LA GEOLOGIA NEL MONDO DEL LAVORO
SEMINARI DI ORIENTAMENTO

Sostenibilità e transizione energetica:

il ruolo del geologo

14 aprile 2022

1. **Glossario**
    1.1 **La sostenibilità**
2. Le **geoscienze** in un mondo che cambia
    2.1 **Agenda 2030** e i 17 Sustainable Development Goals-SDGs
    2.2 **SDG7**: Energia
    2.3 **Statistiche** dell’energia: mondo, UE, Italia
    2.4 **Transizione energetica e geoscienze**: una opportunità da cogliere

Sustainability/ Sustainable *Sostenibilità/Sostenibile*

Oxford Learner's Dictionaries

Sustainability */səˌsteɪnəˈbɪləti/ /səˌsteɪnəˈbɪləti/ noun*

- the use of natural products and energy in a way that does not harm the environment
- the ability to continue or be continued for a long time

Sustainable /səˈsteɪnəbl/ /səˈsteɪnəbl/ *adjective*

- involving the use of natural products and energy in a way that does not harm the environment
- *a company well-known for its commitment to environmental sustainability*
- *an environmentally sustainable society*

TRECCANI

Sostenibilità */so·ste·ni·bi·li·tà/ sostantivo femminile*

- possibilità di essere mantenuto o protratto con sollecitudine e impegno o di esser difeso e convalidato con argomenti probanti e persuasivi.
- possibilità di essere sopportato, spec. dal punto di vista ecologico e sociale.

Sostenìbile */ so·ste·ni·bi·le / aggettivo*

- che si può sostenere: *una tesi difficilmente sostenibile*.
- che può essere affrontato: *una spesa s.*; *questa situazione non è più s*.
- compatibile con le esigenze di salvaguardia delle risorse ambientali: *energia s.*; *sviluppo s.*

What Sustainability is?

No universally agreed definition of sustainability: many different viewpoints on this concept and on how it can be achieved.

Sustainability = (**sustain + able) + ity**. To sustain = “to give support to”, “to hold up”, “to bear” or “to keep up”.

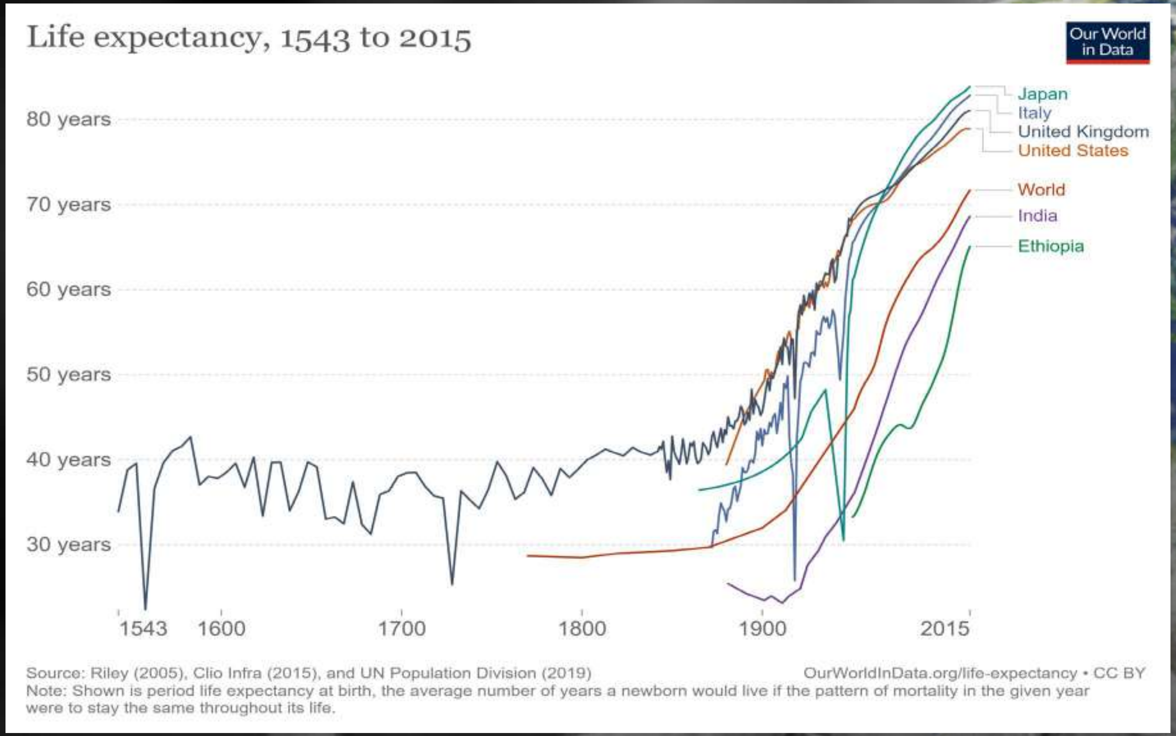
Sustainable = an adjective for something that is able to be sustained, i.e, something that is “bearable” and “capable of being continued at a certain level”.

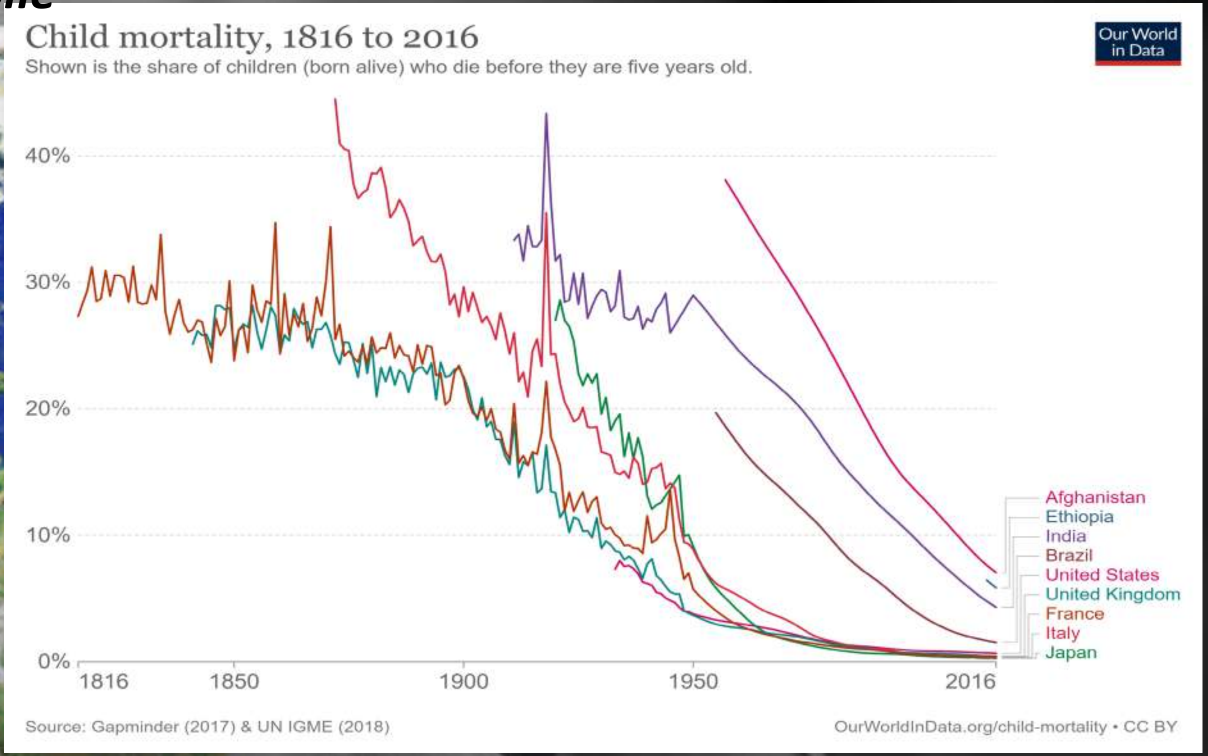
Sustainability can perhaps be seen as **the process(es) by which something is kept at a certain level**.

Nonetheless, nowadays, because of the environmental and social problems societies around the world are facing, sustainability has been increasingly used in a specific way.
Sustainability is usually defined as the **processes and actions through which humankind avoids the depletion of natural resources, in order to keep an ecological balance that doesn’t allow the quality of life of modern societies to decrease.**

Sustainability/ Sustainable *Sostenibilità/Sostenibile*

Sustainability/ Sustainable *Sostenibilità/Sostenibile*





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Agenda 2030 & the SDGs

- **1992, Earth Summit, Rio de Janeiro***:* >178 countries adopt **Agenda 21***,* a global action plan to build a global partnership for sustainable development, to improve human life and protect the environment.
- **2000: New York.** ***A****doption of the *Millennium Declaration* with 8 **Millennium Development Goals** (MDGs) developed to reduce extreme poverty by 2015.
- **2002: UN World Summit, Johannesburg***:* the **Declaration on Sustainable Development** reaffirms the commitment of the global community to eradicate poverty and protect the environment*.*
- **2012: United Nations Conference on Sustainable Development (Rio + 20):** adoption of the document "**The Future We Want**" with the establishment of the United Nations high-level political forum on sustainable development.
- **2013***:* the General Assembly establishes an open working group of 30 members to develop GDS proposal
- **2015**: the General Assembly (Paris) adopts the *2030* ***Agenda for sustainable development***, with *17 SDGs*.

"The **2030 Agenda for Sustainable Development** provides a shared model for peace and prosperity for people and the planet, now and in the future".

17 Sustainable Development Goals: an urgent **call to action** recognizing that *ending poverty* must go hand in hand with strategies that *improve health and education*, *reduce inequality* and *stimulate economic growth*, *tackling climate change* and *preserving oceans and forests*.

Agenda 2030: 17 Goals + 169 Targets + 242 Indicators

NO POVERTY: End poverty in all its forms

ZERO HUNGER: End hunger, achieve food security, improve nutrition and promote sustainable agriculture

GOOD HEALTH AND WELL-BEING. Ensure healthy lives and promote well-being for all at all ages

QUALITY EDUCATION. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

GENDER EQUALITY. Achieve gender equality and empower all women and girls

CLEAR WATER AND SANITATION. Ensure availability and sustainable management of water and sanitation for all

AFFORDABLE AND CLEAN ENERGY. Ensure access to affordable, reliable, sustainable and modern energy for all

DECENT WORK AND ECONOMIC GROWTH. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work conditions for all

Agenda 2030: 17 Goals + 169 Targets + 242 Indicators

INDUSTRY INNOVATION AND INFRASTRUCTURE. Build resilient infrastrucures, promote inclusive and sustainable industrialization and foster innovation

REDUCE INEQUALITIES. Reduce inequalities within and among countries

SUSTAINABLE CITIES AND COMMUNITIES. Make cities and human settlements inclusive, safe, resilient and sustainable

RESPONSIBLE CONSUMPTION AND PRODUCTION. Ensure sustainable consumption and production patterns

CLIMATE ACTION. Take urgent action to combat climate change and its impacts

LIFE BELOW WATER. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

LIFE ON LAND. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and biodiversity loss

PEACE, JUSTICE AND STRONG INSTITUTIONS. Promote peaceful and inclusive societies, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

PARTNERSHIP FOR THE GOAL. Strenghten the means of implementation and revitalize the Global Partnership for Sustainable Development

Goals – Targets - Indicators

7 AFFORDABLE AND CLEAN ENERGY

Ensure universal access to affordable, reliable and modern energy services

targets | indicators

Goals and targets (from the 2030 Agenda for Sustainable Development)	*Indicators*
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all	
7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	7.1.1 Proportion of population with access to electricity 7.1.2 Proportion of population with primary reliance on clean fuels and technology
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption
7.3 By 2030, double the global rate of improvement in energy efficiency	7.3.1 Energy intensity measured in terms of primary energy and GDP
7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology	7.a.1 International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems
7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programmes of support	7.b.1 Investments in energy efficiency as a proportion of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services

1. **Access to electricity**
2. **Access to clean cooking**
3. **Growth of renewables in the energy mix**
4. **Improving of energy intensity**

stainabledevelopment.un.org/topics/sustainabledevelopmentgoals

https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202019%20refinement_Eng.pdf

Goals – Targets - Indicators

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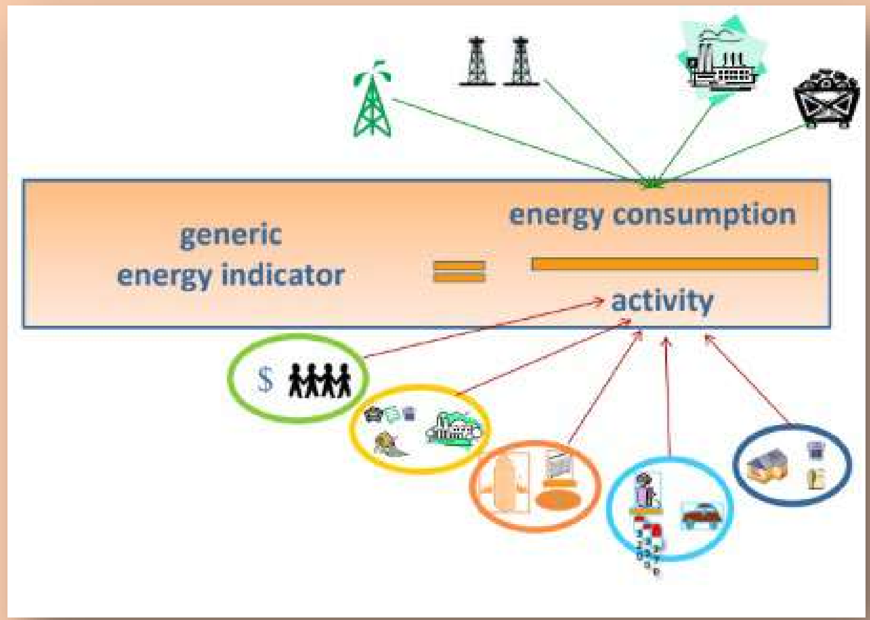
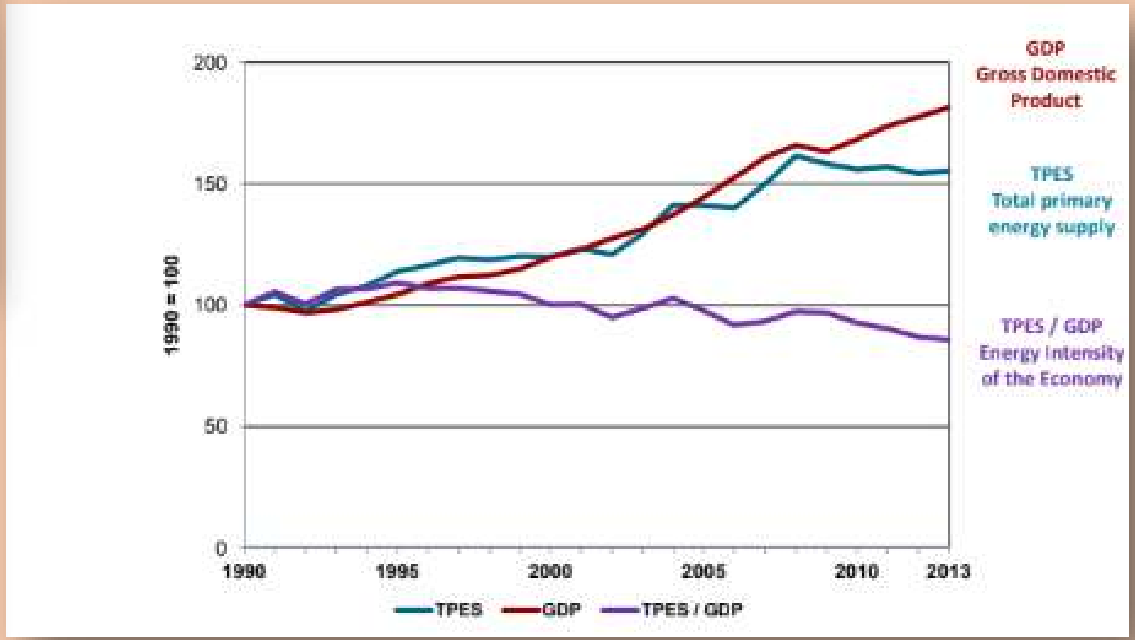
Goals – Targets - Indicators

1. **Access to electricity**



Energy Intensity: energy (TPES) per unit activity (GDP).

Variable due to several reasons: e.g. changes in economic structure, climate, ...



ensity

developmentgoals

https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%202019%20refinement_Eng.pdf

What other goals/targets may be involved in Goal7?

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SDG & En

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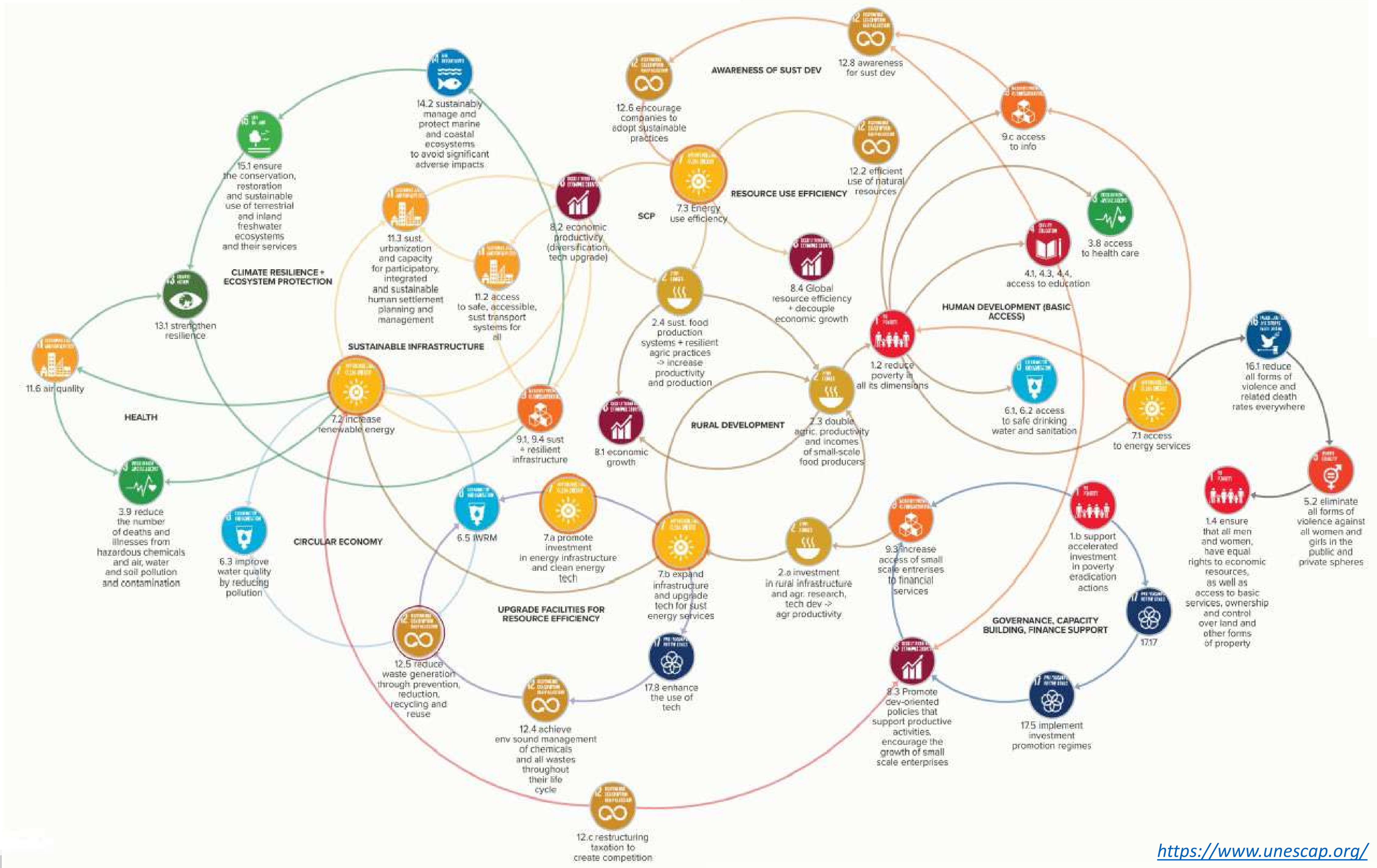


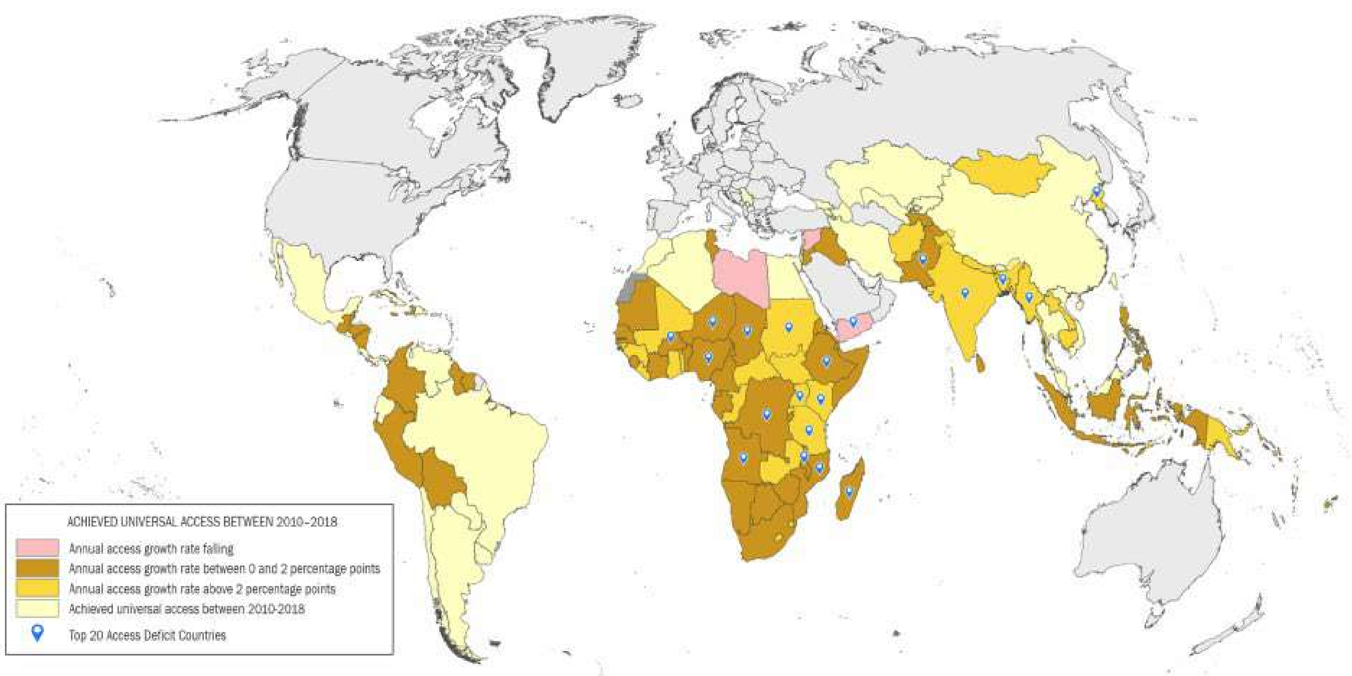
https://www.unescap.org/

Access to electricity-1

860 million people without access

In 2018, the number of people without electricity access dropped to 860 million, a record in recent years.

