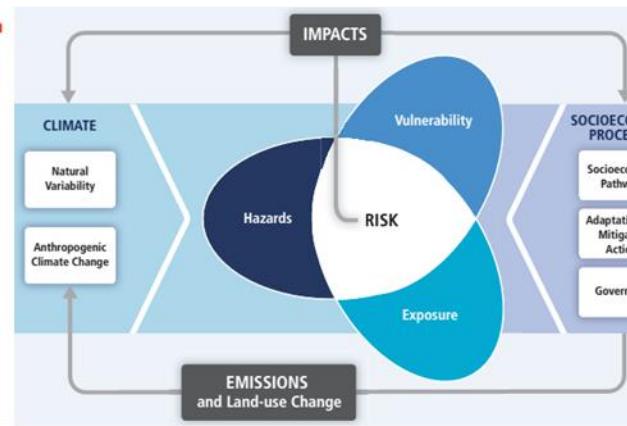
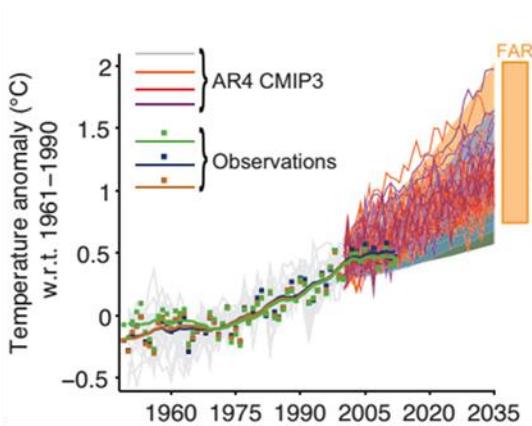
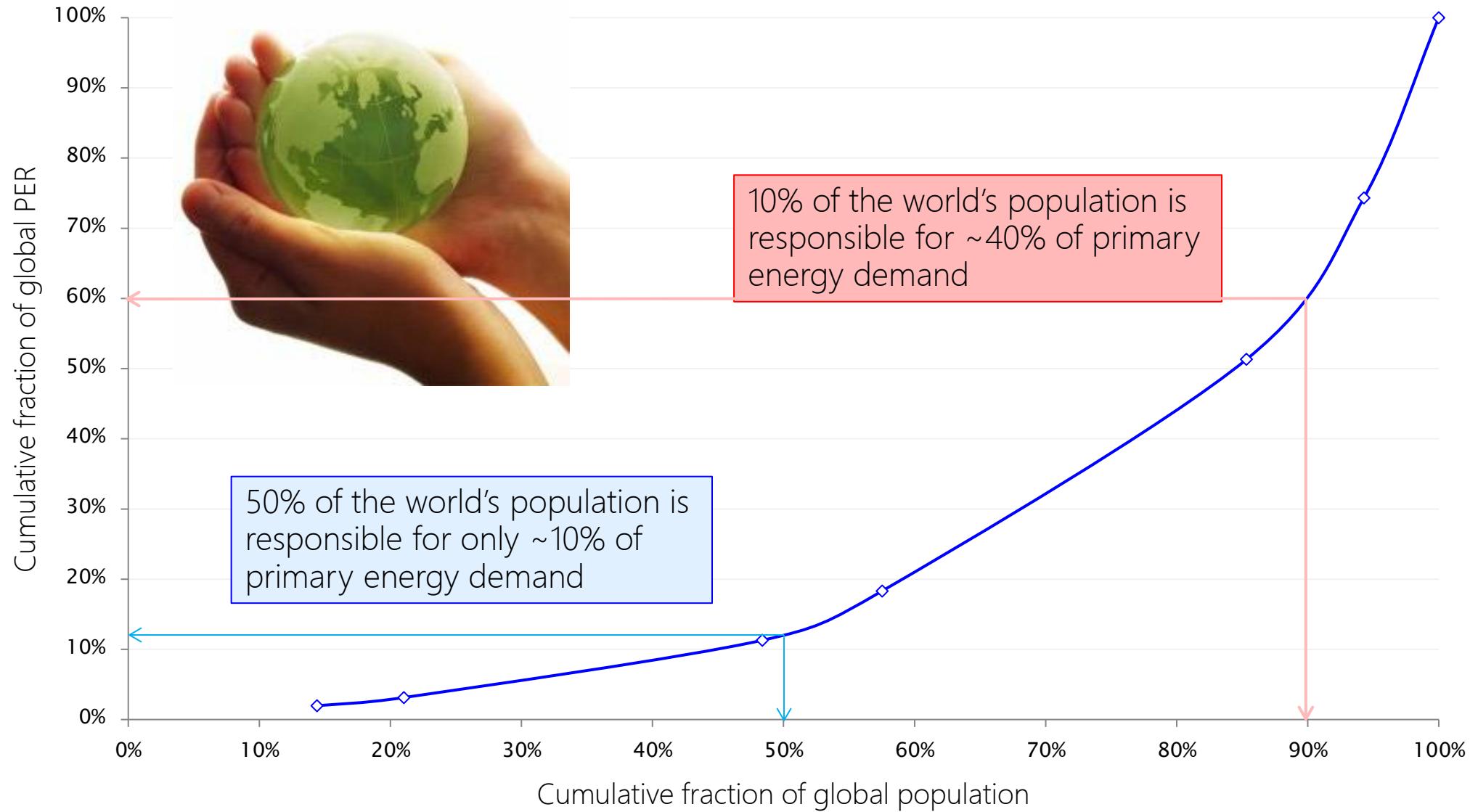


Energy Systems & Climate Change

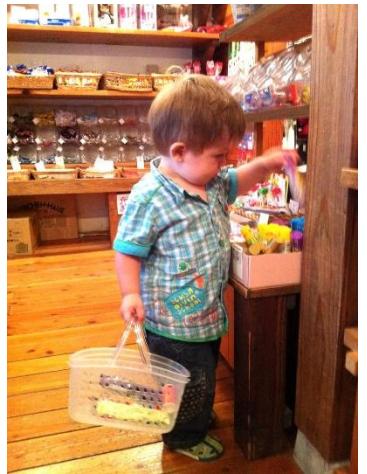






↑ Measures ↓

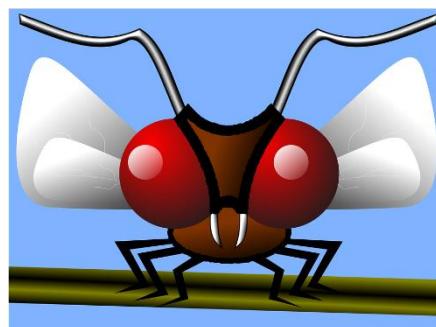
	Secure	Affordable	Sustainable
Increase supply			
Increase share of Renewables			
Energy efficiency			
CCS			
Alternative fuels			
Supply diversification / pooling			
Market adjustments			
Research & innovation			



Am I a buyer, or a seller?



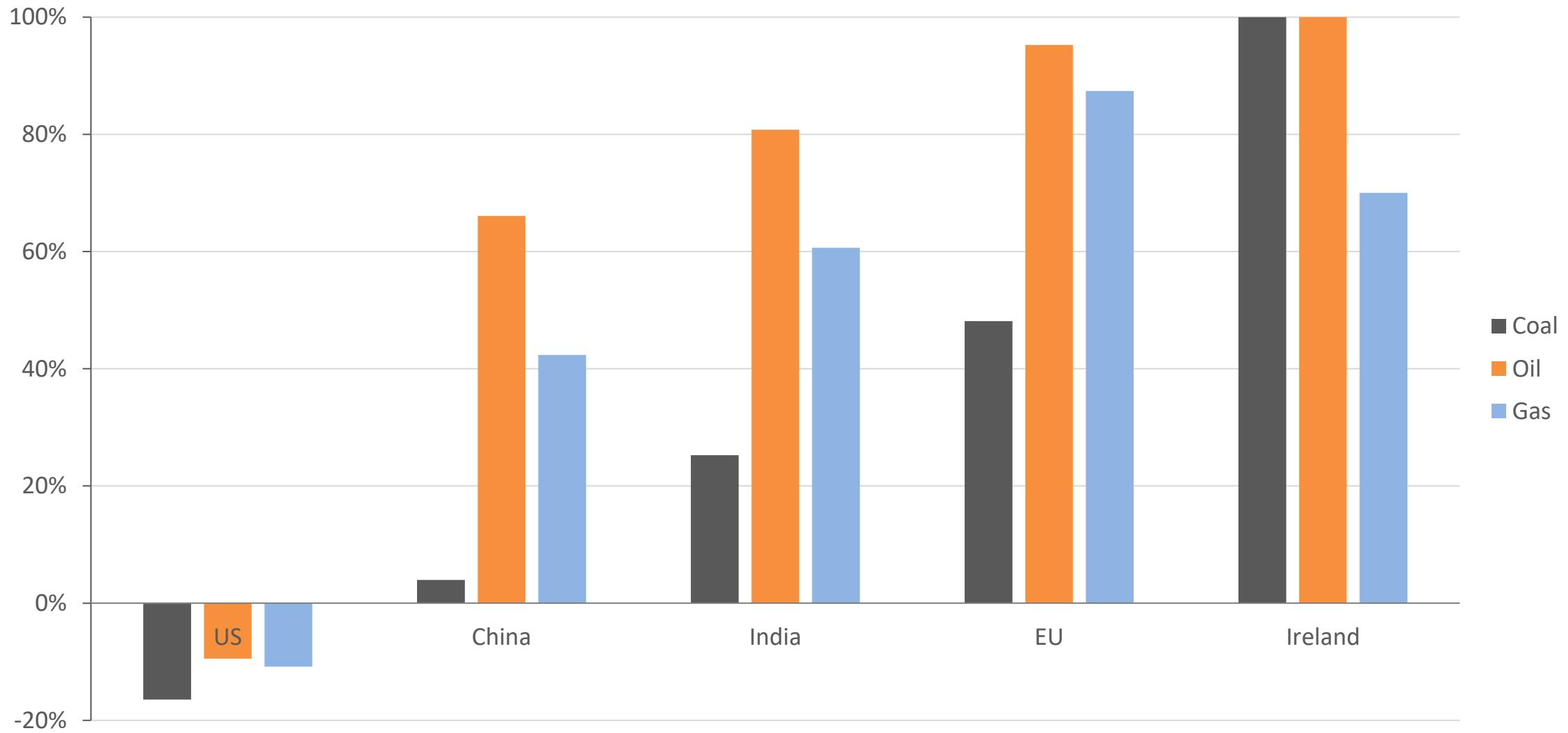
Am I wealthy, or trying to develop?



