DESIGNED FOR YOUR WORLD

SDA Bocconi SCHOOL OF MANAGEMENT

ASSOFOND – ASSEMBLEA GENERALE 22-10-2021

Cambiamento climatico e transizione energetica: quale futuro

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THE AGENDA

I. La sfida climatica
II. Scenari di emissioni ad oggi
III. La transizione energetica

I) LA SFIDA CLIMATICA

CLIMATE CHANGE TODAY

- ✓ The UN's World Meteorological Organisation has declared the **hottest decade on record during 2011 to 2020**, with the past year set to be among the top three warmest years (2016, 2019 and 2020). (FT, 03rd December 2020).
- ✓ According to the latest research, the Earth's average temperature in 2020 was about **1.2C higher** than the 1850-1900 average, as global warming becomes more pronounced.
- ✓ 2020 has also been marked by a number of **unusual weather events and natural disasters linked to climate change**, including a record-breaking **hurricane season** in the north Atlantic and a major heatwave in the Siberian Arctic region.
- ✓ 2021 has been characterized by even worse events (e.g. flooding in Germany, China, India, etc.)
- ✓ **Ocean heat** also reached record levels in 2020, according to the WMO, which contributes to more **powerful hurricanes** forming; **devastating wildfires** across the US west coast, South America, and Australia underscore the impact of higher temperatures.

CLIMATE CHANGE TODAY

- ✓ Cold weather extremes are declining in frequency while heat extremes are increasing dramatically, with serious consequences for society.
- ✓ Heat records are being broken every summer:
  - ✓ In 2021 world-record high for June of 53.2C was recorded in Death Valley, California and July was the hottest month on record!
- ✓ Climate scientists have said these patterns could become the **new normal**, as the planet continues to heat up because of global warming.
- ✓ Indeed science has shown that every heatwave we experience is now made more intense by **human-induced global warming**.
- ✓ **Heatwaves are a silent killer:** people rarely drop dead on the street, but die quietly in their poorly insulated and un-air conditioned homes.
- ✓ Flood risks and storm surges have immediate economic costs, which can be included in insurance premiums; thus they have increasingly reached the awareness of the **finance sector**.
- ✓ Heatwaves, though, are rarely mentioned in finance or in insurance, because their economic costs are harder to assess.

CLIMATE CHANGE TOMORROW OUR CHILDREN

- ✓ Thiery, By Wim, et al. "Intergenerational inequities in exposure to climate extremes." Science (2021).
- ✓ **Children born today will face disproportionate increases in floods, heatwaves, droughts, wildfires, and crop failures due to climate change**.
- ✓ Under current climate policy, newborns across the globe will on average face **seven times** more scorching **heatwaves** during their lives than their grandparents.
- ✓ They will on average live through 2.6 times more **droughts**, 2.8 times as many river **floods**, almost three times as many **crop failures**, and twice the number of **wildfires** as people born 60 years ago.
- ✓ The impacts are also strongly regional
  - ✓ While 53 million children born in Europe and Central Asia since 2016 will experience about four times more extreme events under current pledges, 172 million children of the same age in sub-Saharan Africa face an almost sixfold increase in lifetime extreme event exposure, and even 50 times more heatwaves.
- ✓ This study clearly shows the **fundamental injustice of climate change across generations**, as well as the **responsibilities of today's adults and elders in power**.

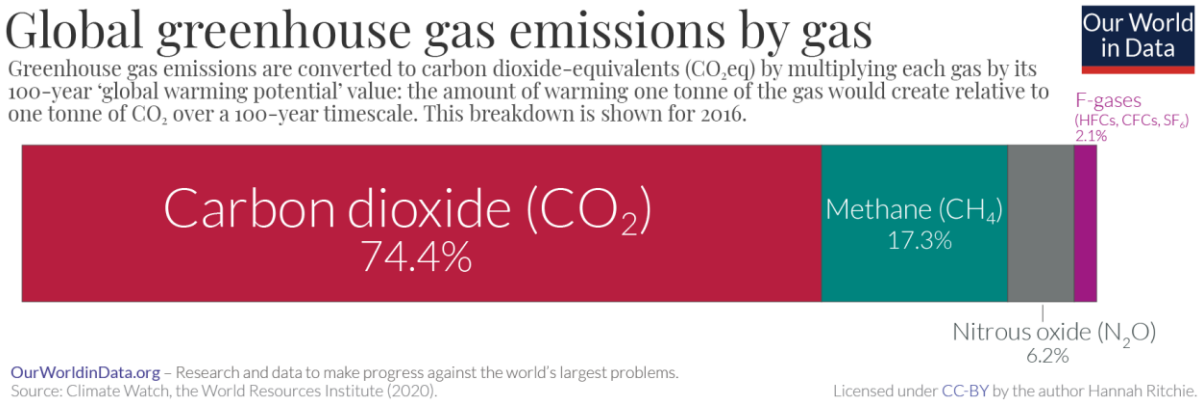
CLIMATE CHANGE TOMORROW «CODE RED FOR HUMANITY»

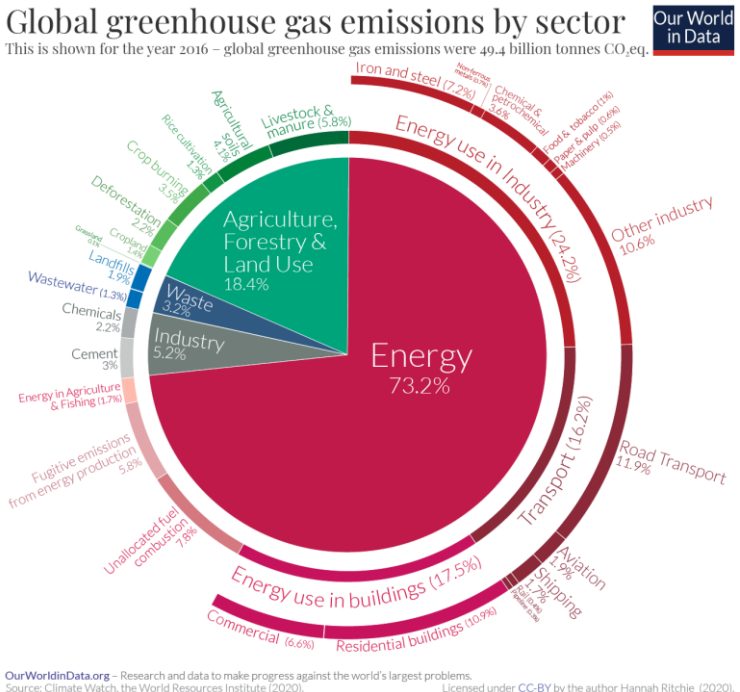
- ✓ While the economic recession caused by the coronavirus pandemic has caused emissions to drop this year, **the level of carbon dioxide in the atmosphere is still increasing**, because it can linger in the air for up to a century.
- ✓ Indeed **carbon dioxide levels** in the atmosphere hit **a new record** in June 2021 (419 ppm), as the accumulation of the warming gas increased despite the brief environmental respite caused by coronavirus and the global recession.
- ✓ According to the latest IPCC report (August 2021), the world is likely to temporarily **reach 1.5C of warming within 20 years even in a best-case scenario** of deep cuts in GHG emissions.

II) SCENARI DI EMISSION AD OGGI

“EVERYTHING IS ENERGY AND THAT’S ALL THERE IS TO IT.” (ALBERT EINSTEIN)

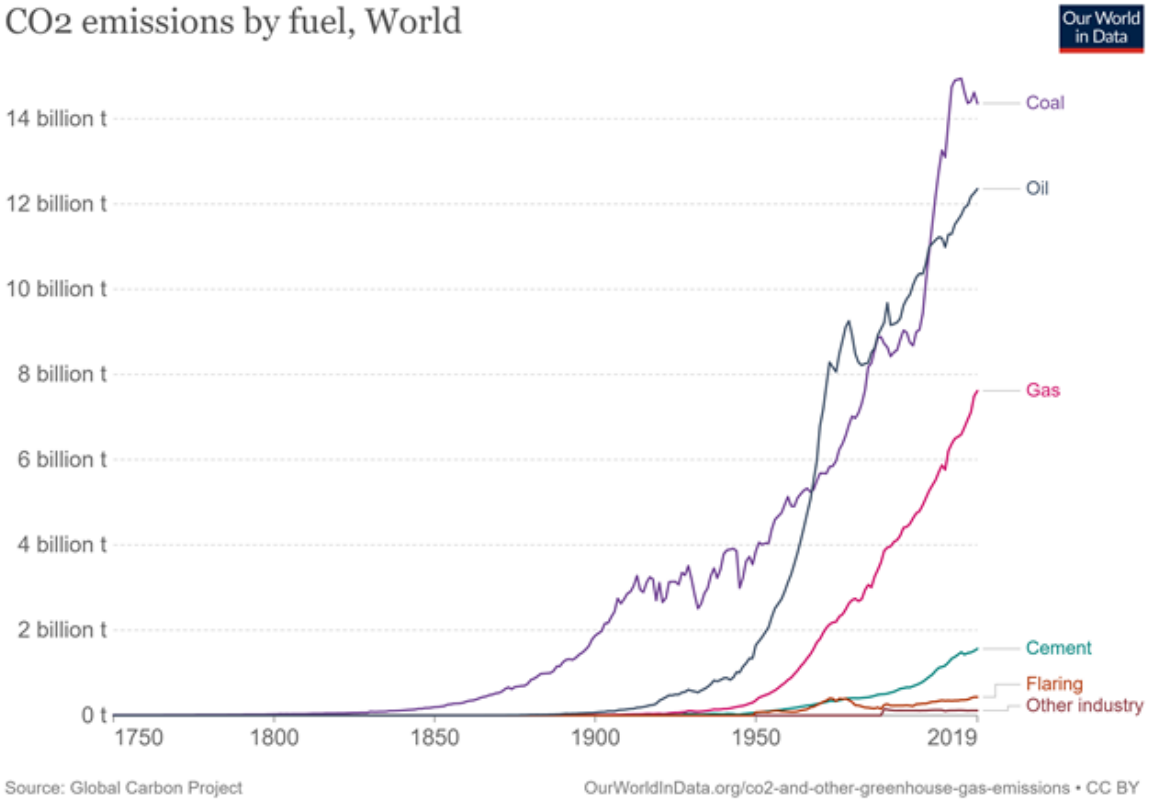
- ✓ **Carbon dioxide** is the largest contributor, accounting for around three-quarters **(≈74%)** of total emissions.
- ✓ Around **three-quarters of GHG emissions** (≈73%) come from **energy use (electricity and heat)**.
- ✓ By the way, energy without fossil fuels represents a more than $1.4 trillion global industry, larger in revenue than pharmaceutical manufacturing.





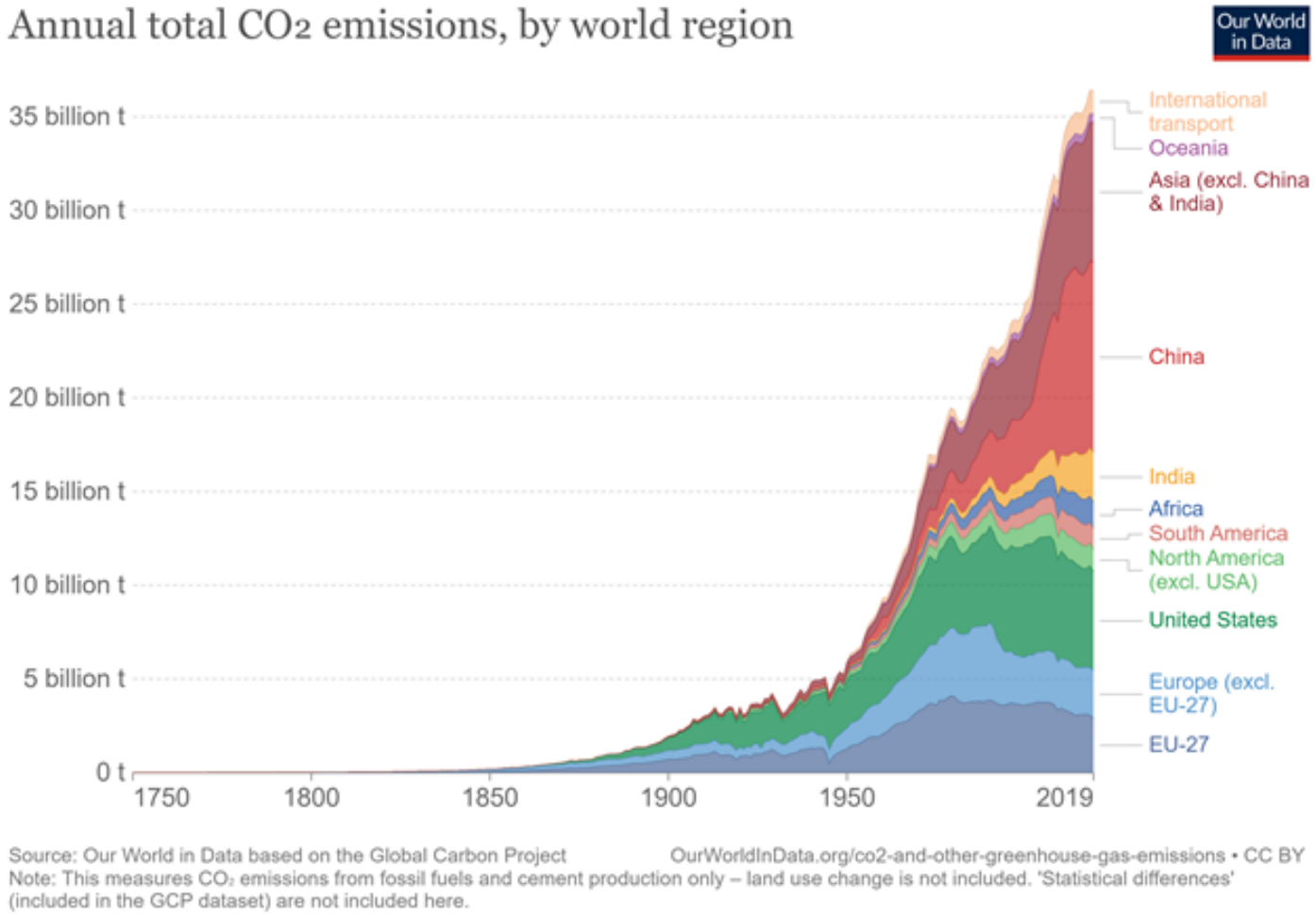
GLOBAL CO_2 EMISSIONS BY FUEL

- ✓ Carbon dioxide emissions associated with energy and industrial production can come from a range of fuel types.
- ✓ The contribution of each of these sources has changed significantly through time.



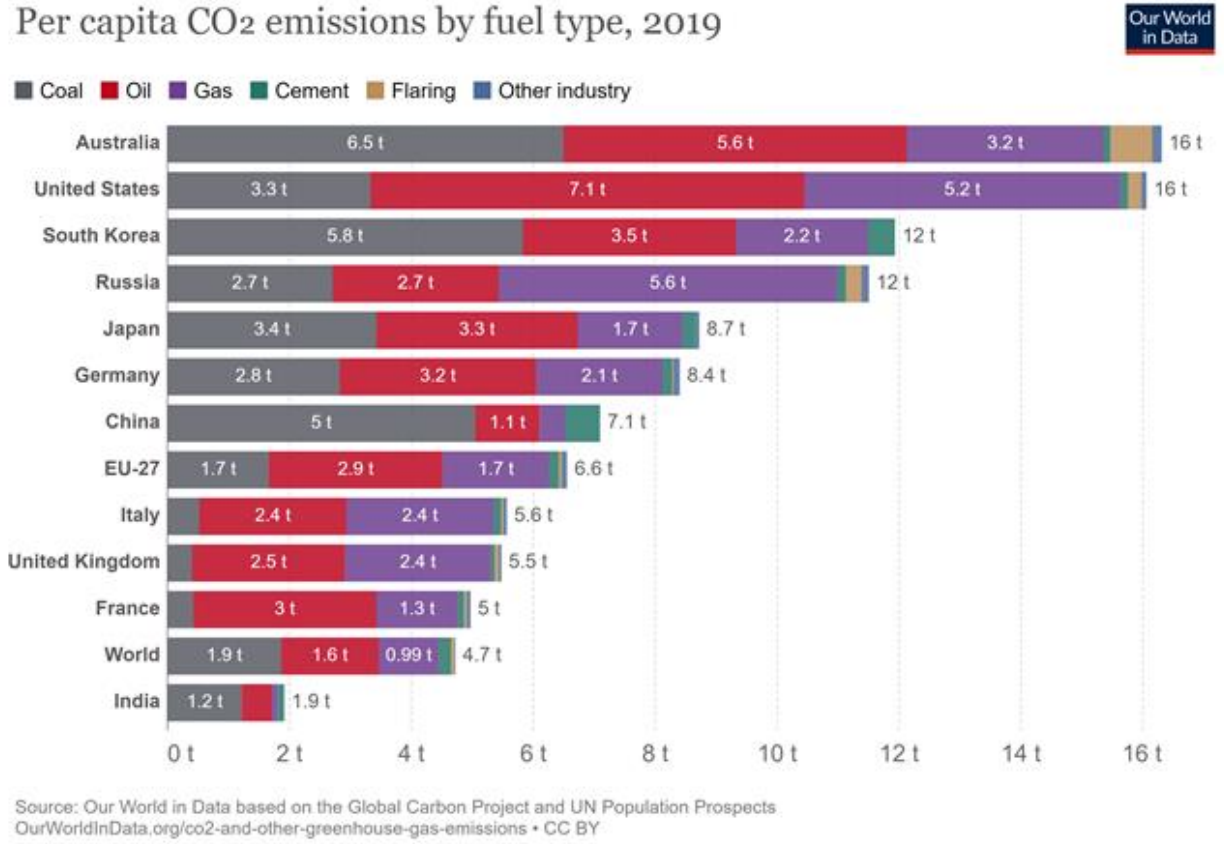
GLOBAL CO_2 EMISSIONS BY REGION
IS IT JUST ABOUT CHINA?

- ✓ At a time when global emissions need to be falling and reach net zero, the harsh reality is that they are in fact still rising in several regions and have not yet peaked.