FIGURE 1.2 • Annual increase in access to electricity rate in access-deficit countries, 2010-18 (percentage points)



Source: World Bank.

Source: IEA, *World Energy Outlook -2019*

Electricity Access, Summary by Region

	Proportion of the population with access to electricity						
	National					Urban	Rural
	2000	2005	2010	2015	2018	2018	2018
WORLD	**73%**	**77%**	**80%**	**85%**	**89%**	**96%**	**79%**
Developing Countries	**64%**	**69%**	**74%**	**80%**	**86%**	**95%**	**77%**
Africa	**36%**	**39%**	**43%**	**49%**	**54%**	**79%**	**35%**
North Africa	91%	96%	>99%	>99%	>99%	>99%	>99%
Sub-Saharan Africa	24%	28%	33%	40%	45%	74%	26%
Developing Asia	**67%**	**74%**	**79%**	**87%**	**94%**	**98%**	**91%**
China	99%	>99%	>99%	>99%	>99%	>99%	>99%
India	43%	58%	68%	79%	95%	>99%	92%
Indonesia	53%	56%	67%	88%	98%	>99%	96%
Other Southeast Asia	65%	76%	79%	85%	90%	97%	83%
Other Developing Asia	38%	46%	57%	74%	79%	89%	73%
Central and South Ameri	**88%**	**91%**	**94%**	**96%**	**97%**	**99%**	**88%**
Middle East	**91%**	**90%**	**91%**	**92%**	**93%**	**98%**	**78%**

Progress is irregular, with 80% of the 800 million people who gained access since 2010 concentrated in Asia.

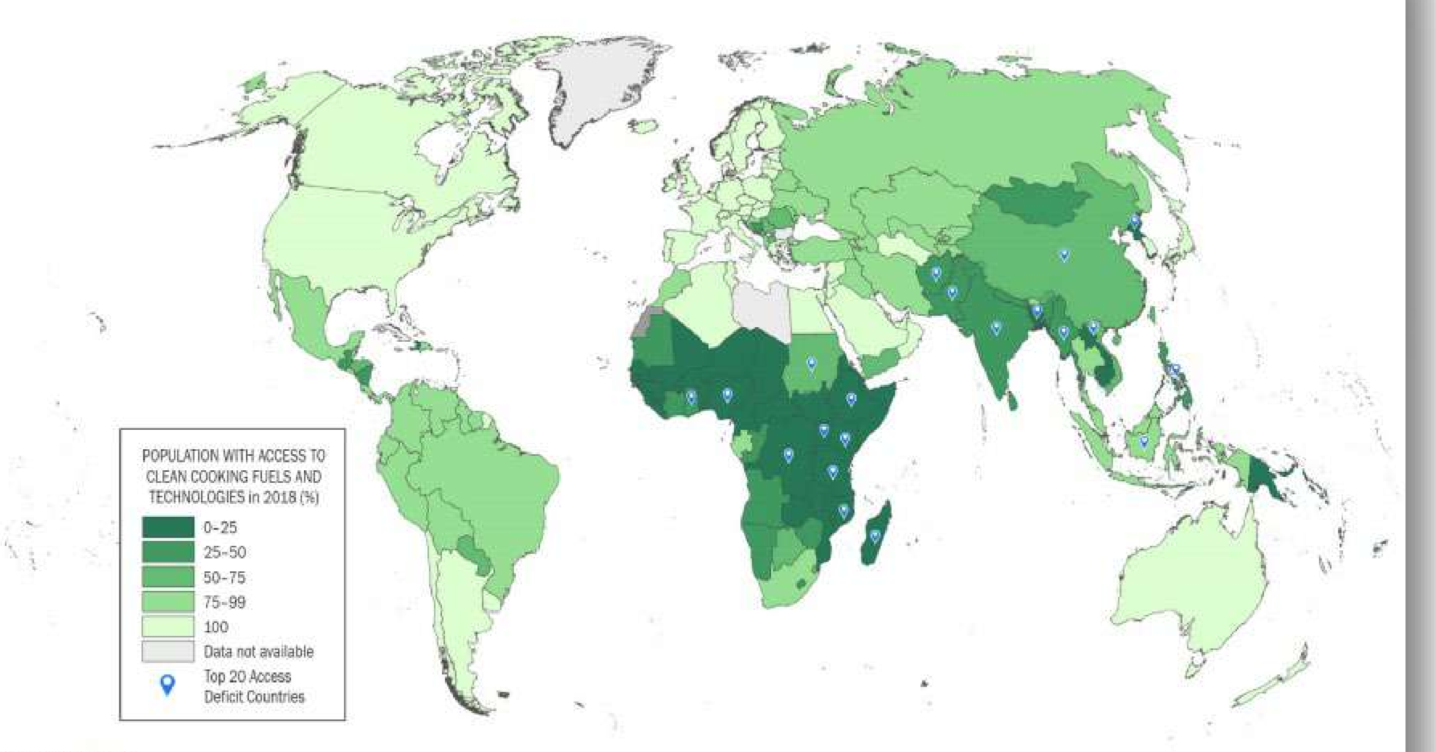
Efforts should step up in Africa if we are to reach universal access to electricity by 2030.

Access to clean cooking-1

2.6 billion people without access

Over **2.6 billion people in 2018** do not have access to clean cooking facilities, relying instead on solid biomass, kerosene or coal as their primary cooking fuel.
This figure has been gradually decreasing from **2.9 billion in 2010**, but efforts need to dramatically accelerate to put the world on track for universal access by 2030.

FIGURE 2.2 • Regional populations, by rate of access to clean cooking fuels and technologies, 2018



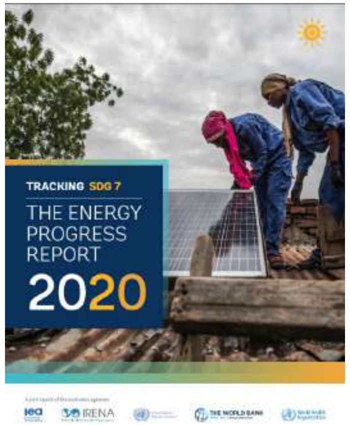
Source: WHO.

Access to Clean Cooking, Summary by Region

	Proportion of the population with access to clean cooking					Populatio n without access (million)	Populati n relying on
	2000	2005	2010	2015	2018	2018	2018
WORLD	**52%**	**55%**	**58%**	**63%**	**65%**	**2651**	**2374**
Developing Countries	**37%**	**41%**	**45%**	**53%**	**56%**	**2651**	**2374**
Africa	**23%**	**25%**	**26%**	**28%**	**29%**	**910**	**853**
North Africa	87%	93%	96%	98%	98%	4	4
Sub-Saharan Africa	10%	11%	13%	15%	17%	905	848
Developing Asia	**33%**	**37%**	**43%**	**53%**	**57%**	**1674**	**1460**
China	47%	51%	55%	67%	72%	399	242
India	22%	28%	34%	44%	49%	688	681
Indonesia	12%	18%	40%	68%	68%	85	55
Other Southeast Asia	36%	42%	48%	54%	58%	164	163
Other Developing Asia	22%	26%	27%	33%	35%	337	318
Central and South Americ	**78%**	**82%**	**85%**	**88%**	**89%**	**57**	**53**
Middle East	**84%**	**91%**	**95%**	**96%**	**96%**	**10**	**9**

Renewables-1

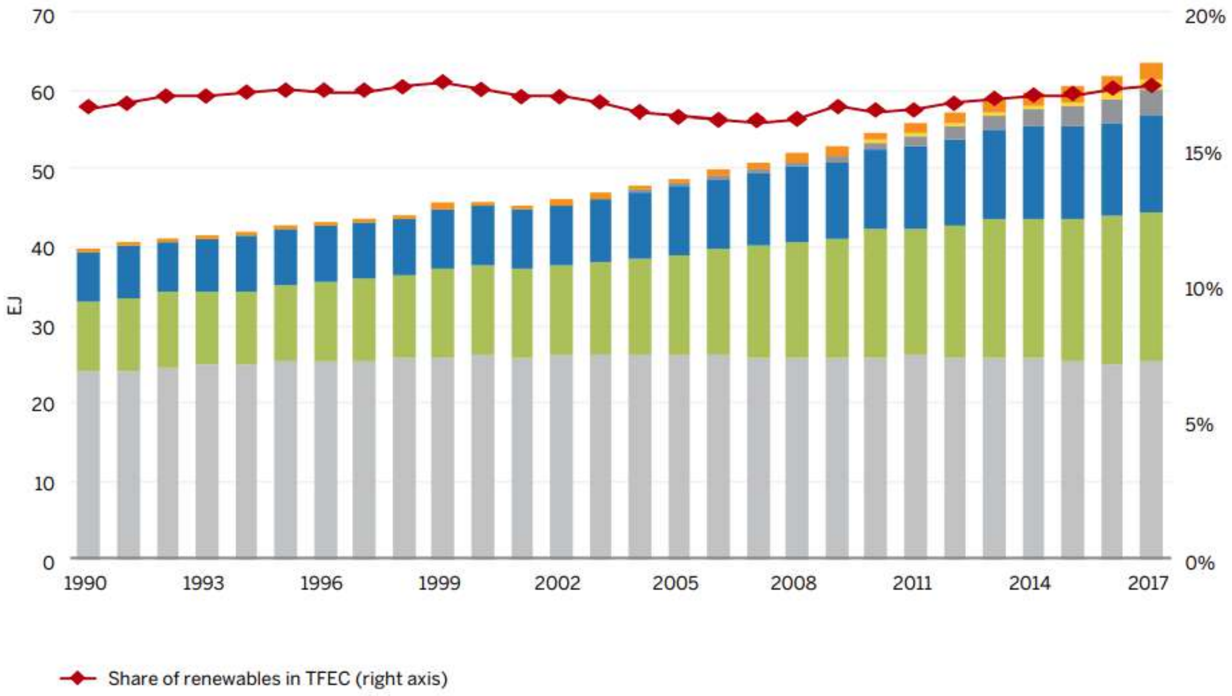
"Modern" renewables are @ 10.6% of total final energy consumption



After **2007**, the share of renewable energy slowly increased after a period of modest decline, due to strong growth in coal consumption in China. In 2016 it recovered to the same level as in 2000.
Overall, bioenergy accounts for 70% of global renewable energy consumption, followed by hydropower.

2018: renewable energy's share of total final energy consumption increased at a faster rate at 17.3%: rapid growth of hydropower and wind and solar.

FIGURE 3.1 • Renewable energy consumption by technology, and share in total energy consumption, 1990–2017



Source: IEA and UNSD.

2018: 17.3%
2017: 17.5%

__Bioenergy__ is renewable energy made available from materials derived __from biological sources__. Biomass is any organic material which has stored sunlight in the form of chemical energy. As a fuel it may include wood, wood waste, straw, and other crop residues, manure, sugarcane, and many other by-products from a variety of agricultural processes.

Renewables-1

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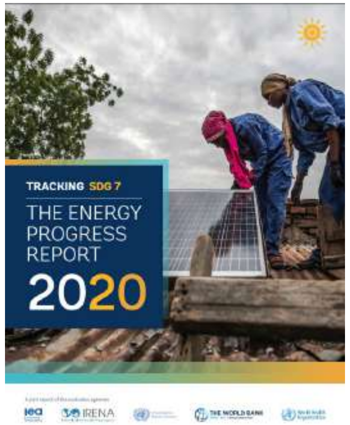

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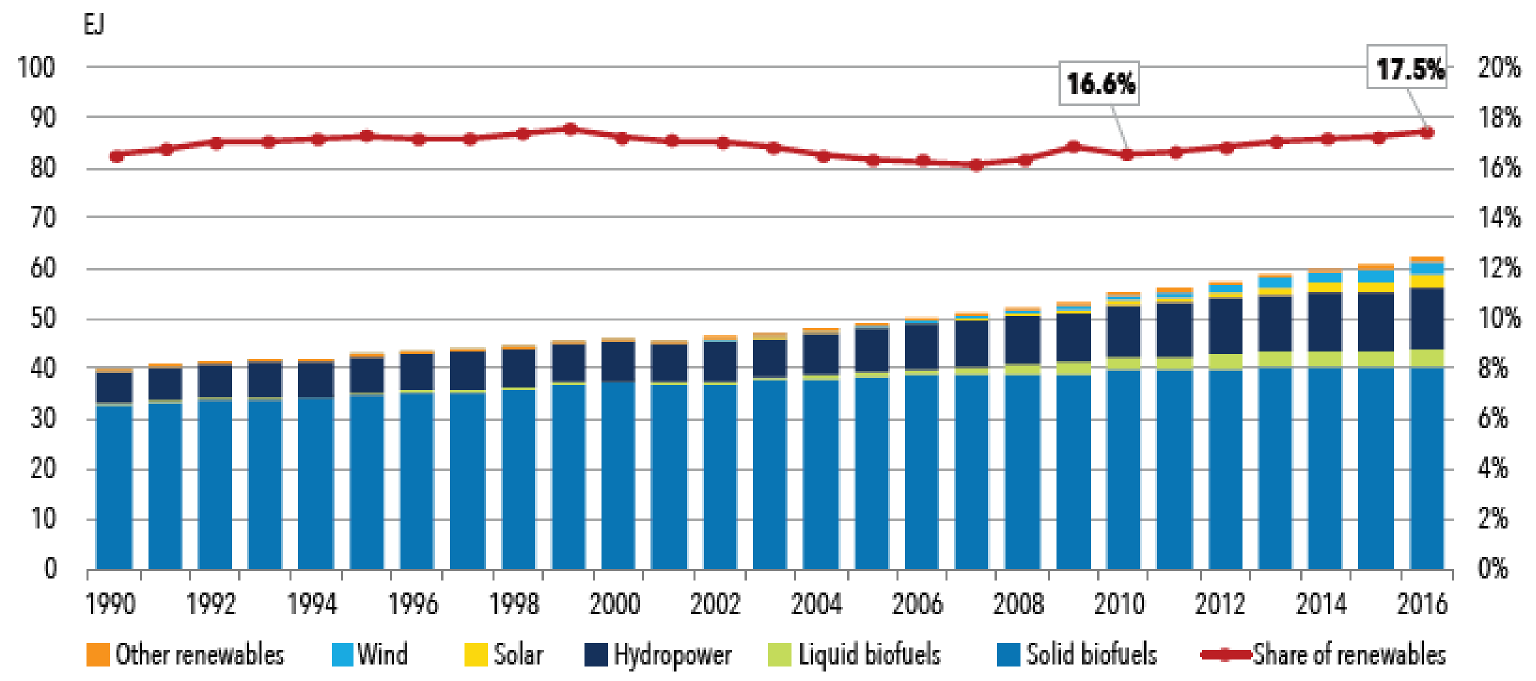
Overall, bioenergy accounts for 70% of global renewable energy consumption, followed by hydropower.

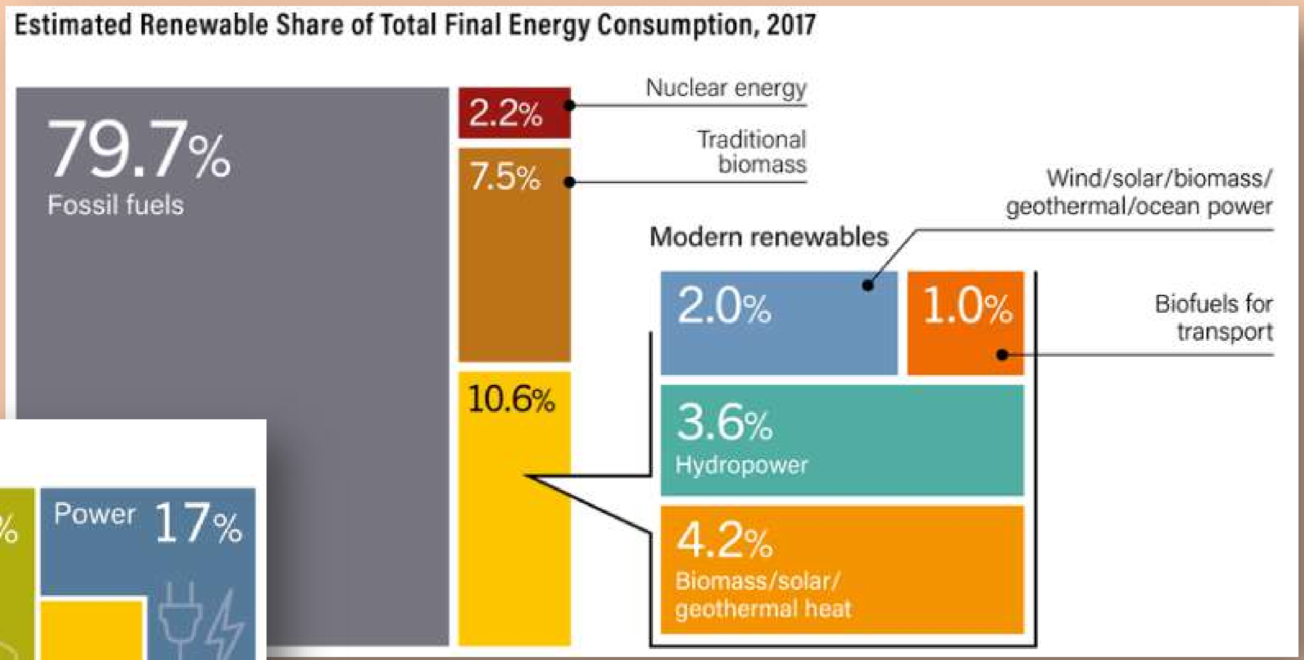
2016: renewable energy’s share of total final energy consumption increased at a faster rate at 17.5%: rapid growth of hydropower and wind and solar.

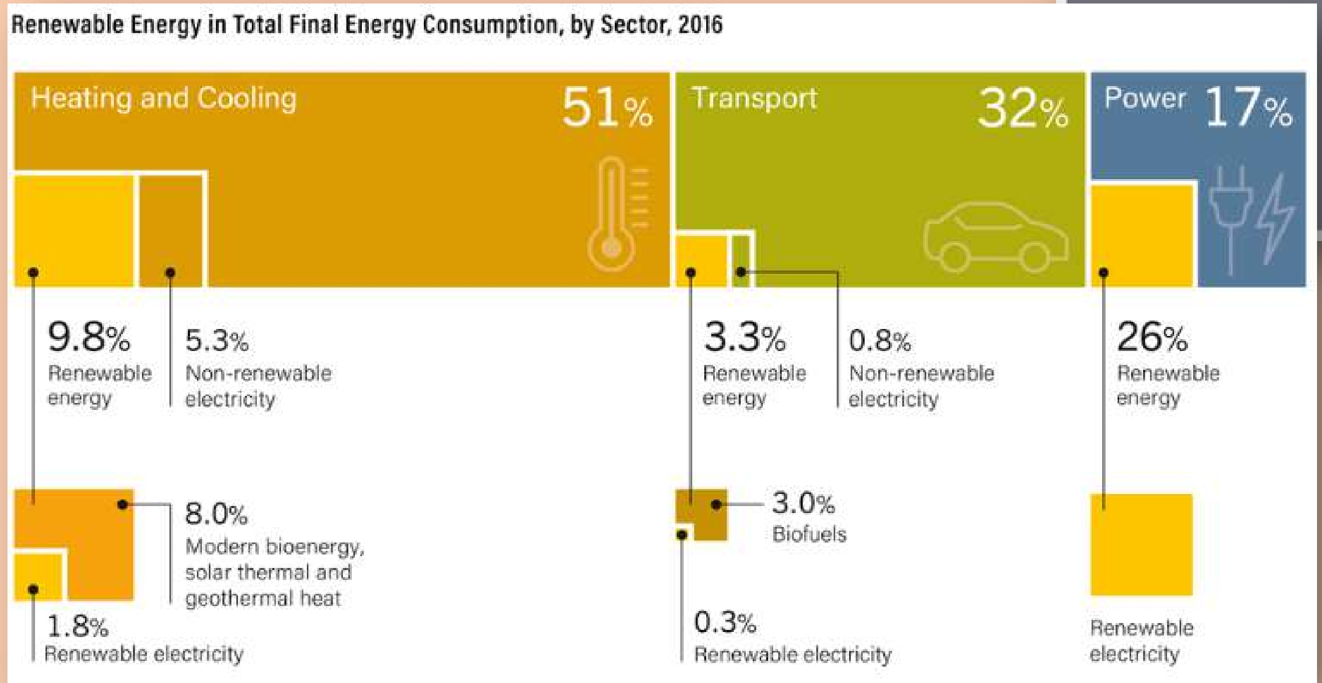
FIGURE 3.1 • RENEWABLE ENERGY CONSUMPTION BY TECHNOLOGY AND SHARE OF TOTAL ENERGY CONSUMPTION, 1990-2016



***Bioenergy** is renewable energy made available from materials derived **from biological sources**. Biomass is any organic material which has stored sunlight in the form of chemical energy. As a fuel it may include wood, wood waste, straw, and other crop residues, manure, sugarcane, and many other by-products from agricultural processes.*

Modern renewables: renewable technologies with exception to traditional biomass. These include **hydropower**, **solar**, **wind**, **geothermal** and **modern biofuel** production (including modern forms of waste-to-biomass conversion).