Is my time horizon short, or long?

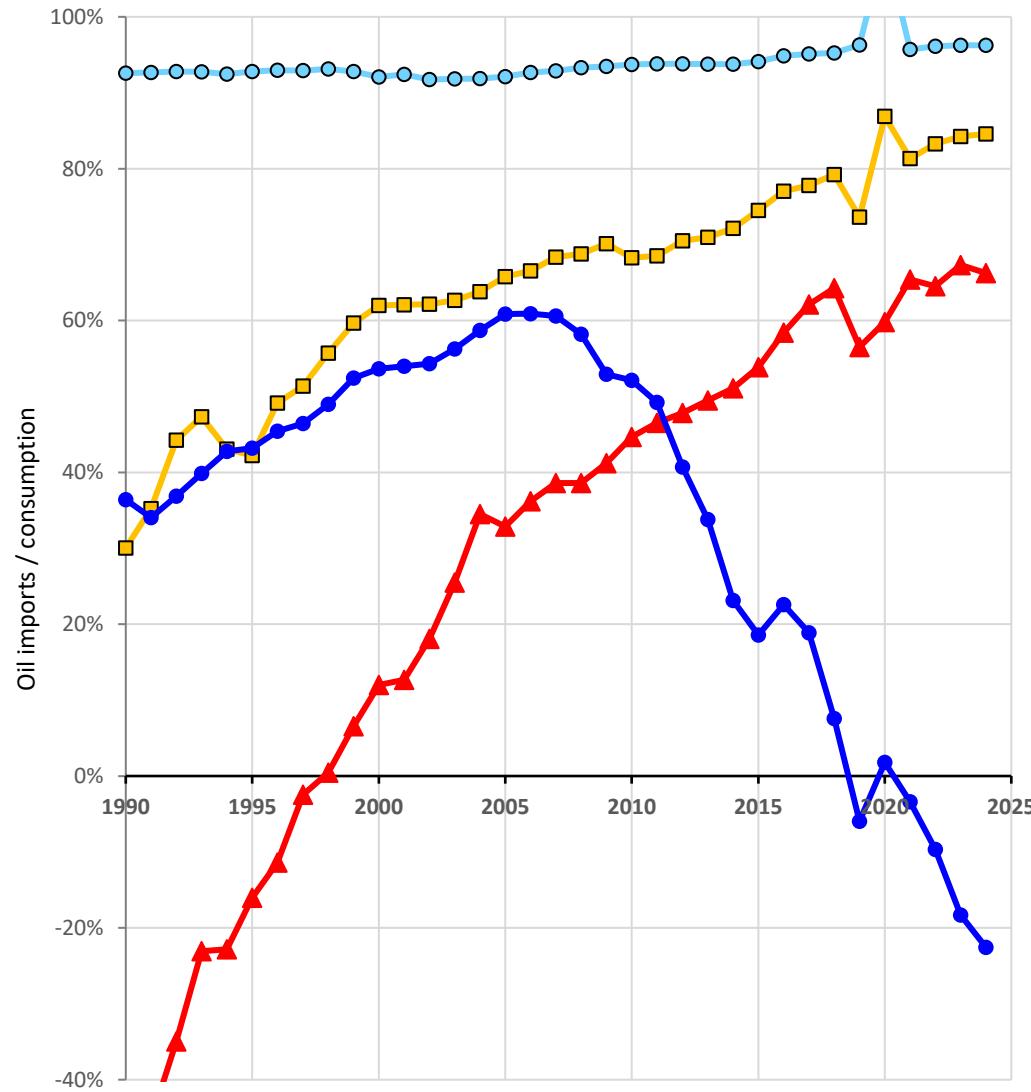


Import dependence, by region and fuel, 2020

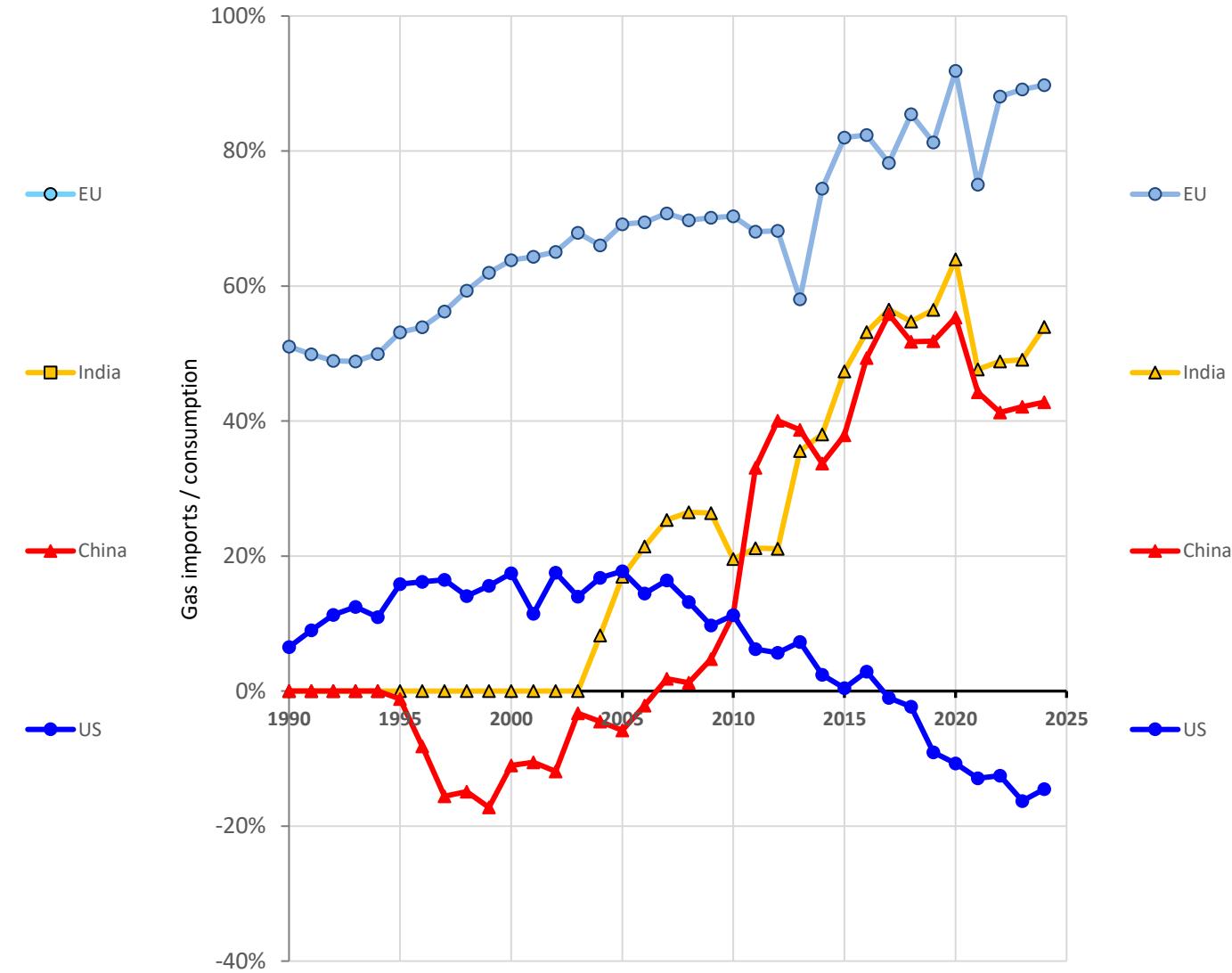


Raw data: BP Statistical Review of World Energy 2021

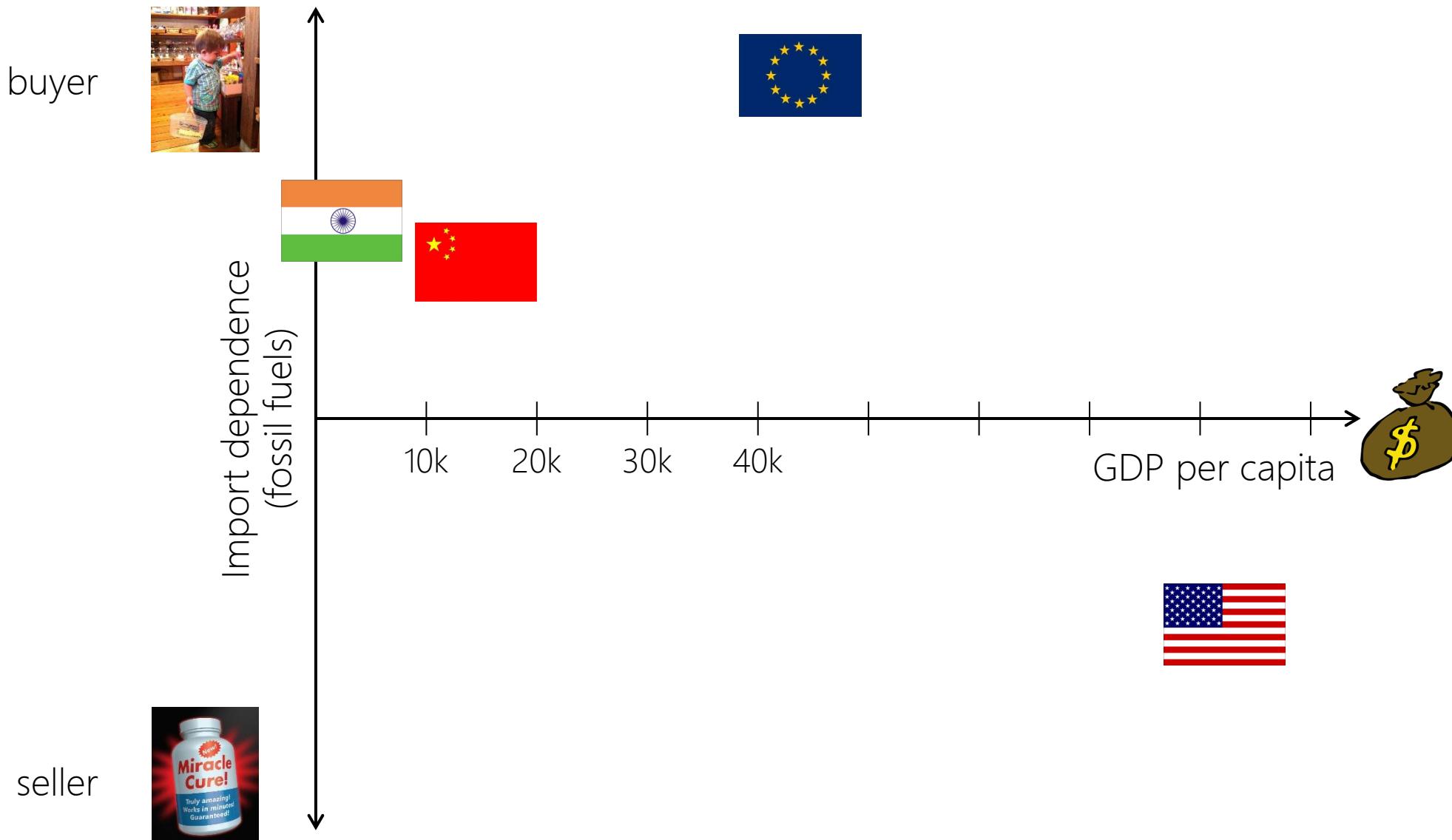
Oil: implied import-dependence



Gas: implied import-dependence



Raw data: Statistical Review of World Energy





India's perspective: increase supply, at minimum cost



China's perspective: grow supply; increase security; improve efficiency; reduce environmental impact



US perspective: guarantee supply, minimise costs, let the markets decide ("drill, baby, drill")



EU perspective: reduce demand; diversify supply; increase sustainability;control costs?



Russia's perspective: increase exports; achieve best prices; exploit political leverage

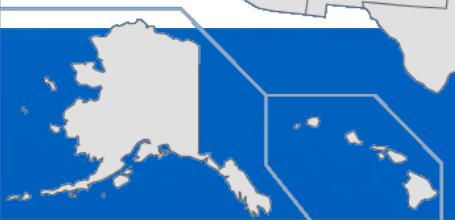


Africa's perspective: who cares...?



4





U.S.A.





Mostly State-based: Historically, no clearly-articulated energy policy at Federal level:
States develop individual policies, and pursue them at a local rate.

A more centralised (coherent) approach was developed under the Obama administration:

- 2009 American Recovery and Reinvestment Act
- 2013 Clean Air Plan
- 2015 Clean Power Plan; signed Paris Climate Agreement



