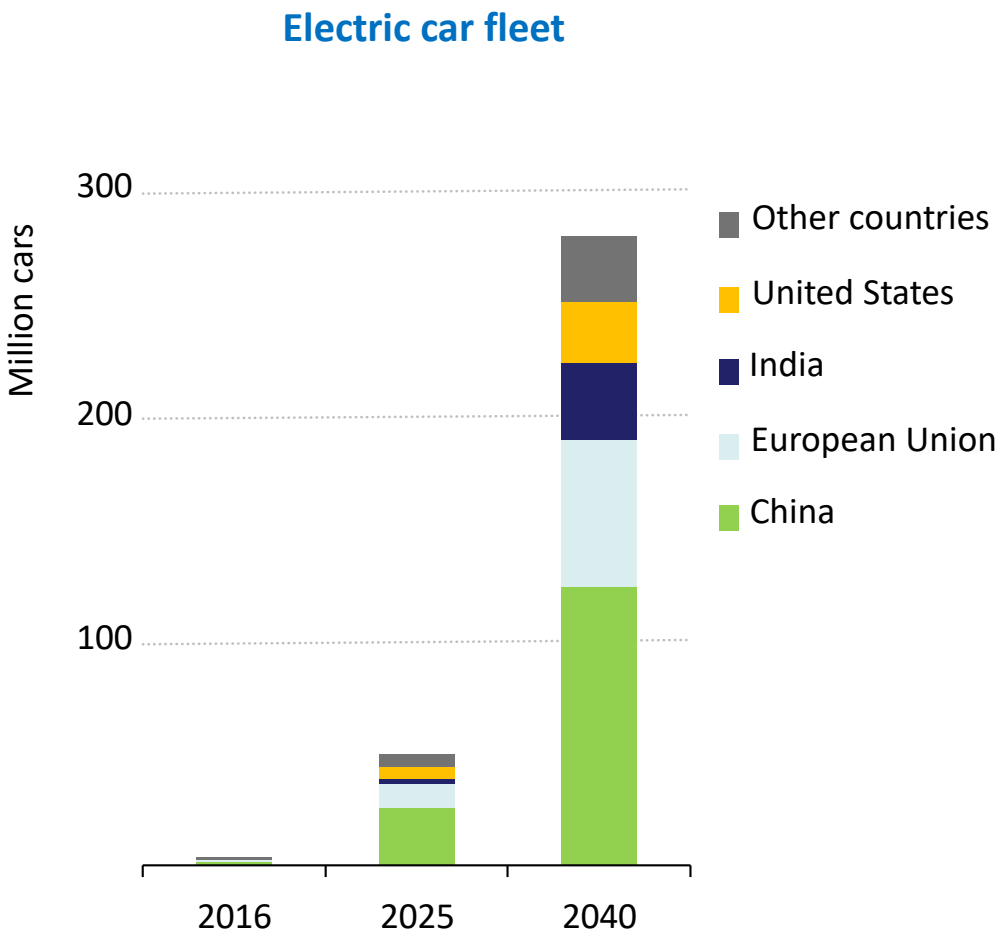


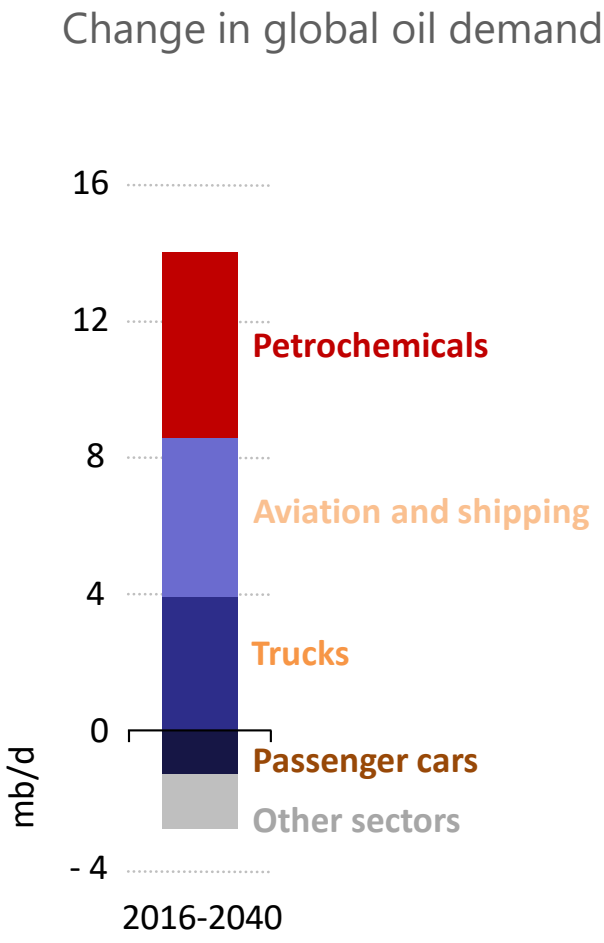
Sources of global electricity demand growth