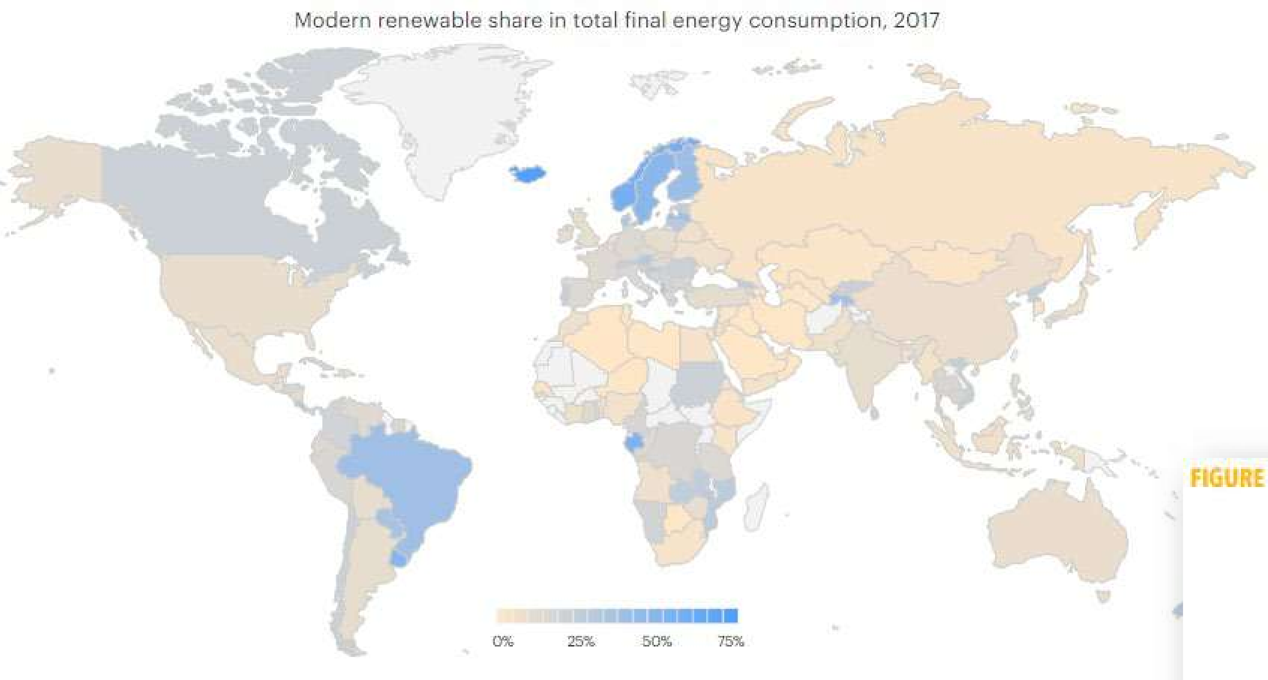




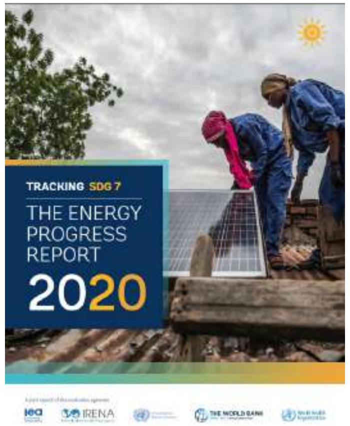
www.ren21.net/gsr-2019/chapters/chapter_01/chapter_01/#target_i_01

products from agricultural processes.

Renewables-2

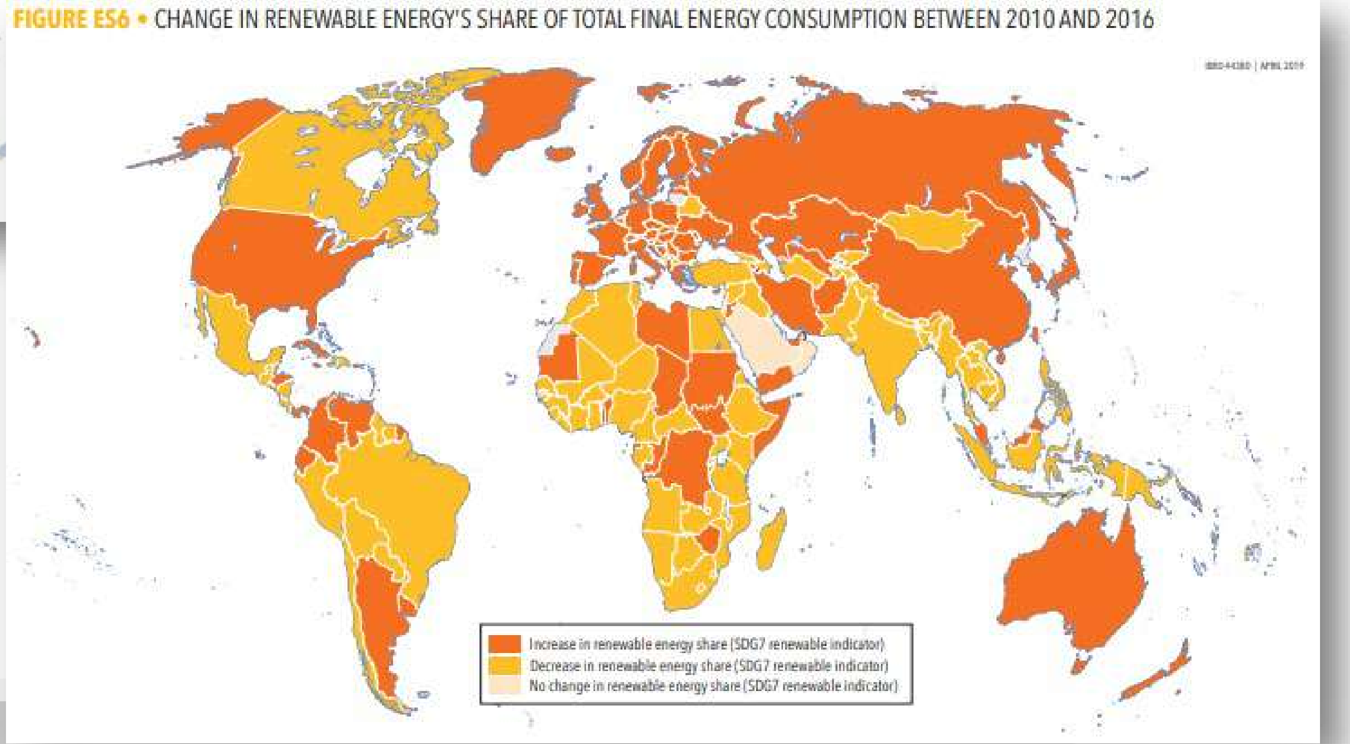


"Modern" renewables are @ 10.6% of total final energy consumption



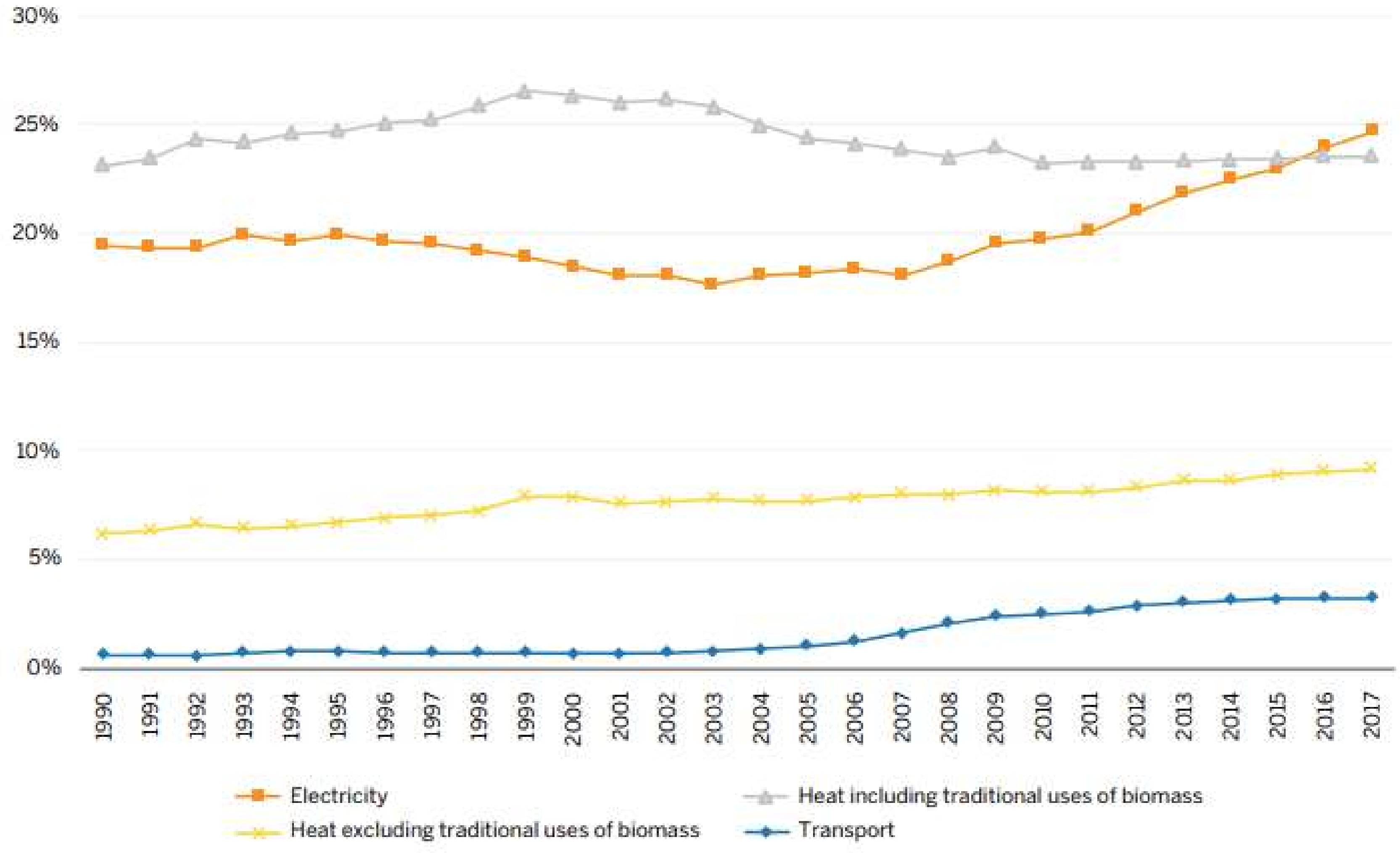
In **2018**, the share of modern renewables rose to almost 11% of total final energy consumption, having steadily increased since the 2000s.

Nonetheless, an acceleration is needed to realise a substantial increase, as set out in SDG target 7.2.

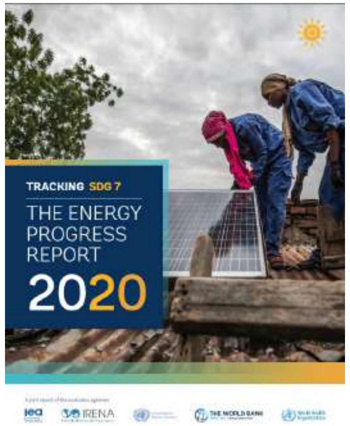


Renewables-2

FIGURE 3.3 • Renewable energy share by end use, 1990–2017



Source: IEA and UNSD.

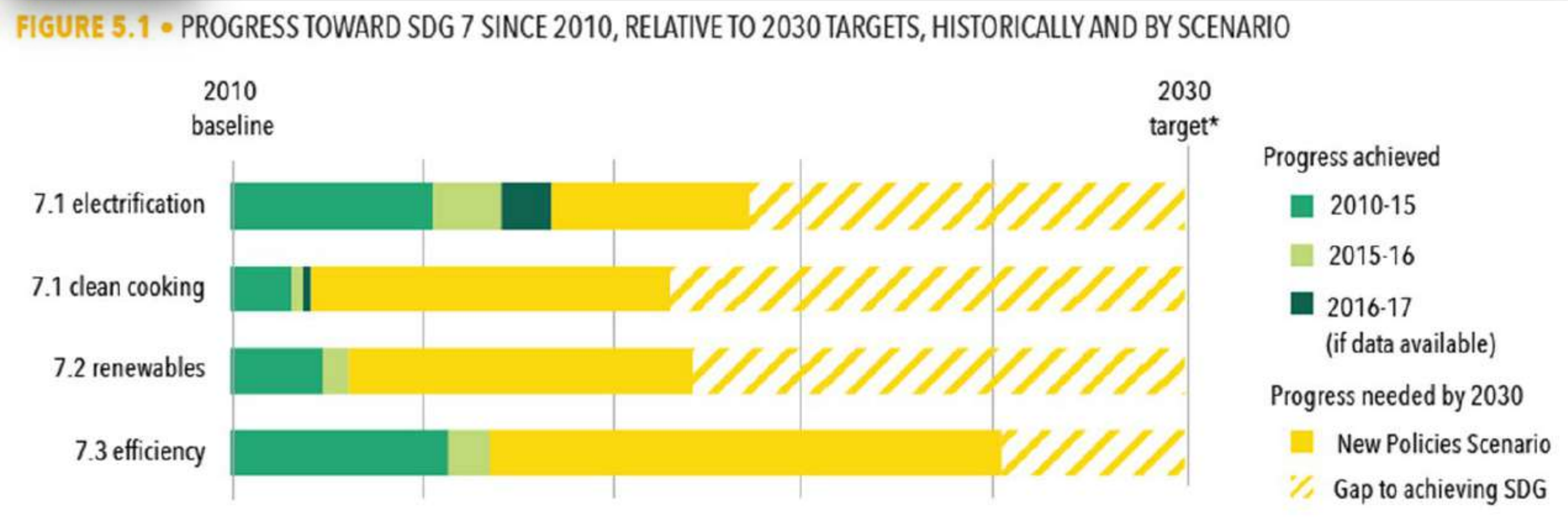


7 AFFORDABLE AND CLEAN ENERGY

Ensure universal access to affordable, reliable and modern energy services

Main messages, outlook for overall progress by 2030

FIGURE 5.1 • PROGRESS TOWARD SDG 7 SINCE 2010, RELATIVE TO 2030 TARGETS, HISTORICALLY AND BY SCENARIO



Two scenarios developed by IEA as benchmarks:

- ✓ The **New Policies Scenario**, which accounts for current and planned policies, shows that none of the SDG 7 targets will be achieved by 2030.
- ✓ The **Sustainable Development Scenario** indicates a possible pathway by which the world's energy system could be on track to achieve the SDG targets most closely related to energy.

The world is not on track to achieve Sustainable Development Goal (SDG) 7 at the current rate of progress

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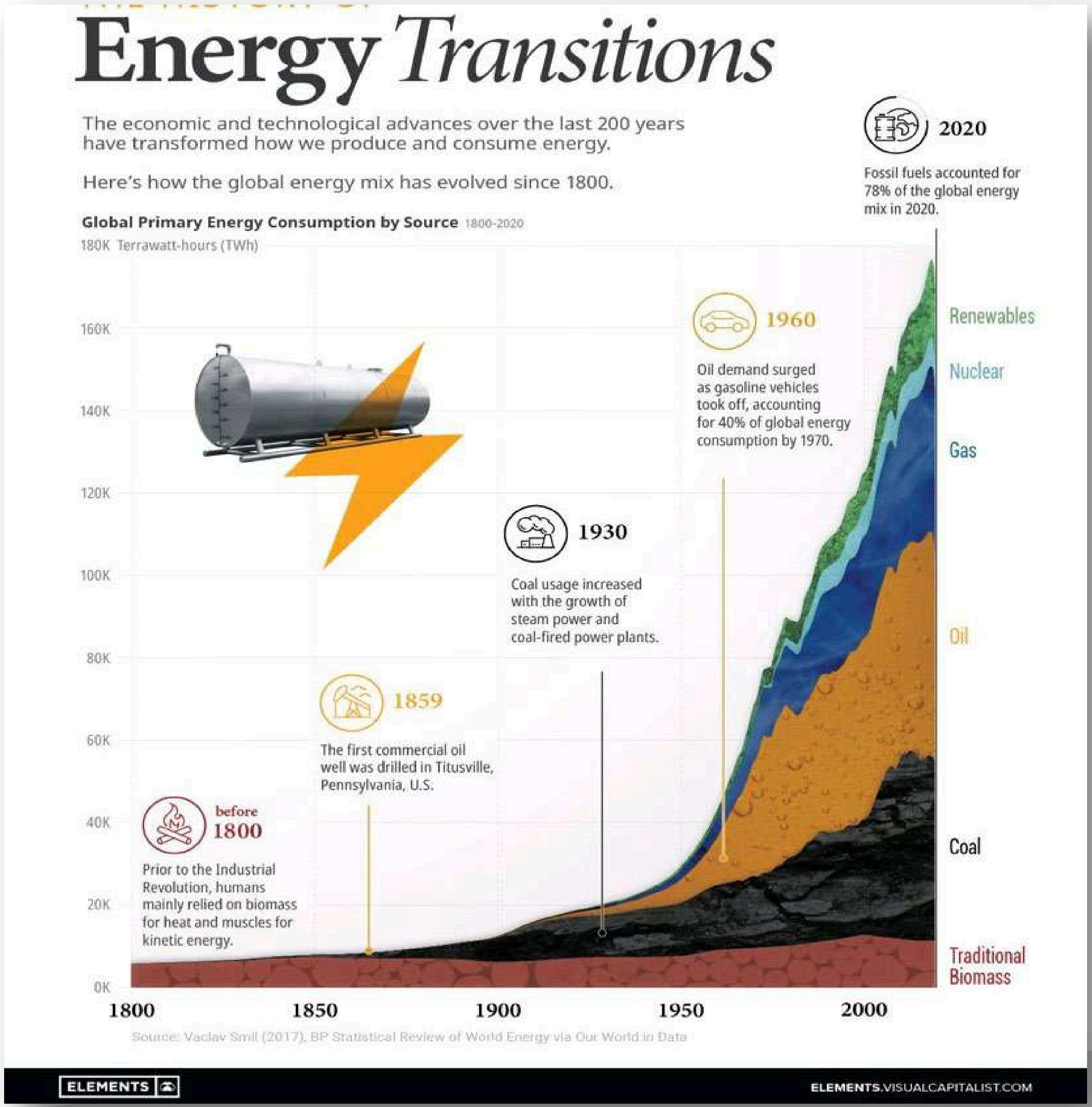
Energy statistics - mondo



Year	Coal % of Energy Mix	Oil % of Energy Mix	Natural Gas % of Energy Mix
1950	44.2%	19.1%	7.3%
1960	37.0%	26.6%	10.7%
1970	25.7%	40.2%	14.5%
1980	23.8%	40.6%	16.3%
1990	24.4%	35.5%	18.4%
2000	22.5%	35.1%	19.7%

Year	Traditional Biomass	Renewables	Fossil Fuels	Nuclear Power
2000	10.2%	6.6%	77.3%	5.9%
2005	8.7%	6.5%	79.4%	5.4%
2010	7.7%	7.7%	79.9%	4.7%
2015	6.9%	9.2%	79.9%	4.0%
2020	6.7%	11.2%	78.0%	4.0%

Energy statistics – World outlook - IPPC

Table 2.6 | Global primary energy supply of 1.5°C pathways from the scenario database (Supplementary Material 2.SM.1.3). Values given for the median (maximum, minimum) across the full range of 85 available 1.5°C pathways. Growth Factor = [(primary energy supply in 2050)/(primary energy supply in 2020) – 1]

	Median (max, min)	Count	Primary Energy Supply (EJ)			Share in Primary Energy (%)			Growth (factor) 2020-2050
			2020	2030	2050	2020	2030	2050	
Below-1.5°C and 1.5°C-low-OS pathways	total primary	50	565.33 (619.70, 483.22)	464.50 (619.87, 237.37)	553.23 (725.40, 289.02)	NA	NA	NA	–0.05 (0.48, –0.51)
	renewables	50	87.14 (101.60, 60.16)	146.96 (203.90, 87.75)	291.33 (584.78, 176.77)	14.90 (20.39, 10.60)	29.08 (62.15, 18.24)	60.24 (87.89, 38.03)	2.37 (6.71, 0.91)
	biomass	50	60.41 (70.03, 40.54)	77.07 (113.02, 44.42)	152.30 (311.72, 40.36)	10.17 (13.66, 7.14)	17.22 (35.61, 9.08)	27.29 (54.10, 10.29)	1.71 (5.56, –0.42)
	non-biomass	50	26.35 (36.57, 17.78)	62.58 (114.41, 25.79)	146.23 (409.94, 53.79)	4.37 (7.19, 3.01)	13.67 (26.54, 5.78)	27.98 (61.61, 12.04)	4.28 (13.46, 1.45)
	wind & solar	44	10.93 (20.16, 2.61)	40.14 (82.66, 7.05)	121.82 (342.77, 27.95)	1.81 (3.66, 0.45)	9.73 (19.56, 1.54)	21.13 (51.52, 4.48)	10.00 (53.70, 3.71)
	nuclear	50	10.91 (18.55, 8.52)	16.26 (36.80, 6.80)	24.51 (66.30, 3.09)	2.10 (3.37, 1.45)	3.52 (9.61, 1.32)	4.49 (12.84, 0.44)	1.24 (5.01, –0.64)
	fossil	50	462.95 (520.41, 376.30)	310.36 (479.13, 70.14)	183.79 (394.71, 54.86)	82.53 (86.65, 77.73)	66.58 (77.30, 29.55)	32.79 60.84, 8.58)	–0.59 (–0.21, –0.89)
	coal	50	136.89 (191.02, 83.23)	44.03 (127.98, 5.97)	24.15 (71.12, 0.92)	25.63 (30.82, 17.19)	9.62 (20.65, 1.31)	5.08 (11.43, 0.15)	–0.83 (–0.57, –0.99)
	gas	50	132.95 (152.80, 105.01)	112.51 (173.56, 17.30)	76.03 (199.18, 14.92)	23.10 (28.39, 18.09)	22.52 (35.05, 7.08)	13.23 (34.83, 3.68)	–0.40 (0.85, –0.88)
	oil	50	197.26 (245.15, 151.02)	156.16 (202.57, 38.94)	69.94 (167.52, 15.07)	34.81 (42.24, 29.00)	31.24 (39.84, 16.41)	12.89 (27.04, 2.89)	–0.66 (–0.09, –0.93)