Many of these measures were rolled back during the Trump administration.

- 2020 Formally withdrew from Paris Climate Agreement



Biden administration restores environmental focus

- 2021 Officially rejoined Paris Climate Agreement
- 2022 Climate Bill signed into law

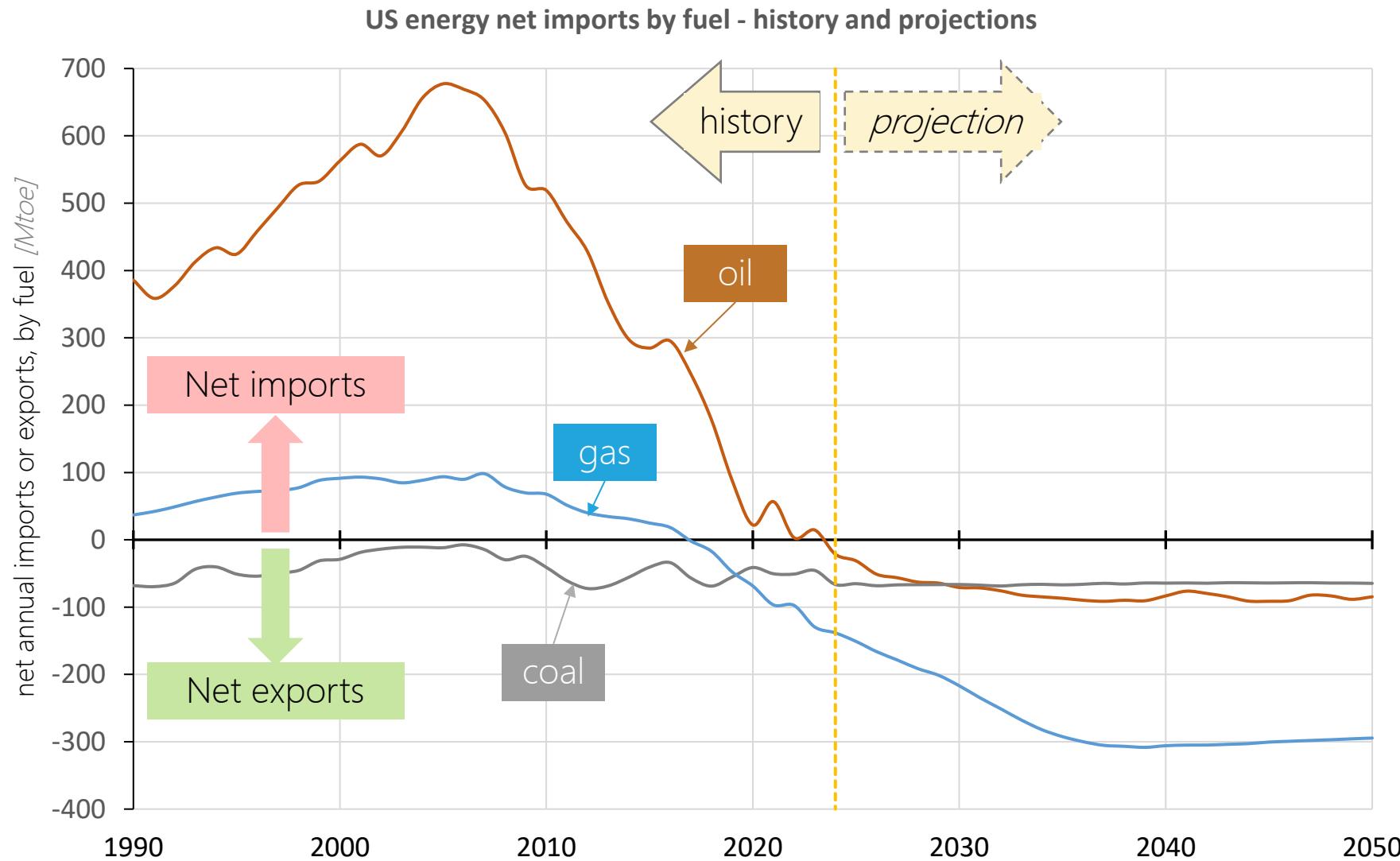


¹ Statistical Review of World Energy. www.energyinst.org

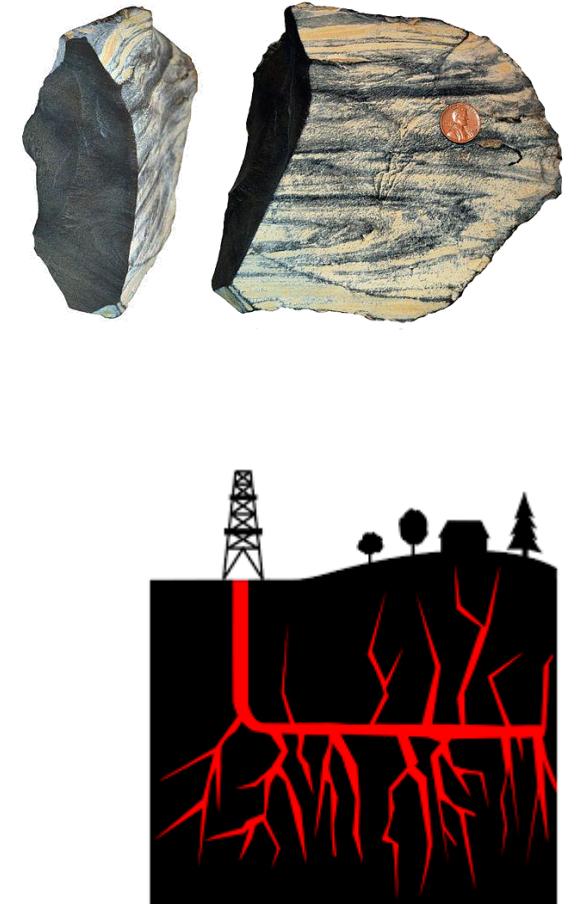
² World Bank. databank.worldbank.org



Shale gas, and shale oil, have transformed the U.S. energy landscape.



Raw data: Annual Energy Outlook 2025, US Energy Information Administration. <https://www.eia.gov/outlooks/aeo/>





Scarcity mindset

1973 – 2008



Energy security

Shale oil / gas

Trump



Abundance mindset

2017 – 2020



“Energy dominance”

- maximise energy production,
- benefit from larger energy exports,

Russia, Saudi Arabia

China

- be a global leader in energy technologies

- keep consumer energy bills in check.



Biden



Sustainability mindset

2021 – 2024

NDC (2021):
50-52% reduction in GHG,
by 2030, re 2005

Net-zero pledge: 2050

Infrastructure Bill (2021)

Climate Bill (2022)

Suggested reading: International Energy Agency (2019). Energy Policies of IEA Countries: United States 2019 Review.