India adds the equivalent of today's European Union to its electricity generation by 2040, while China adds the equivalent of today's United States

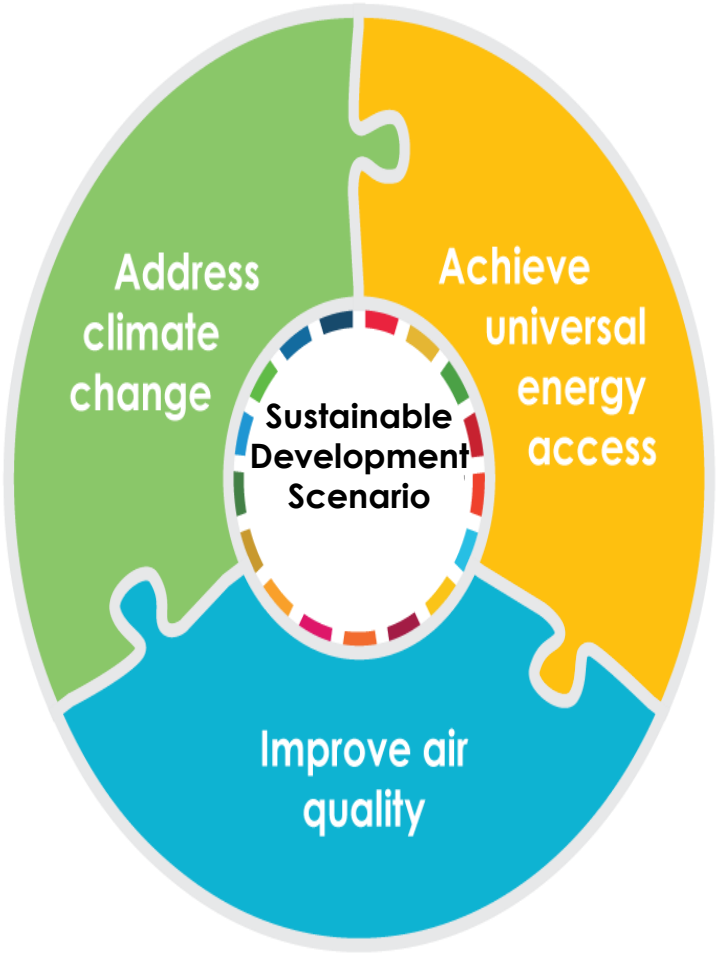
EVs are on the way, but oil demand still keeps rising