Issued October 2019

2.4.2 Energy Supply

Several energy supply characteristics are evident in 1.5°C pathways assessed in this section:

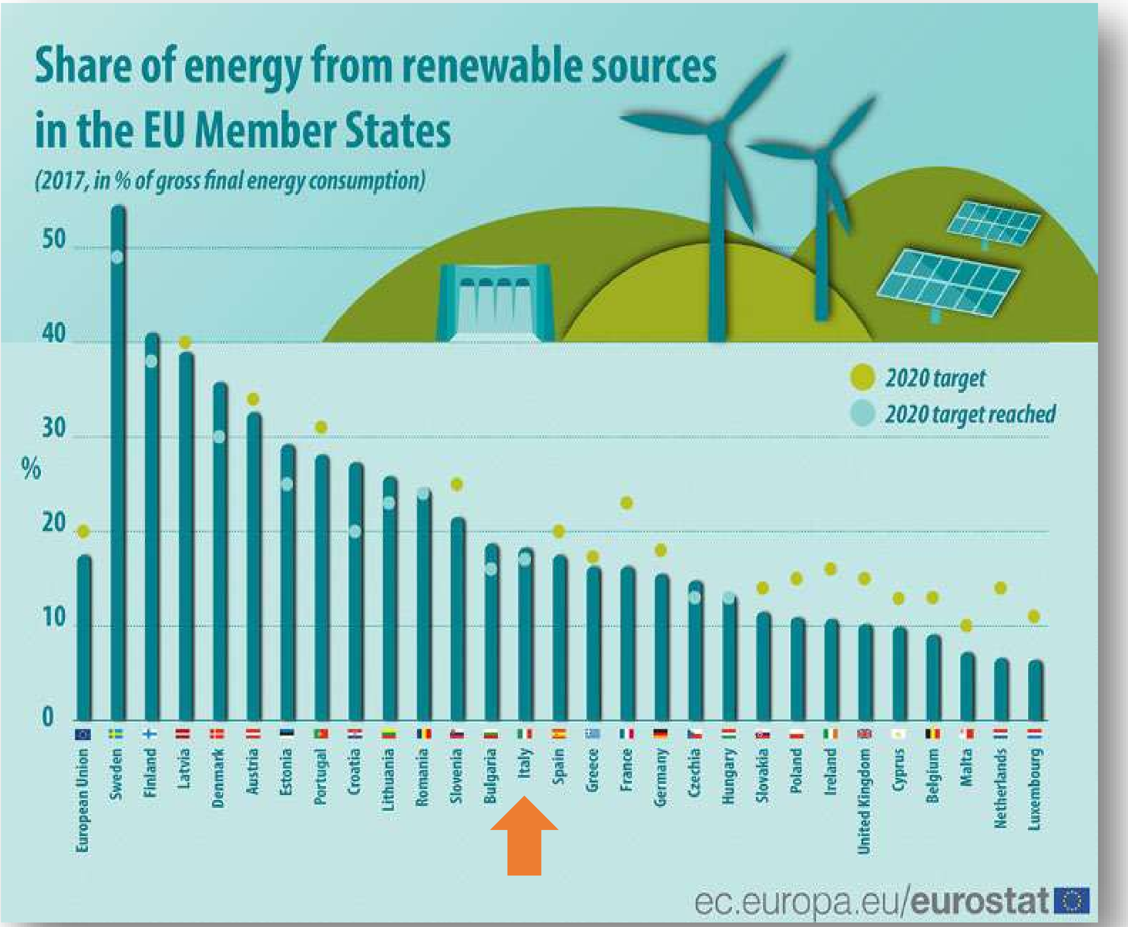
i. growth in the share of energy derived from low-carbon-emitting sources (incl. **REN, nuclear and fossil fuel with CCS**) (Section 2.4.2.1),

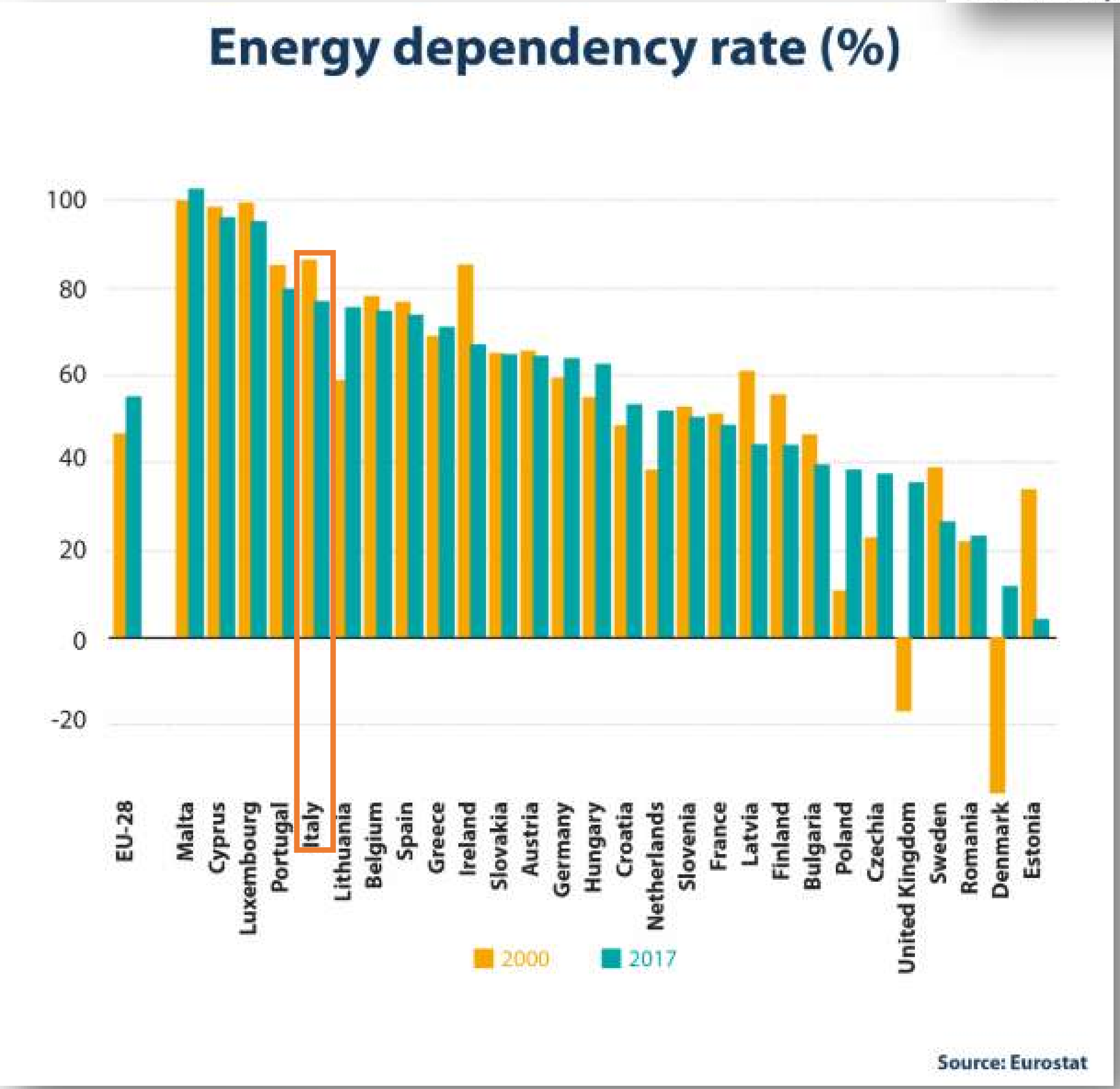
ii. rapid decline in the carbon intensity of electricity generation simultaneous with further electrification of energy end-use (Section 2.4.2.2),

iii. growth in the use of **CCS applied to fossil and biomass** carbon in most 1.5°C pathways (Section 2.4.2.3)

https://www.ipcc.ch/sr15/

Energy statistics - EU





eurostat
Statistics Explained

Energy statistics - Italy

National Energy Balance -2020 «La situazione energetica Nazionale» (MiSE) https://dgsaie.mise.gov.it/situazione-energetica

Tabella 2: Il bilancio dell'energia in Italia – La disponibiltà energetica lorda (Ktep)

	2019	2020*								
	Totale	Combustibili solidi	Petrolio e prodotti petroliferi	Gas naturale	Rinnovabili e bioliquidi	Rifiuti non rinnovabili	Calore derivato	Energia elettrica	Totale	Var % (2020/2019
+ Produzione	36.910	-	5.811	3.287	26.985	1.175	-	-	37.258	0,9%
+Saldo Importazioni	151.903	4.636	65.562	54.376	2.694	-	-	3.421	130.689	-14,0%
- Saldo Esportazioni	29.411	216	23.645	258	492	-	-	652	25.264	-14,1%
+ Variazioni scorte	-1.315	327	180	881	159	-	-	-	869	-166,1%
=Disponibilità energetica lorda	**158.086**	**4.747**	**47.549**	**58.286**	**29.027**	**1.175**	**-**	**2.769**	**143.552**	**-9,2%**

Fonte: Ministero della Transizione Ecologica - Bilancio Energetico Nazionale - Metodologia Eurostat . (*) Dati provvisori

Tabella 13: Consumi finali lordi di energia in Italia (Mtep)

	2014	2015	2016	2017	2018	2019	2020*
CFL FER – Settore Elettrico	9,2	9,4	9,5	9,7	9,7	9,9	10,1
CFL FER – Settore Termico	9,9	10,7	10,5	11,2	10,7	10,6	10,1
CFL FER – Settore Trasporti	1,1	1,2	1,0	1,1	1,2	1,3	1,3
Consumi finali lordi di energia da FER	**20,2**	**21,3**	**21,1**	**22,0**	**21,6**	**21,877**	**21,549**
Consumi finali lordi di energia (CFL)	118,5	121,5	121,1	120,4	121,4	120,3	107,5
Quota dei CFL coperta da FER	**17,1%**	**17,5%**	**17,4%**	**18,3%**	**17,8%**	**18,2%**	**20,0%**

(*) Stime preliminari

Fonte: GSE

Gross Final Consumption (CFL) of energy from renewables in 2018 = 21.55 Mtoe, slightly declining with respect to the previous years.

Renewable resources (FER/RES) = **20% of gross final consumption**, above the 2020 targets set by Europe for Italy (17%). An excellent result when compared with other EU countries, but which denotes how long the road towards total removal from fossil sources is still.

Energy statistics - Italy

National Energy Balance 2020 «La situazione energetica

Italy	ktoe								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Gross available energy	166 908	160 570	151 759	157 630	156 490	161 815	159 711	158 086	144 035
Solid fossil fuels	15 715	13 536	13 059	12 300	10 983	9 342	8 538	6 480	5 095
Peat & peat products	0	0	0	0	0	0	0	0	0
Oil shale & oil sands	0	0	0	0	0	0	0	0	0
Crude oil & other hydrocarbons	73 625	62 673	58 970	66 995	64 586	70 108	66 992	67 272	55 650
Petroleum products	61 115	58 516	56 565	58 623	57 043	57 722	57 470	56 683	47 351
Natural gas	61 356	57 387	50 706	55 302	58 080	61 549	59 513	60 949	58 286
Nuclear heat	0	0	0	0	0	0	0	0	0
Renewable energies	23 885	26 371	26 512	26 269	26 018	28 821	29 282	29 512	29 345
Non-renewable wastes	1 132	1 138	1 158	1 149	1 183	1 134	1 133	1 182	1 190
Primary production	34 964	36 767	36 694	36 098	33 519	36 667	37 342	36 910	37 673
Solid fossil fuels	51	46	55	51	0	0	0	0	0
Peat	0	0	0	0	0	0	0	0	0
Oil shale and oil sands	0	0	0	0	0	0	0	0	0
Crude oil & other hydrocarbons	5 396	5 501	5 764	5 470	3 746	4 138	4 684	4 279	5 384
Natural gas	7 048	6 335	5 855	5 545	4 738	4 536	4 462	3 931	3 287
Nuclear heat	0	0	0	0	0	0	0	0	0
Renewable energies	21 104	23 500	23 644	23 564	23 569	26 540	26 657	27 088	27 339
Non-renewable wastes	1 132	1 138	1 158	1 149	1 183	1 134	1 133	1 182	1 190
Net imports	132 039	123 216	115 050	121 422	121 520	124 564	121 920	122 492	105 799
Solid fossil fuels	15 187	13 023	12 889	12 318	10 711	9 360	8 622	6 387	4 739
Crude oil	67 932	57 824	53 475	61 748	60 254	65 652	61 551	63 140	50 186
Gas/Diesel Oil (w/o bio)	-8 795	-5 541	-2 371	-6 016	-4 998	-5 241	-3 698	-4 500	-3 177
Motor Gasoline (w/o bio)	-9 653	-7 924	-6 976	-8 439	-8 175	-8 728	-8 544	-8 487	-6 203
Naphtha	-73	572	235	266	602	108	846	-298	270
LPG	1 916	2 086	2 185	2 226	2 282	2 259	2 238	2 394	1 971
All other oil & petroleum products	55 043	53 082	50 080	52 428	51 879	52 824	51 634	52 437	42 008
Natural gas	55 353	50 564	45 471	49 996	53 294	56 820	55 268	57 936	54 117

+ Produzione
+Saldo Importazioni
- Saldo Esportazioni
+ Variazioni scorte
=Disponibilità energetica lorda
Fonte: Ministero d

CFL FER –
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Fonte: GSE

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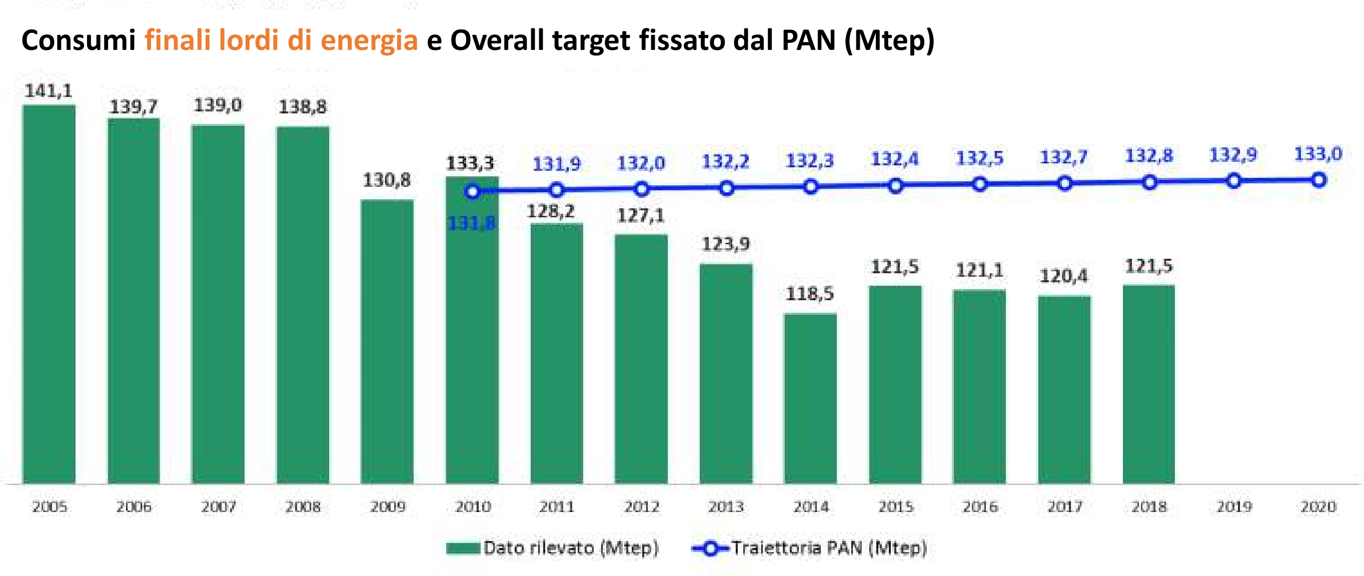
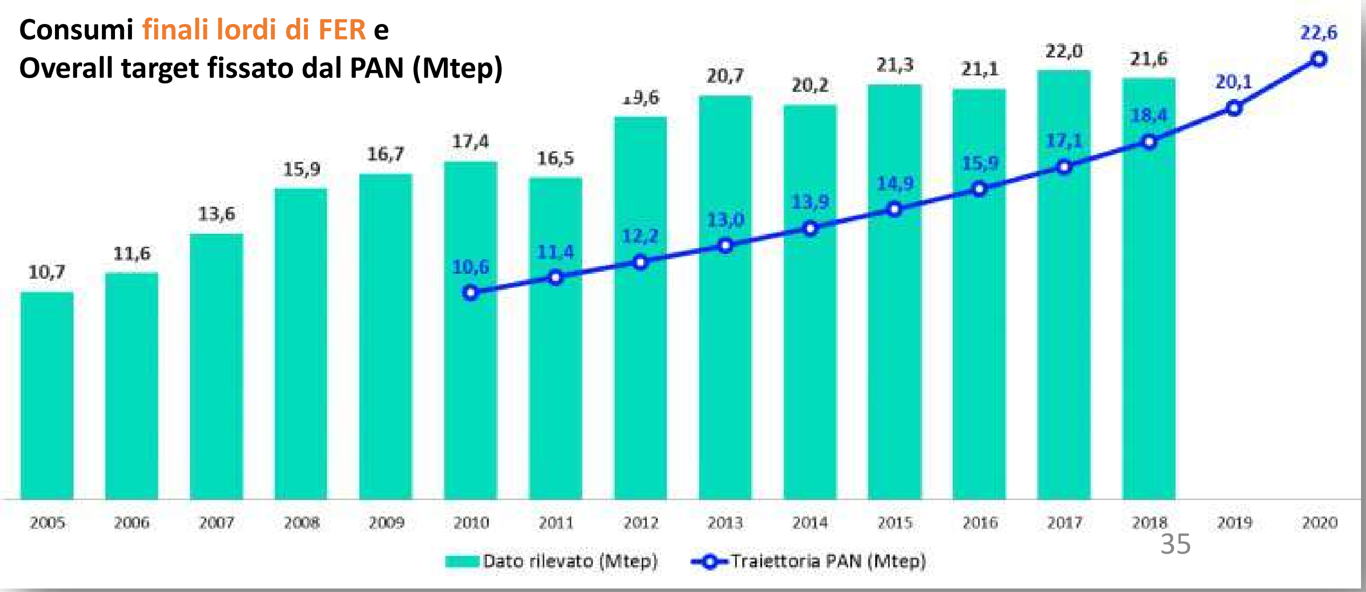
Energy statistics - Italy

Rapporto Statistico sulle Fonti Rinnovabili (2017) (GSE, [*https://www.gse.it/documenti_site/Documenti%20GSE/Rapporti%20statistici/GSE%20-%20Rapporto%20Statistico%20FER%202018.pdf*](https://www.gse.it/documenti_site/Documenti%20GSE/Rapporti%20statistici/GSE%20-%20Rapporto%20Statistico%20FER%202018.pdf)



*** Piano d’Azione Nazionale per le energie rinnovabili (PAN)**, (Directive 2009/28/EC: “Promotion of the use of energy from renewable sources”. It implements the 2020 objectives defined for each EU Member State, the trajectories foreseen for achieving them and the main policies to be implemented.*



1. **Glossario**
2. Le **geoscienze** in un mondo che cambia

    2.1 **Agenda 2030** e i 17 Sustainable Development Goals-SDGs

    2.2 **SDG7**: Energia

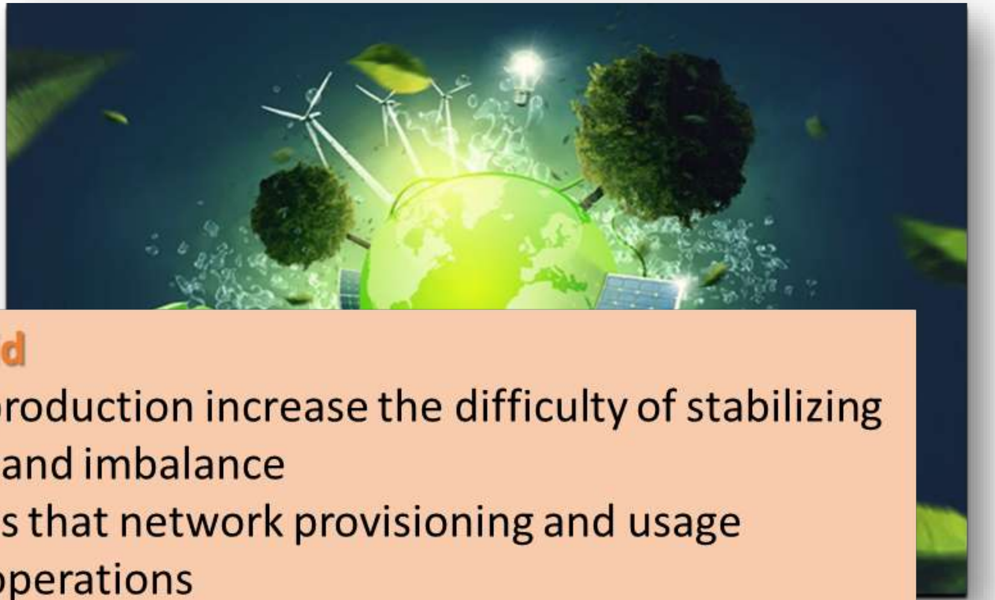
    2.3 **Statistiche** dell’energia: mondo, UE, Italia

    2.4 **Transizione energetica e geoscienze**: una opportunità da cogliere

what future for a geologist in this changing world?