Trump 2.0

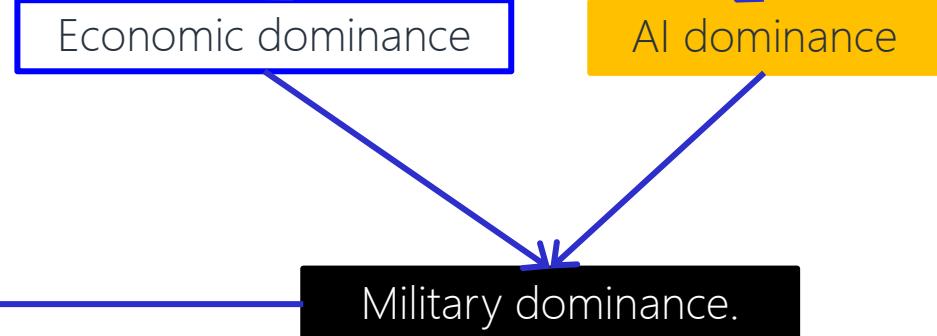
2025 – 2028

Executive Order 14154
(20 Jan 2025)



The return of
“Energy dominance”

- Abundant
- Cheap
- Secure





Unleashing American Energy

It is the policy of the United States:

Executive Orders | January 20, 2025

- (a) to encourage energy exploration and production on Federal lands and waters, including on the Outer Continental Shelf, in order to meet the needs of our citizens and solidify the United States as a global energy leader long into the future;
- (b) to establish our position as the leading producer and processor of non-fuel minerals, including rare earth minerals, which will create jobs and prosperity at home, strengthen supply chains ...and reduce the global influence of malign and adversarial states;
- (c) to protect the United States's economic and national security and military preparedness by ensuring that an abundant supply of reliable energy is readily accessible in every State and territory of the Nation;
- (d) to ensure that all regulatory requirements related to energy are grounded in clearly applicable law;

abundance



Unleashing American Energy

It is the policy of the United States:

Executive Orders | January 20, 2025

- (e) to eliminate the "electric vehicle (EV) mandate" and promote true consumer choice, ...elimination of unfair subsidies...that favor EVs...and effectively mandate their purchase...by rendering other types of vehicles unaffordable;
- (f) to safeguard the American people's freedom to choose from a variety of goods and appliances, including but not limited to lightbulbs, dishwashers, washing machines, gas stoves, water heaters, toilets, and shower heads, ...;
- (g) to ensure that the global effects of a rule, regulation, or action shall, whenever evaluated, be reported separately from its domestic costs and benefits, in order to promote sound regulatory decision making and prioritize the interests of the American people;
- (h) to guarantee that all executive departments and agencies (agencies) provide opportunity for public comment and rigorous, peer-reviewed scientific analysis; and
- (i) to ensure that no Federal funding be employed in a manner contrary to the principles outlined in this section, unless required by law.

THE CLAREMONT INSTITUTE
CENTER FOR THE



- Big boost for oil and gas
- Encouragement for nuclear industry
- Big focus on (energy for) AI
- "Whiplash" discourages RES investors

8th April 2025

Executive Order 14260: Protecting American Energy From State Overreach

4th July 2025

One Big Beautiful Bill Act (focuses mainly on taxes, and tax credits)

- Removes tax credits for EV
- Removes tax credits for home insulation
- Removes tax credits for residential solar, batteries, heat pumps, etc.
- Requires the leasing of at least 50% of public lands that private companies desire to lease for drilling, mining or logging
- Accelerates phase-out of tax credits for wind and solar
- Retains tax credits for nuclear, biofuels....and CCS (!)
- Increases tax credits for advanced semiconductor manufacturing





Context:

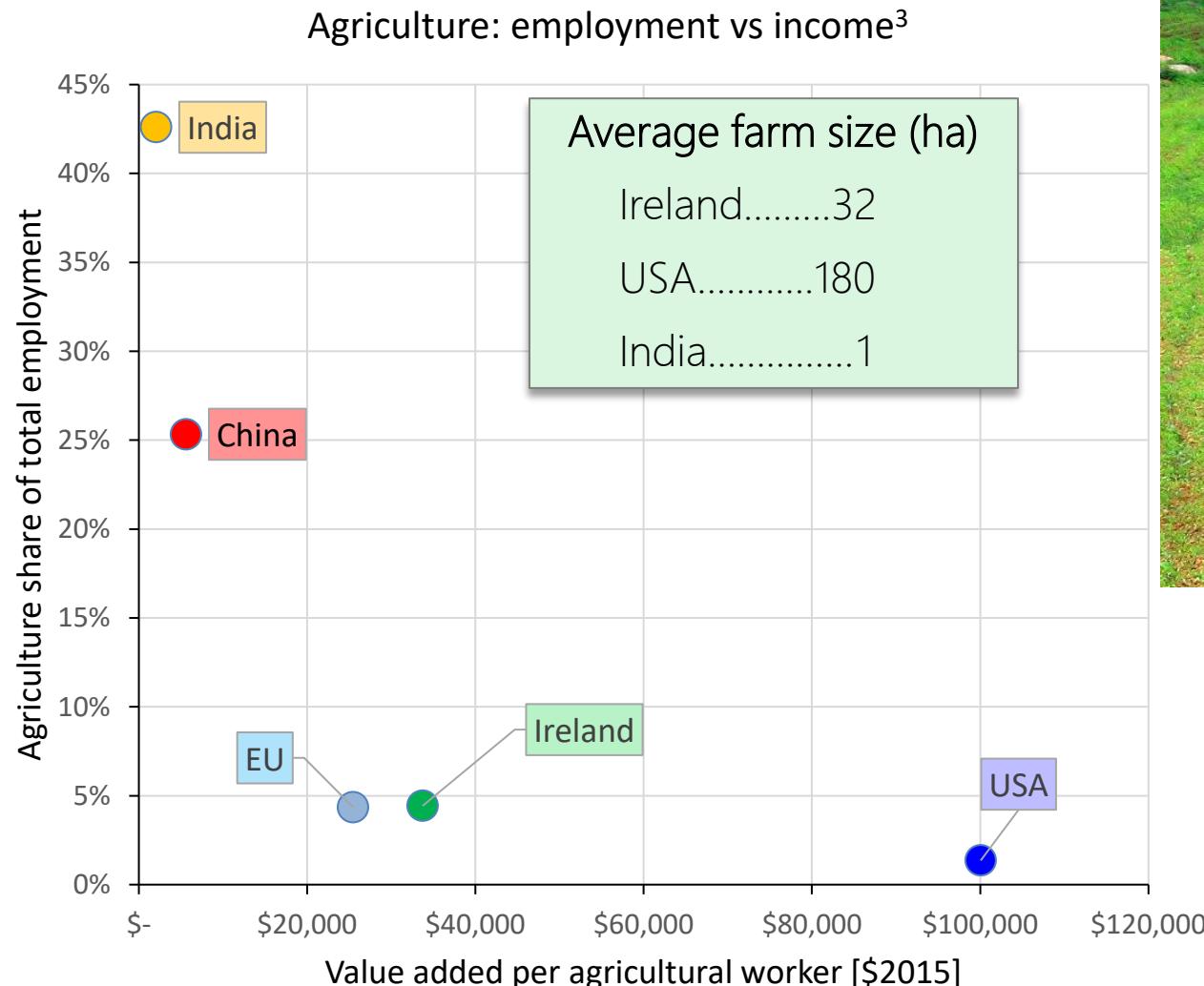
Energy-intensity (PPP), relative to Ireland²: 340%

	India	EU27	Ireland
Land area [million km ²]	3.3	4.0 (121%)	0.07
Area/Coastline [km]	434	60 (14%)	0.02
Population	1,390	447 (32%)	5
Median age [y]	29	44 (150%)	38 (130%)
Official Languages	22	24	2
GDP per capita [\$'000, PPP]	7	48 (x 6.9)	106 (x 16.5)

¹ Statistical Review of World Energy, 2025. www.energyinst.com² World Bank. databank.worldbank.org³ Raw data: World Development Indicators. databank.worldbank.org



Context:

Energy-intensity (PPP), relative to Ireland²: 340%¹ Statistical Review of World Energy, 2025. www.energyinst.com² World Bank. databank.worldbank.org³ Raw data: World Development Indicators. databank.worldbank.org