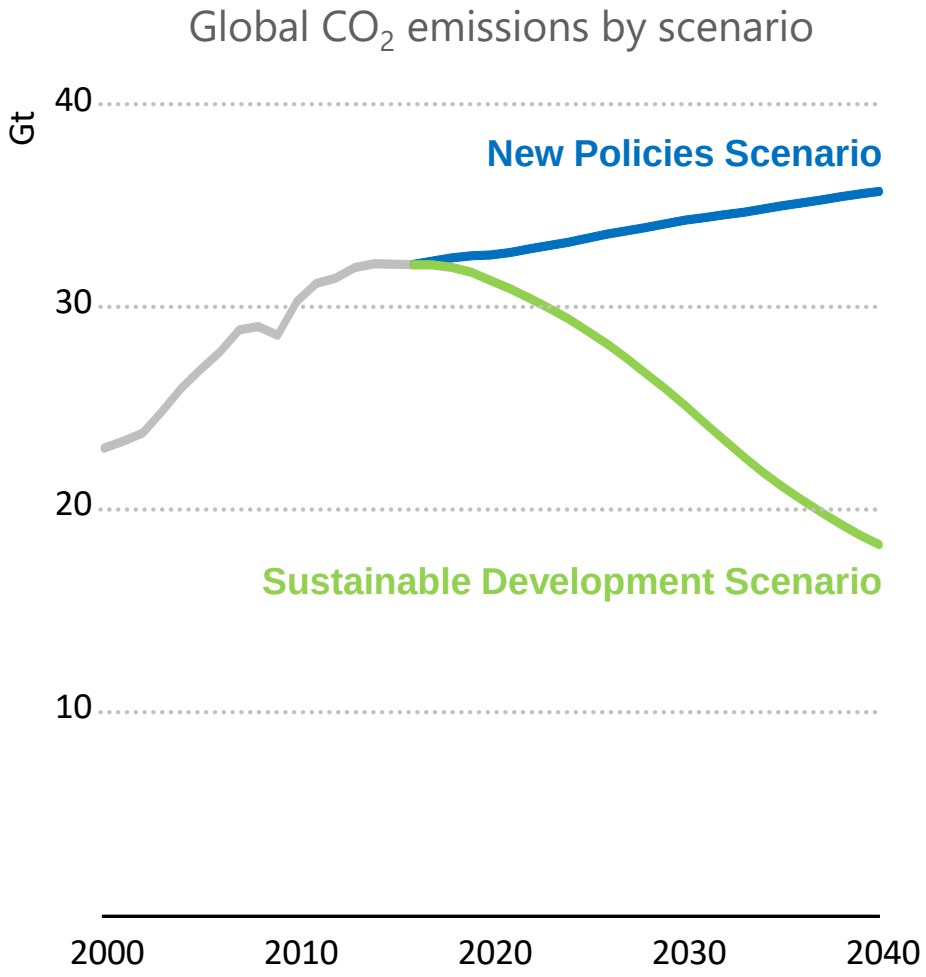




***Electric cars are helping to transform energy use for passenger cars**, slowing the pace of growth in global oil demand: however, trucks, aviation, shipping & petrochemicals keep oil on a rising trend*

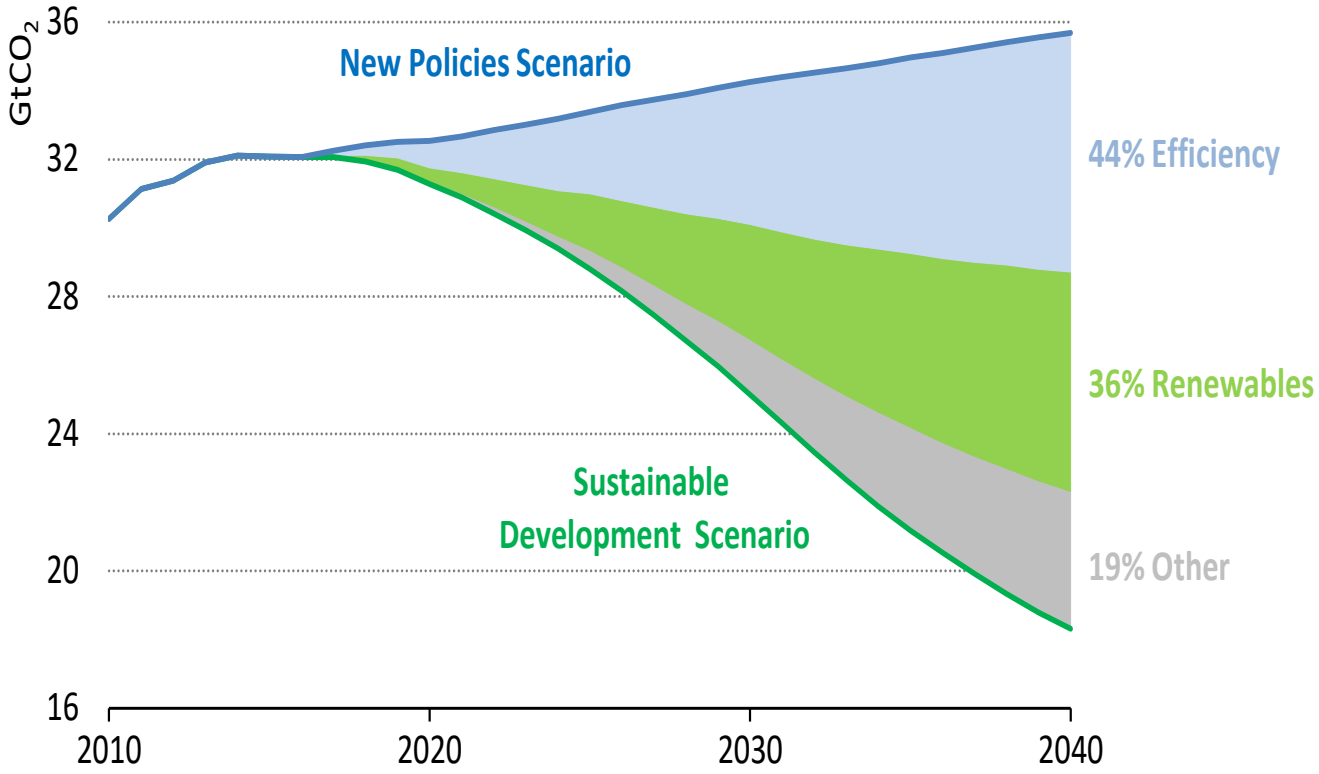
A new strategy for energy & sustainable development