Traditional energy sources: the resource availability is homogeneous; the delivery of power/energy from their production plants can be modulated according to the demand

Renewable energy sources: the delivery of power/energy from their production plants is higly dependant on the resource availability/storage. **Intermittent energy sources**



Traditional energy sources: the resource availability is homogeneous; the delivery of power/energy from their production plants can be modulated according to t

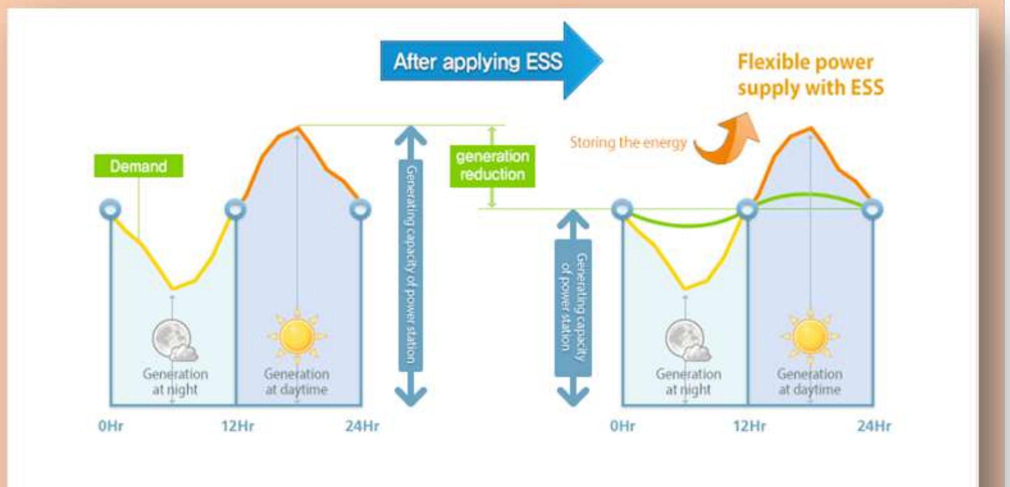
Renewable energy sourc
production plants is higly
availability/storage. **Inter**

Difficulties with renewables integration in the grid

- Fluctuating sources and decentralized energy production increase the difficulty of stabilizing the power network, mainly due to supply/demand imbalance
- Unpredictable character of renewables requires that network provisioning and usage regulations be established for optimal system operations
- Peak supply of renewables (solar, wind) and demand of energy do not match and hence create a gap

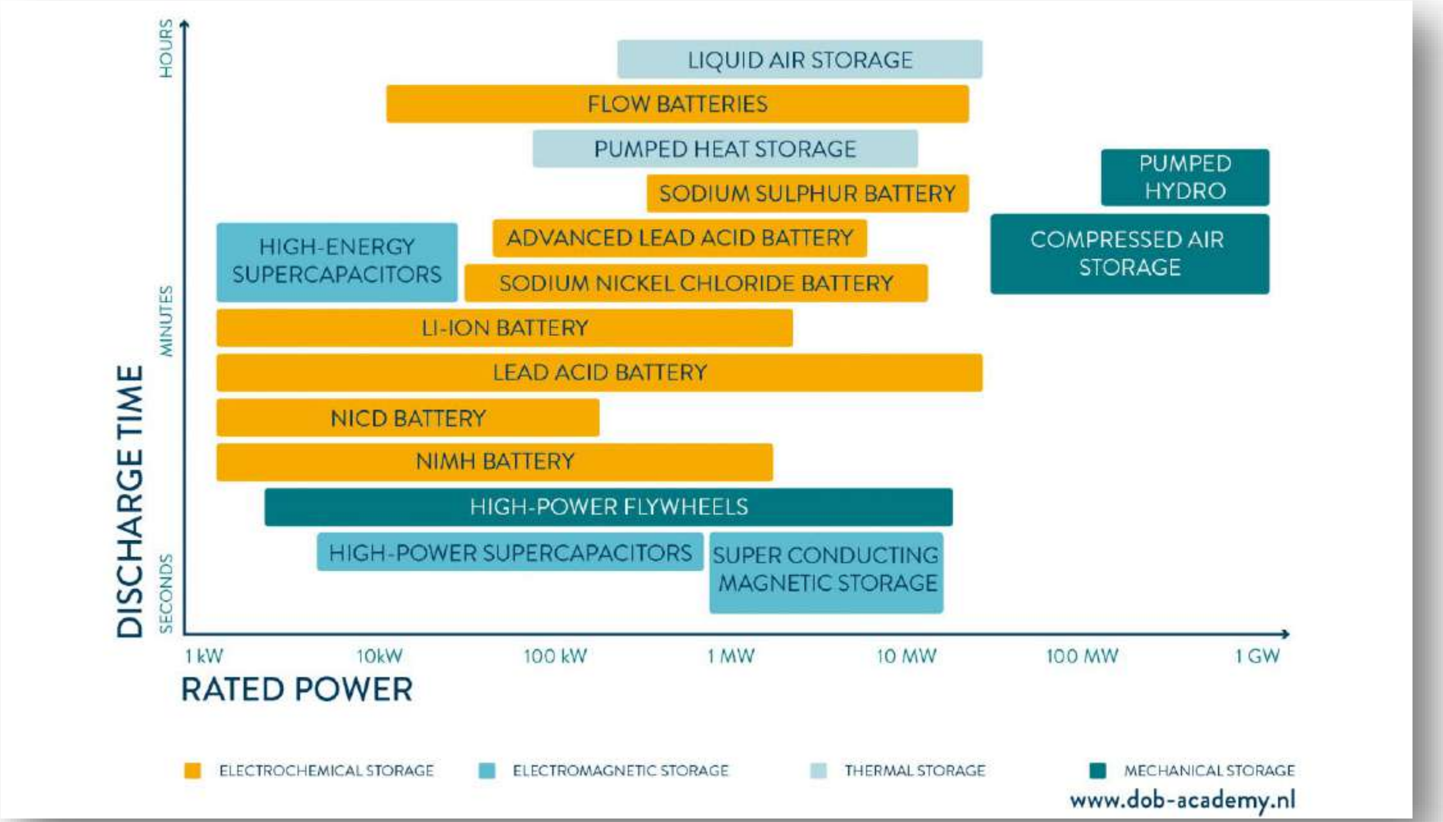
Energy Storage Systems - ESS

- Conversion of excess energy into a different form of energy, to be converted in electricity with minimum losses
- Increases the dispatch ability, makes power available on demand; by reducing the supply/demand gap reduces the nedd for newer power plants



Concept Map of Energy Storage System (ESS)

Energy storage



Intermittency of energy supply: increase of energy storage capabilities. This could include:

- advancement in **battery technologies**
- **subsurface air & thermal energy** and **pumped hydro**

Decarbonisation/transition of power generation, industry, transport and heating needs expansion in renewables and nuclear, many of which require **critical raw materials and metals** to manufacture (which rely on sources of minerals and metals e.g. lithium, cobalt, cadmium).

A **sustainable and secure supply of mined materials** is required

The Role of Geoscience in Decarbonisation

The Geological Society
serving science, profession & society

21 - 23 January 2019
The Geological Society, Burlington House
https://www.geolsoc.org.uk/Lovell19

Decarbonisation/transition of power generation, industry, transport and heating to meet climate change targets: a major challenge that intrinsically involves the subsurface and geoscience.

Renewables	increase in grid-scale energy storage to cover intermittency: greater efforts on more efficient batteries, pumped storage and compressed air energy storage
Civil nuclear	understanding of risks associated with natural hazards (seismicity); challenge of geological disposal of radioactive waste
Geothermal power, heating and cooling	assessment of resources and impacts
Hydrogen *(it is a vector, not a source!!!)*	development of technology; environmental and geological assessment for underground storage and transport
Carbon Capture and Storage (CCS)	definition of the reservoirs and volumes of potential storage; risks assessment associated with natural and induced hazards (seismicity, …)
Natural gas	the **energy resource for the transition** needs environmental and resources assessment

All require **geological studies**: investigating the geological origin and prospectivity of transition metals and rare earth elements for batteries; for siting of power station, dams and tunnels in pumped water storage; geological studies for CCS; detailed characterisation of the subsurface for radio- waste disposal.

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Scientific and technological challenges for Geosciences in the Energy Transition

- ✓ **Characterise** the physical properties, chemistry and structure of the subsurface to determine feasibility of various subsurface storage and infrastructure projects.
- ✓ **Improve** understanding of how the properties of the subsurface respond to changing physical and chemical conditions, e.g. during cyclical pressurisation and depressurisation of hydrogen or thermal fluids.
- ✓ **Assess** the origin, distribution and extractability of subsurface critical raw materials needed for decarbonisation.
- ✓ **Develop** and design effective and cost-efficient monitoring techniques for various uses of the subsurface.
- ✓ **Improve** scientific understanding on how fluids flow in the subsurface (HC, thermal energy storage, geothermal resources).

Critical to the success of the decarbonisation initiative is **knowledge and data sharing** across geographical borders, between industries, and by all “subsurface stakeholders”.

There are key geoscientific lessons to be learned across planning, exploration, exploitation, decommissioning and remediation

The Role of Geoscience in Decarbonisation
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The opportunity for Geosciences in the Energy Transition

Europe is well placed to develop subsurface decarbonisation technologies. It has an excellent base of worldclass universities, research institutes, and **the experience of Oil&Gas companies**.
A combination of state-of-the-art technology, improvements to efficiency and low-carbon fuel switching will be needed to achieve the ambitious decarbonisation targets.

However, for some industrial processes, such as steel manufacturing, cement production, and refining, subsurface carbon-capture technologies are the only viable decarbonising solution.

According to IPCC, negative emissions can only realistically be achieved adding nuclear and carbon capture and storage (CCS)

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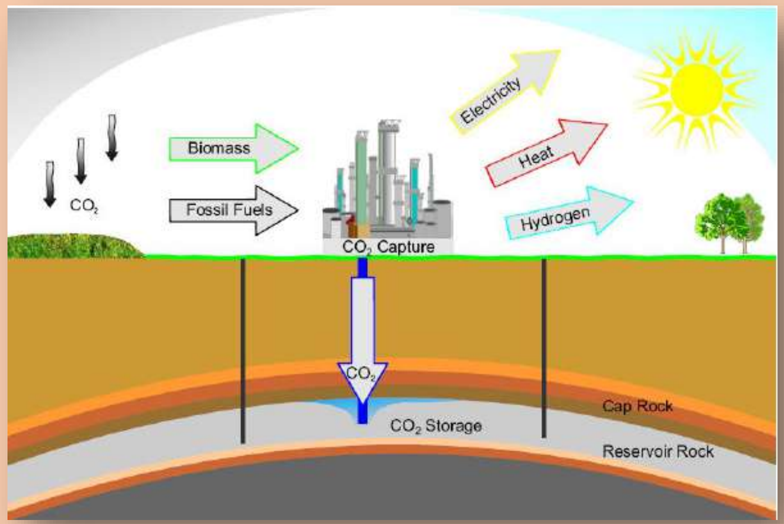
CCS - Carbon Capture & Storage

The quantity of CO_2 to be stored via CCS over this century in 1.5°C pathways ranges, depending by different scenarios, from zero to >1,200 $GtCO_2$.

The **2005 IPCC Special Report on Carbon Dioxide Capture and Storage** found that, worldwide, it is likely that there was a technical potential of at least about 2,000 $GtCO_2$ of storage capacity in geological formations, with possible additional potential for geological storage in saline formations.

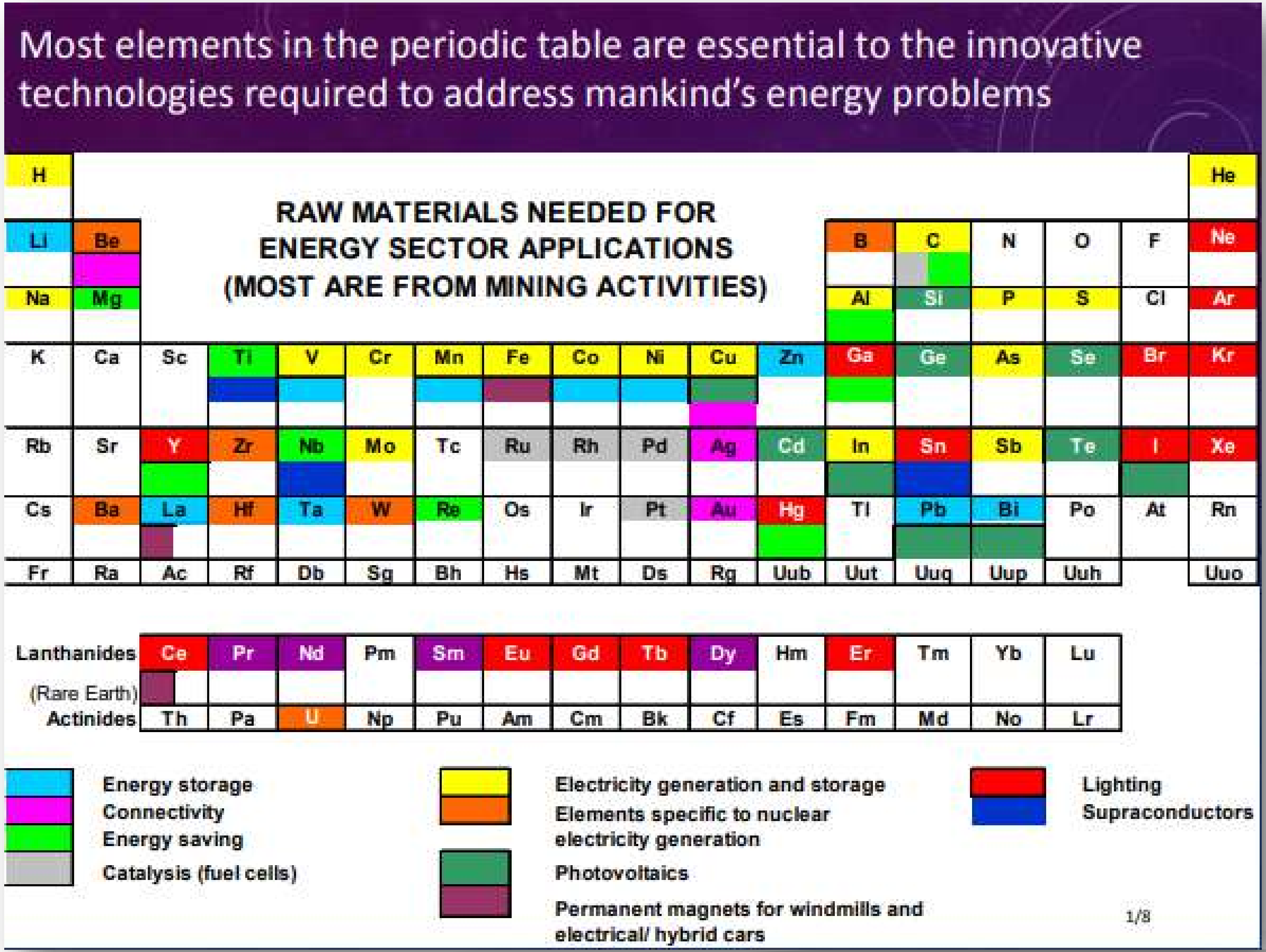


The **cumulative demand for CO_2 storage was small compared to a practical storage capacity estimate worldwide**.

The global potential storage capacity is estimated today from 8,000 to 55,000 $GtCO_2$,which is sufficient at a global level for this century.

The storage capacity of all of these global estimates is likely to be larger than the cumulative CO_2 stored via CCS in 1.5°C pathways over this century

Mining



The **energy sector** contributes to the rapid demand growth for a **wide range of minerals and metals**.

The production of minerals and metals

- **requires energy** (currently about 10.5% of the global production),
- **generates emissions** (CO2, sulfur and nitrogen oxydes, particulate matter, mercury from coal production, radionucleides from coal combustion and rare earth production…).

http://www.mineralinfo.fr/sites/default/files/upload/ancre_rapport_2015-ressources_minerales_et_energie_0.pdf

Mining

https://www.iea.org/articles/clean-energy-progress-after-the-covid-19-crisis-will-need-reliable-supplies-of-critical-minerals

AAPG Energy Transition Forum
A New Era in Geoscience
https://energytransition.aapg.org/2018/About/About-the-Conferenc

Geosciences drivers underpinning the transition:

The **hydrocarbon era** is not over soon: fossil fuel use might flatten from 2035, with oil and coal in decline but gas use continuing to expand.

- **Coal demand**: peak expected in next 10y, with a rapid shift toward gas. Gas is a viable and profitable alternative to coal.
- **Oil demand**: expected to peak in the next 15-20y. Decline won't be for lack of supply: technological and economic competition for oil is coming, with a shift from oil-based transport to electricity-based transport. The question is "when" rather than "if".
- **Gas demand**: will continue to grow to 2040, due to its affordability relative to other fuels, technologies and policies.
- **Electrification**, particularly in buildings and road transport, underlies an acceleration of electricity demand. Energy intensity is improving across regions and end-use sectors with the switches to more efficient fuels and technologies. Strong improvements in economics of electric vehicles trigger rapid uptake. In a disrupted case, electricity demand growth could be boosted to 2.9%/y.
- **Renewables**' cost decline accelerates, out-competing new-built fossil capacity today and existing capacity in 5-10 years causing electricity demand to grow four times faster than all other fuels.
- **CCS & Nuclear** can play a prominent role in the Energy Transition, but face much resistance from communities. Technological, political and social constraints are the challenge.

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Geosciences in the Energy transition.

- **Natural energy resources**: a primary role for **oil** and mainly **gas** E&P– certainly until 2050 - 2060. Crucial in **CCS**, **geothermal** and new energy solutions (technologies and concepts to be developed;
- The **2050 2°c economy** will generate a huge demand for **new metals and minerals**: + 200% for aluminum, iron, lead and nickel; +1000% for cobalt, lithium, manganese. Challenge? Very little understanding of geology means huge demand for skill sets;
- The **mix of skills** of a geoscientists is unique, particularly in **managing data** and **solving complex problems**. There will be a need for **multiskilled people**, able to integrate geological knowledge with IT, economy and social sciences. Geoscientists have much to contribute because of way they think, used to dealing with complex environments, good at systems thinking and without full data sets;
- **Universities** need to proactively reinforce the message that petroleum/underground geologists are still needed in the future; they need to **adapt the curriculum** and how the profession is promoted;
- The **next generation** is already hugely **environmentally aware:** important that senior professionals/politicians inject optimism and empowerment into the next generation of decision makers;
- We have to develop the **ability to speak** easy and, more important, the **ability to listen** to the requests and doubts of the local communities. This is the only way for a correct **dissemination of knowledge**.

AAPG Energy Transition Forum
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Geosciences in the Energy transition.