5-year cycle for National Energy Plan and National Electricity Plan



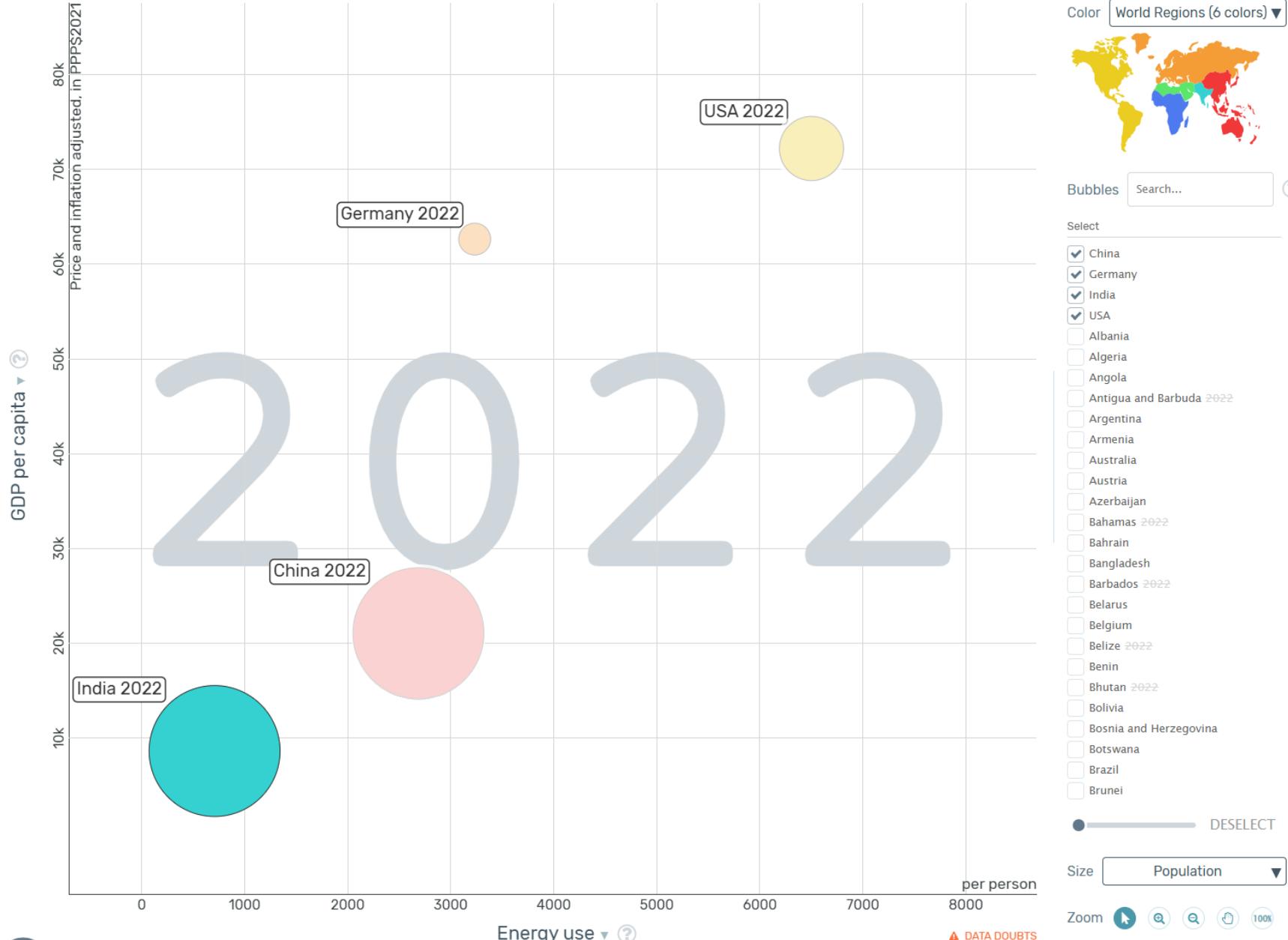
India's National Energy Policy (NEP)¹:

1. Access at affordable prices
2. Improved security and independence
3. Greater sustainability
4. Economic growth

- ~750 million people in India gained (some) access to electricity between 2000 and 2019.
- significant reduction in the use of traditional biomass in cooking (replaced by LPG)
- coal continues to be the largest domestic source of energy supply and of electricity generation (>70% of electricity from coal)
- energy and CO₂ intensities of GDP have decreased by >20% over the past decade

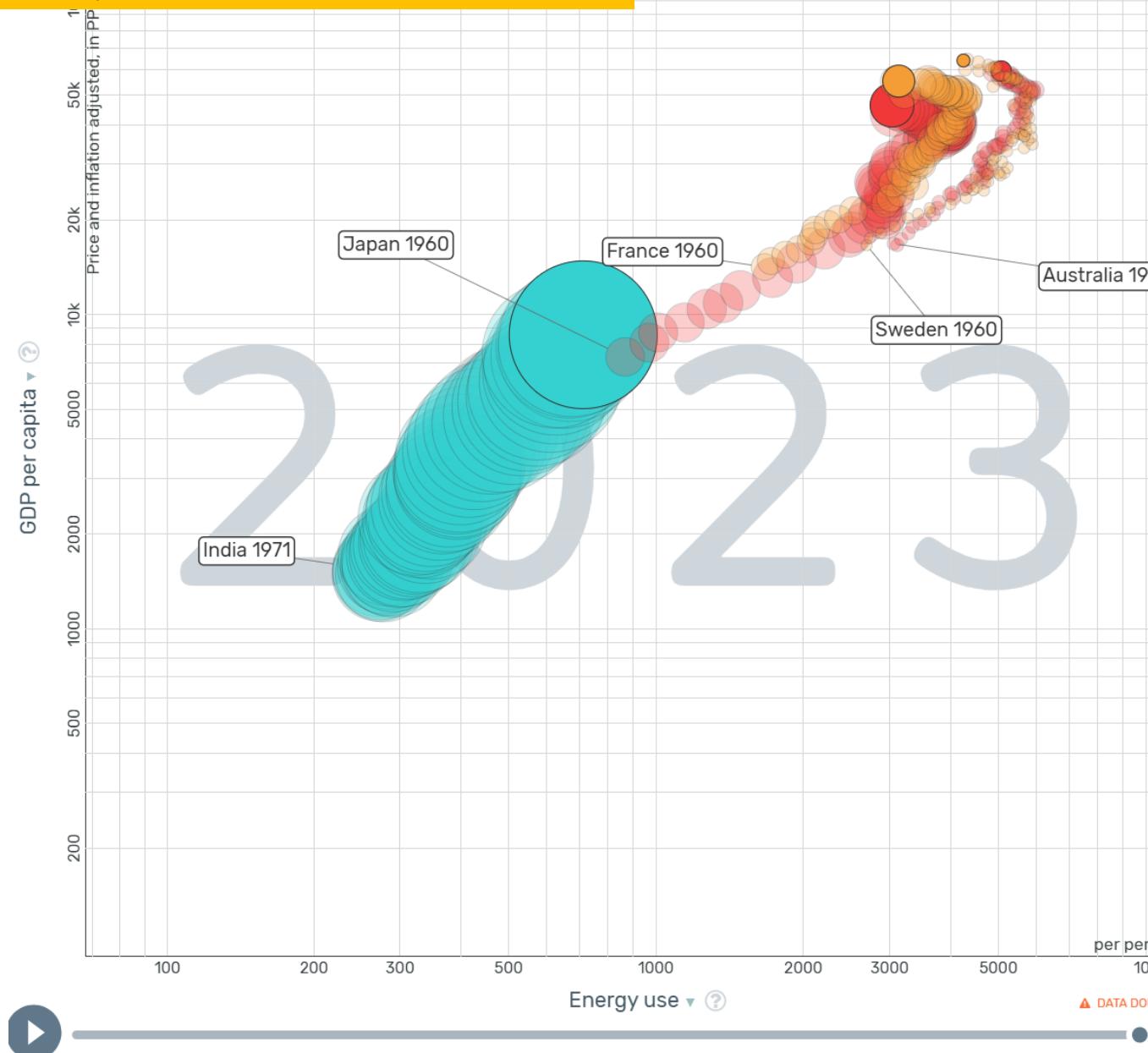
¹ Source: <https://www.jagranjosh.com/articles/highlights-of-niti-aayogs-draft-national-energy-policy-2017-1507285915-1>
Data Source: India 2020 Energy Policy Review. International Energy Agency, 2020

Energy & climate policies: India



Energy & climate policies: India

Color World Regions (6 colors) ▾



Bubbles Search... ?

- India
- Japan
- Sweden
- Albania 2023
- Algeria 2023
- Angola 2023
- Antigua and Barbuda 2023
- Argentina 2023
- Armenia 2023
- Austria
- Azerbaijan 2023
- Bahamas 2023
- Bahrain
- Bangladesh 2023
- Barbados 2023
- Belarus 2023
- Belgium
- Belize 2023
- Benin 2023
- Bhutan 2023
- Bolivia 2023
- Bosnia and Herzegovina 2023
- Botswana 2023
- Brazil
- Brunei 2023
- Bulgaria 2023
- Burkina Faso 2023
- Cambodia 2023