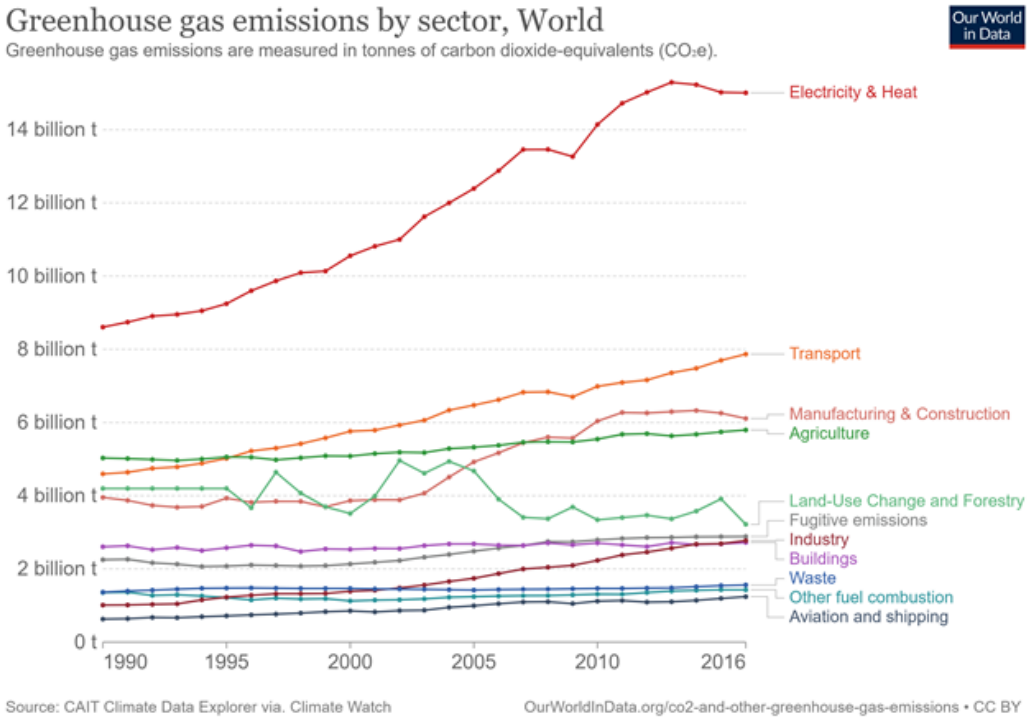
PER CAPITA CO_2 EMISSIONS BY FUEL THINK AGAIN!

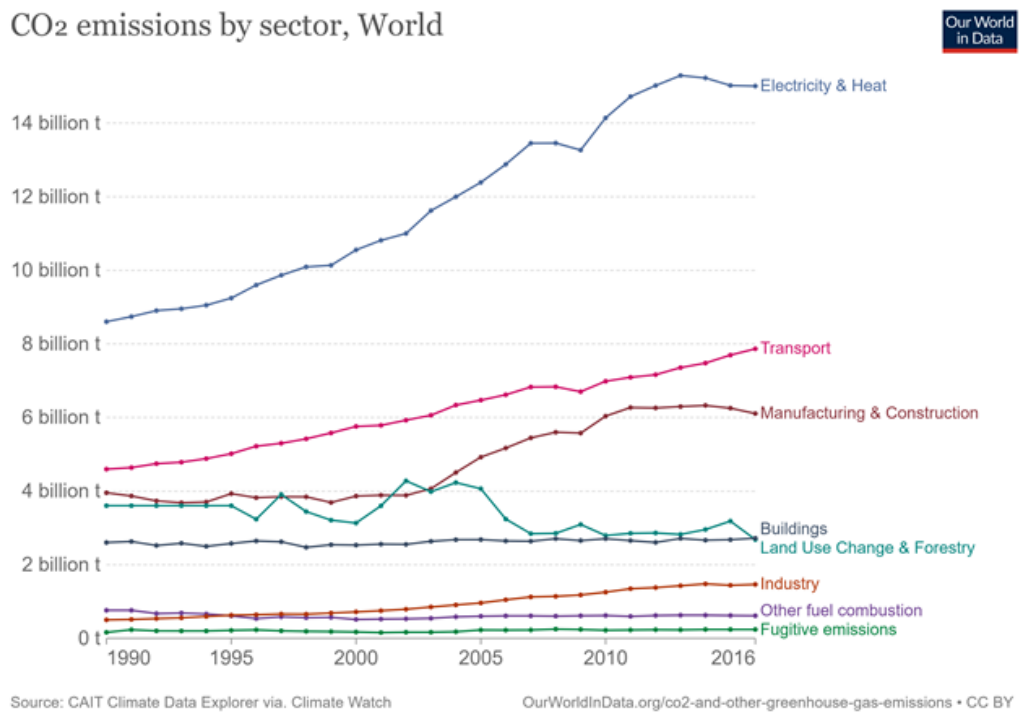
- ✓ Thus which country is polluting the most? Is just coal the issue?
- ✓ The distribution across different fuel sources is very dependent on energy production and mix in a given country: e.g. in the US oil followed by gas are the largest contributors, while coal dominates in China and India.



GLOBAL CO_2 EMISSIONS BY SECTOR WHERE SHALL I DECARBONIZE?

- ✓ The global breakdown for CO_2 is similar to that of total GHGs: **electricity and heat** production dominates, followed by **transport**, **manufacturing and construction**.
- ✓ One key difference is that direct **agricultural emissions** (if we exclude land use change and forestry) are not shown; most of them result from methane (production from livestock) and nitrous oxide (released from the application of fertilizers).

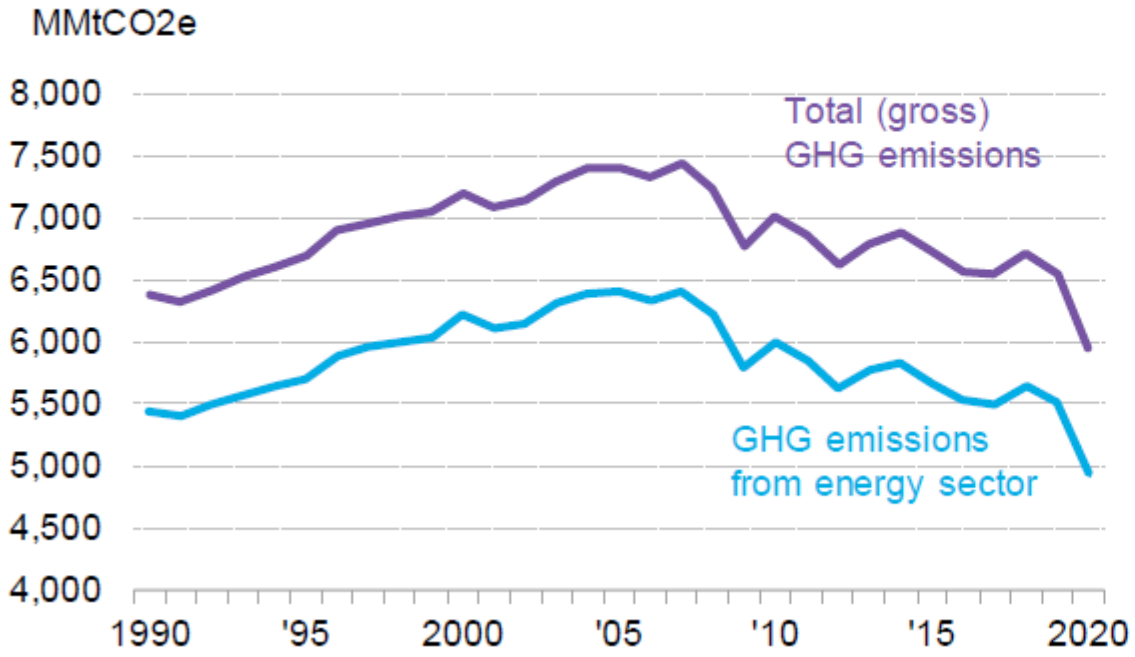




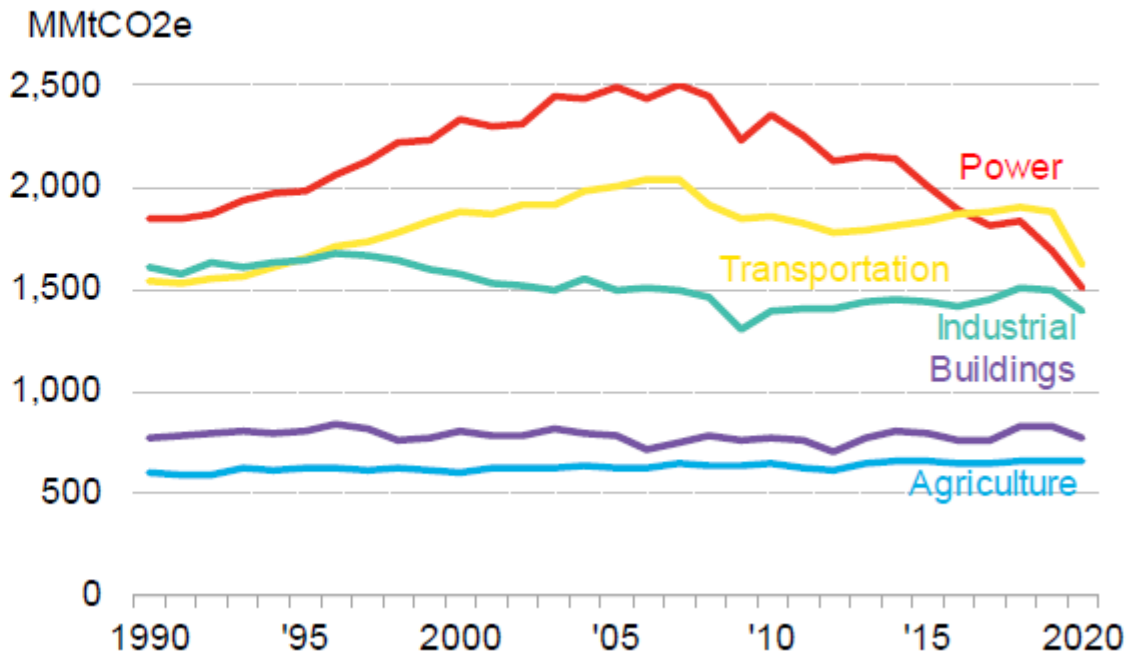
US GHG EMISSIONS BY SECTOR

- ✓ GHG emissions plummeted in 2020 by an estimated 9.2% from the year prior, following a year of deeply depressed power and transportation sector emissions.
- ✓ The sharpest drop in the long run came from **the power sector**, whose emissions are only 2% higher than the industrial sector. The **transportation sector** remained the largest (27%) single source of carbon emissions for the 5th consecutive year.

Economy-wide and energy sector emissions



Emissions by sector

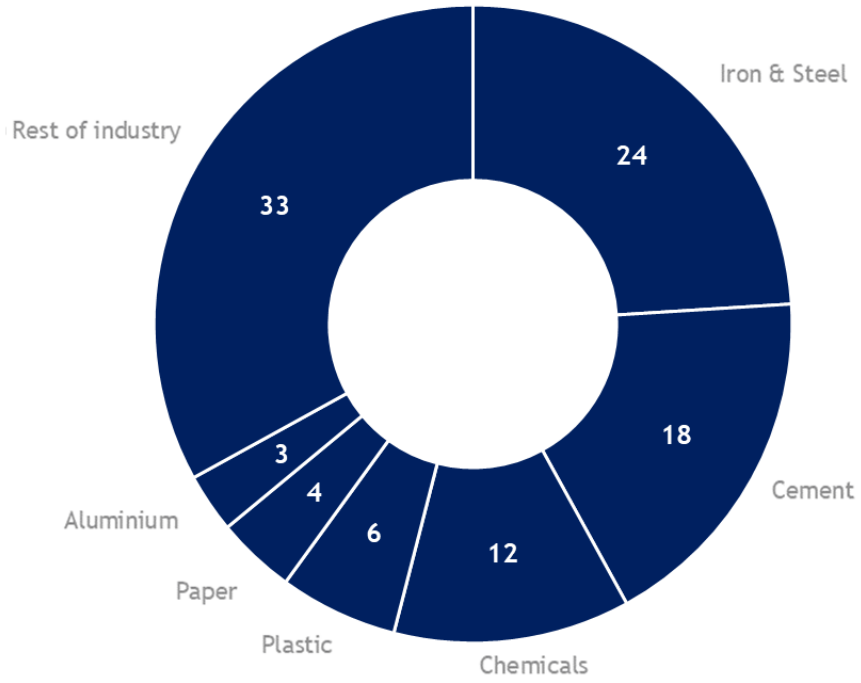


Source: EIA, EPA, BNEF (2021)

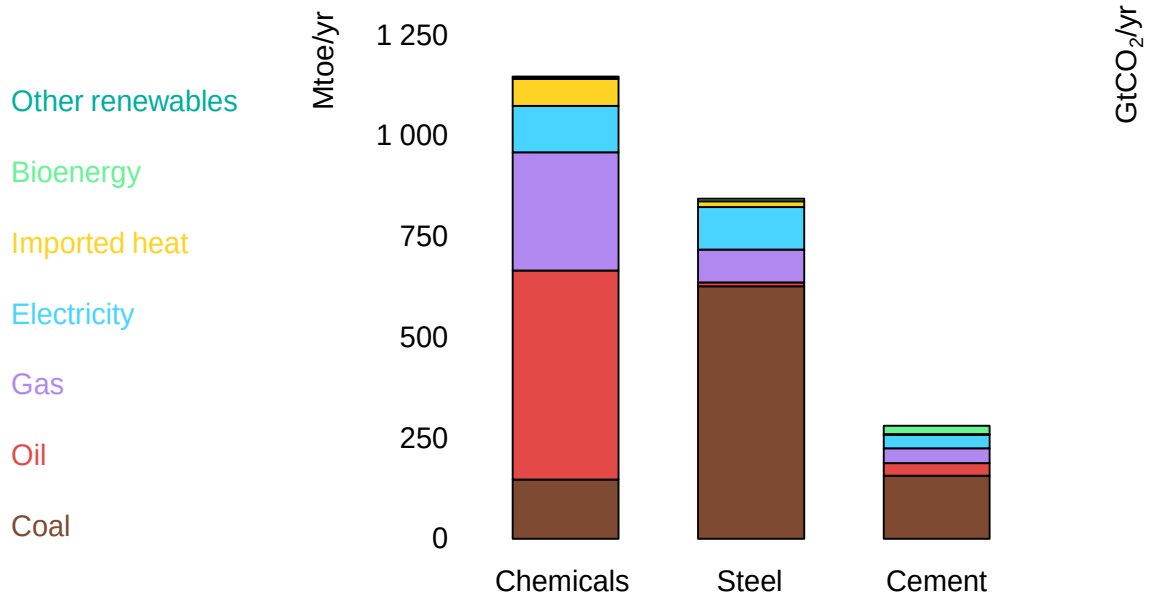
IT'S NOT JUST ABOUT ENERGY PRODUCTION
HARD-TO-ABATE INDUSTRY

- ✓ In spite of their large carbon footprint, "harder-to-abate" energy-intensive sectors (i.e. chemicals, steel and cements) still lack the necessary attention from policy makers, regulators, academia and industry players at large.
- ✓ It is urgent to investigate and monitor all those technological and operational solutions which could reduce emissions from these harder-to-abate industries and, ultimately, allow to achieve emissions reduction targets.

Total Industry CO_2 emissions, by subsectors (%, 2017)



Heavy industry final energy demand

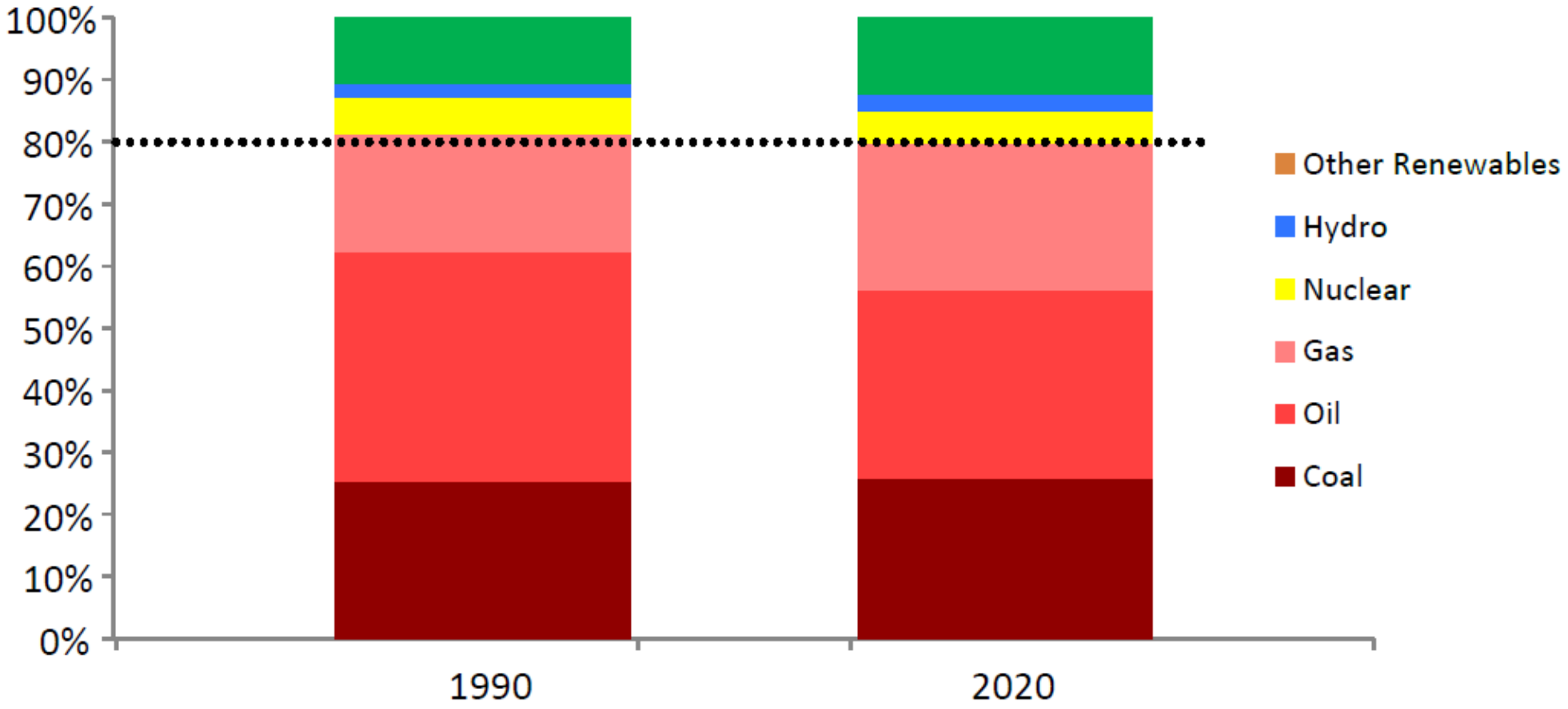


Source: FT and IEA (2021)

III) LA TRANSIZIONE ENERGETICA

WORLD PRIMARY ENERGY MIX

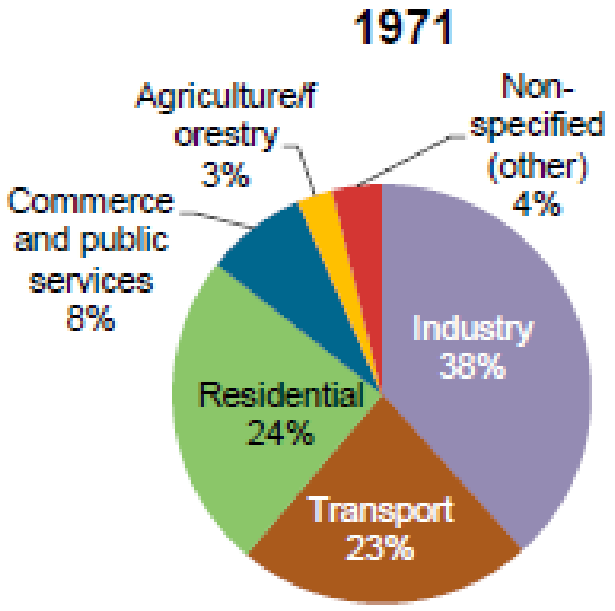
- ✓ In the last **30 years** the share of **fossil fuels** has remained around **80%** while global **energy demand** increased by **55%**.
- ✓ In 2020 hydrocarbons represented 54% of primary energy consumption.