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- The **2050 2°c econo**
  200% for aluminum
  Challenge? Very litt
- The **mix of skills** of
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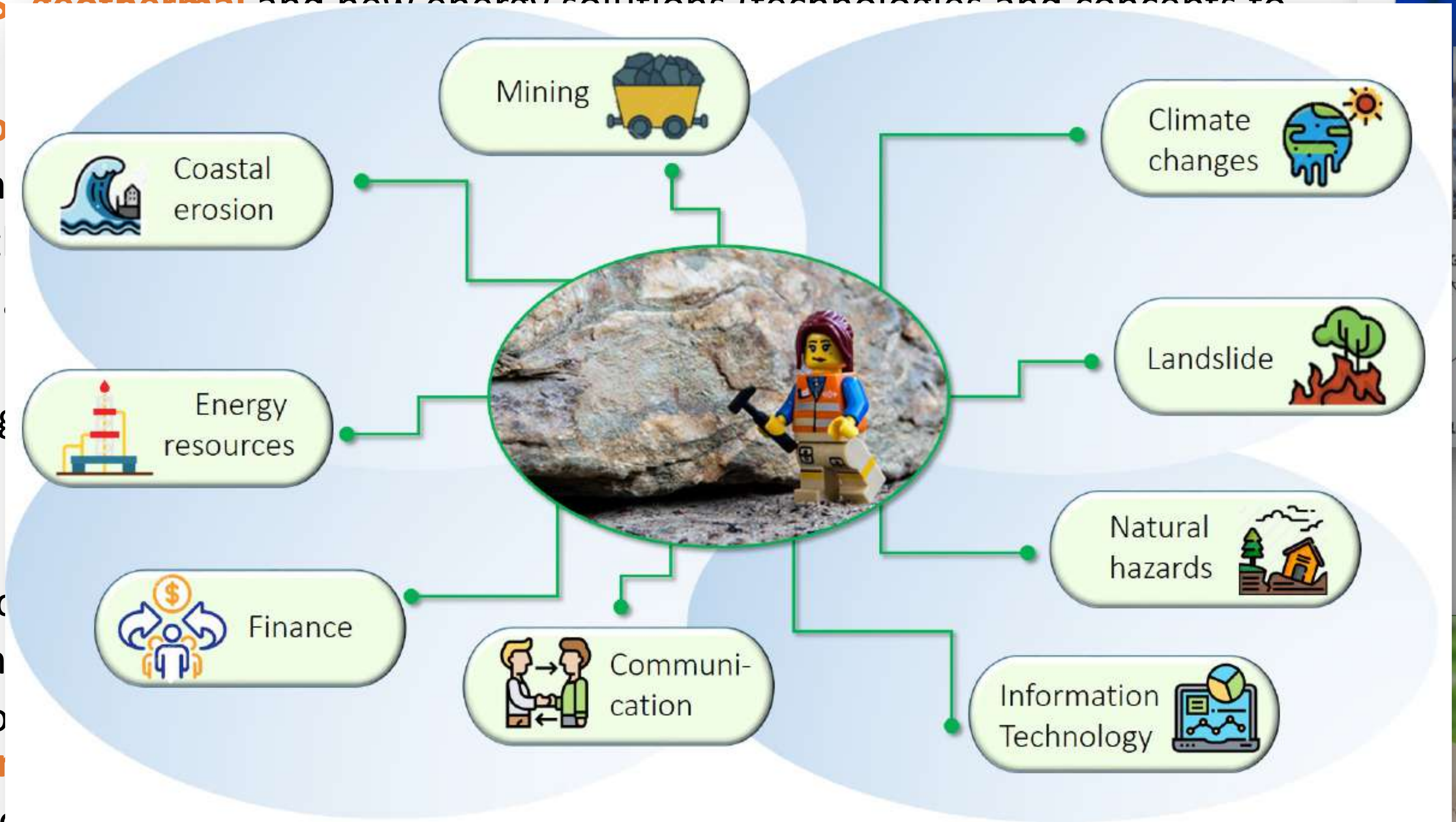
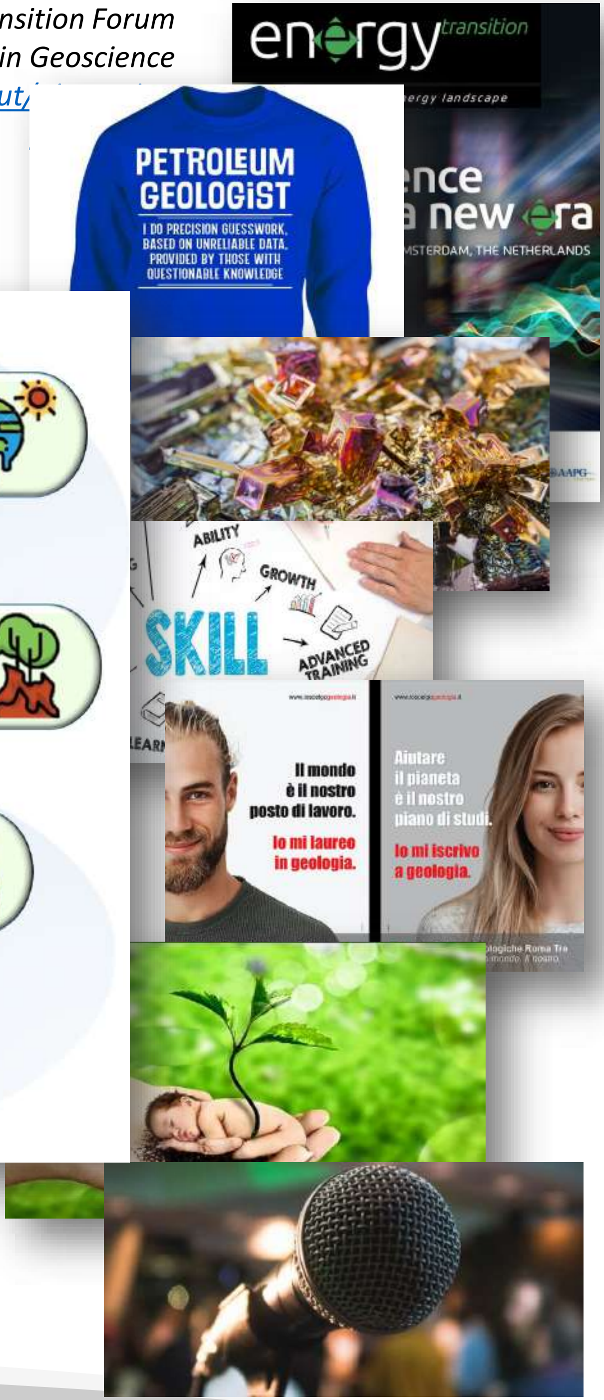
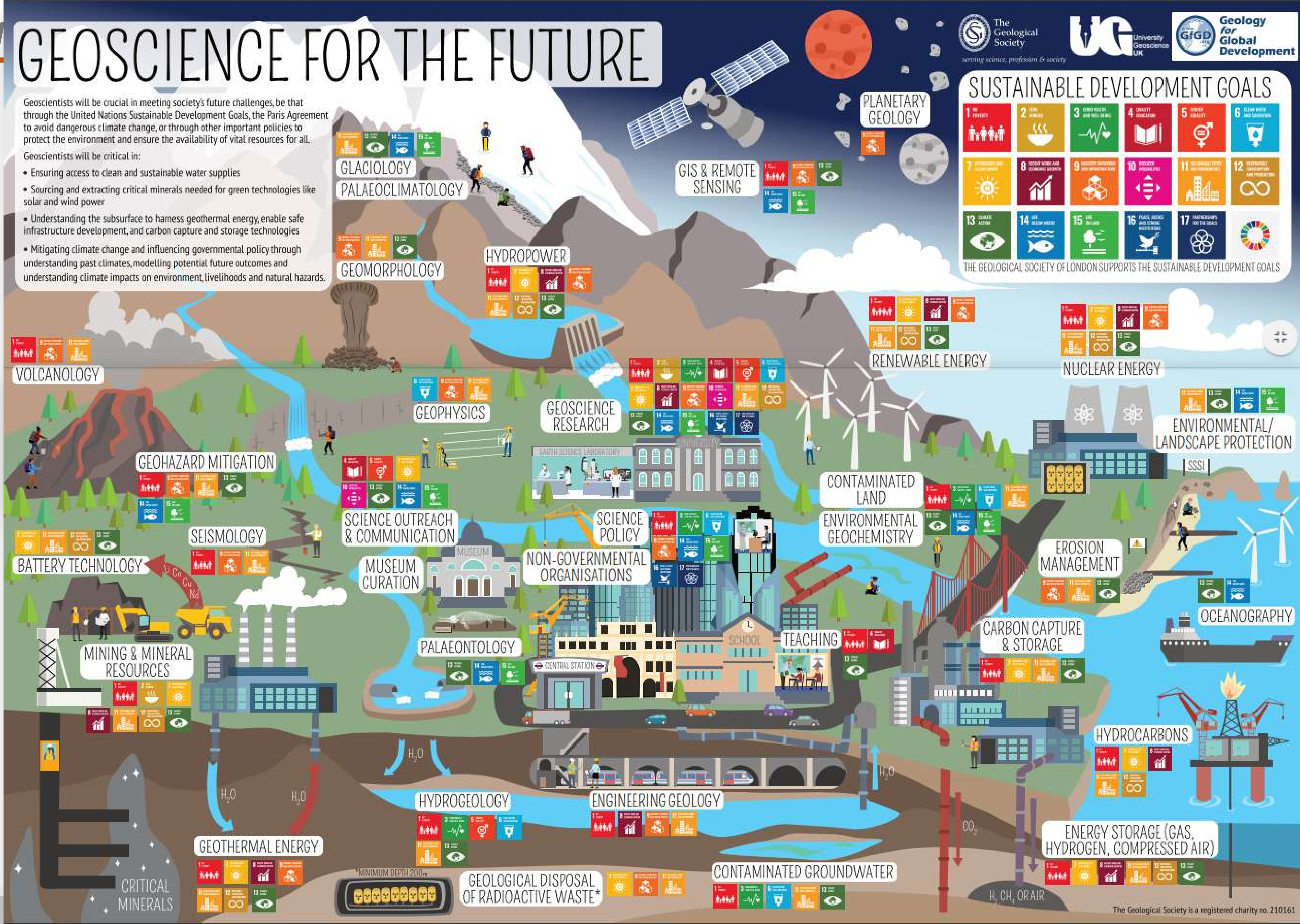




- We have to develop the **ability to speak** easy and, more important, the **ability to listen** to the requests and doubts of the local communities. This is the only way for a correct **dissemination of knowledge**.

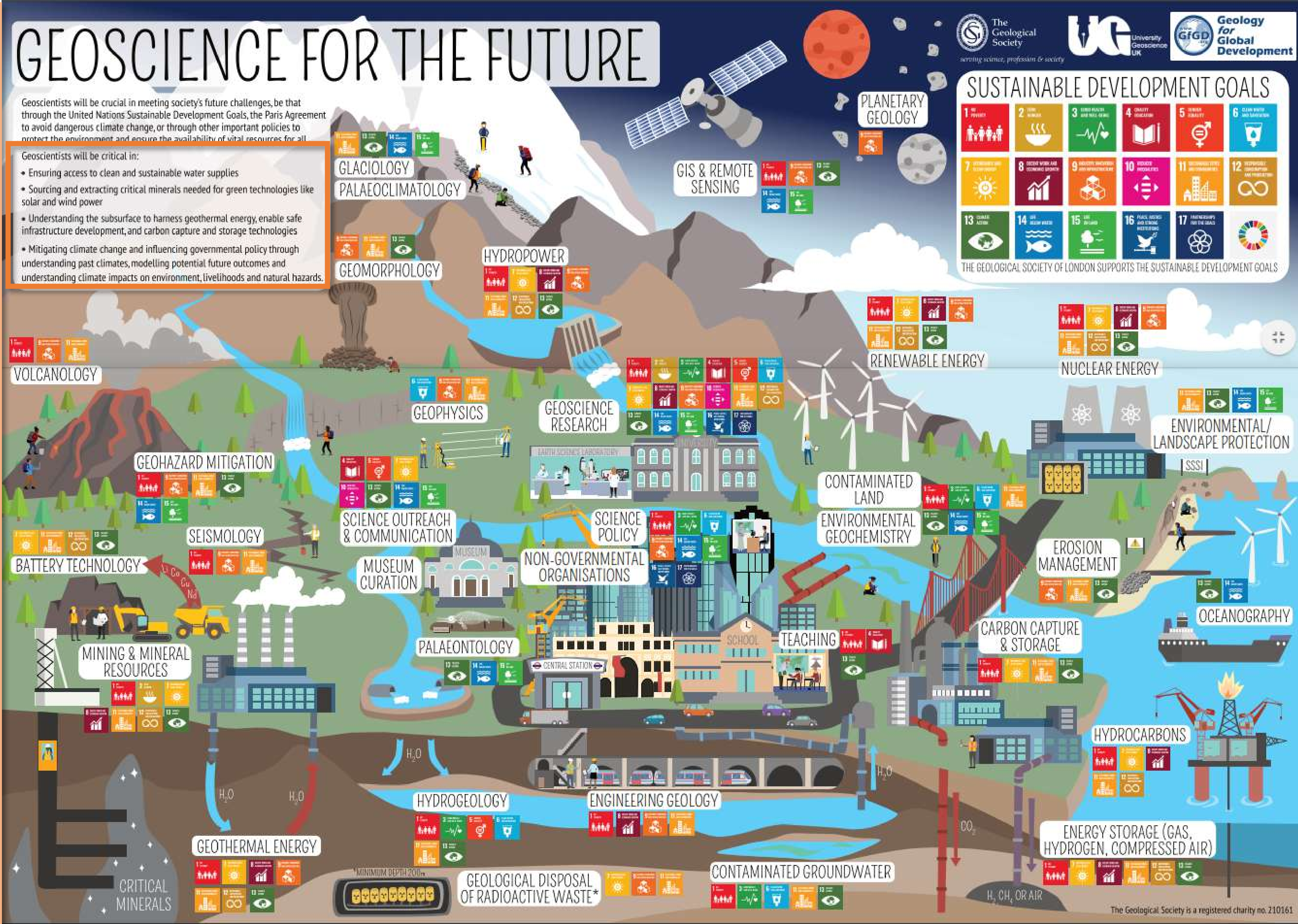
Geosciences in the changing world

To sum up:



Le geoscienze saranno fondamentali per:

- **Garantire** l'accesso a forniture idriche pulite e sostenibili
- **Esplorare e produrre** i minerali critici necessari per tecnologie pulite come l'energia solare ed eolica
- **Comprendere** il sottosuolo per sfruttare O&G e l'energia geotermica; **consentire** lo sviluppo di infrastrutture sicure e di tecnologie CCS
- **Mitigare** i cambiamenti climatici influenzando le politiche governative attraverso la comprensione del passato, la modellazione di scenari futuri e degli impatti climatici sull'ambiente, sulla vita e sugli eventi naturali



CO_2 emissions

Global emissions of carbon dioxide from fossil fuels and industry are expected to grow slowly in 2019 due to a decline in global coal use.

The growth rate in 2019 is set to fall to 0.6%, down from 2.1% in 2018.

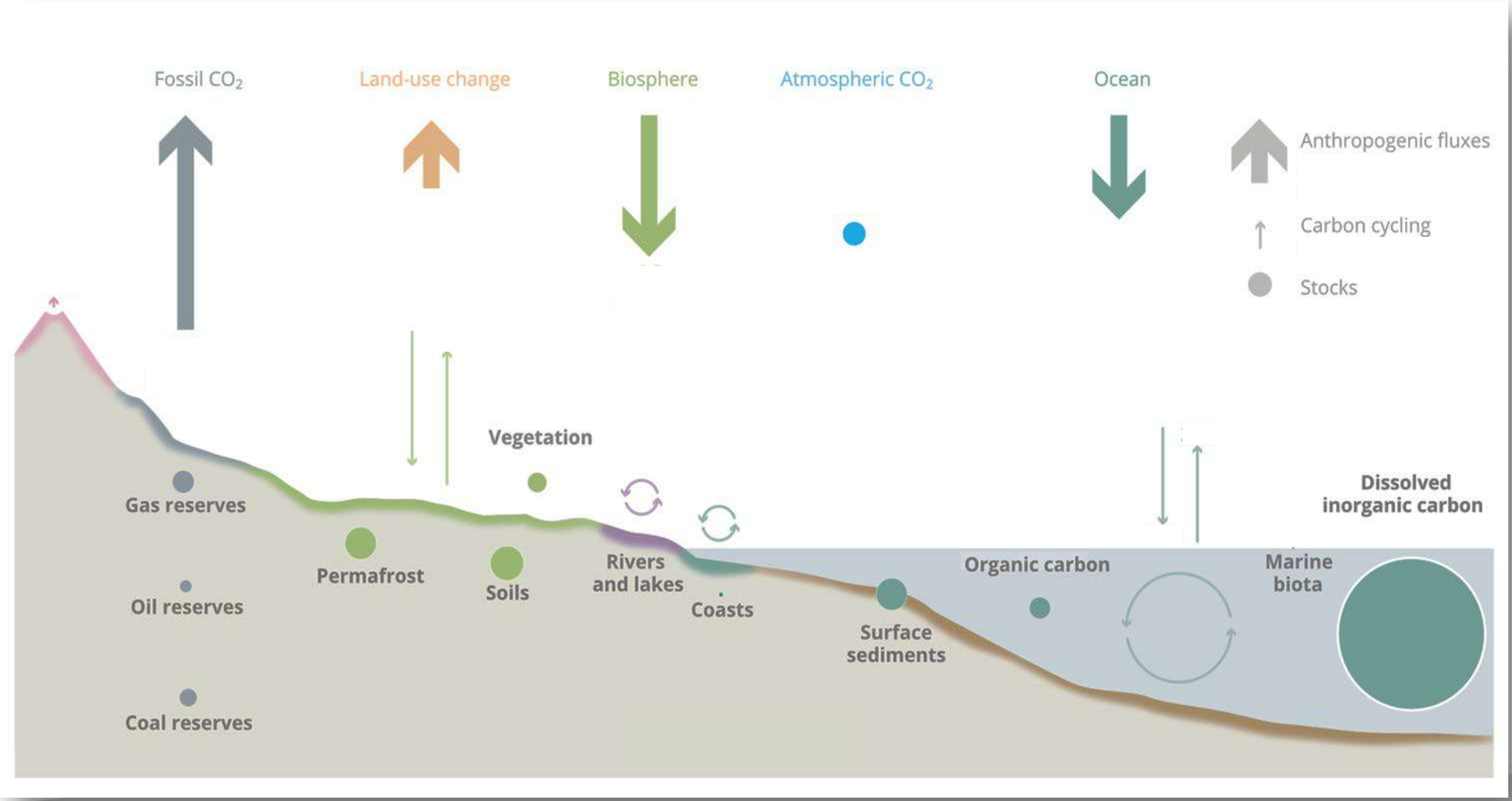
This is due to **declines in coal** use in the European Union and the United States, as well as **slower growth in coal use** in China and India, and overall **weaker global economic growth**.

The decline in coal use has been offset by sustained growth in oil and natural gas.

www.globalcarbonproject.org/index.htm

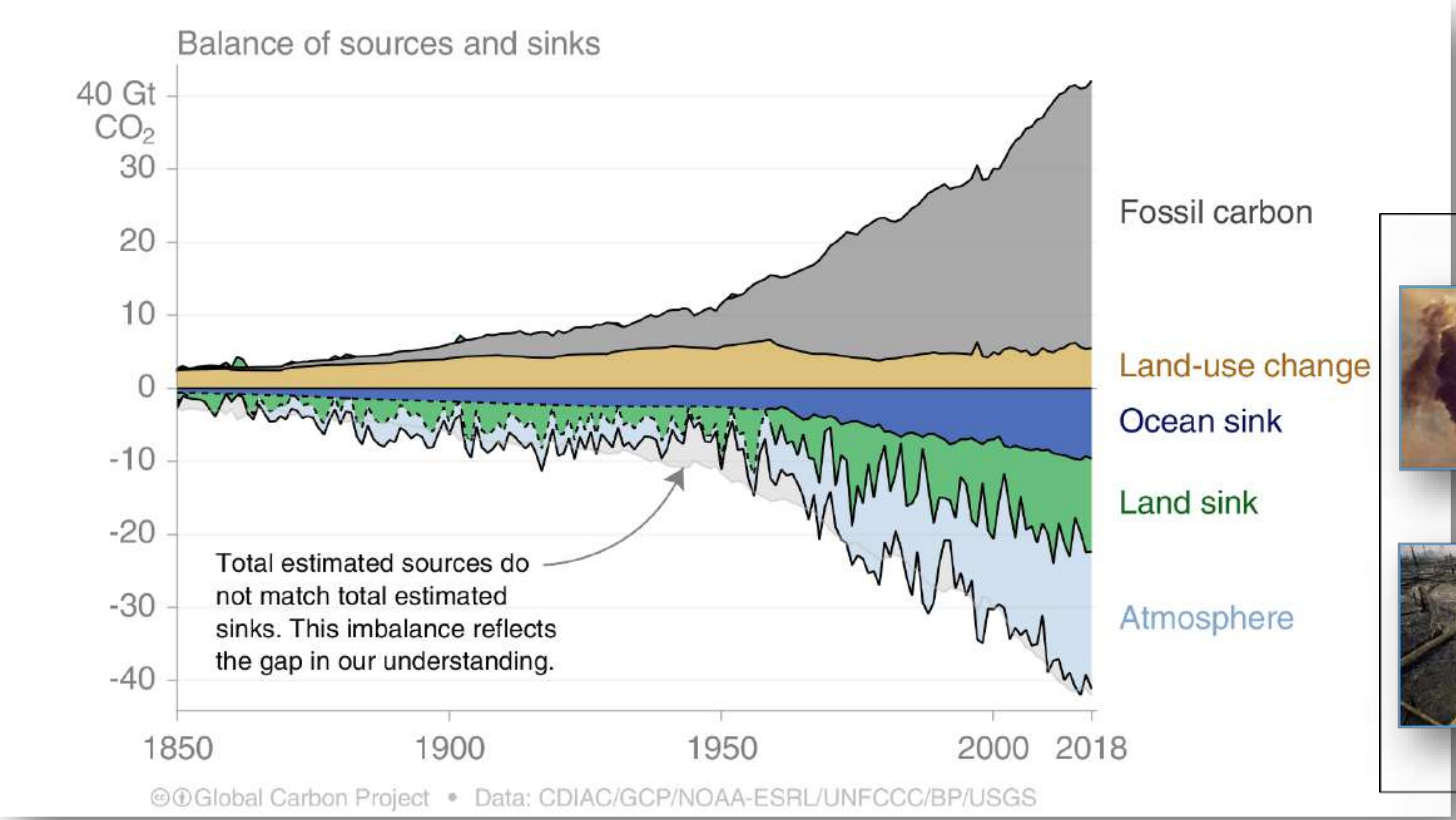
References & methodology
www.earth-syst-sci-data.net/11/1783/2019/

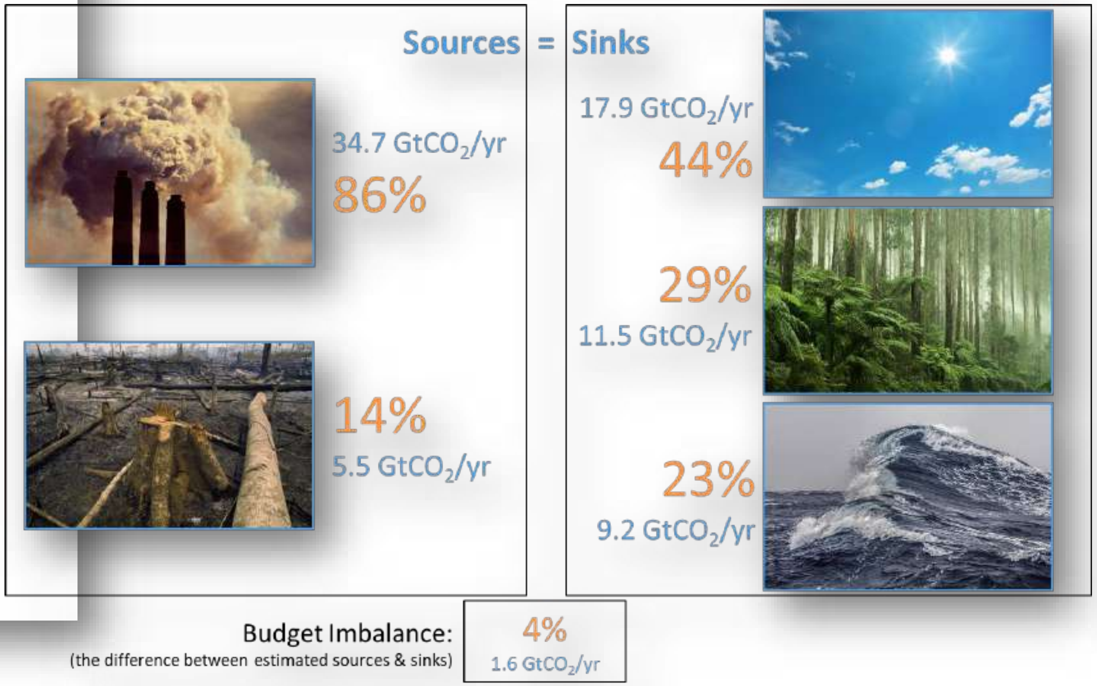
The global carbon cycle



Carbon emissions are partitioned among the atmosphere and carbon sinks on land and in the ocean