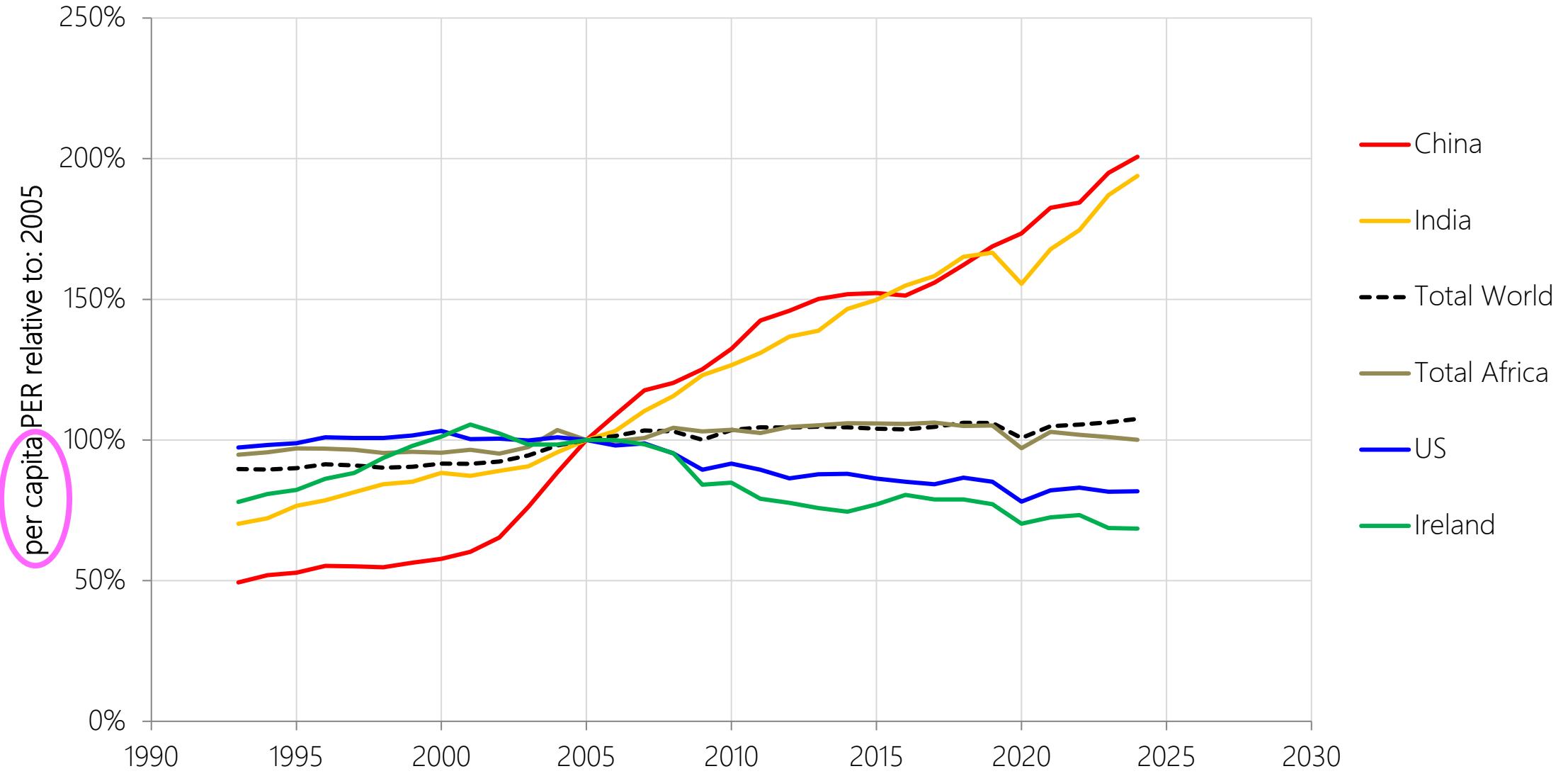
DESELECT

Size Population ▾

Zoom 100%

TRAILS OPTIONS PRESENT EXPAND





Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>



COP26: India PM Narendra Modi pledges net zero by 2070

① 2 November



COP26



India's Prime Minister outlines five commitments for his country at COP26

India wants to tie installations to local manufacturing

Future Solar Bids to be Coupled with 50 Percent Manufacturing Component: R.K. Singh

Power Minister R.K. Singh said the government will gradually add storage systems to solar tenders

JUN 27, 2018 / NITIN KABEER / MANUFACTURING, SOLAR

ENVIRONMENT

COP27 | India insists on new global climate finance target by 2024



PTI

NEW DELHI NOVEMBER 10, 2022 16:13 IST
UPDATED: NOVEMBER 10, 2022 20:38 IST

SHARE ARTICLE | [f](#) | [t](#) | [g](#) | [w](#) | [m](#) | [c](#) 0 | [PRINT](#) | [A](#) | [A](#) | [A](#)

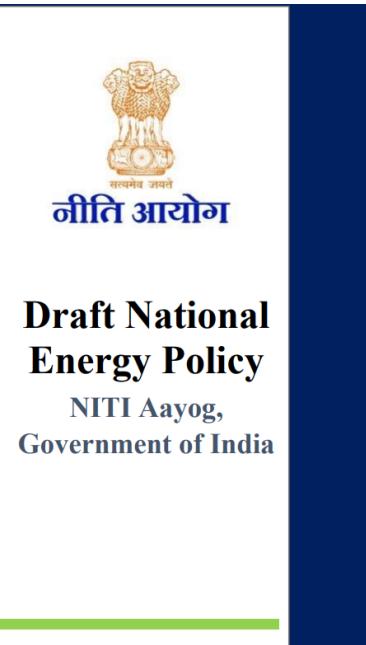


India's Union Minister for Environment Forest and Climate Change Shri Bhupender Yadav at the second edition of the summit of the Green Middle East Initiative, held on the sidelines of the COP27 climate conference at Egypt's Red Sea resort city of Sharm el-Sheikh on November 7, 2022. | Photo Credit: AFP

Source: <http://www.pib.nic.in/release/release.asp?relid=46172>



5-year cycle for National Energy Plan and National Electricity Plan



Implications of the Draft National Energy Policy for 2030:

- Share of non-fossil-based capacity in electricity: **54%-64%**
- Increase the share of natural gas in the energy mix to 15% by 2030, from 6% today.
- Per capita energy demand: **+30% re 2017**
- Per capita, energy-related, CO₂ emissions: **+85% re 2017**
- Per capita electricity consumption: **+100% re 2017**
- Reduction in emissions intensity **46%-55% re 2005**

Note: India's population is expected to increase by ~10% between 2017 and 2030.

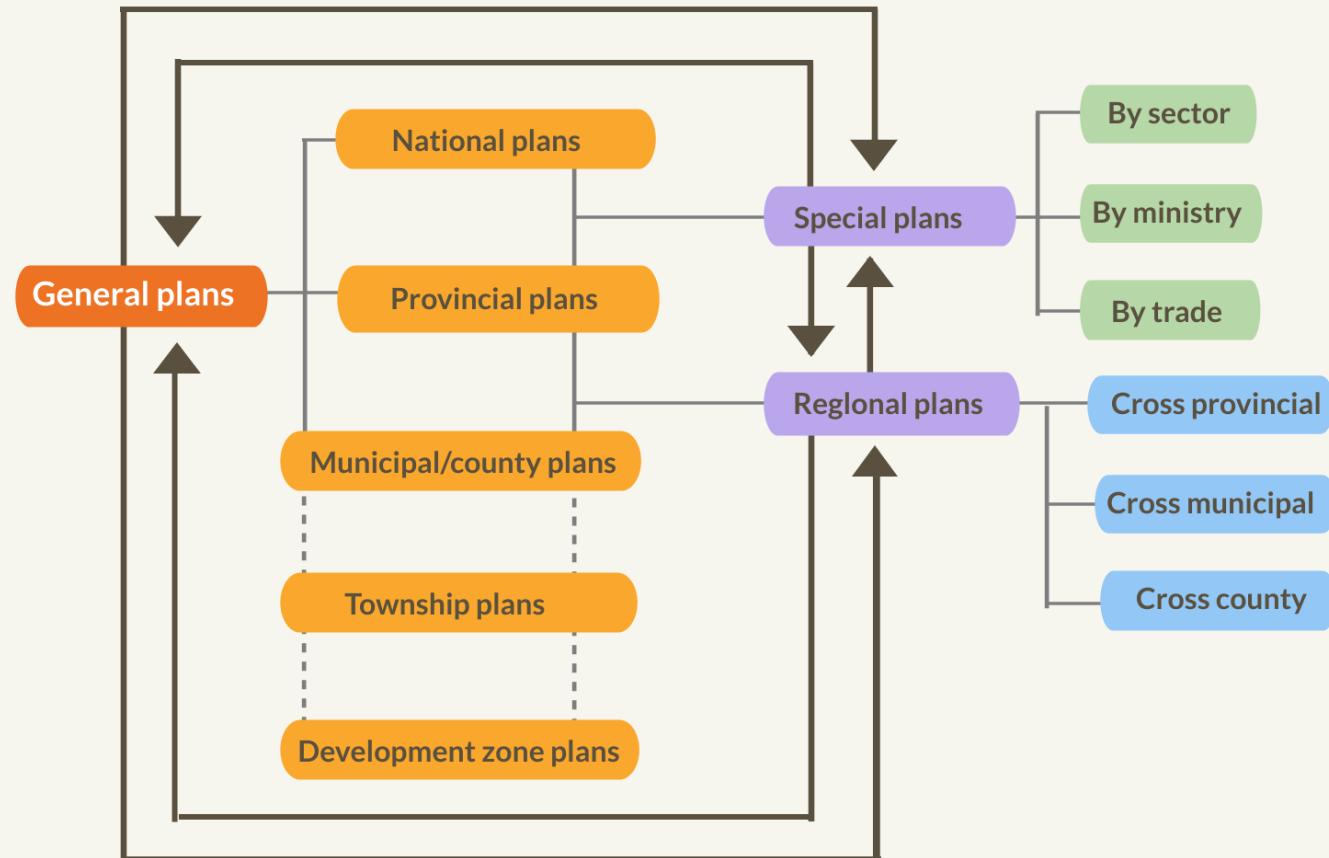
Source: <https://www.niti.gov.in/draft-national-energy-policy>



China



Flow chart of plan formulation in China

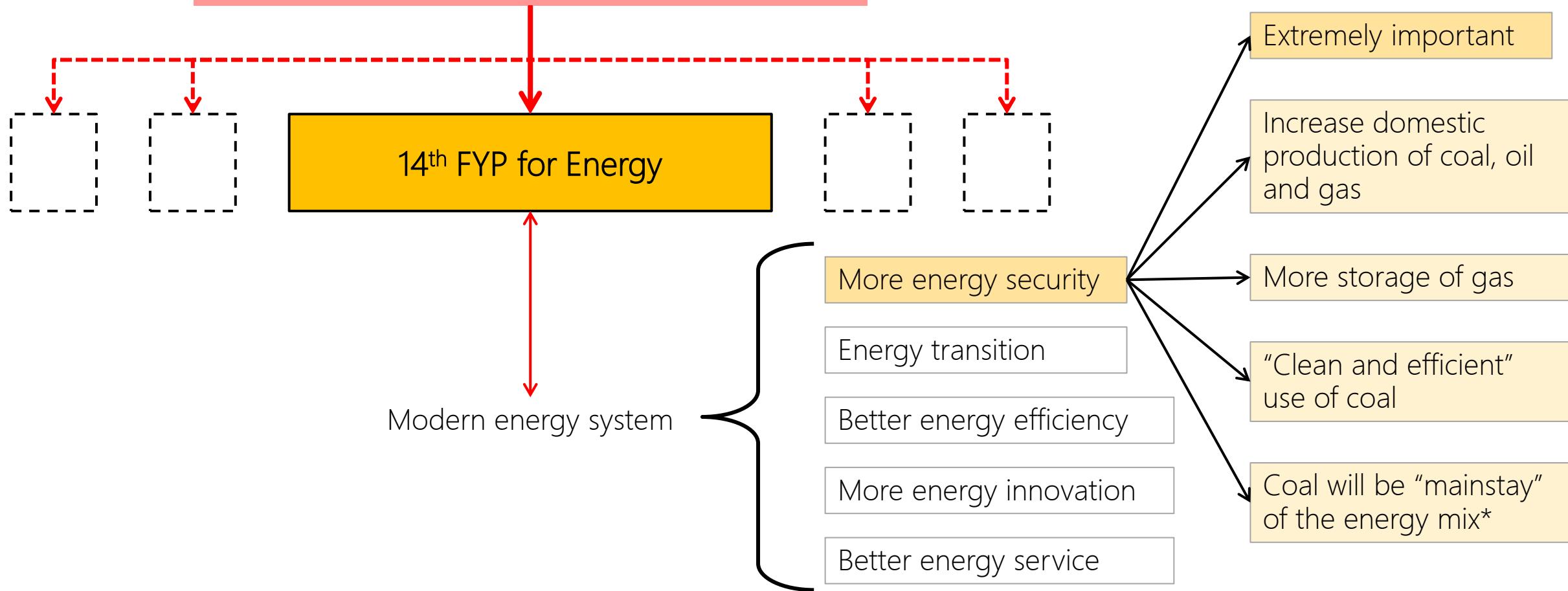


China's policies are formulated in 5-year plans.