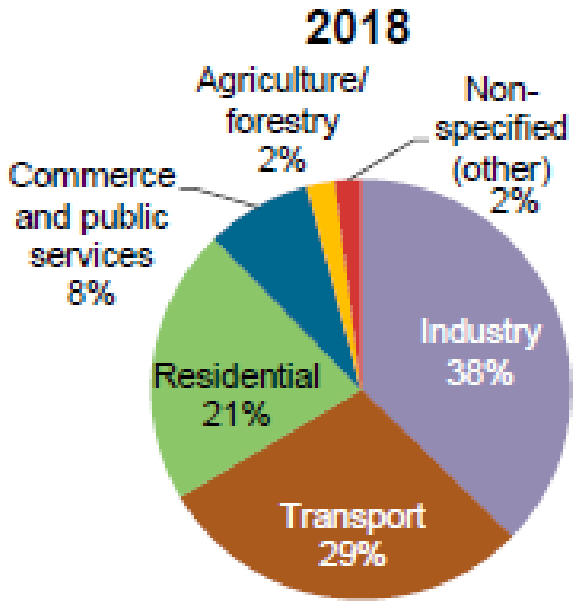
Source: IEA (2021)

WORLD TOTAL FINAL CONSUMPTION BY SECTOR

- ✓ Between 1971 and 2018, total final consumption (TFC) was multiplied by 2.3.
- ✓ The share of energy use of most sectors has been stable.
- ✓ However, energy use in **transport** significantly increased, from 23% of TFC in 1971 to 29% since 2015; the **industry** remained the largest consuming sector globally, with the same share as in 1971 (38%); the **residential** sector ranked third in 2018 (21%).



4 243 Mtoe



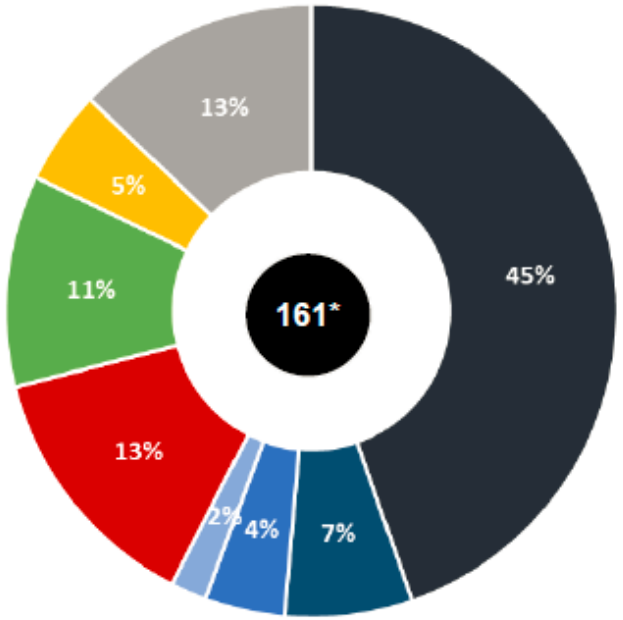
9 938 Mtoe

Source: IEA (2020)

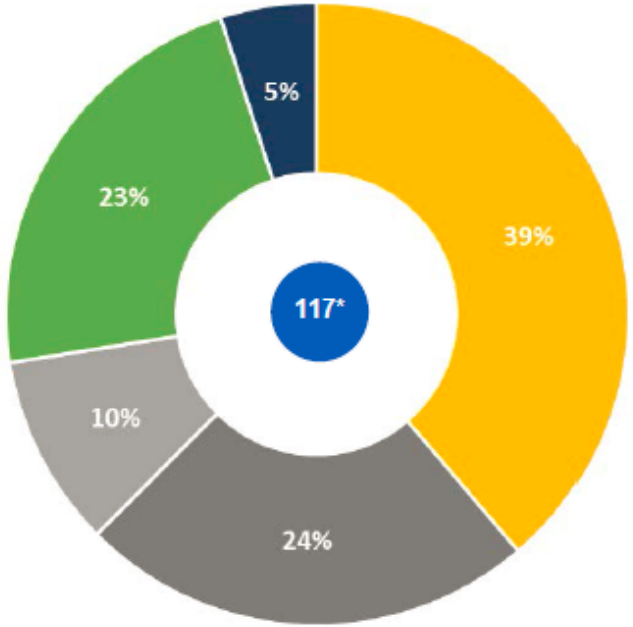
WORLD FOSSIL FUELS CONSUMPTION BY SECTOR

✓ Demand segmentation as a proxy of climate risk across different sectors. **Transport** (cars, trucks, ships, planes and trains) represents **58%** of global total oil demand.

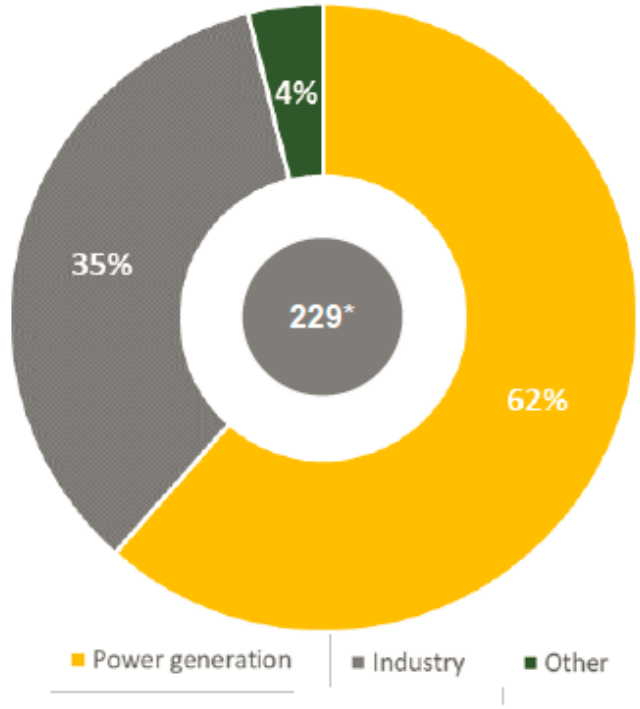
What do we use oil for?



What do we use gas for?



What do we use coal for?

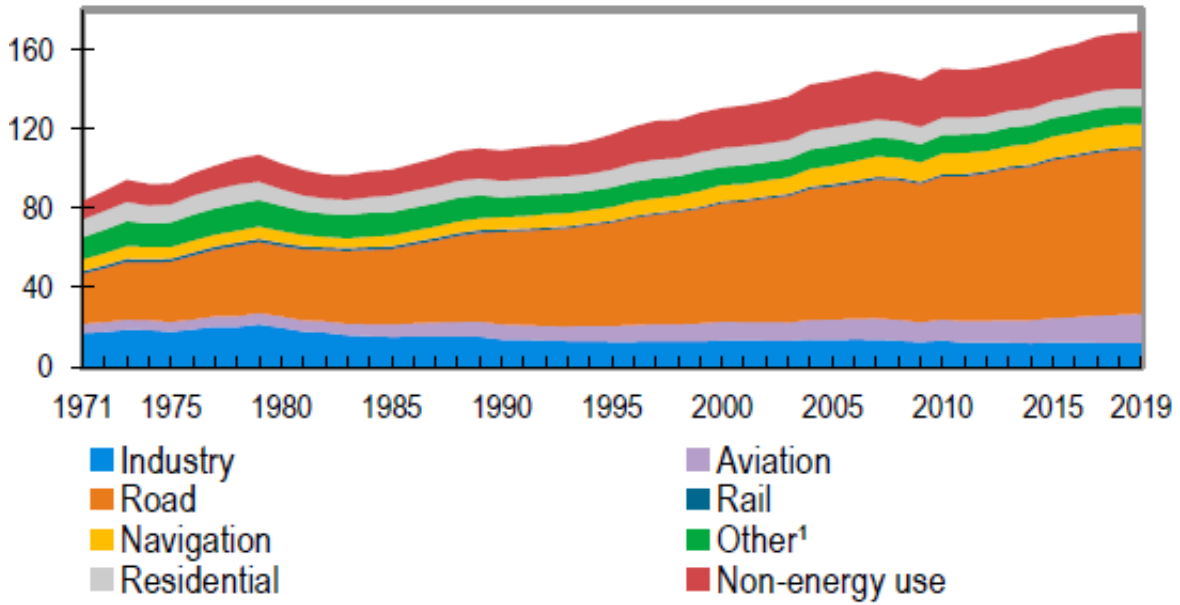


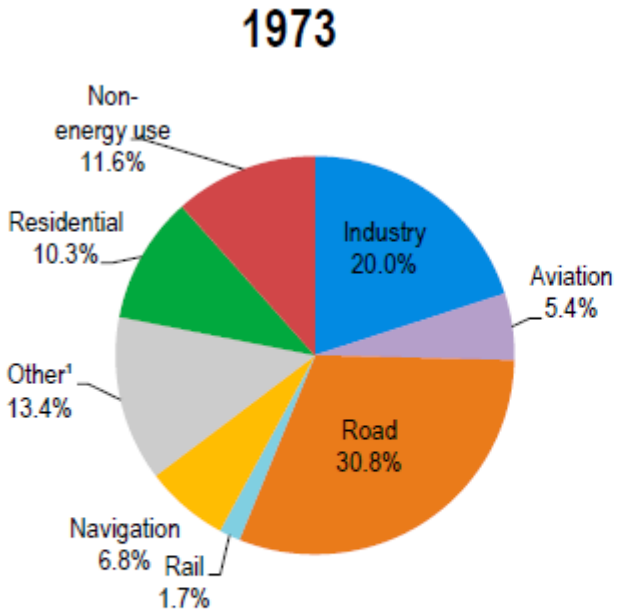
*CO2 specific emission intensity by fuel (pounds of CO_2 per Million British thermal units)

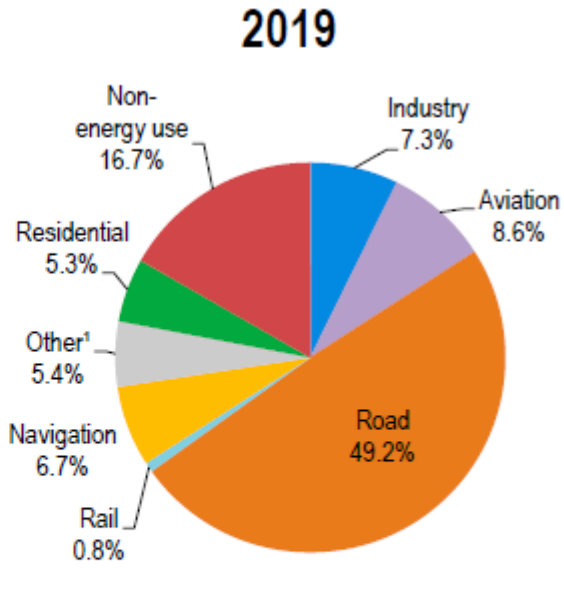
Source: BP (2020)

WORLD TOTAL OIL CONSUMPTION BY SECTOR

✓ Notice how between 1973 and 2019 only two sectors have increased their share within total oil consumption, i.e. **road, aviation and non-energy uses**.







94 EJ

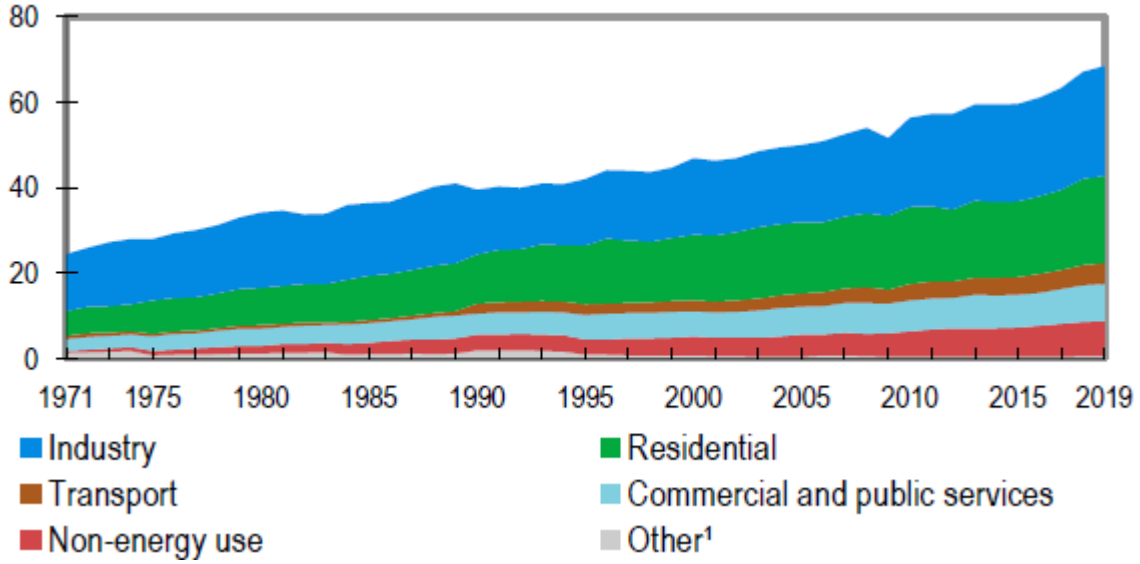
169 EJ

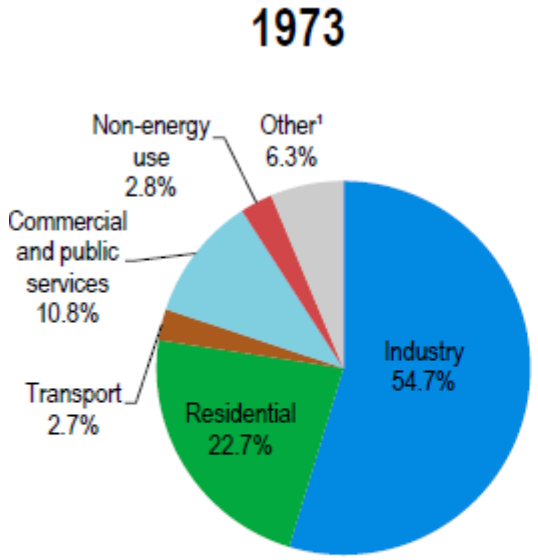
1. Includes agriculture, commercial and public services, non-specified other, pipeline and non-specified transport.

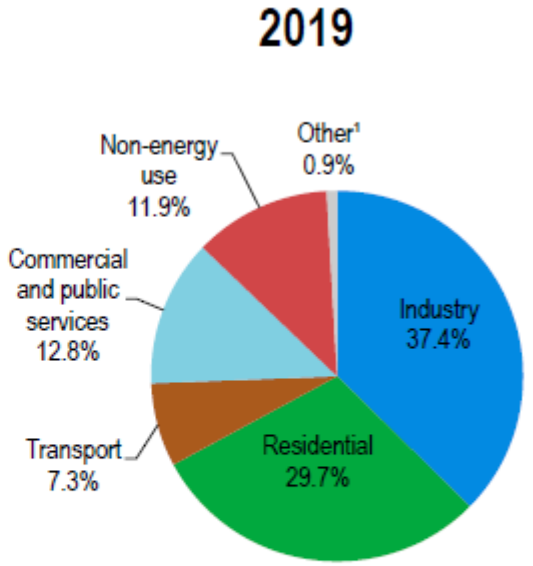
Source: IEA (2021)

WORLD TOTAL GAS CONSUMPTION BY SECTOR

✓ Notice how between 1973 and 2019 gas consumption has more than doubled, while the share of **non-energy uses** has more than quadrupled.