The Sustainable Development Scenario reduces CO_2 emissions in line with the objectives of the Paris Agreement, while also tackling air pollution and achieving universal energy access

Global energy-related CO2 emissions abatement and key contributions in the SDS

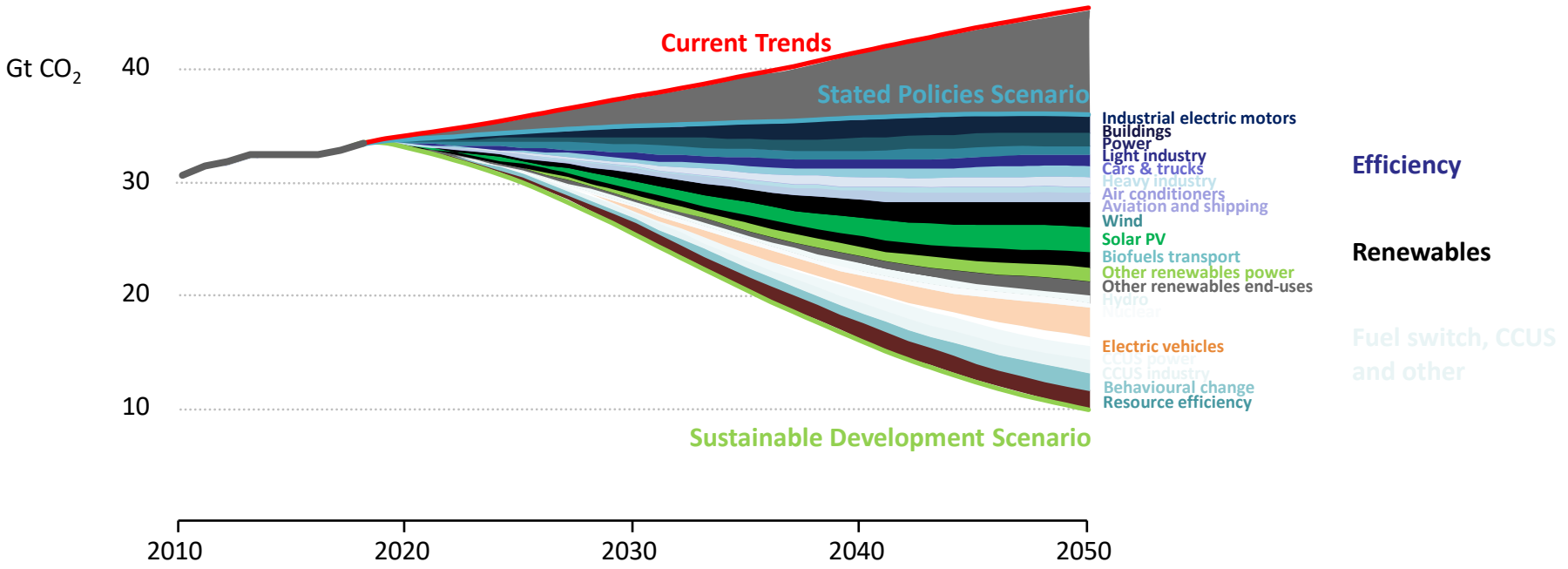


Energy efficiency and renewables are the two key abatement measures in the New Policies and Sustainable Development Scenarios