¹ BP Statistical Review of World Energy, 2022. www.bp.com

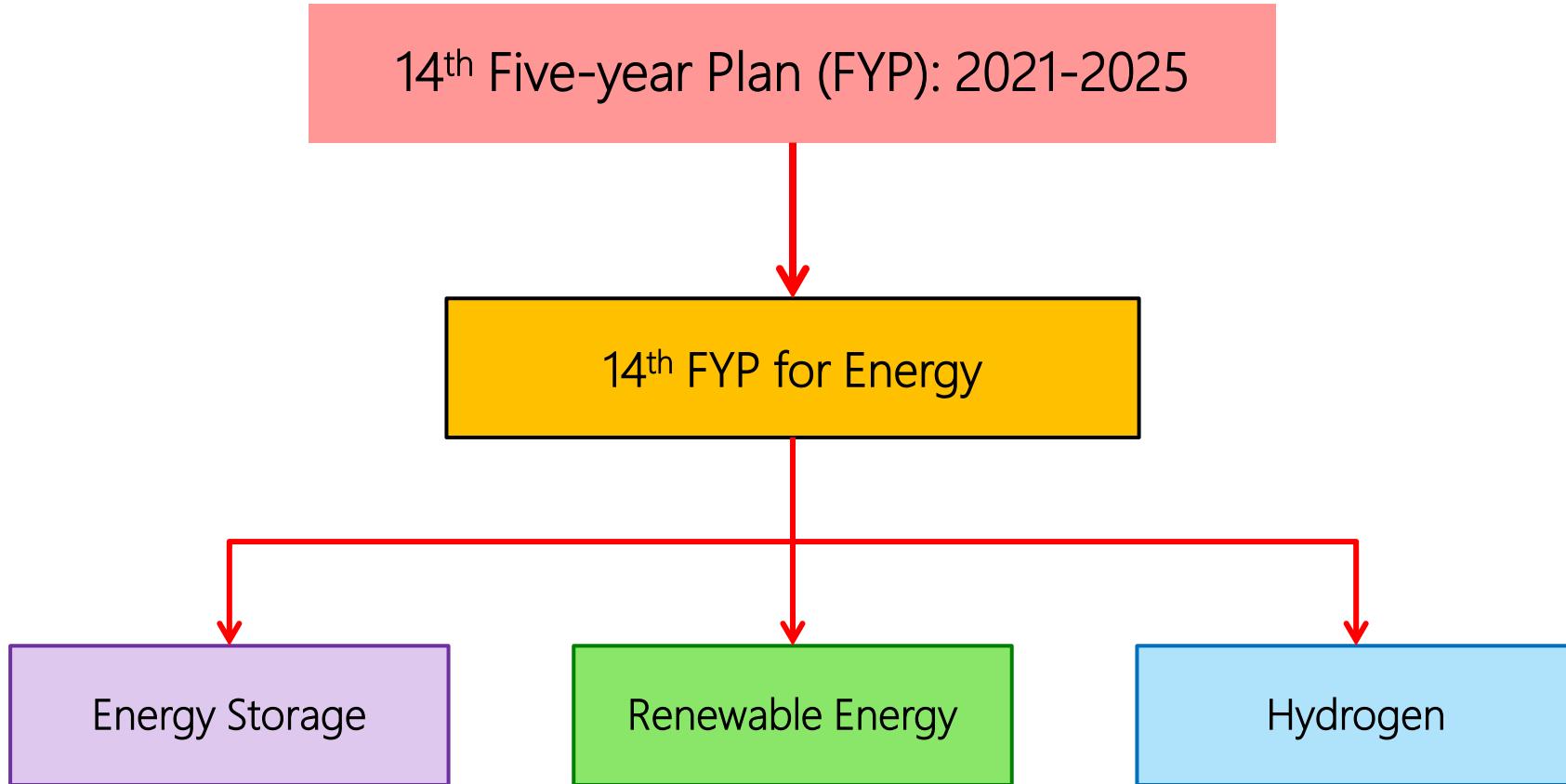
² World Bank. databank.worldbank.org

Image source: <https://chinadialogue.net/en/climate/9532-china-raises-its-low-carbon-ambitions-in-new-2-2-targets/>

14th Five-year Plan (FYP): 2021-2025

Further reading: <https://www.carbonbrief.org/china-briefing-24-march-2022-14fyp-energy-plan-more-plans-on-energy-storage-and-hydrogen-chinas-emissions-analysis/>

* <https://www.mei.edu/publications/china-prioritizes-short-term-energy-security-implications-sino-middle-east-relations/>



More reading: <https://www.carbonbrief.org/china-briefing-24-march-2022-14fyp-energy-plan-more-plans-on-energy-storage-and-hydrogen-chinas-emissions-analysis/>



China's 2025 Renewable Energy Targets				
Indicators	Unit	2020 level	2025 target	
1. Renewable electricity utilization				
Renewable electricity consumption share	%	28.8	33.0	
Non-hydro renewable electricity consumption share	%	11.4	18.0	
Renewable electricity generation	TWh	2.21	3.30	
2. Renewable non-electric utilization (geothermal heating, biomass heating and fuel, as well as solar heating)	Mtce	/	60	
3. Total renewable consumption	Gtce	0.68	1.00	
4. Non-fossil power generation share	%	33.9	39.0	
5. Electrification rate	%	27.0	30.0	
6. During 2021 to 2025, more than 50% of the country's incremental electricity and incremental energy consumption to come from renewables.				

¹ Source: <https://www.efchina.org/Blog-en/blog-20220905-en#:~:text=The%20plan%20targets%20a%2050,China's%20incremental%20electricity%20and%20energy>



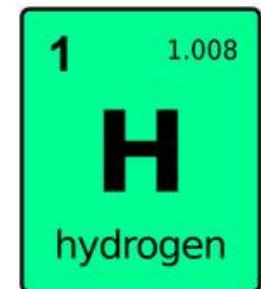
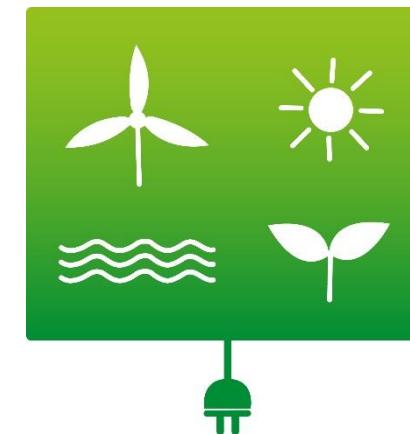
China's Top Priorities Have Changed Regarding Energy

- Energy security the number 1 priority
- Increased emphasis on decarbonisation
- Focus on capacity expansion