27 EJ

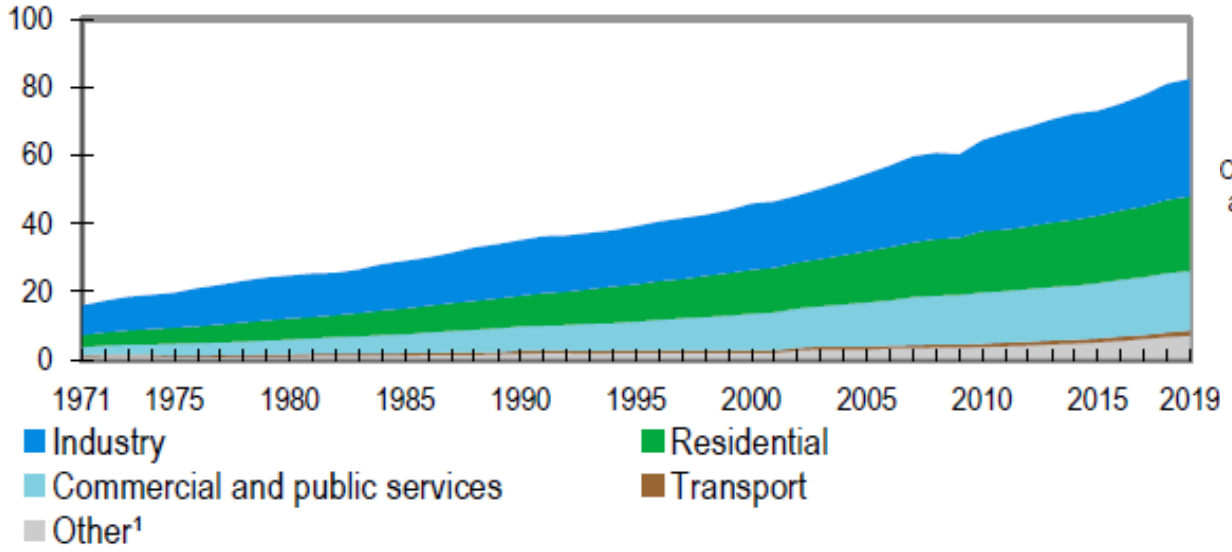
68 EJ

1. Includes agriculture, fishing and non-specified other.

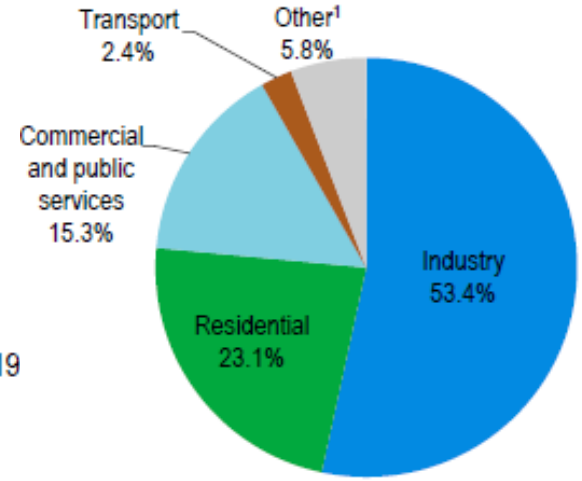
Source: IEA (2021)

WORLD TOTAL ELECTRICITY CONSUMPTION BY SECTOR

- ✓ Notice how between 1973 and 2019, total electricity consumption has more than quadrupled; the electrification of energy demand (e.g. EVs and heatpumps) and the progress in electricity access (e.g. Sub-Saharan Africa) will significantly increase total consumption across all sectors.

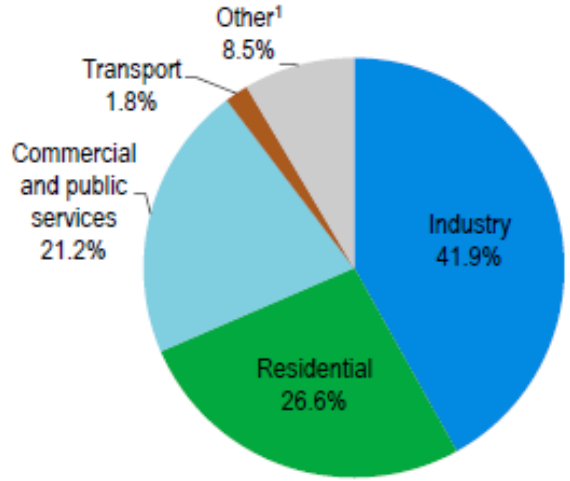


1973



18 EJ

2019



82 EJ

1. Includes agriculture, fishing and non-specified other.

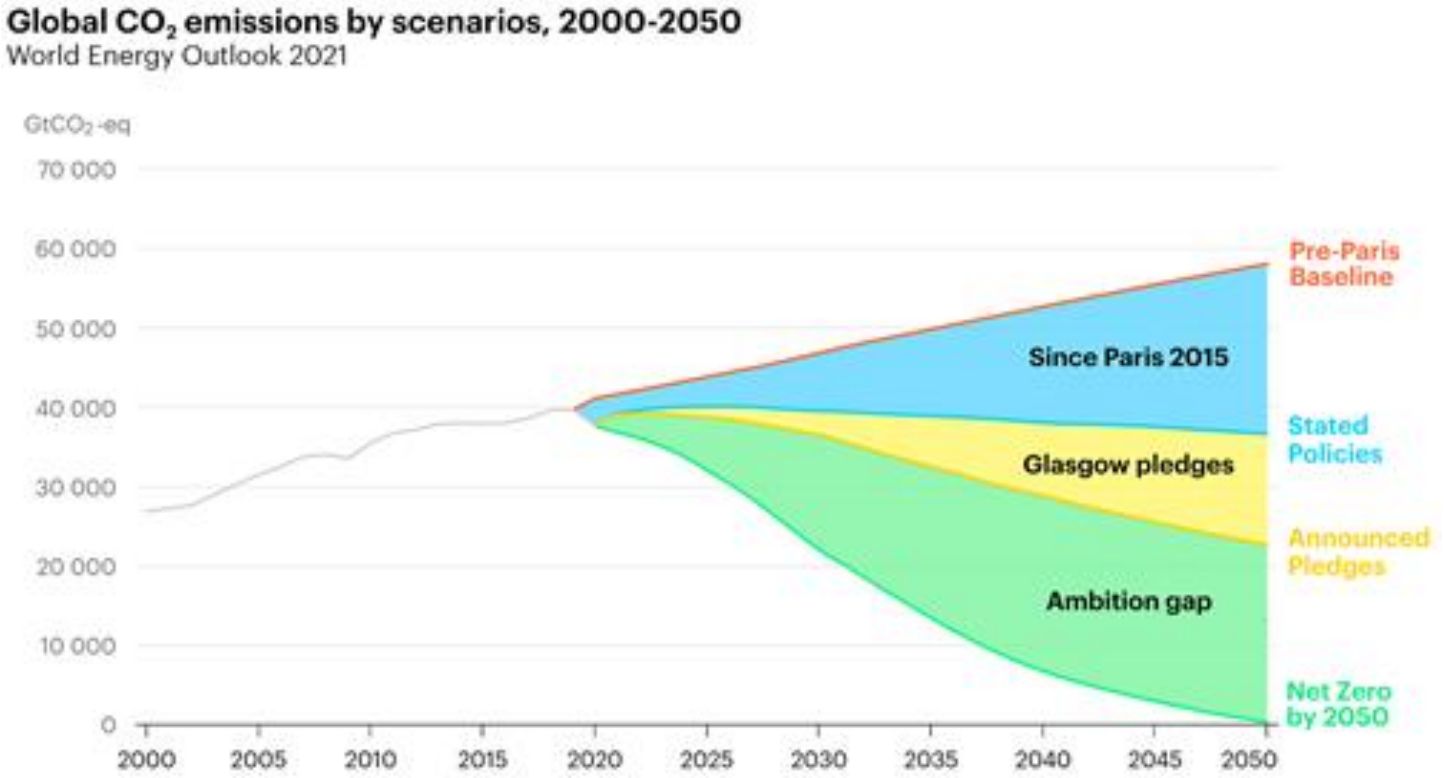
Source: IEA (2021)

FUTURE EMISSIONS SCENARIOS
IEA'S WORLD ENERGY OUTLOOK 2021

- ✓ **Clean energy progress is still far too slow** to put global emissions into sustained decline towards net zero; this emphasizes the need for an unmistakable signal of ambition and action from government leaders at COP26 in Glasgow.
- ✓ In spite of significant progress with regards to the growth of clean energy technologies, **the world is still far from a path that is likely to limit global warming to 1.5 °C and avoid the worst effects of climate change**.
- ✓ Instead, global consumption of coal and oil is growing strongly this year, pushing **carbon dioxide emissions towards their second largest annual increase in history**.
- ✓ Reaching net-zero by 2050 requires **investment in clean energy projects and infrastructure to more than triple over the next decade**.
- ✓ **Some 70% of that additional spending needs to happen in emerging and developing economies**, where financing is scarce and capital remains up to seven times more expensive than in advanced economies

FUTURE EMISSIONS SCENARIOS CHOOSE YOUR PATH

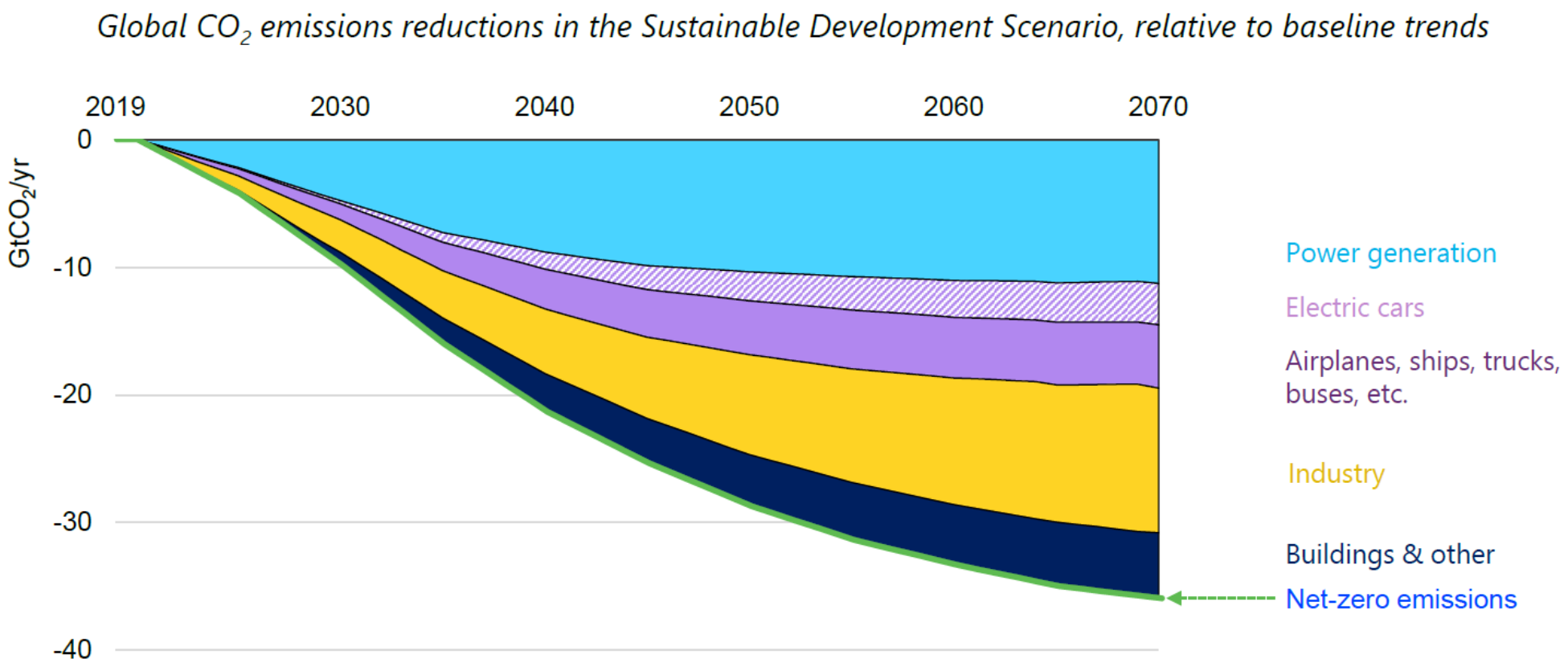
- ✓ “More than 40% of the required emissions reductions come from measures that are highly cost-effective, and successfully pursuing net zero would create a market for wind turbines, solar panels, lithium-ion batteries, electrolysers and fuel cells of well **over USD 1 trillion a year by 2050**, comparable in size to the current oil market, while creating millions of new jobs.



Source: IEA (2021)

FUTURE EMISSIONS SCENARIOS EFFORTS BY SECTOR

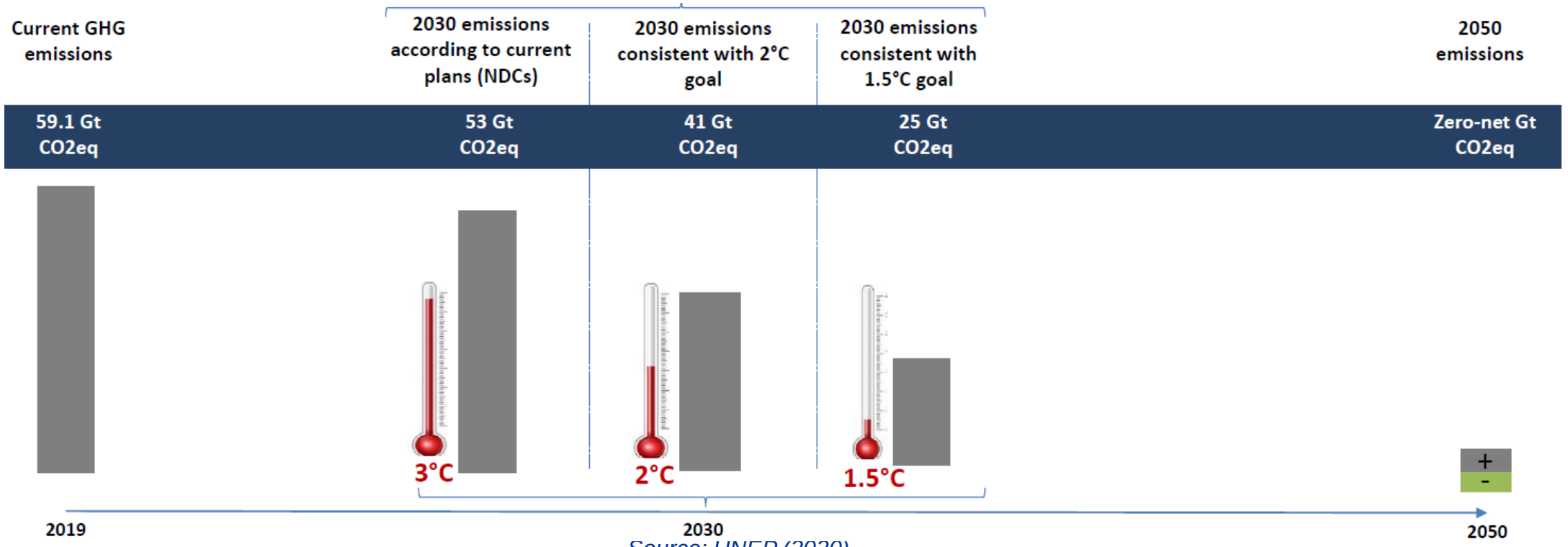
✓ Transport will play a key role in achieving net zero emissions!



Source: IEA (2020)

FUTURE EMISSIONS SCENARIOS
THE HALF-WAY CHECK-POINT

- ✓ We need to **cut emissions by almost 60% by 2030** if we want to stay within the 1.5 C target by 2050!
- ✓ According to IEA's WEO 2021, today's announced climate pledges close less than 20% of the CO2 emissions gap to 2030 that is needed to put the world on a path to net zero by 2050.



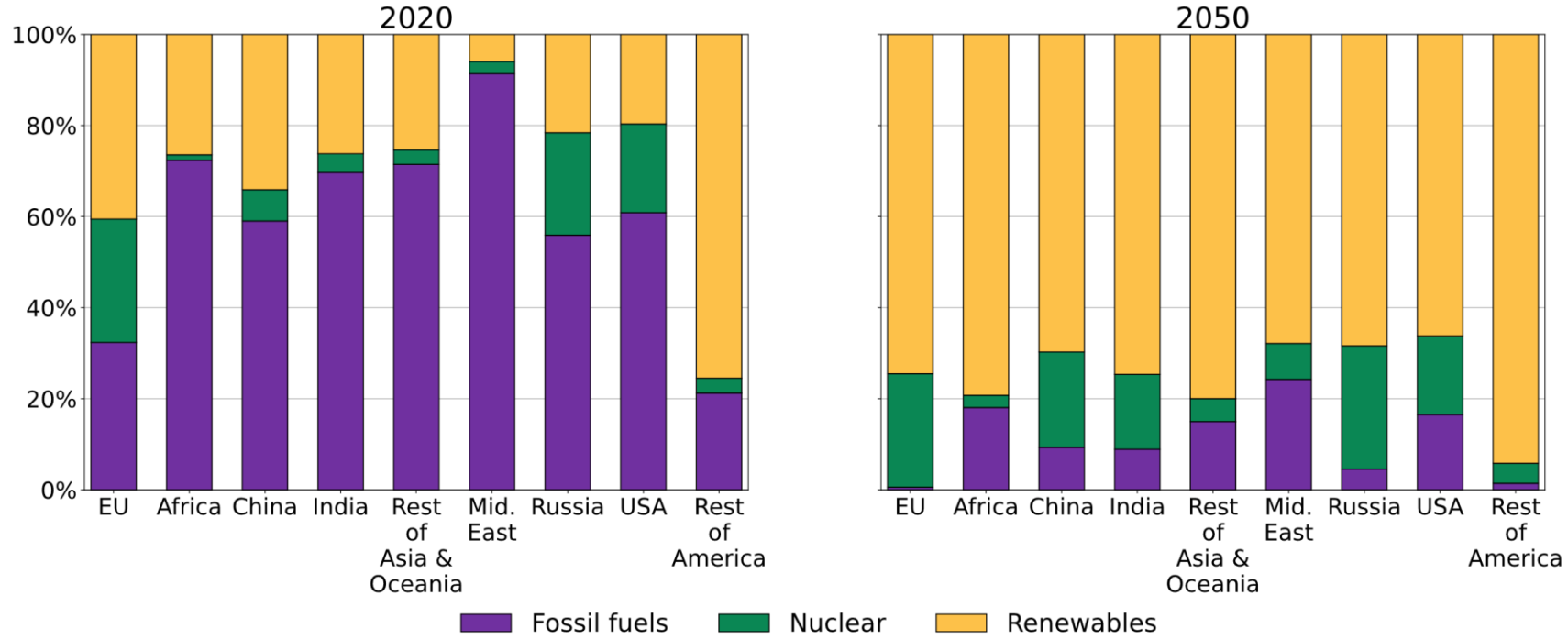
Source: UNEP (2020)