IEA: World energy scenarios

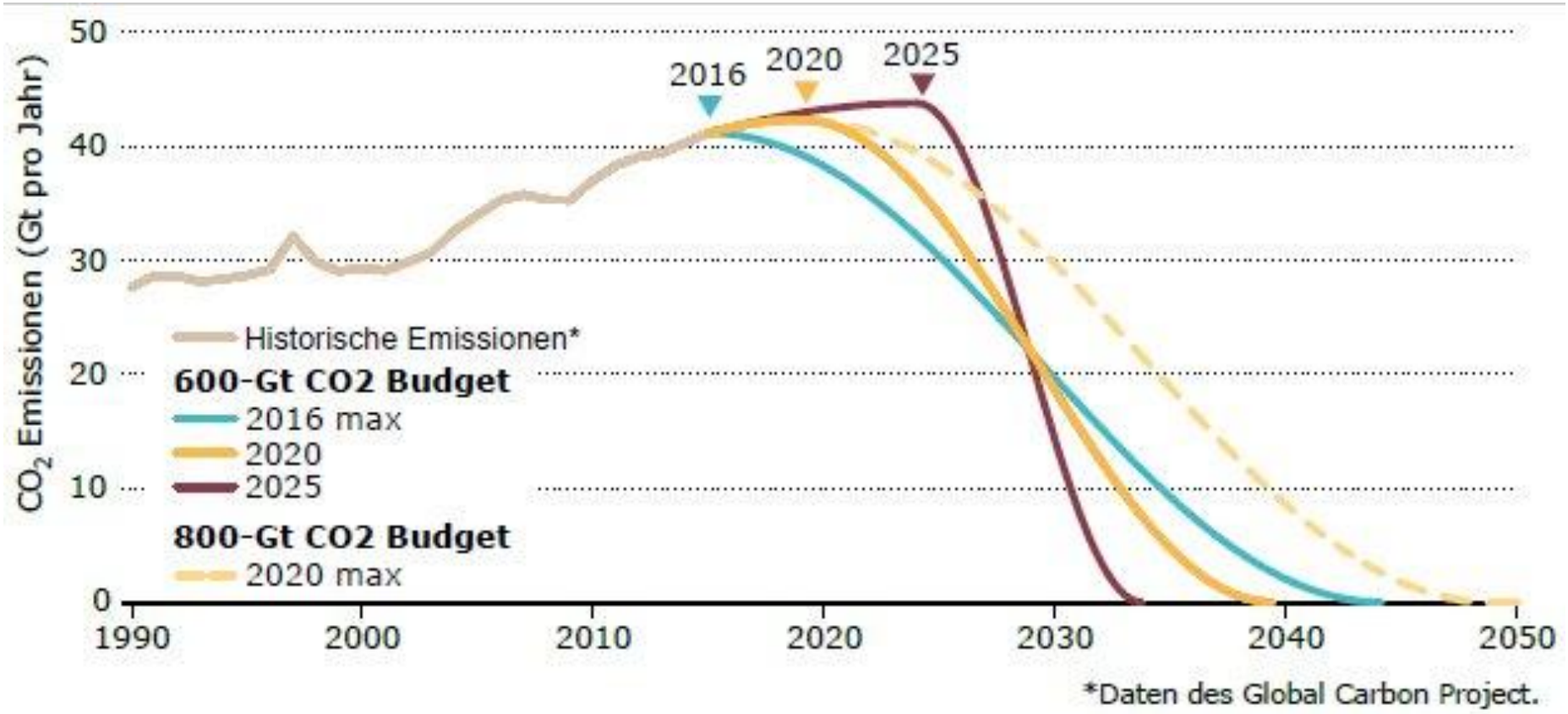
No single or simple solutions to reach sustainable energy goals