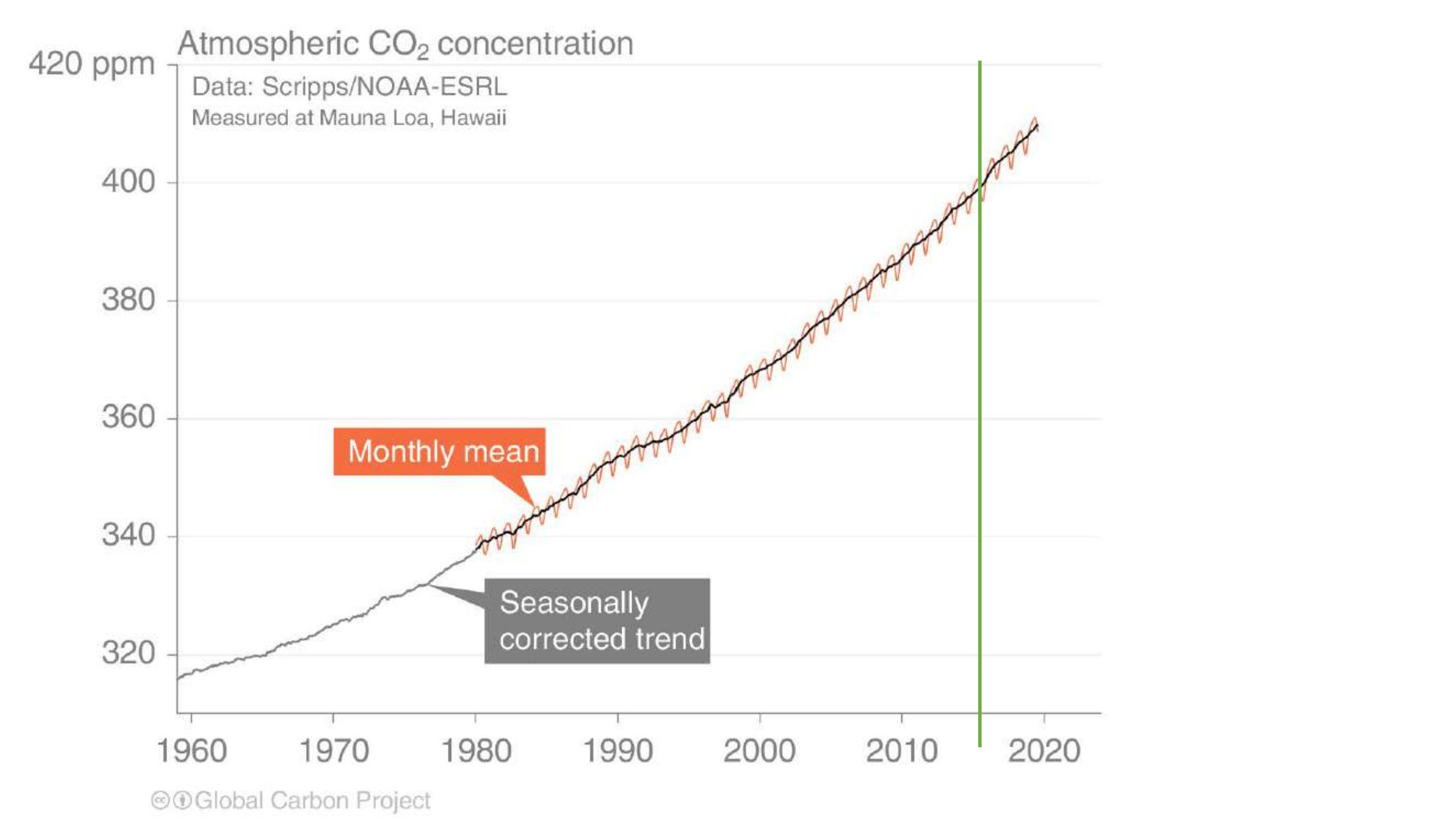
The “imbalance” between total emissions and total sinks reflects the gap in the understanding of the whole phenomenon





The global CO2 concentration increased from ~277ppm in 1750 to 407ppm in 2018 (up 46%)

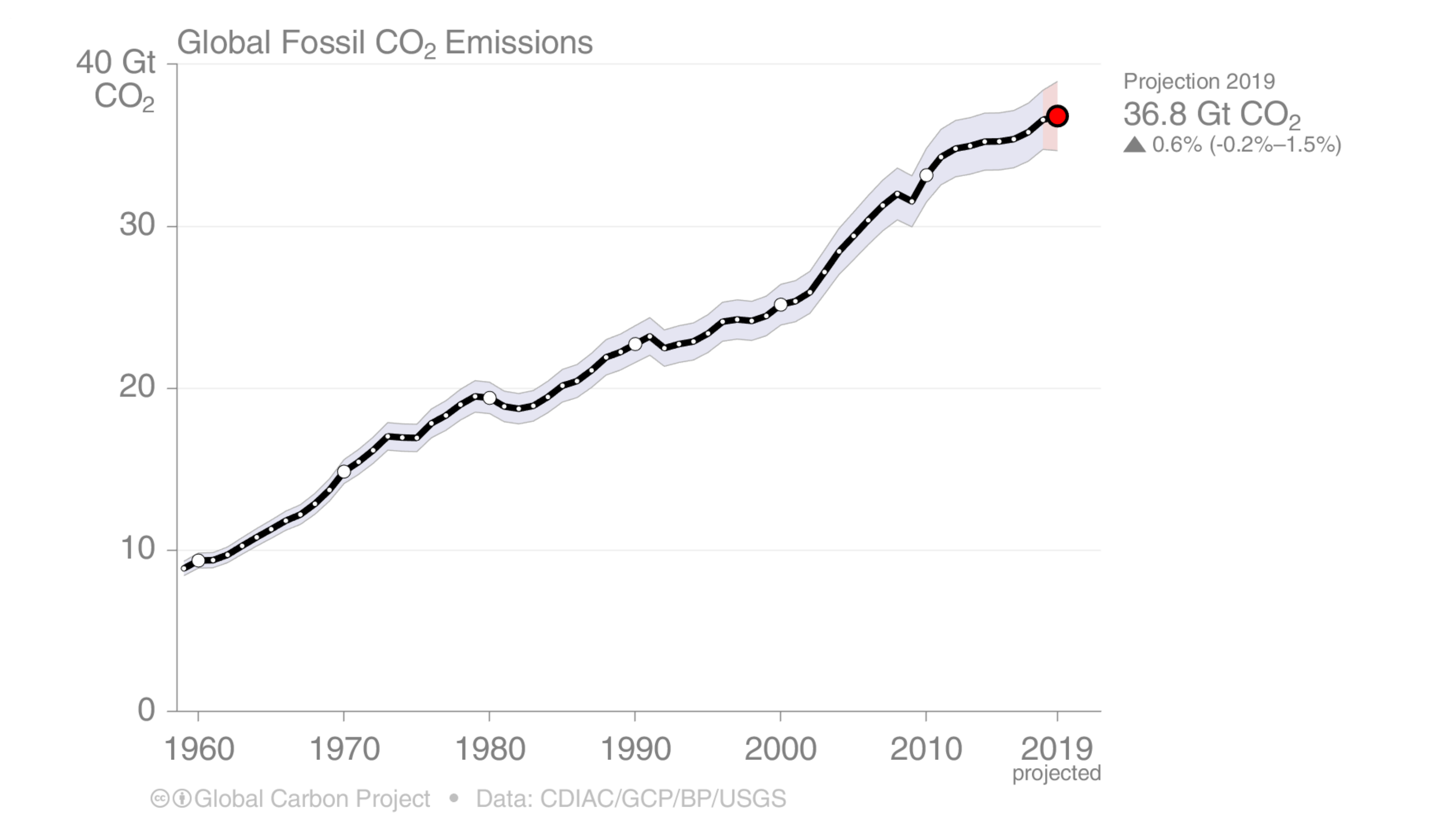
2016 was the first full year with concentration above 400ppm



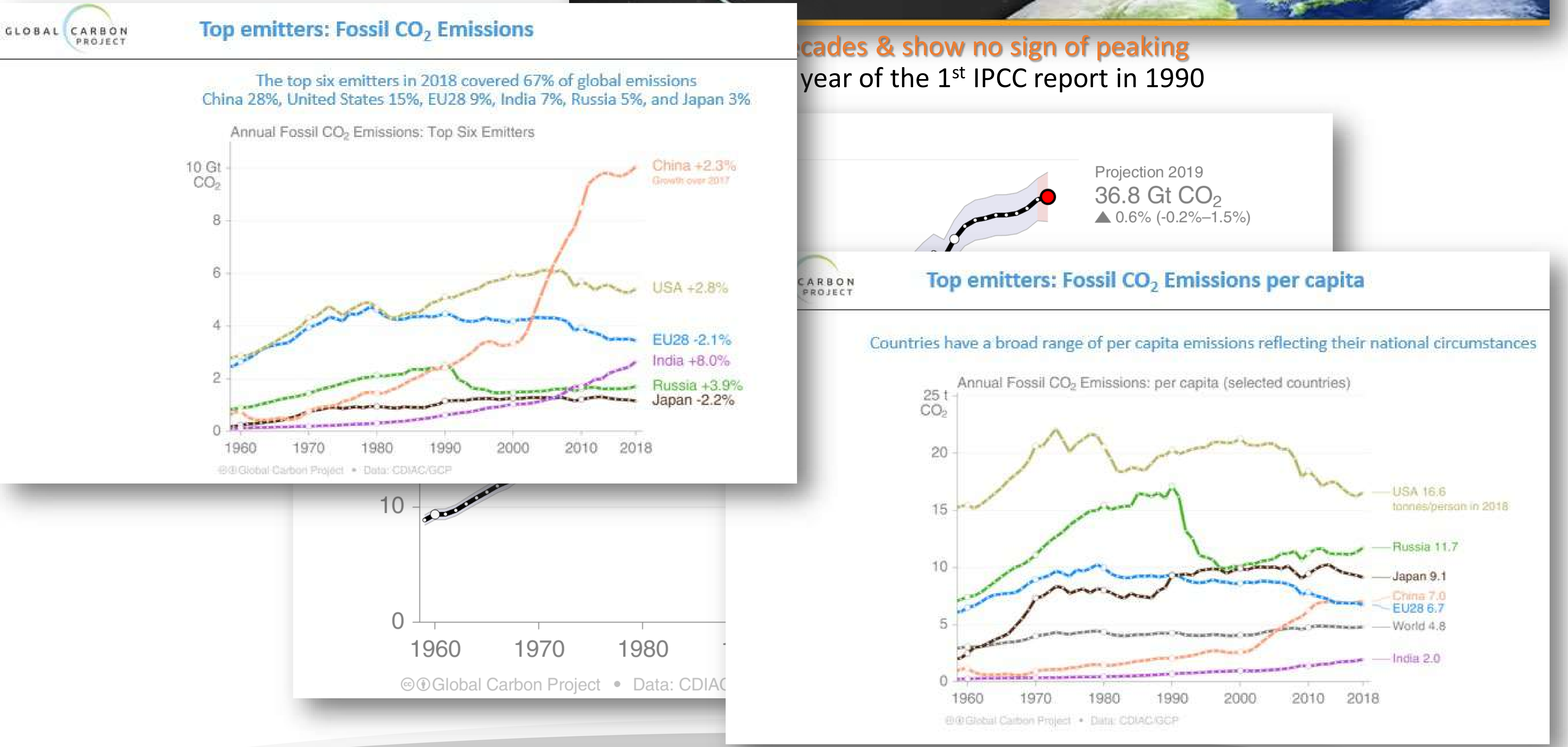
GLOBAL CARBON PROJECT

Global fossil CO2 emissions have risen steadily over the last decades & show no sign of peaking

Fossil CO_2 emissions will likely be 62% higher in 2019 than the year of the 1st IPCC report in 1990

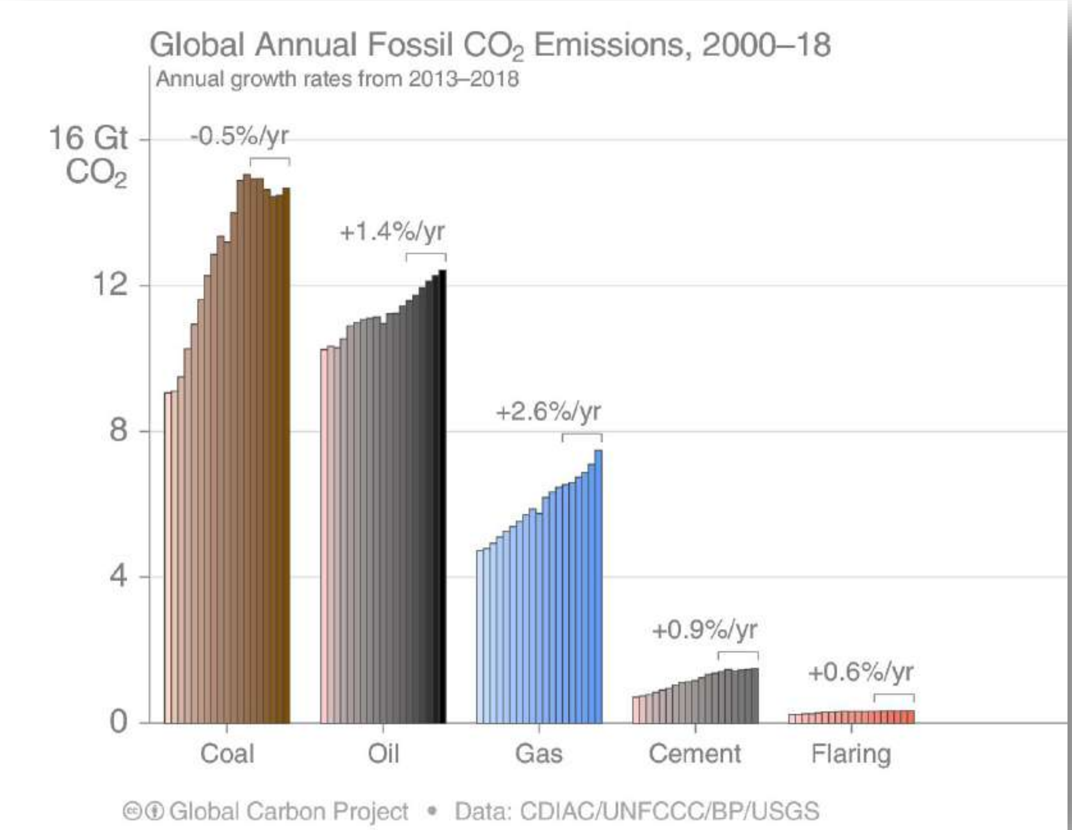


CO2 emissions



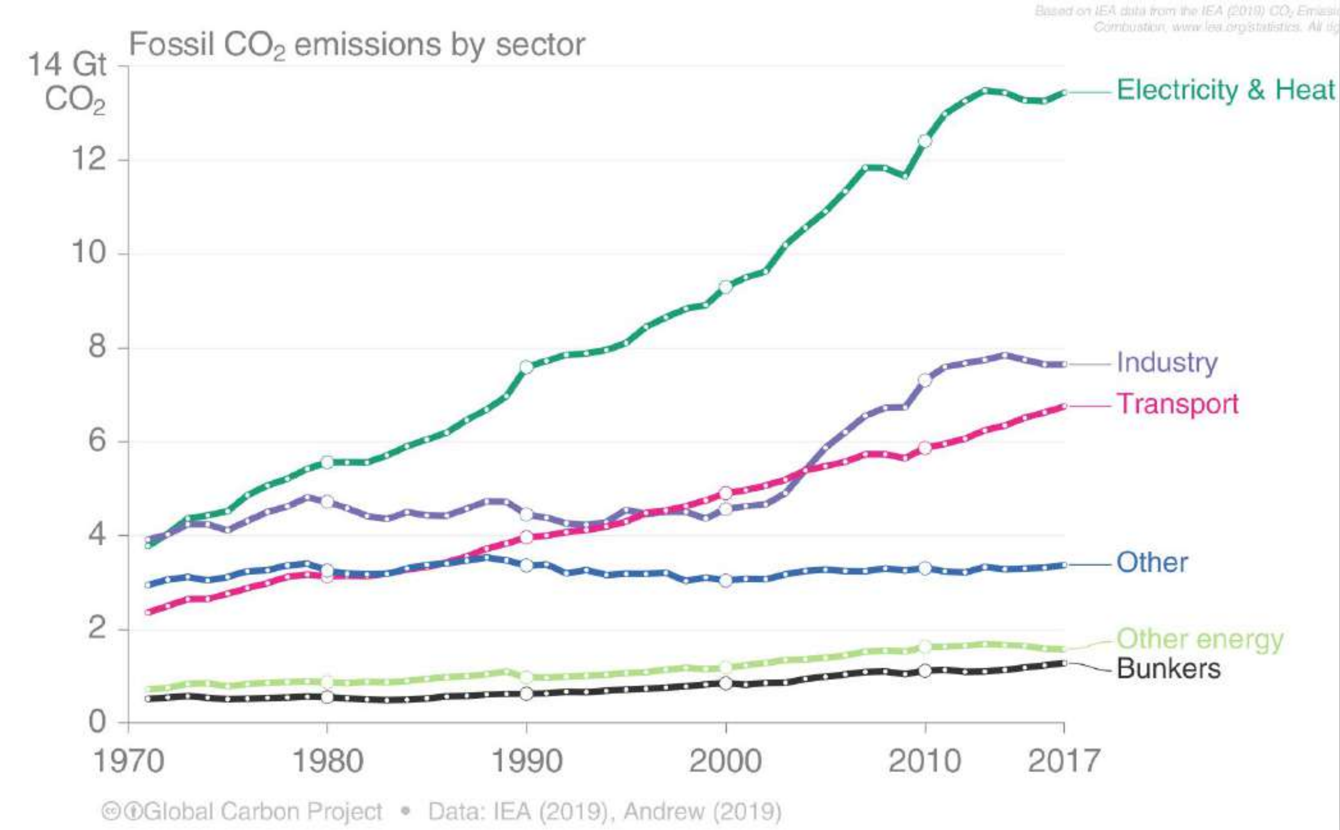
Emissions by category from 2000 to 2018

growth rates indicated for the more recent period of 2013 to 2018

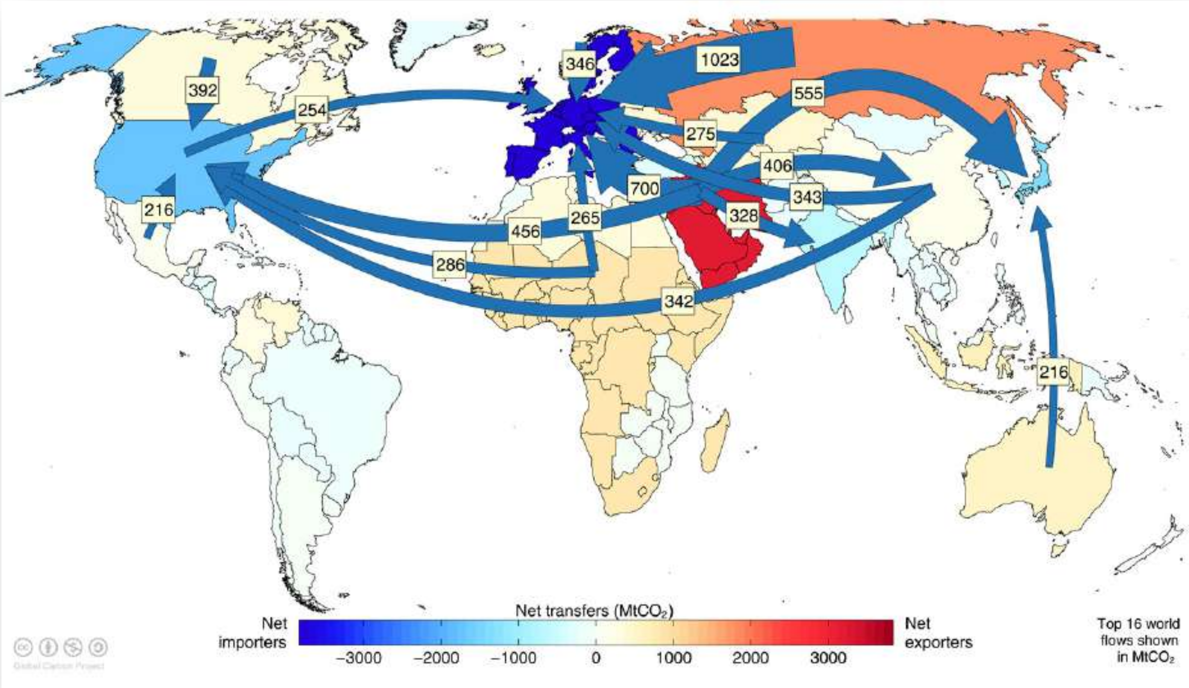


Global fossil CO2 emissions

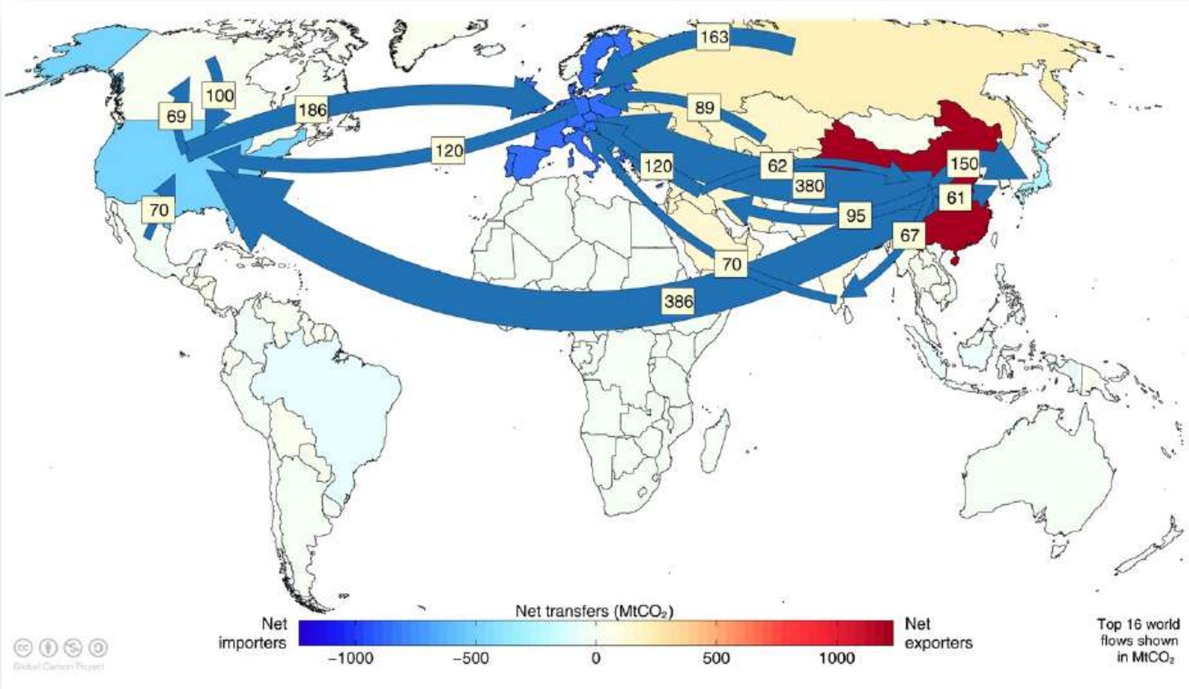
electricity, heat, & energy (45%), industry (23%), national transport (19%), international aviation and marine bunkers (3.5%), remaining sectors (10%)