FUTURE ENERGY SCENARIOS
ELECTRICITY MIX BY REGION

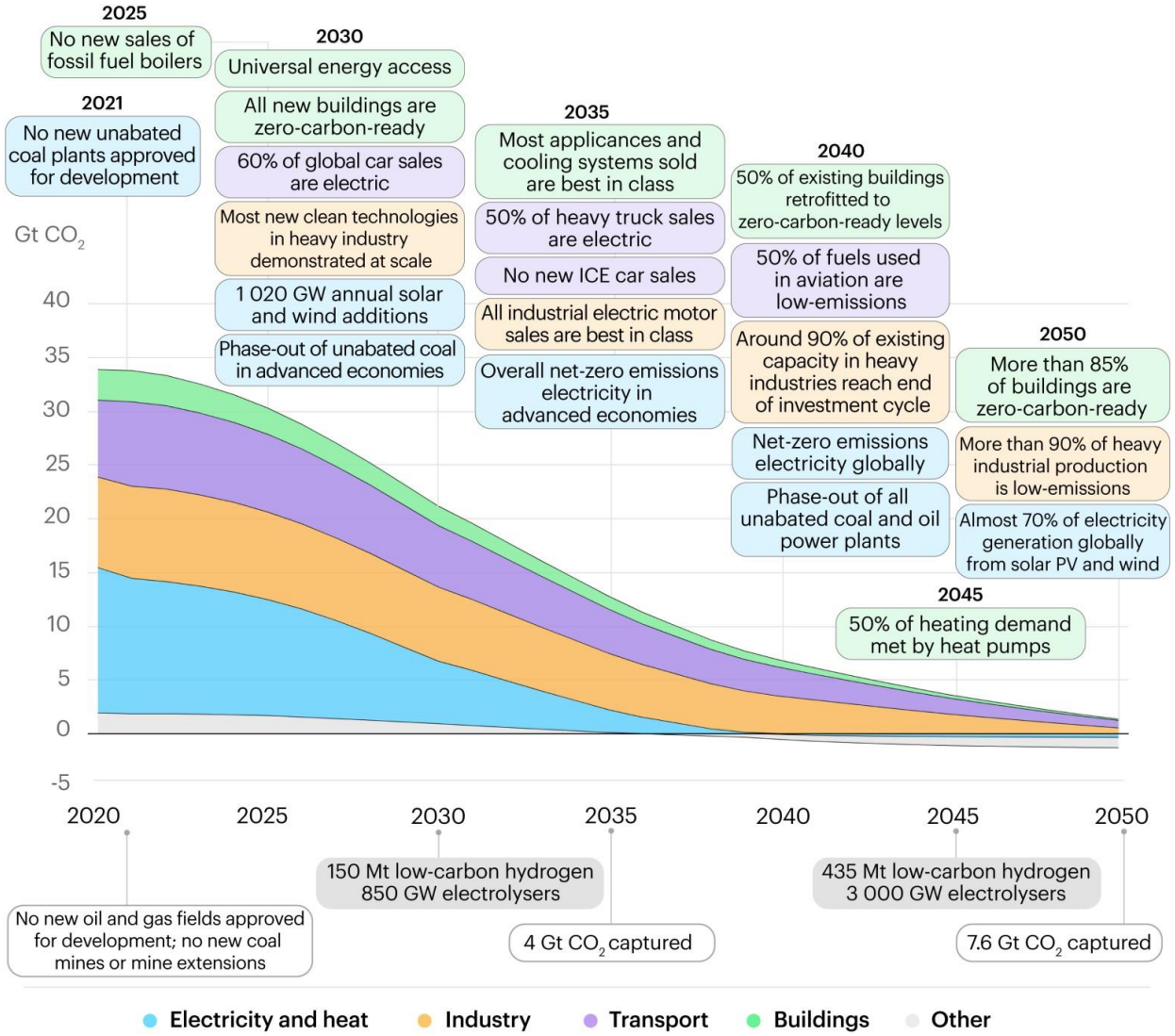
- ✓ Renewables will represent an even greater share of the electricity mix, at the expenses of fossil fuels.
- ✓ China is expected to have the largest share of renewable technologies in absolute terms, while Europe (which is already leading the scene) emerges as the only region without fossil fuels in the power mix by 2050, thanks to its ambitious environmental policies.
- ✓ Europe's climate credentials could contribute to empower its political leadership within the G7 and the G20.

Source: SDA Bocconi and Polimi (2021)

Share (%) of fossil fuels, nuclear and renewables in the power mix by region



IEA ROADMAP TO NET ZERO BY 2050 KEY MILESTONES

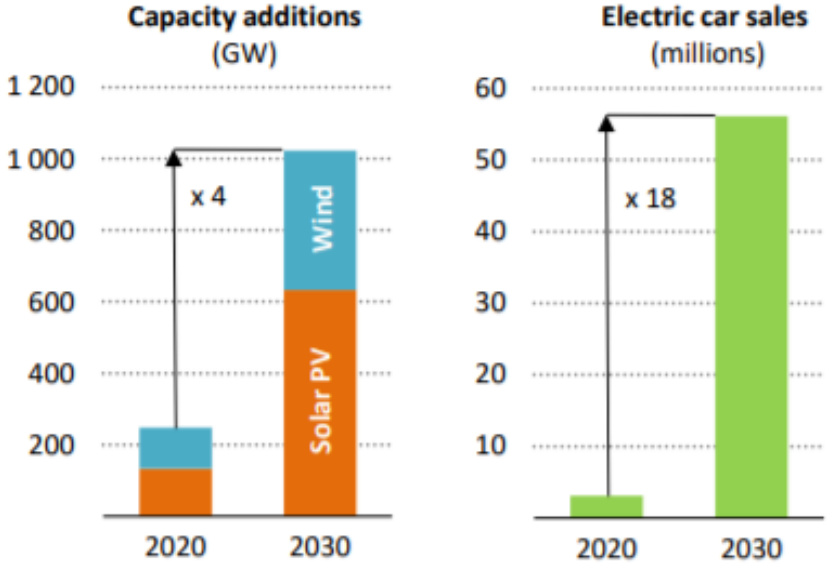


Source: IEA (2021)

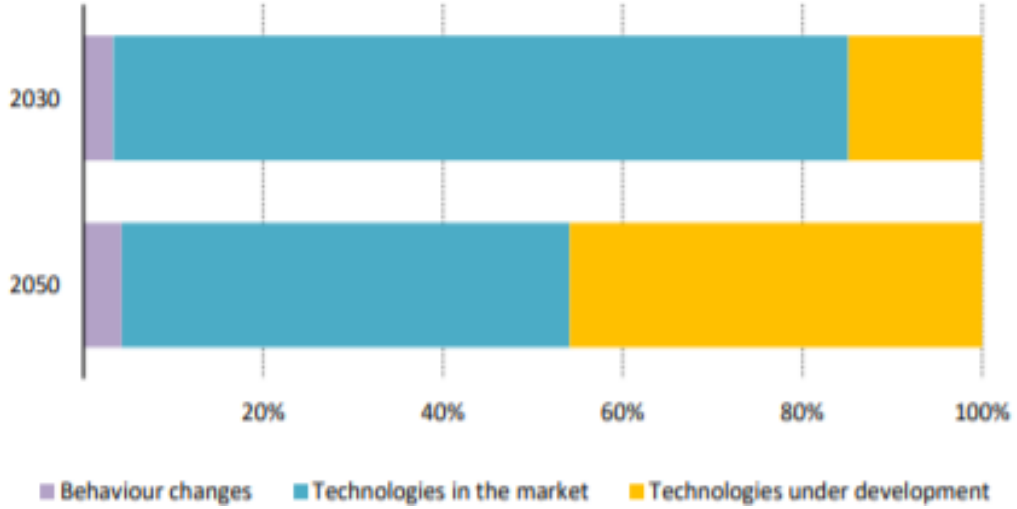
IEA ROADMAP TO NET ZERO BY 2050
THE NEED FOR TECHNOLOGICAL INNOVATION

- Reaching **net zero by 2050** requires further rapid deployment of **both available technologies and new technologies** that are not on the market yet.
- **Major innovation** efforts must occur over this decade in order to bring these new technologies to market in time.
- **Public and private R&D spending** needs to be increased and reprioritised:
  - e.g. critical areas such as electrification, hydrogen, bioenergy and carbon capture, utilisation and storage (CCUS) today receive only around 1/3 of the level of public R&D funding of the more established low-carbon electricity generation and energy efficiency technologies.

Key clean technologies ramp up by 2030 in the net zero pathway



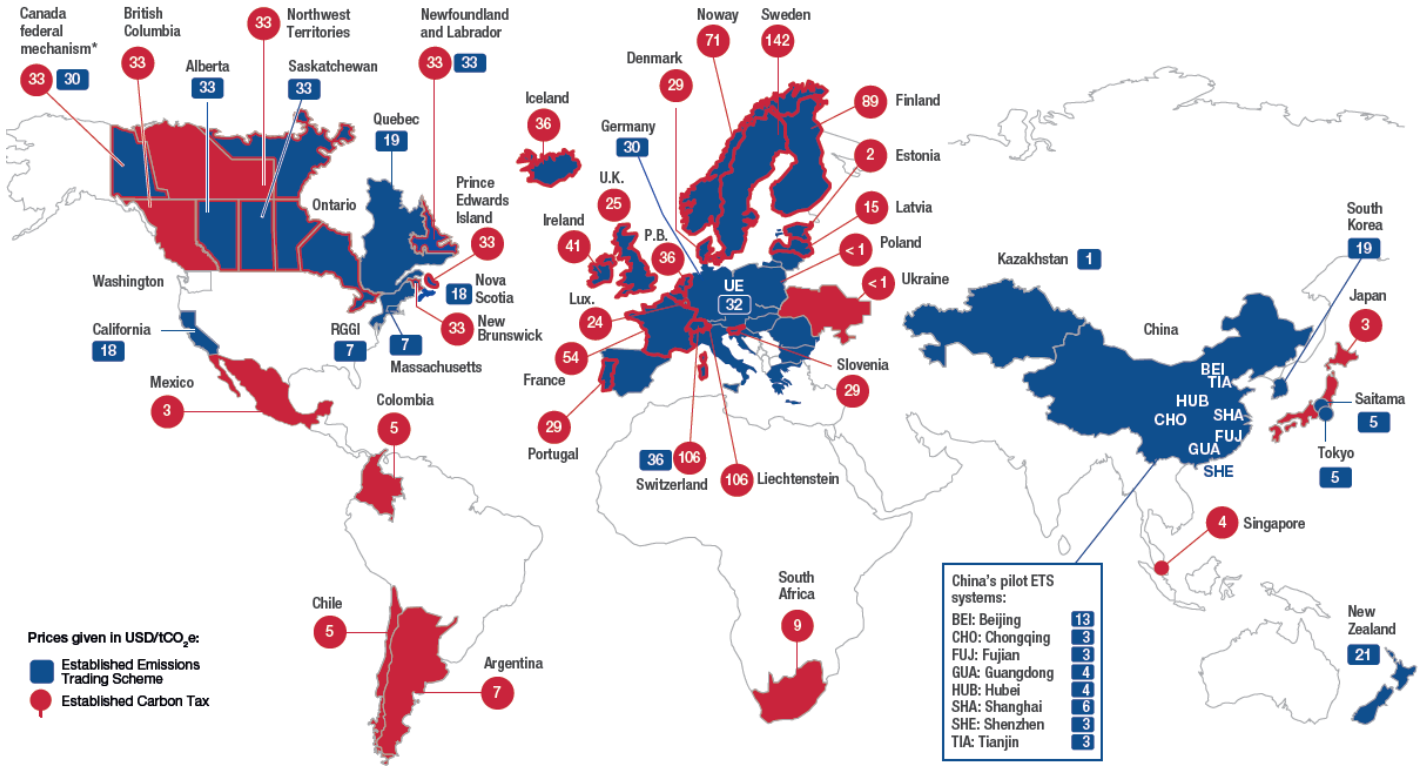
Annual CO2 emissions savings in the net zero pathway, relative to 2020

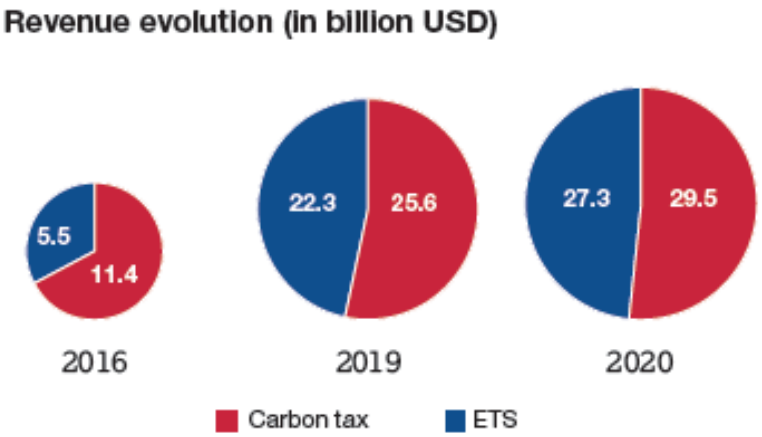


Source: IEA (2021)

CARBON PRICING WORLDWIDE

- ✓ Although the EU was the first area to launch a carbon market (ETS) in 2005, several mechanisms for carbon pricing have been introduced worldwide since then. As of October 1st 2021, **47 jurisdictions** (countries, provinces, or cities) are operating a carbon pricing scheme (carbon tax and/or an Emissions Trading System). Together, they account for around **60%** of global gross domestic product.



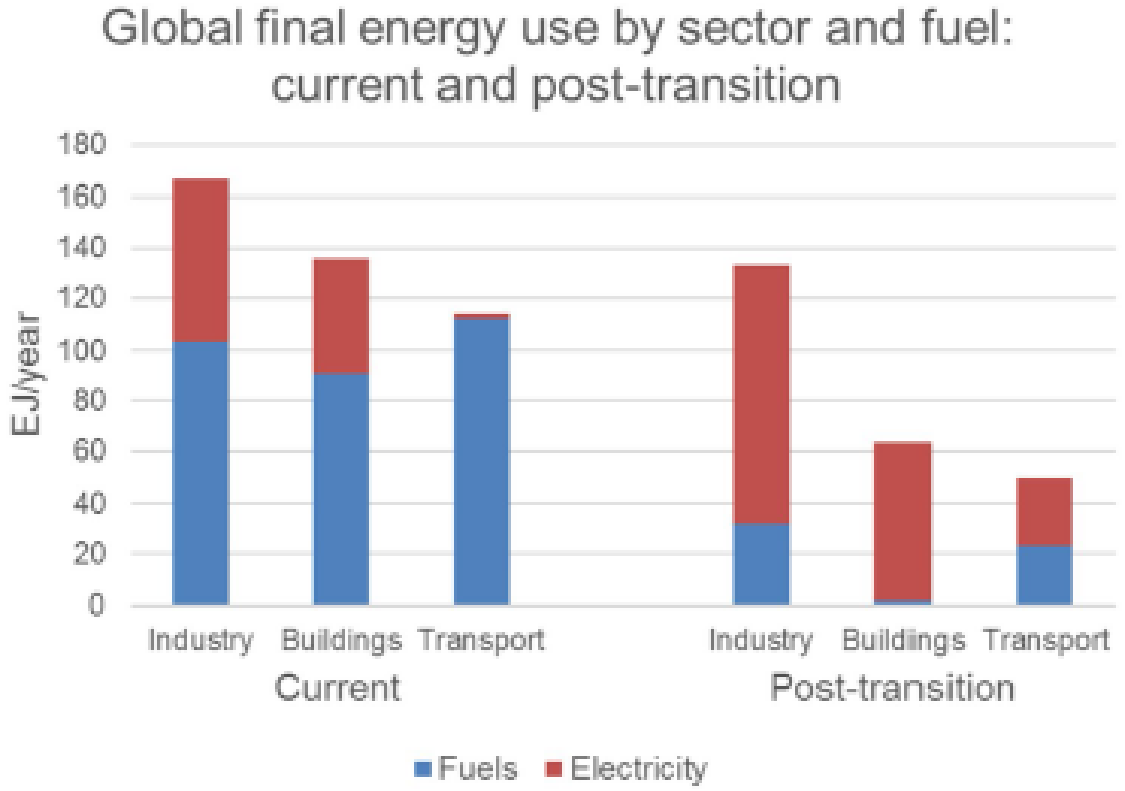


Source: Institute for Climate Economics (2021)

APPENDIX

FUTURE ENERGY SCENARIOS FROM USING HEAT TO USING WORK

- ✓ The energy transition can be seen as a systematic shift from heat-producing to work producing energy sources (Eyre, N, 2021).
- ✓ This shift enables very large improvements in the conversion efficiency of final energy, through the use of **electricity and hydrogen**, in particular **in heating and transportation**, with a possible **reduction in final energy demand of up to 40%.**