Energy-related CO_2 emissions and reductions in the Sustainable Development Scenario by source



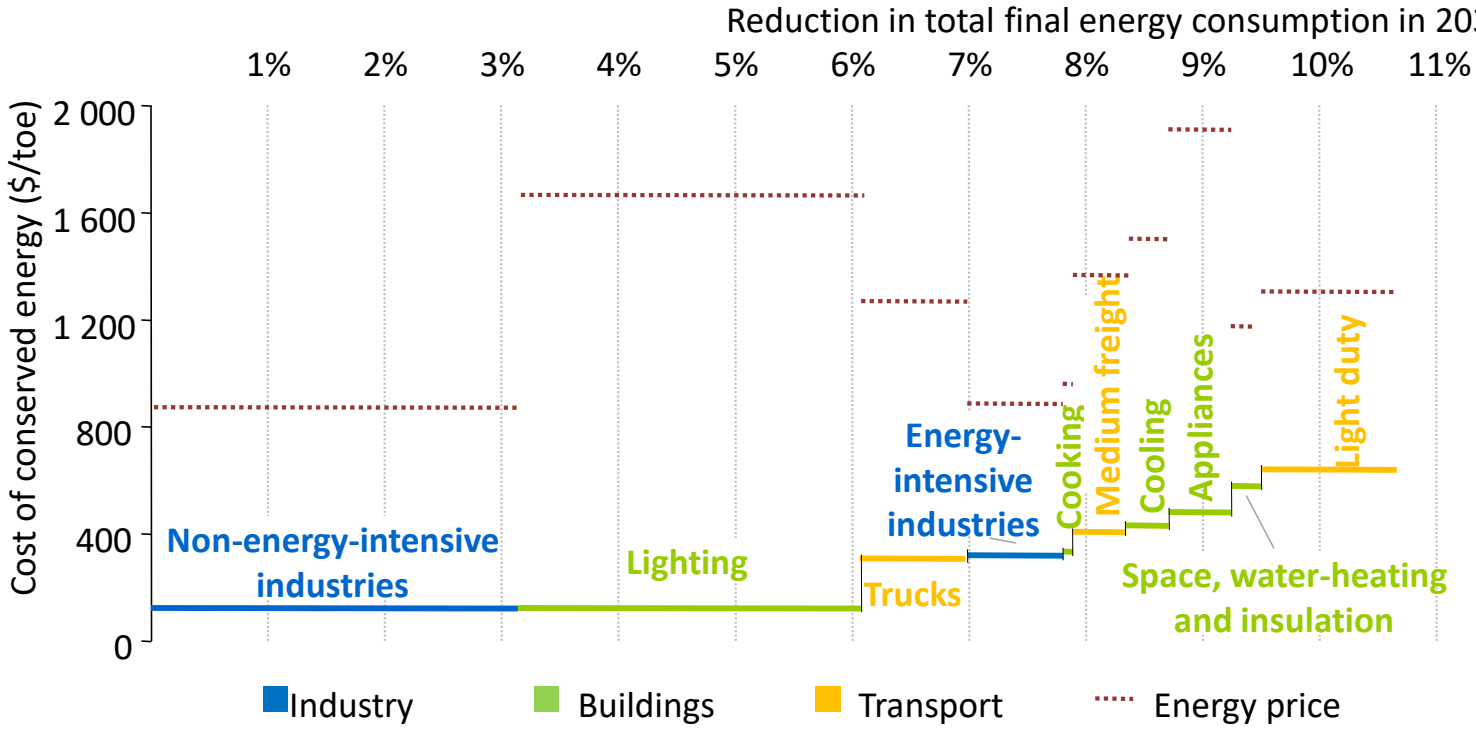
A host of policies and technologies will be needed across every sector to keep climate targets within reach, and further technology innovation will be essential to aid the pursuit of a 1.5°C stabilisation

Scenarios CO2 budgets



Saving more energy is not necessarily expensive

Cost of conserved energy of the untapped global energy efficiency potential, 2030



On average, the cost of conserved energy of efficiency measures beyond the New Policies Scenario is only one-fifth of the respective energy price