Flows from location of fossil fuel extraction to location of consumption of goods and services

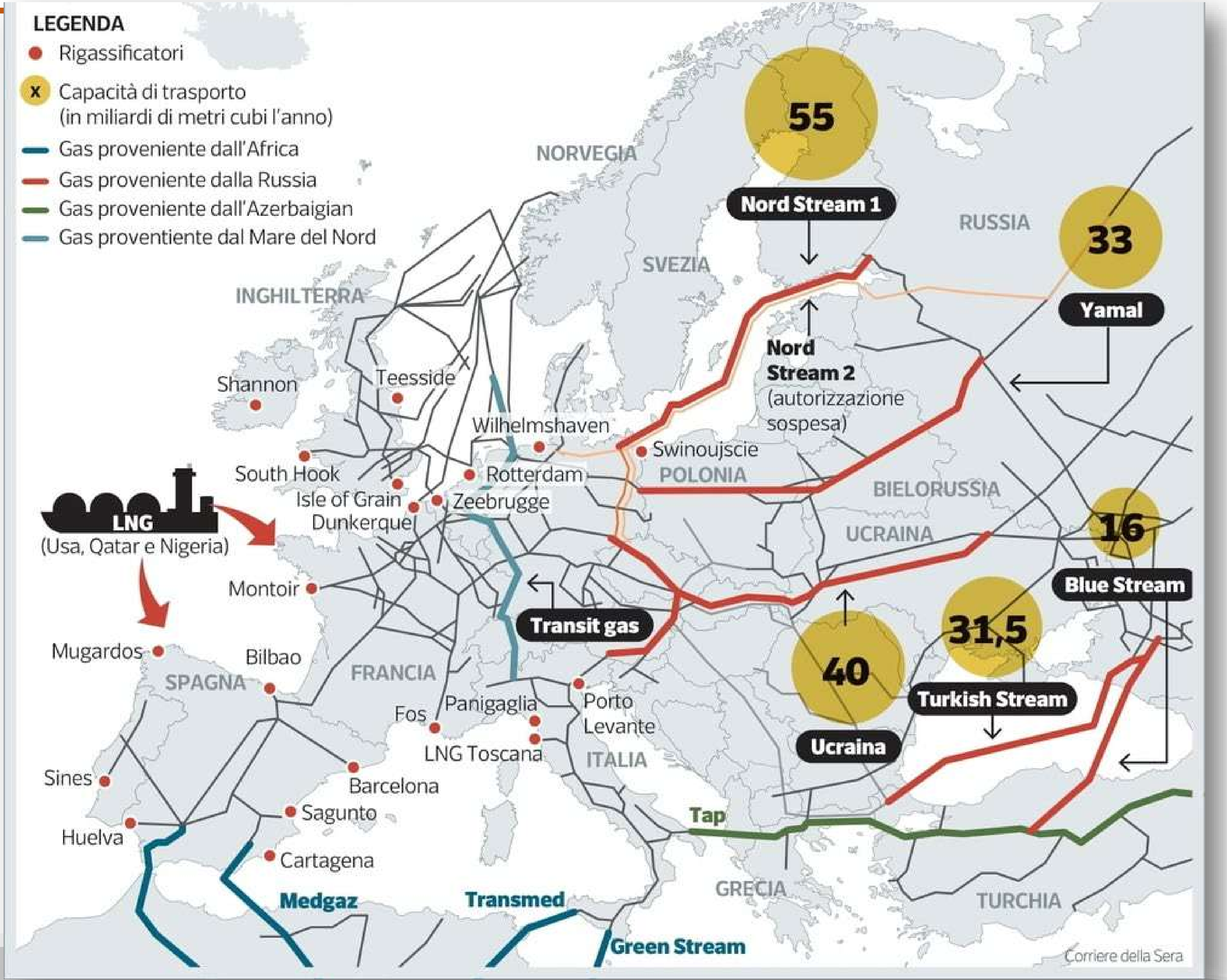


Flows from location of generation of emissions to location of consumption of goods and services



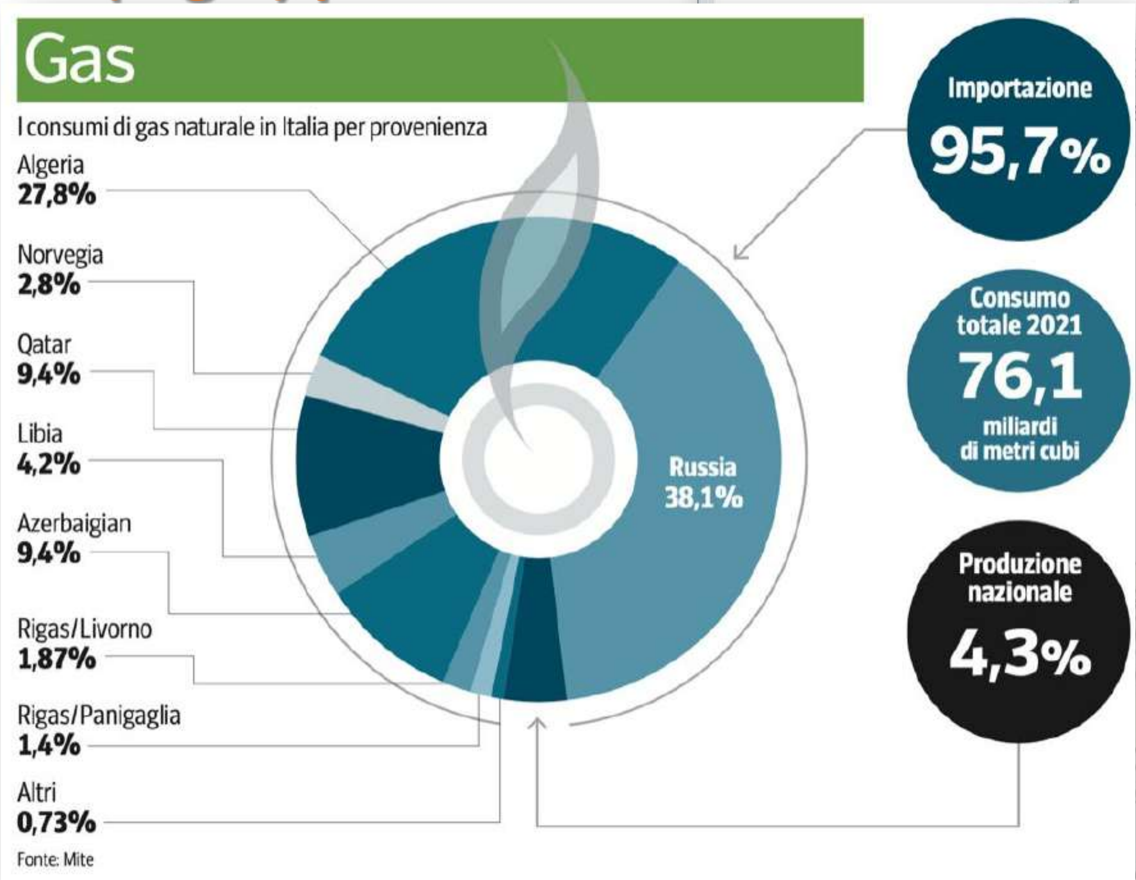
Geo(grafia) politica

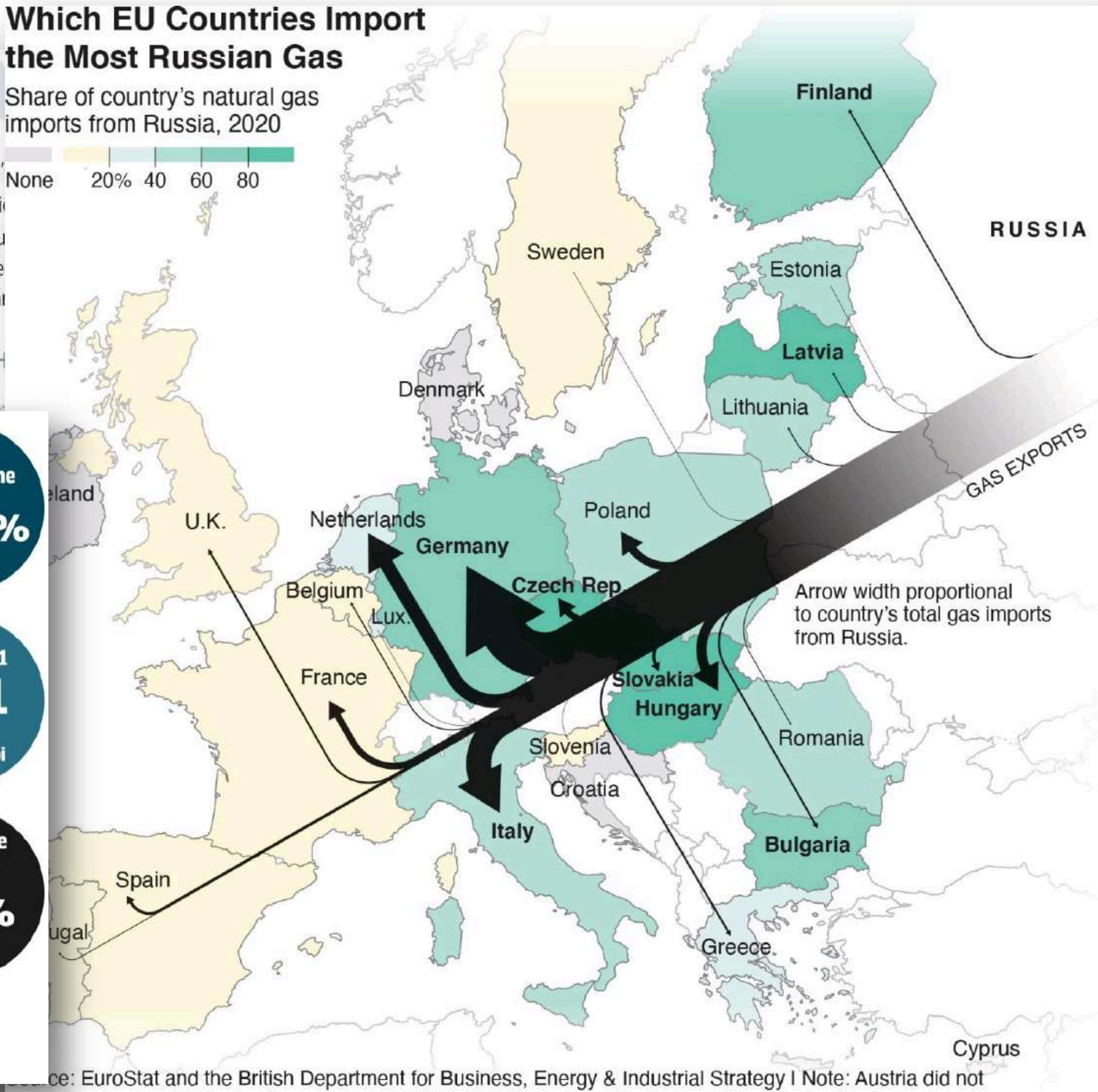
Geo(logia) politica



Geo(grafia) politica

Geo(logia) politica





Perché le previsioni a volte sbagliano clamorosamente?

*Due tipi di incertezze possono portare a grandi errori di previsione di sistemi complessi: le incognite sconosciute (**unknown unknowns**) e le incognite conosciute (**known unknowns**).*
*Le prime, dette **epistemiche**, riguardano il fatto che nei sistemi complessi ci sono più variabili di quante se ne possano considerare. Le seconde, dette **stocastiche**, si riferiscono alla natura intrinsecamente non lineare di molti sistemi complessi, tra cui i sistemi energetici.*
*Gli eventi che portano ai primi tipi di errori sono definiti "cigni neri" (**black swan**), quelli che portano ai secondi sono invece definiti "cigni morenti" (**dying swan**).*

(Alberto Clò)

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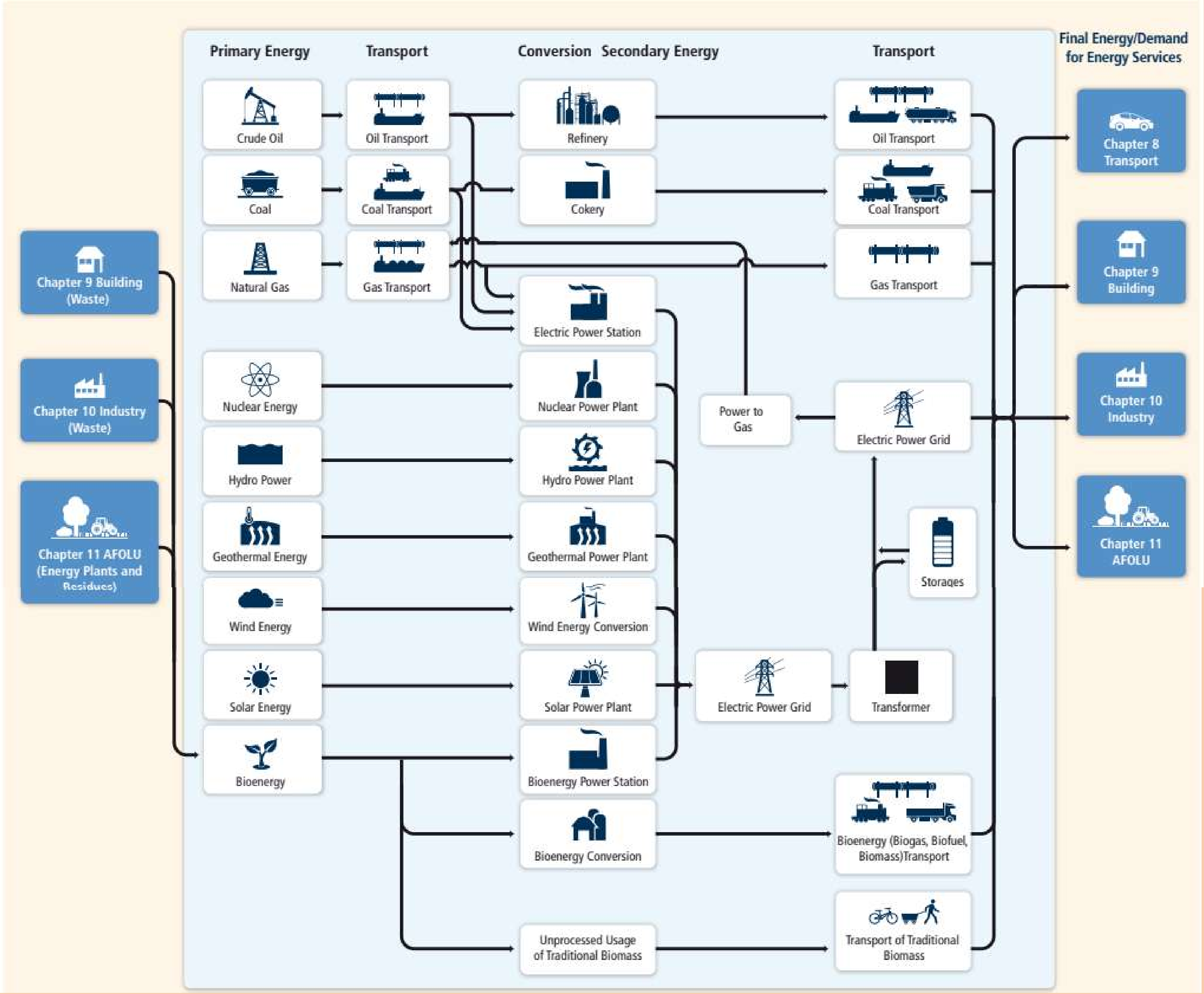

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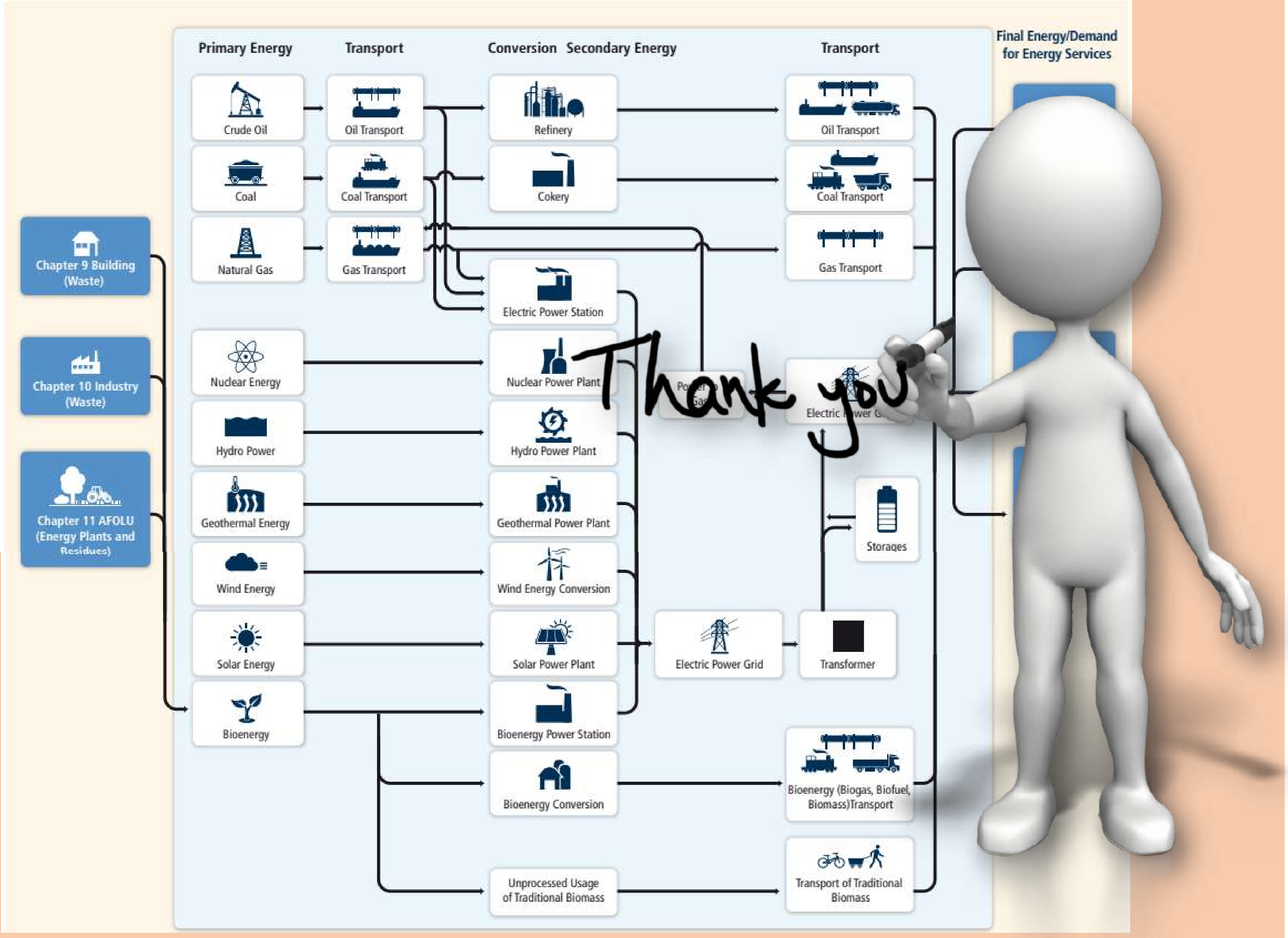

Primary Energy
Transport
Conversion
Secondary Energy
Transport
Final Energy/Demand for Energy Services
Chapter 9 Building (Waste)
Chapter 10 Industry (Waste)
Chapter 11 AFOLU (Energy Plants and Residues)
Crude Oil
Oil Transport
Refinery
Oil Transport
Coal
Coal Transport
Cokery
Coal Transport
Natural Gas
Gas Transport
Gas Transport
Electric Power Station
Nuclear Energy
Nuclear Power Plant
Hydro Power
Hydro Power Plant
Geothermal Energy
Geothermal Power Plant
Wind Energy
Wind Energy Conversion
Solar Energy
Solar Power Plant
Electric Power Grid
Transformer
Storages
Bioenergy
Bioenergy Power Station
Bioenergy Conversion
Bioenergy (Biogas, Biofuel, Biomass)Transport
Unprocessed Usage of Traditional Biomass
Transport of Traditional Biomass
Thank you