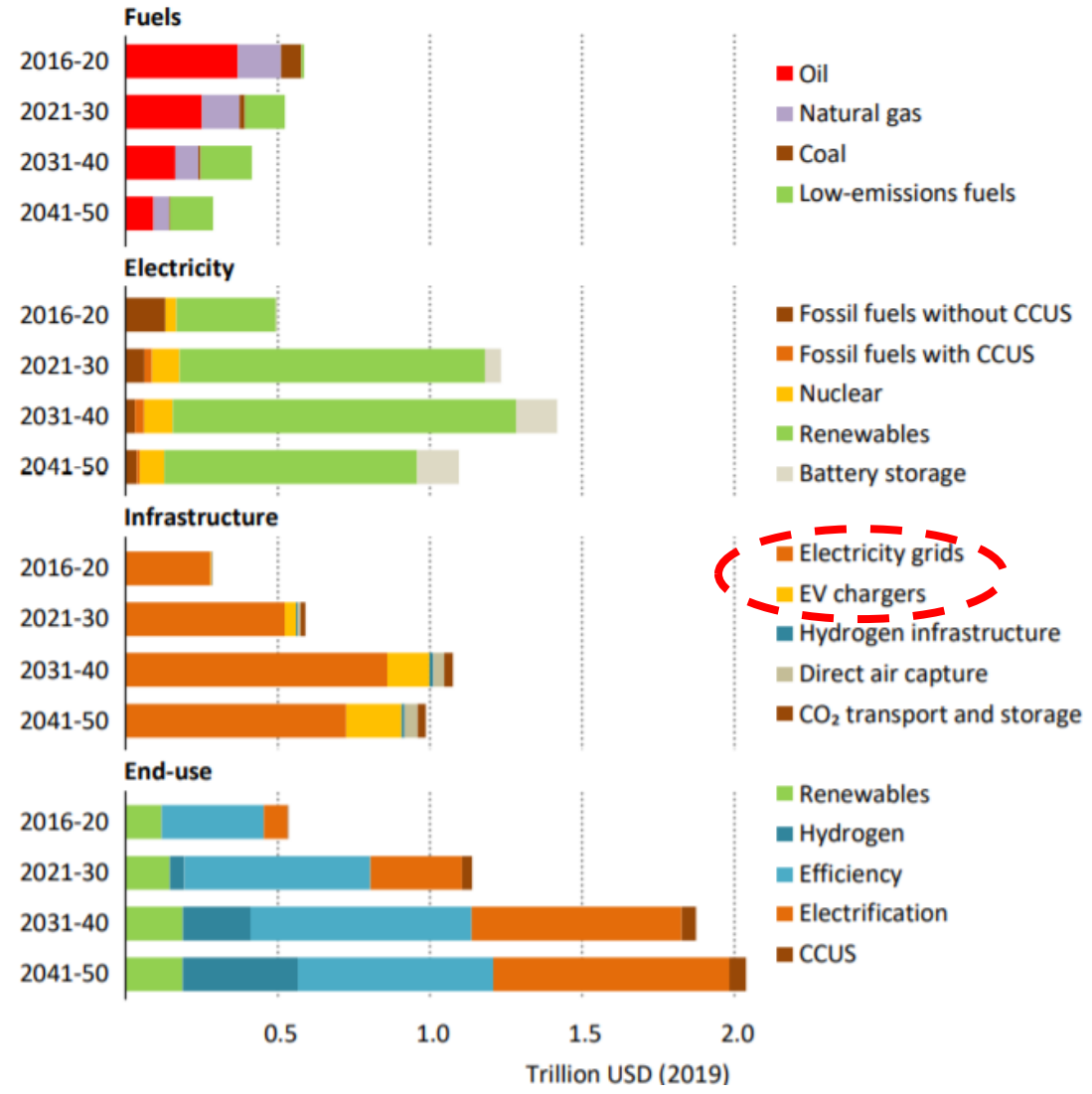
Source: Nick Eyre (2021)

IEA ROADMAP TO NET ZERO
THE FUTURE IS ELECTRIC BUT….

- ✓ **Annual investment in transmission and distribution grids** grows from $260 billion today to $820 billion in 2030.
- ✓ The number of **public charging points for EVs** rises from around 1 million today to 40 million in 2030, requiring annual investment of almost $90 billion in 2030.

Source: IEA (2021)

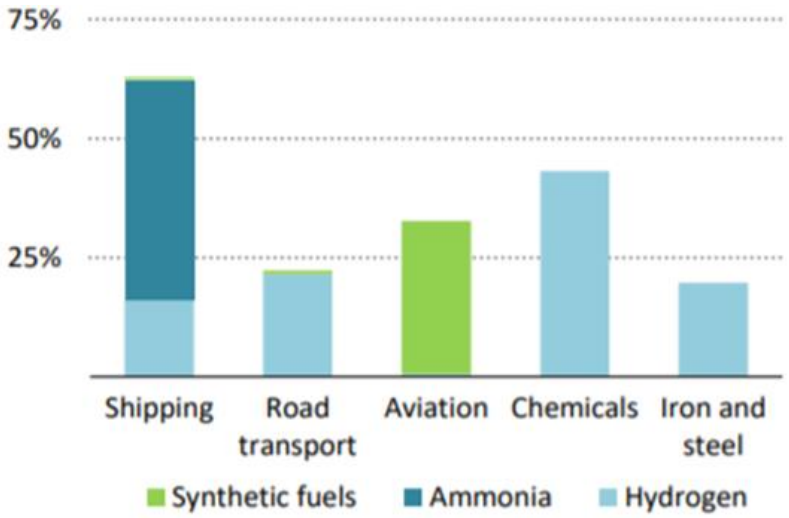
Global average annual energy investment needs by sector and technology:



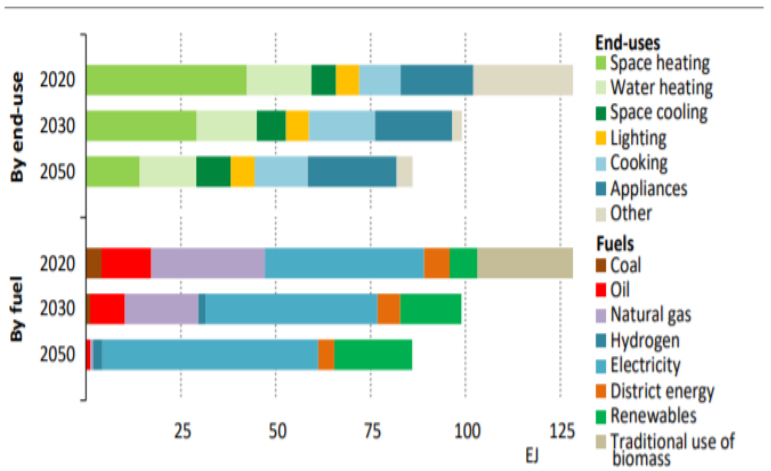
IEA ROADMAP TO NET ZERO ….WHAT ABOUT HYDROGEN?

- Hydrogen demand must increase almost six fold to 2050, relative to today levels; **50% will be used in heavy industry (mainly steel and chemicals production) and in the transport sector**; 30% is converted into other hydrogen-based fuels, mainly ammonia for shipping and electricity generation, synthetic kerosene for aviation (one-third of global aviation fuel demand in 2050) and synthetic methane blended into gas networks; and 17% is used in gas-fired power plants to balance increasing electricity generation from intermittent renewables.
- Overall, hydrogen-based fuels (hydrogen, ammonia as well as synthetic hydrocarbon fuels produced from hydrogen and CO2) will account for 13% of global final energy demand in 2050

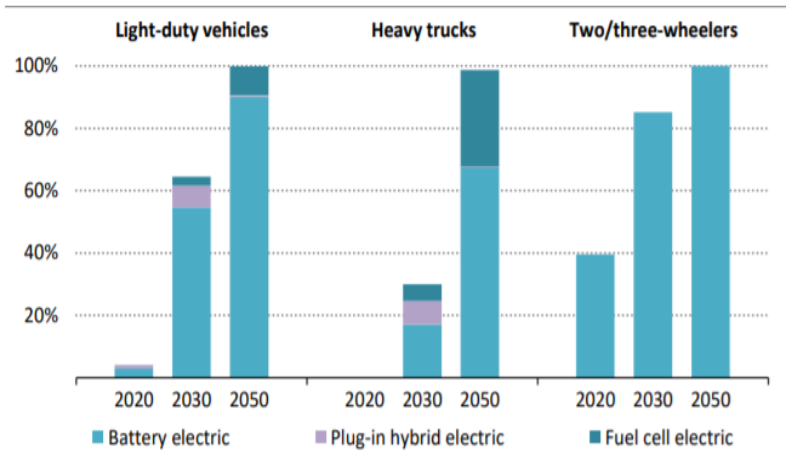
Share of hydrogen by sector in 2050



Buildings - global final energy consumption by fuel and end-use application



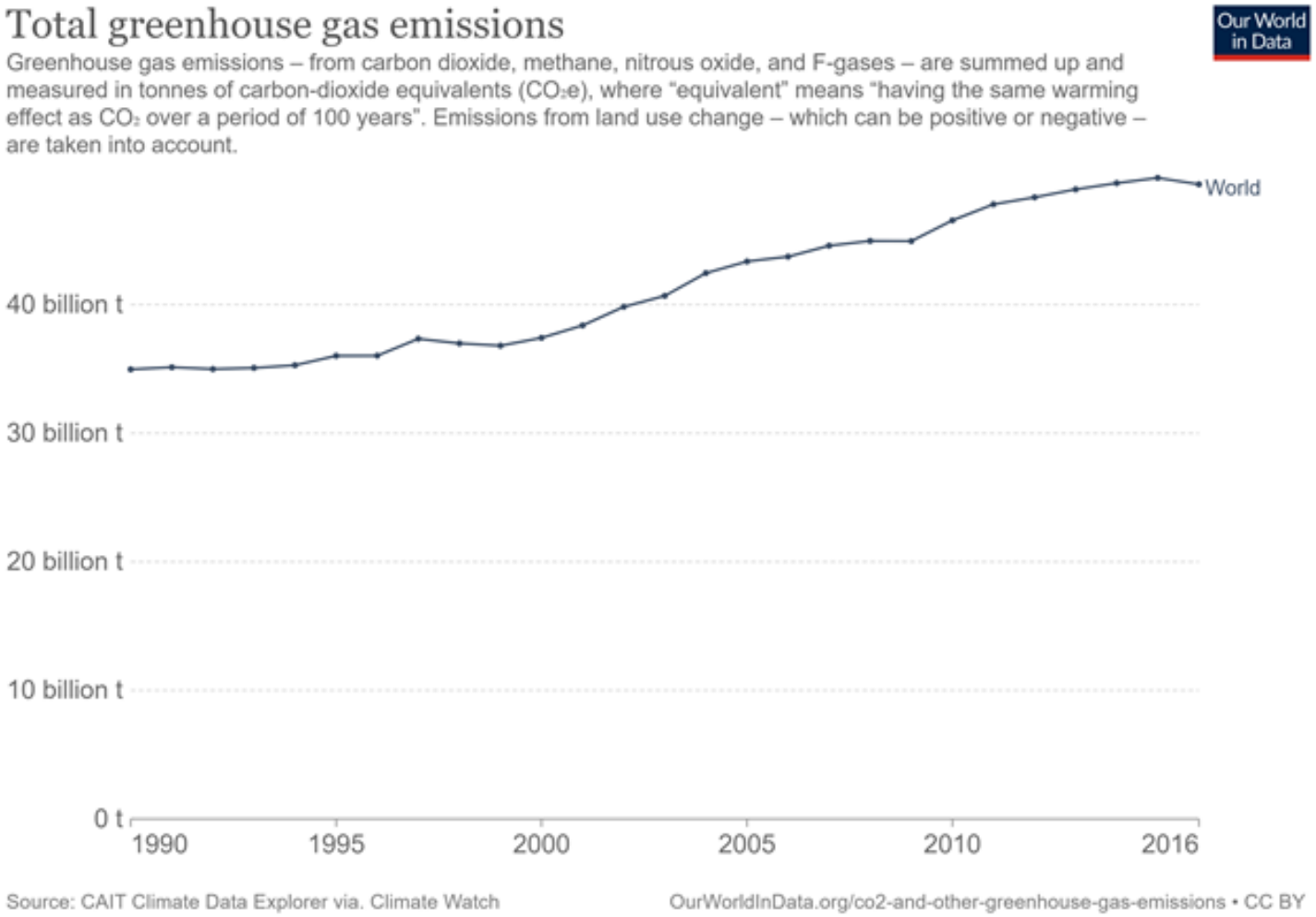
Road transport - expected global share of low carbon vehicles in total sales by type



Source: IEA (2021

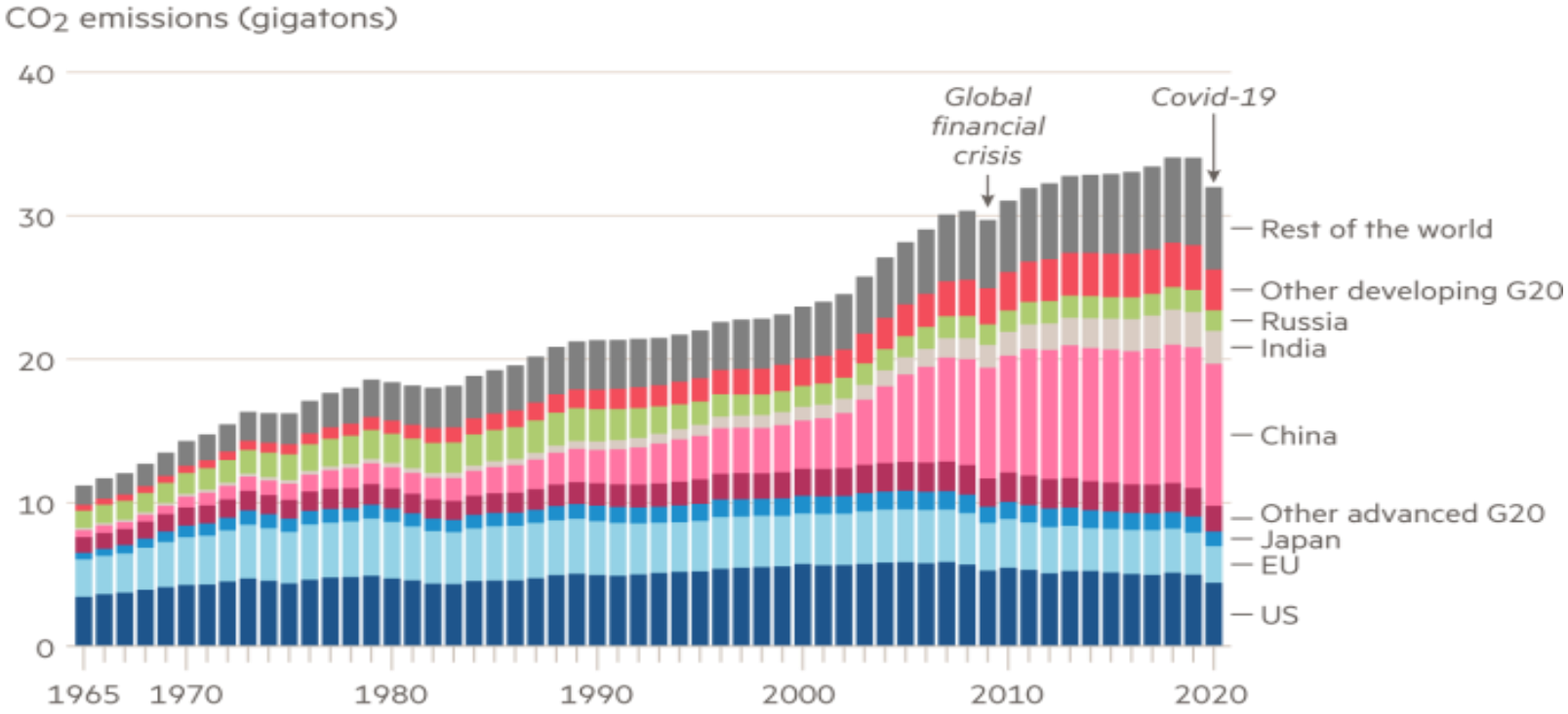
TRENDS IN GHG EMISSIONS

- ✓ Greenhouse gases are measured in 'carbon dioxide-equivalents' (CO_2e).
- ✓ Today, we collectively emit around **50 billion tonnes** of CO_2e each year, i.e. more than 40% higher than emissions in 1990, which were around 35 billion tonnes.



THE EVOLUTION IN TIME
WORLD ENERGY-RELATED CO_2 EMISSIONS

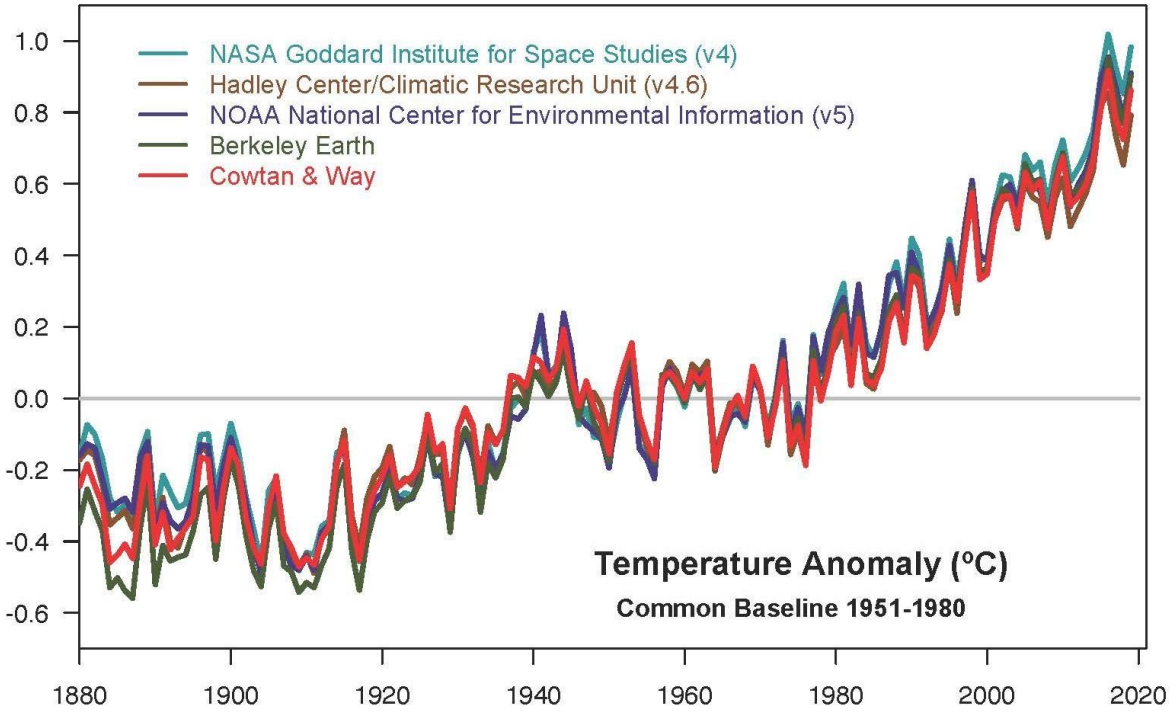
- ✓ After two years of growth, global energy-related CO_2 emissions **remained unchanged** at 33 Gigatonnes in 2019, even as the world economy expanded by almost 3%.
- ✓ This was mostly due to **declining emissions from electricity generation in advanced economies**, thanks to the expanding role of renewable sources (mainly wind and solar), fuel switching from coal to natural gas, and higher nuclear power generation; total emissions from advanced economies' power sectors fell to levels "last seen in the late 1980s; other factors included milder weather in several countries, and slower economic growth in some emerging markets.



Source: BP (2021)

CLIMATE CHANGE TODAY

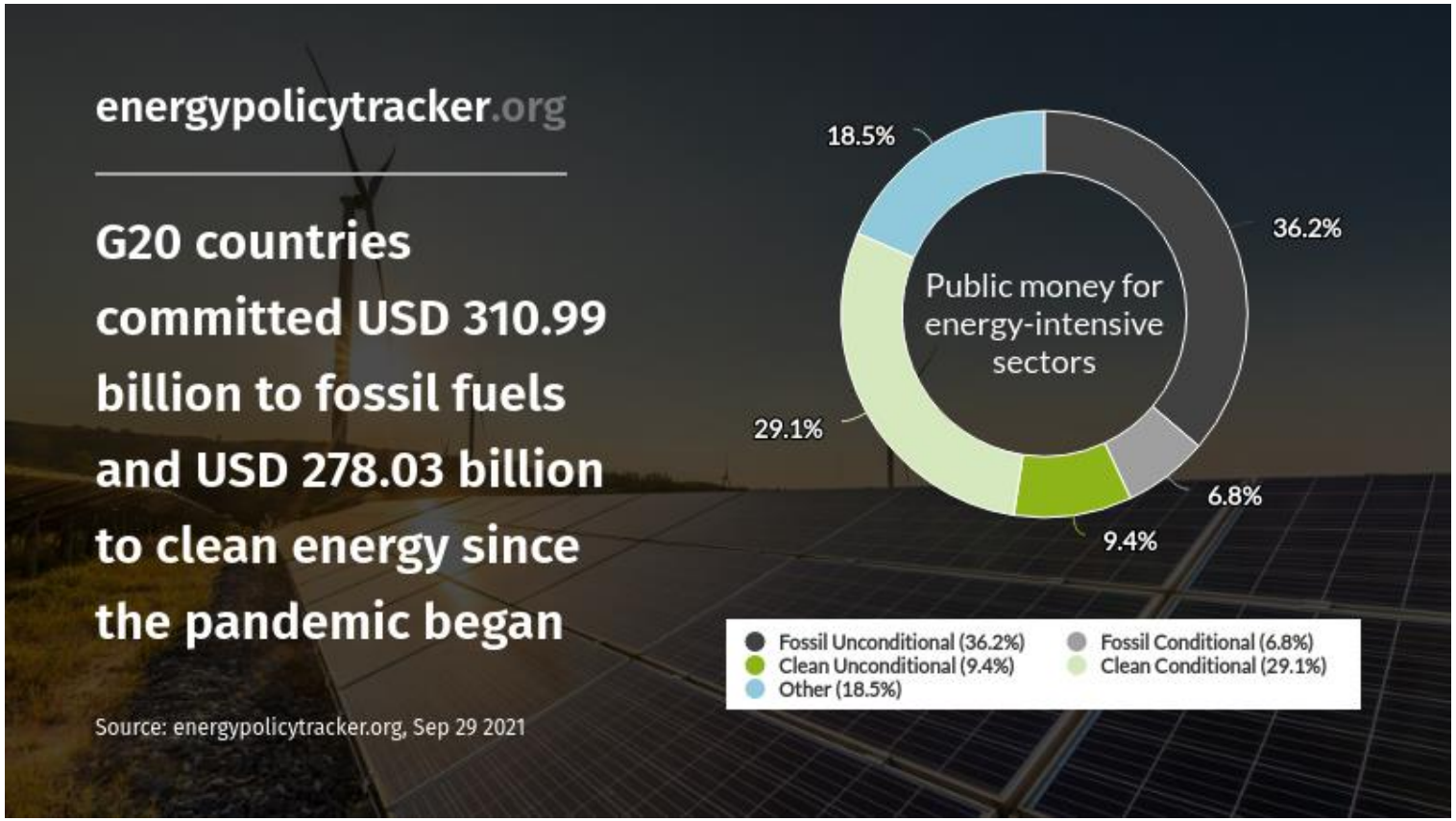
- ✓ Multiple studies published in peer-reviewed scientific journals show that **97% or more of actively publishing climate scientists agree**: climate-warming trends over the past century are extremely likely due to human activities.
- ✓ Temperature data showing **rapid warming in the past few decades**. 2016 and 2020 are tied for **the warmest year** since 1880, continuing a long-term trend of rising global temperatures; the **10 warmest years in the 141-year record** have occurred since 2005, with the seven most recent years being the warmest.



Source: NASA (2021)

WALK THE TALK
PUBLIC FINANCE AND CLIMATE POLICY

- ✓ Energy Policy Tracker is an online database that tracks how the G20 and other governments are planning to rebuild their economies, from a climate and energy perspective.

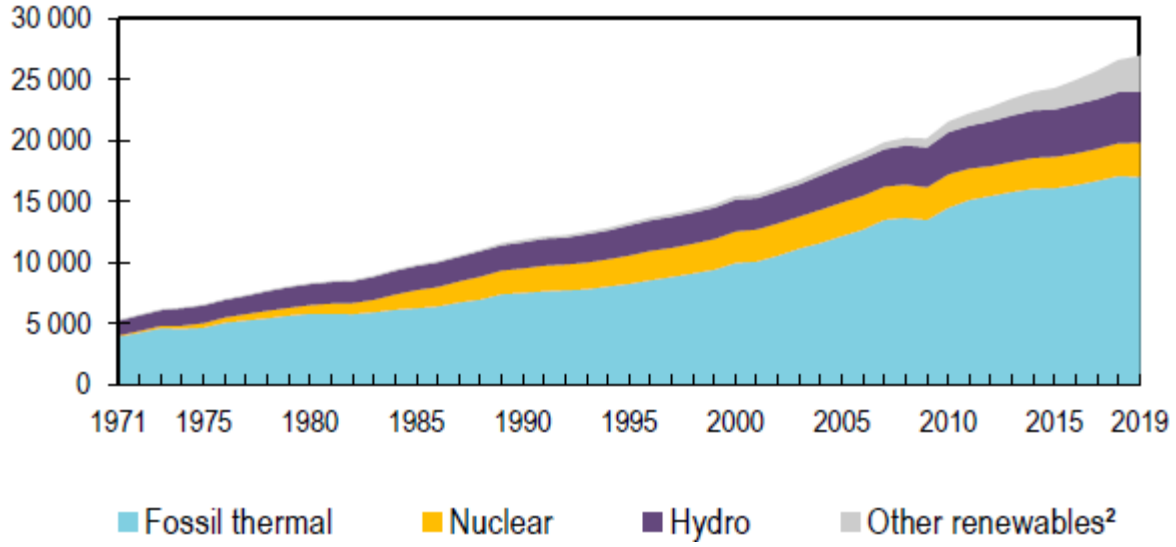


Source: Energy Policy Tracker (2021)

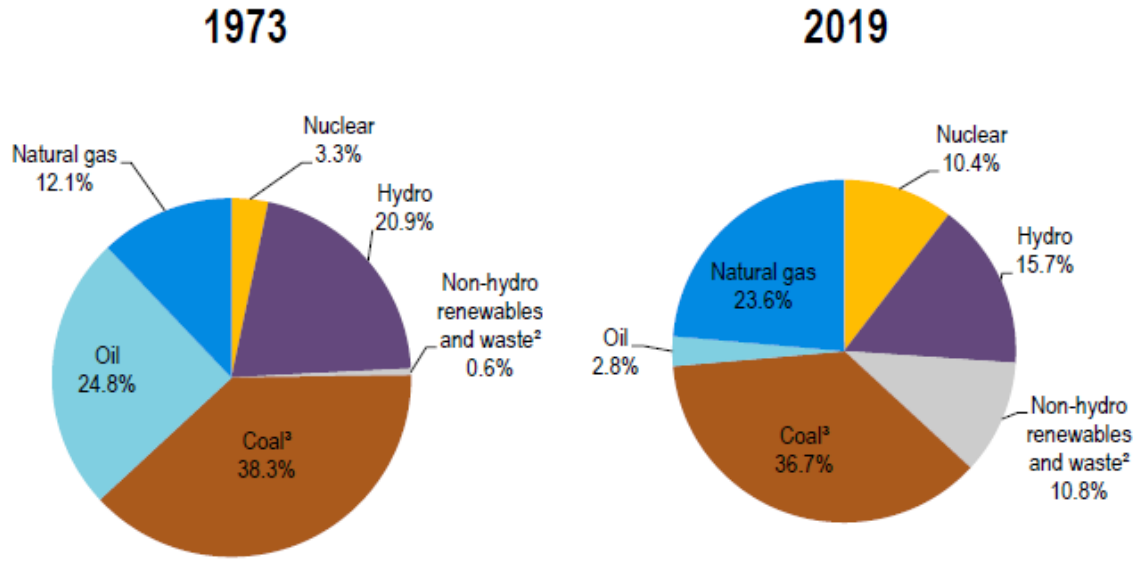
WORLD TOTAL ELECTRICITY CONSUMPTION BY FUEL

- ✓ With its 36% share, **coal** remained the largest single source of electricity worldwide; however **low-carbon** generation exceeded that of coal for the first time, providing 37% of global electricity supply in 2019 (39% in 2020) with **renewables** at 27%, the highest ever (29% in 2020).

World electricity generation[1] by source, 1971-2019 (TWh)



Share of world electricity generation[1] by source, 1973 and 2019



1. Excludes electricity generation from pumped storage.
2. Includes geothermal, solar, wind, tide/wave/ocean, biofuels, waste, heat and other.
3. In these graphs, peat and oil shale are aggregated with coal.

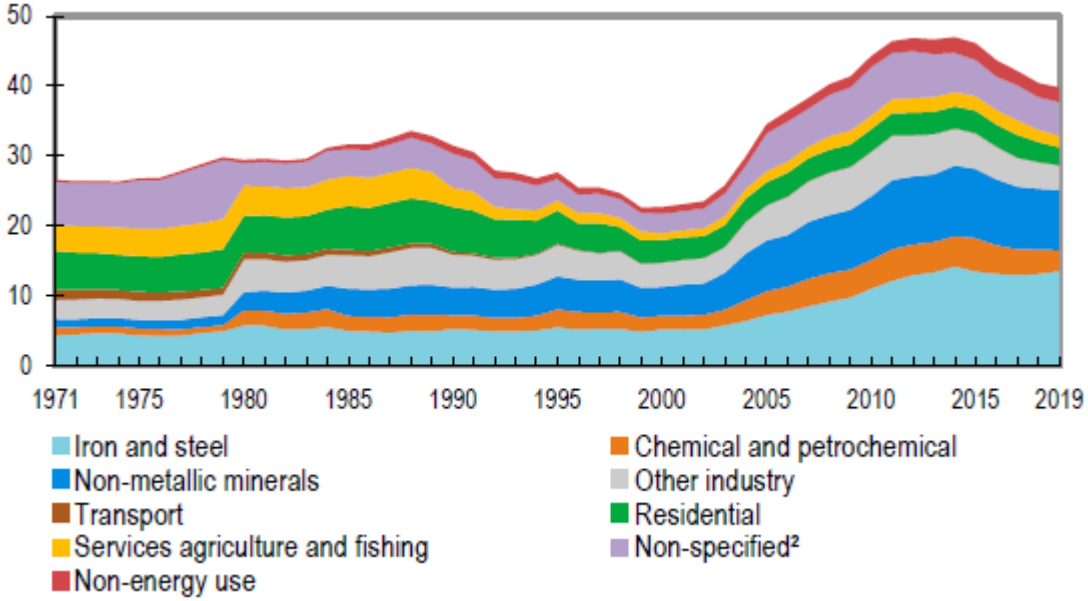
Source: IEA (2021)

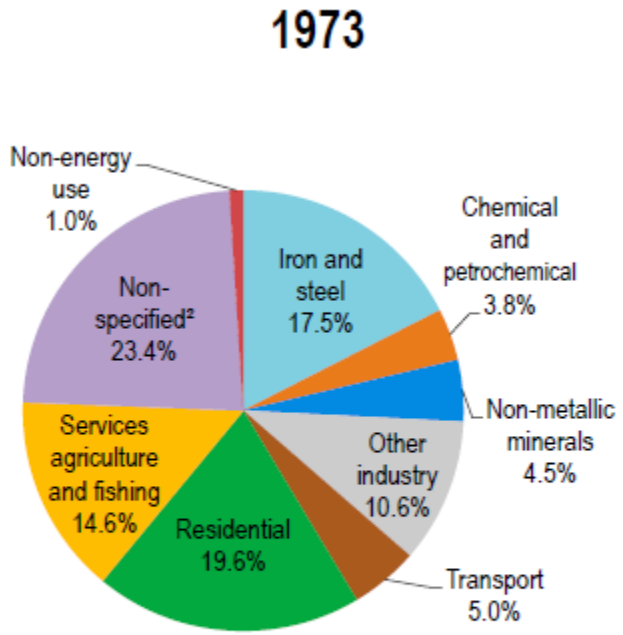
6 131 TWh

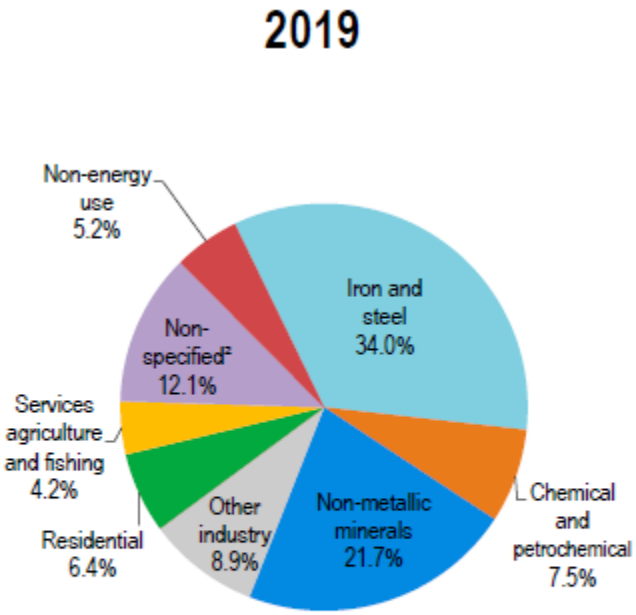
26 936 TWh

WORLD TOTAL COAL CONSUMPTION BY SECTOR

- ✓ Notice how between 1973 and 2019 coal consumption has increased by 50%, i.e. much less than gas and oil, the share of **non-energy uses** has more than quadrupled.







26 EJ

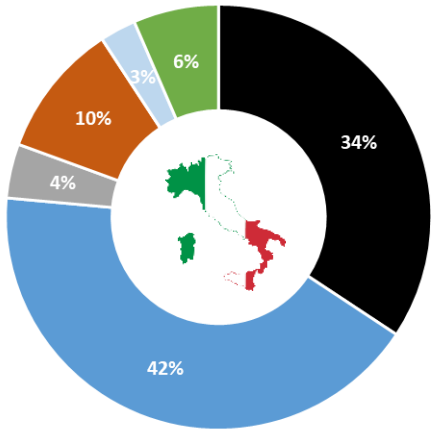
40 EJ

1. In these graphs, peat and oil shale are aggregated with coal.
2. Includes non-specified industry, transport and other.

Source: IEA (2021)

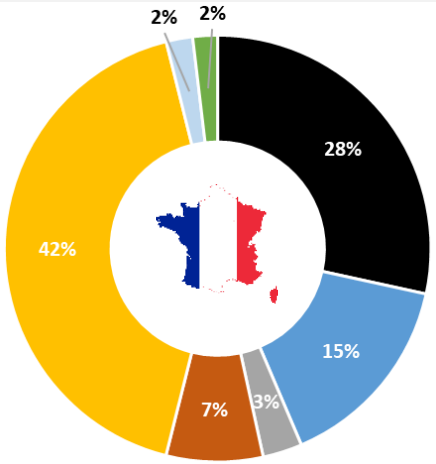
ITALY VS. FRANCE AND GERMANY

Italy Energy Mix



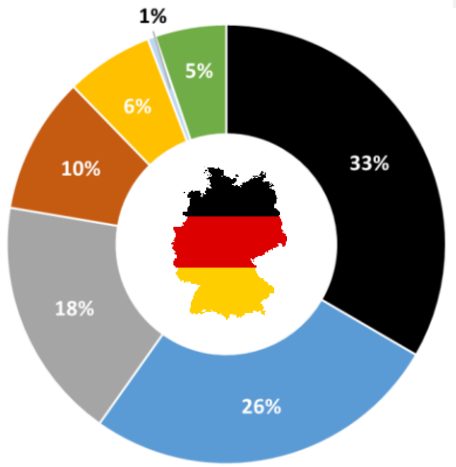
Electricity ≈ 21% of total final energy consumption

France Energy Mix



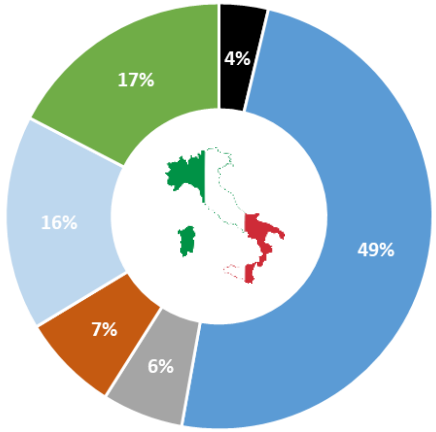
Electricity ≈ 25% of total final energy consumption

Germany Energy Mix

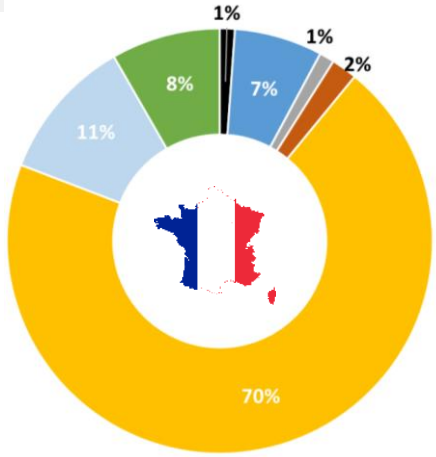


Electricity ≈ 20% of total final energy consumption

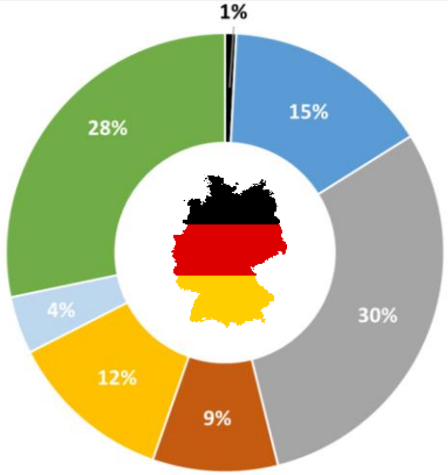
Italy Electricity Mix



France Electricity Mix



Germany Electricity Mix

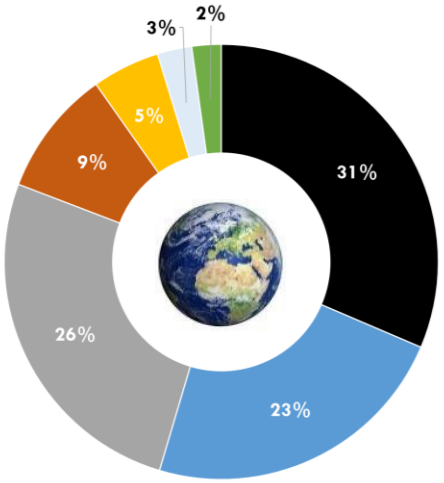


■ Oil ■ Gas ■ Coal ■ Bioenergy ■ Nuclear ■ Hydro ■ New Renewables

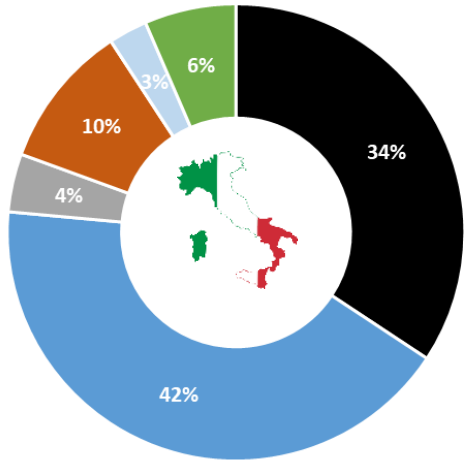
Source: International Energy Agency, 2020

ITALY VS. THE WORLD

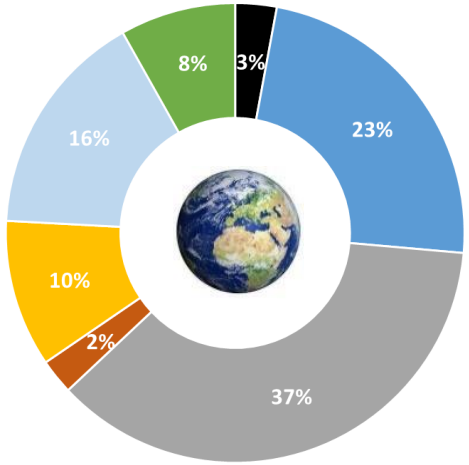
World Energy Mix



Italy Energy Mix



World Electricity Mix

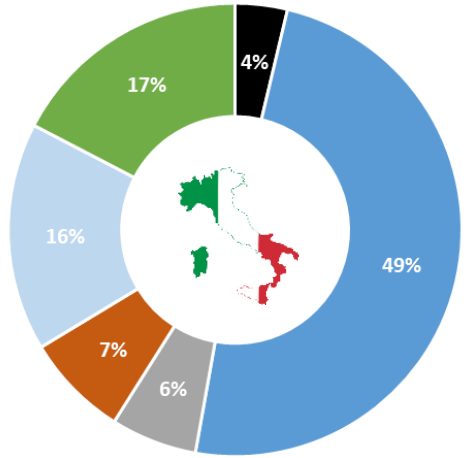


Electricity ≈ 19-20% of total final energy consumptions

- Oil
- Gas
- Coal
- Bioenergy
- Nuclear
- Hydro
- New Renewables

Source: International Energy Agency, 2020

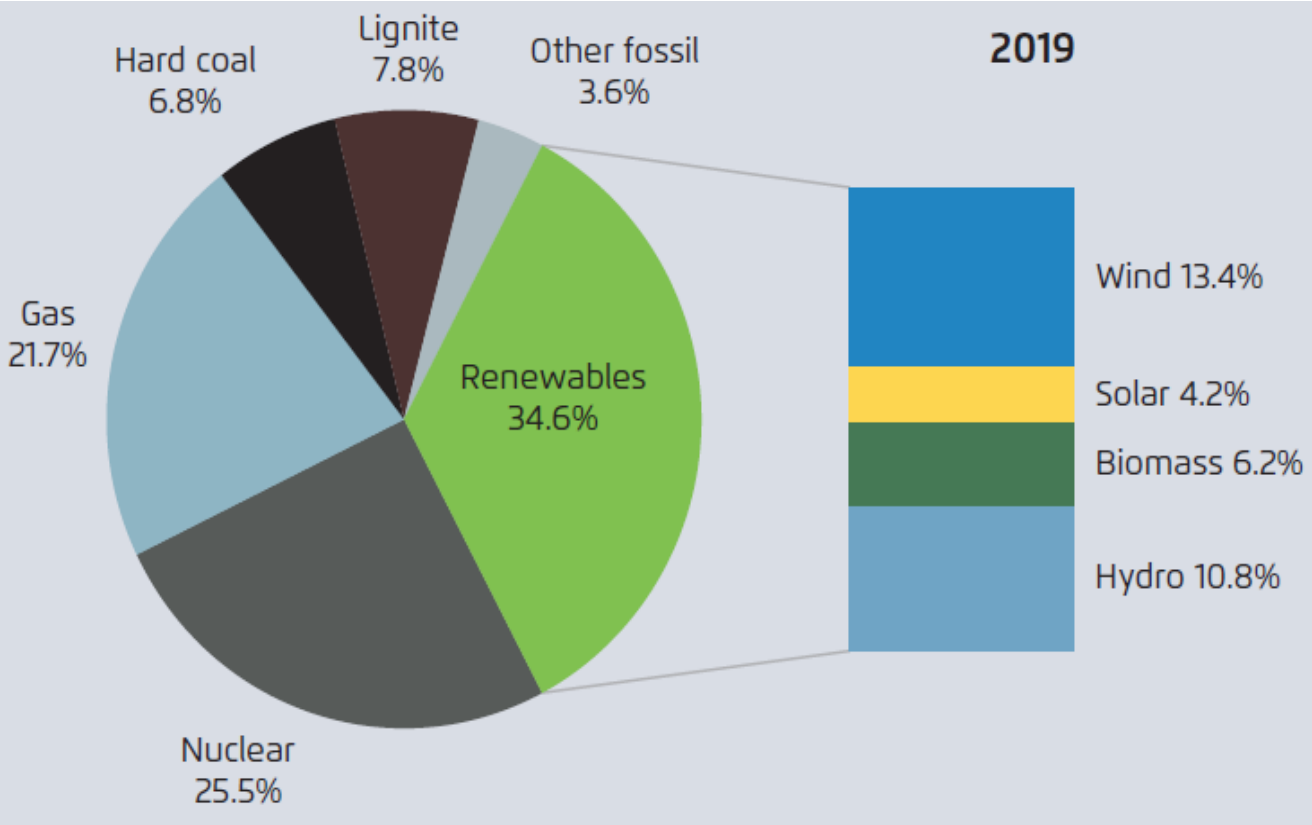
Italy Electricity Mix

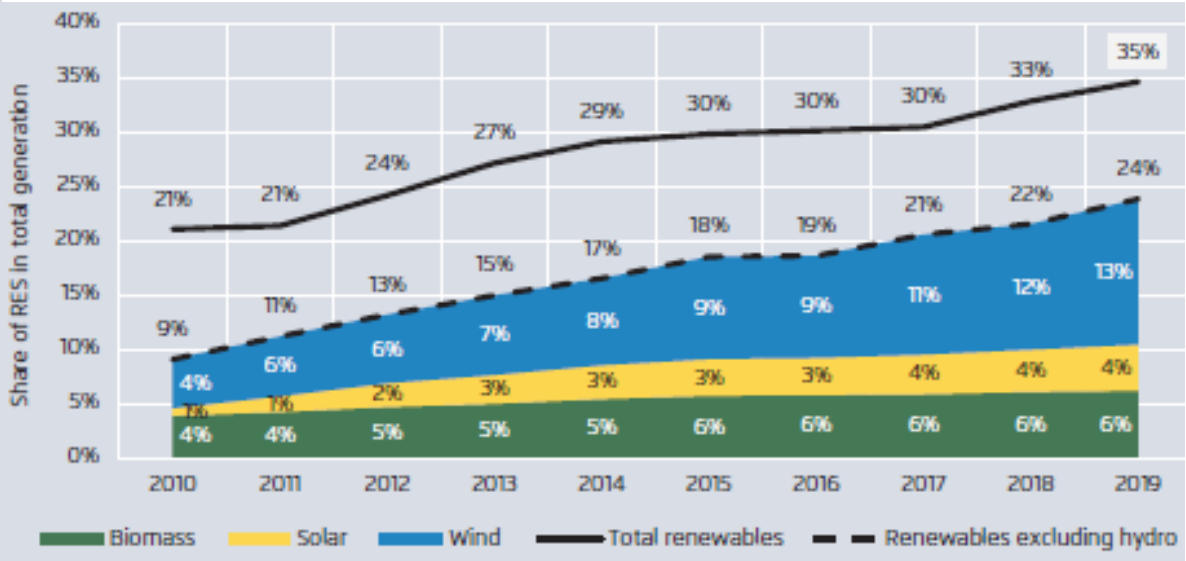


Electricity ≈ 21% of total final energy consumptions

TODAY'S ELECTRICITY MIX THE EU

- ✓ As a result of **EU policies and costs** coming down, in 2019, like in 2017-18, **renewables** represented Europe's dominant power source, with almost 35% of the power mix (38.2% in 2020). For the first time in 2019, wind and solar combined provided more electricity than coal generation, which collapsed by 24%.

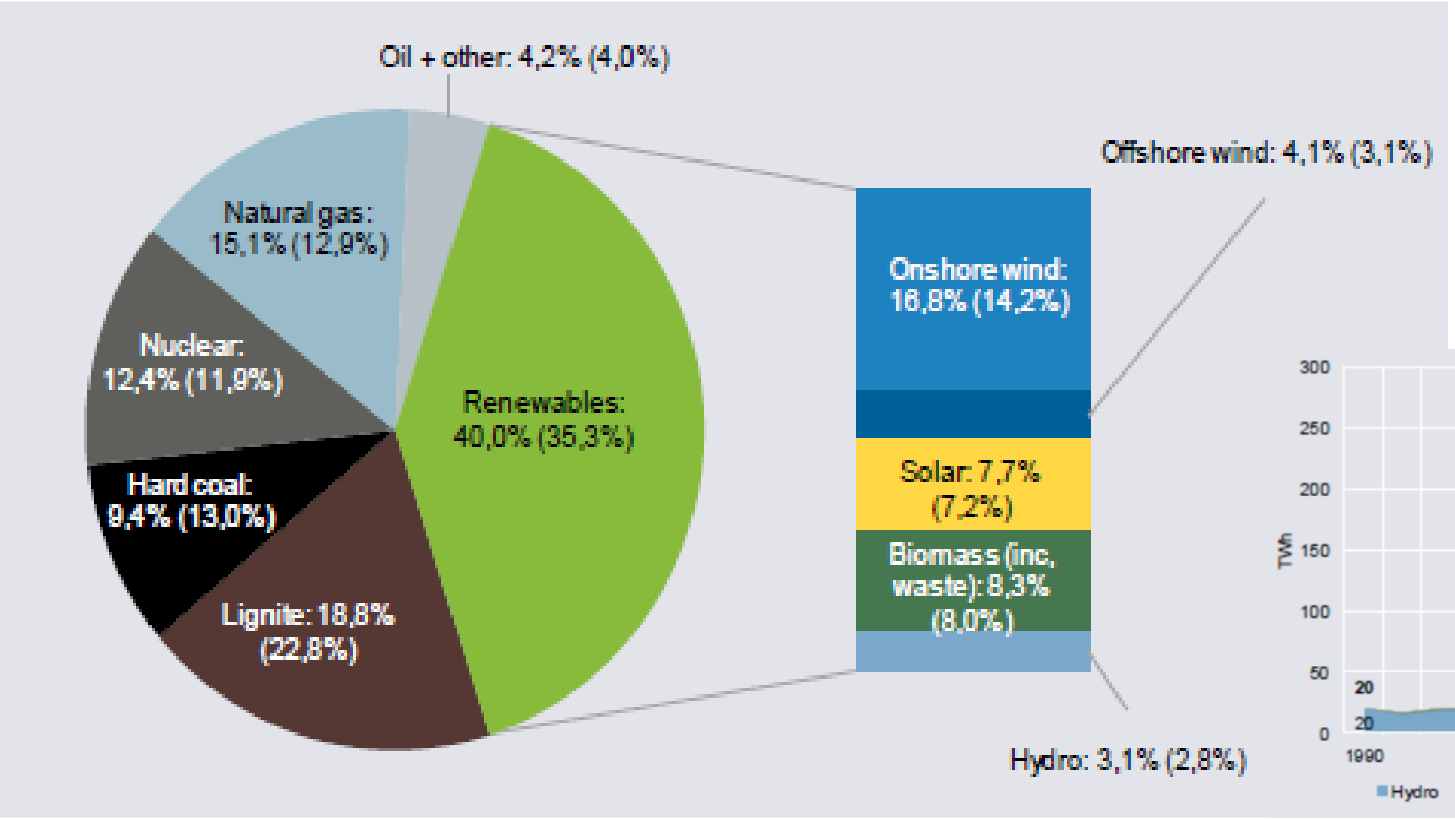


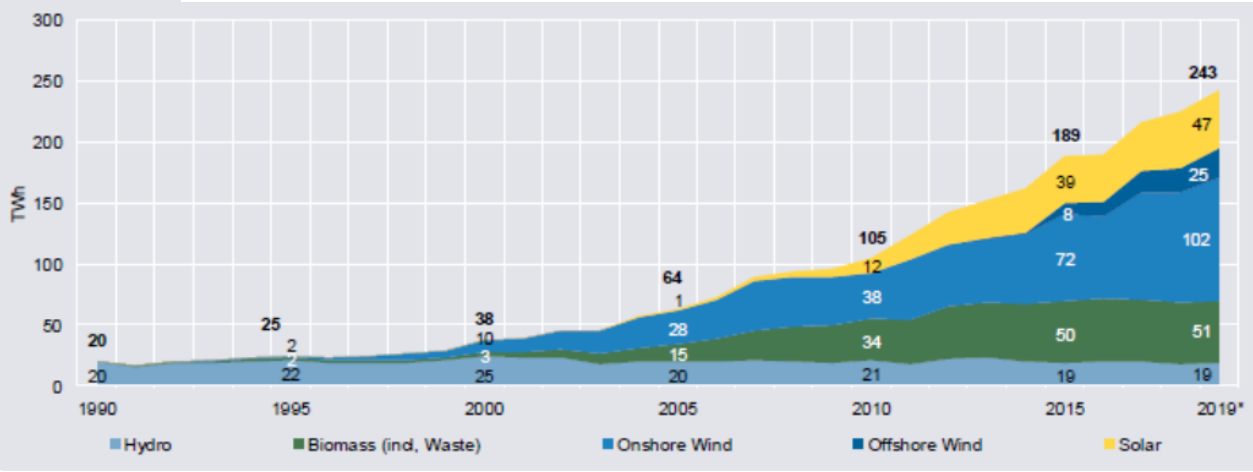


Source: Eurostat and Agora-Sandbag (2020)

TODAY'S ELECTRICITY MIX GERMANY

- ✓ In 2019 **renewables** provided as much electricity as coal and nuclear combined, each around 40% (46.2% in 2020!) of the total generation.





Source: Eurostat and Agora-Sandbag (2020)

FUTURE EMISSIONS SCENARIOS
CLIMATE ACTION PLANS

- ✓ In September 2021, UN Climate Change published a synthesis of climate action plans, i.e. the countries' Nationally Determined Contributions (NDCs).
- ✓ The NDC Synthesis report shows that while there is a clear trend that GHG emissions are being reduced over time, nations must urgently **redouble their climate efforts** if they are to prevent global temperature increases beyond the Paris Agreement's goal of well below 2C – ideally 1.5C – by the end of the century.
- ✓ The report includes information from all 191 Parties to the Paris Agreement based on their latest NDCs available in the interim NDC registry as at 30 July 2021.
- ✓ **The available NDCs of all 191 Parties taken together imply a sizable increase in global GHG emissions in 2030 compared to 2010, of about 16%. According to the latest IPCC findings, such an increase, unless actions are taken immediately, may lead to a temperature rise of about 2.7C by the end of the century**.

EUROPEAN CLIMATE POLICY
FIT FOR 55 – JULY 2021

- ✓ On 14th July 2021, the EC has unveiled its long anticipated Fit for 55 package, made of of more than a dozen policies to decarbonise the European economy and reduce average GHG at least 55% by 2030.

- ✓ The package introduces:
  - ✓ 40% renewable energy target by 2030;
  - ✓ A revamping of EU's emissions trading scheme (e.g. 61% reduction by 2030 wrt. 2005);
  - ✓ An ad-hoc carbon market for road transport and buildings;
  - ✓ A foreign levy on polluting imports, i.e. the carbon adjustment border tax (CABT), replacing free allocations to hard-to-abate industries.
  - ✓ Measures to phase out the internal combustion engine (e.g. fuel taxes and ban new petrol and diesel cars sales by 2035).
- ✓ The EU's decarbonization package, which involves mixing regulation with carbon taxes, will trigger years of complex negotiations over regulations and directives that will touch on **all parts of economic life**; the laws will need to be agreed and adopted by EU governments and the European parliament.