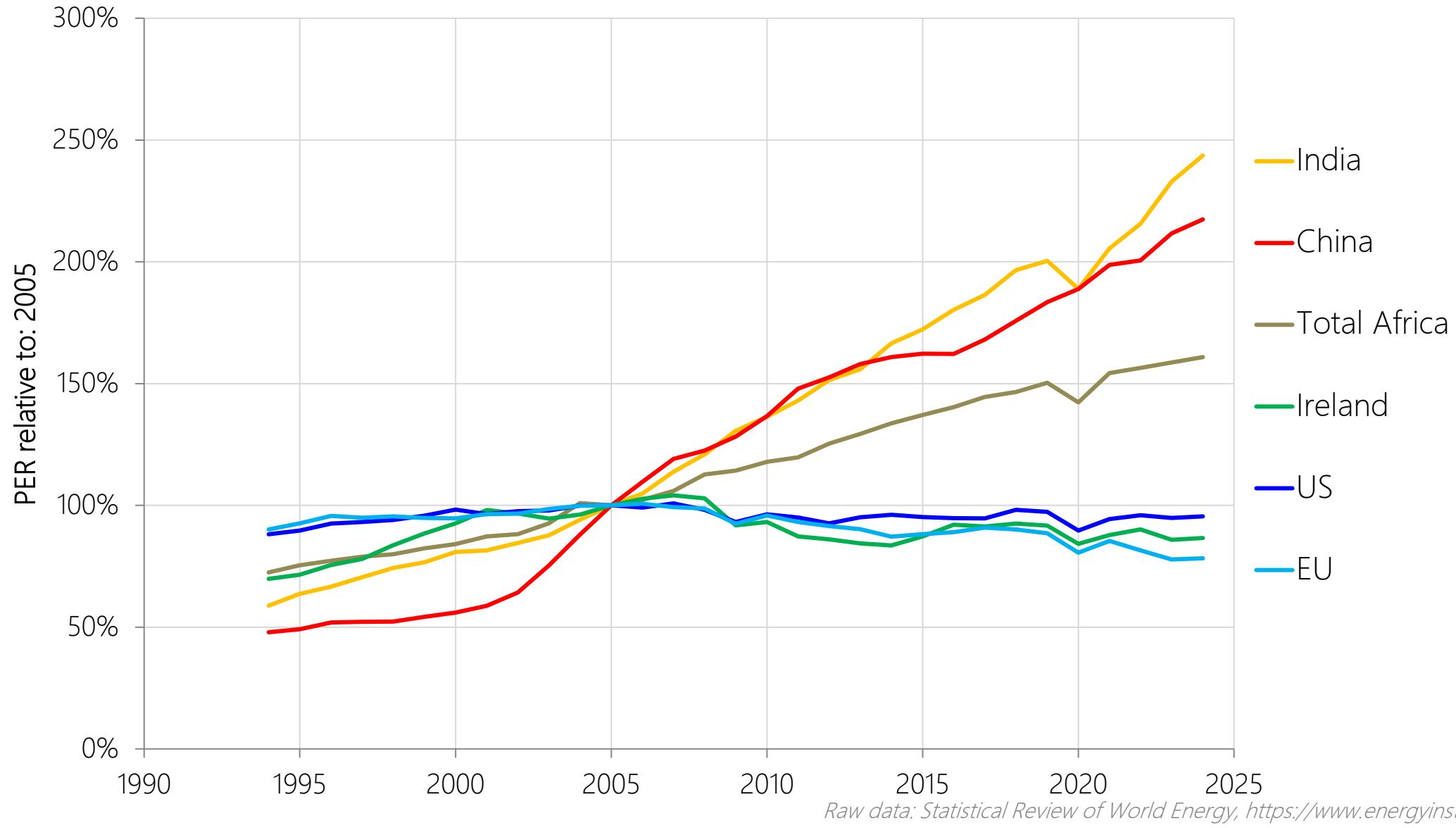
An increased emphasis on RES

- RES has become the main feature of the electricity market
- Focusing on renewables consumption instead of installation
- No separate installation targets for 2025
- Electricity system to support Wind and Solar
- Energy storage, and Green Hydrogen, the rising stars



Technology innovation

¹ Source: https://energyiceberg.com/14th-five-year-plan-renewable-china/#Energy_Storage_and_Green_Hydrogen_the_Rising_Stars



Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>



China will aim for carbon neutrality by 2060, Xi Jinping says

By Chloé Farand and Megan Darby | Climate Home News

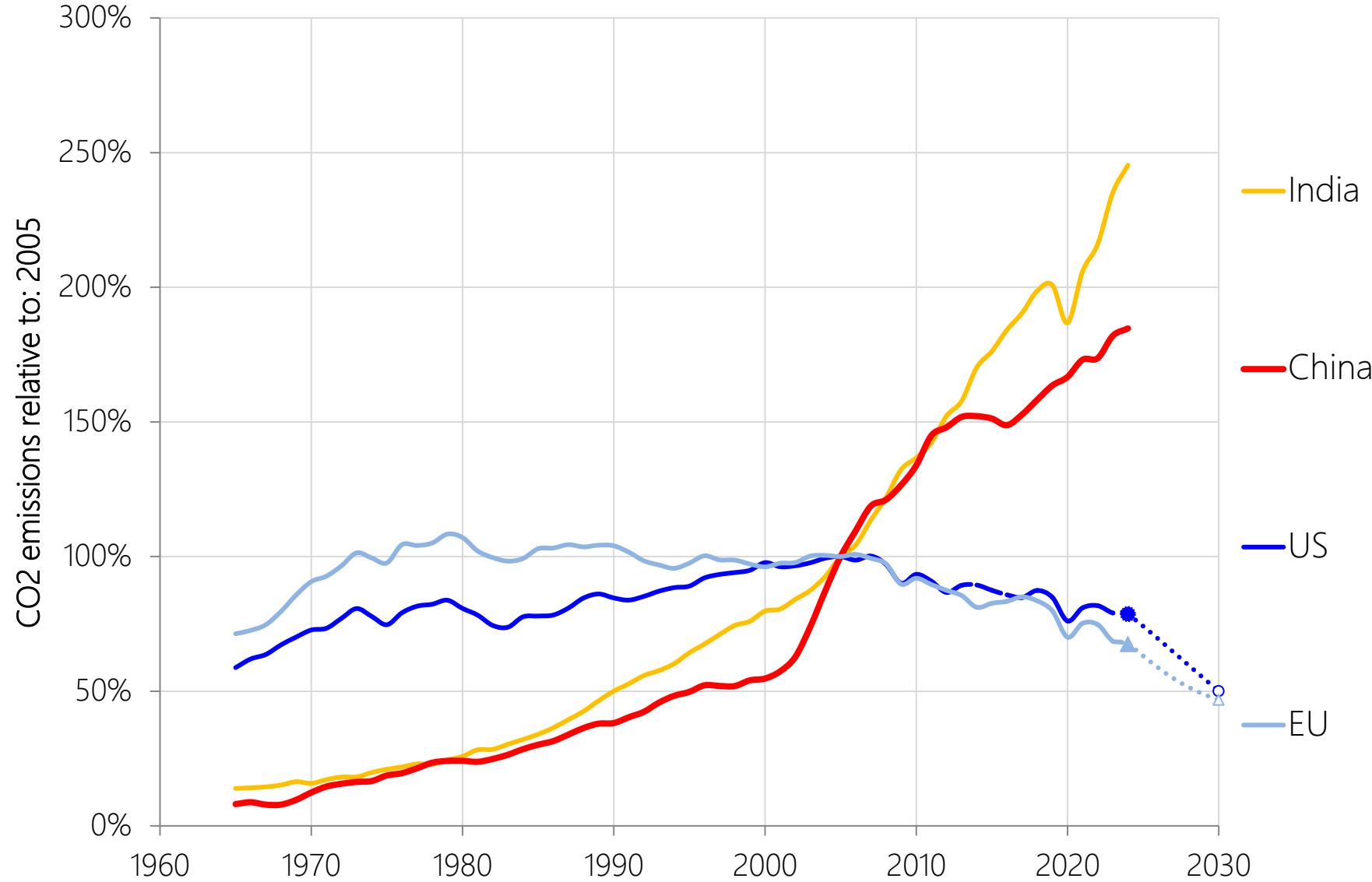
Sep 23, 2020



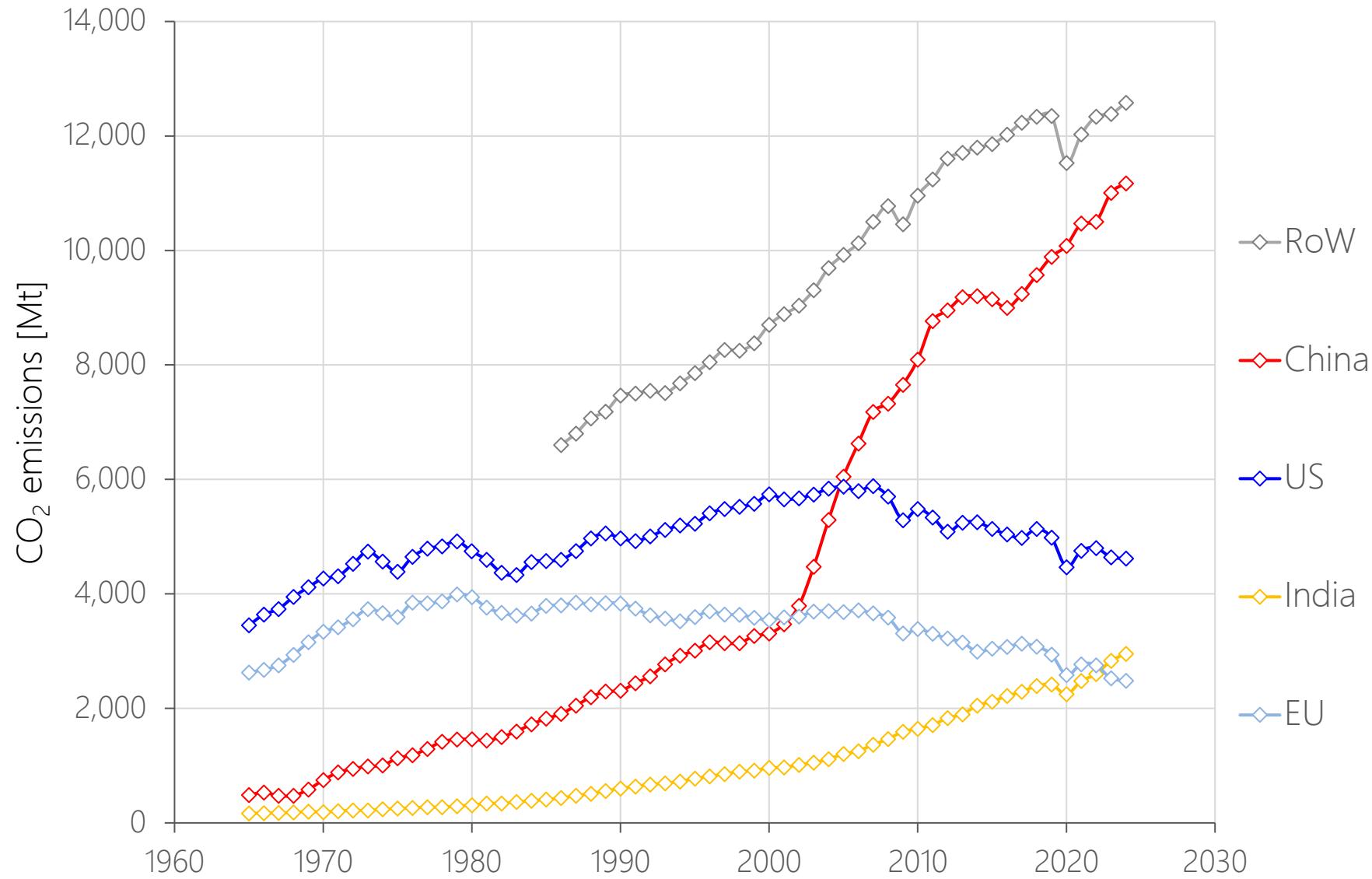
Chinese President Xi Jinping is seen remotely addressing via video the General Debate of the 75th session of the General Assembly of the United Nations on a screen in the international news office area at United Nations headquarters in New York, New York, USA, 22 September 2020. [EPA-EFE/JUSTIN LANE]

Is this realistic...?

<https://www.euractiv.com/section/energy/news/china-will-aim-for-carbon-neutrality-by-2060-xi-jinping-says/>



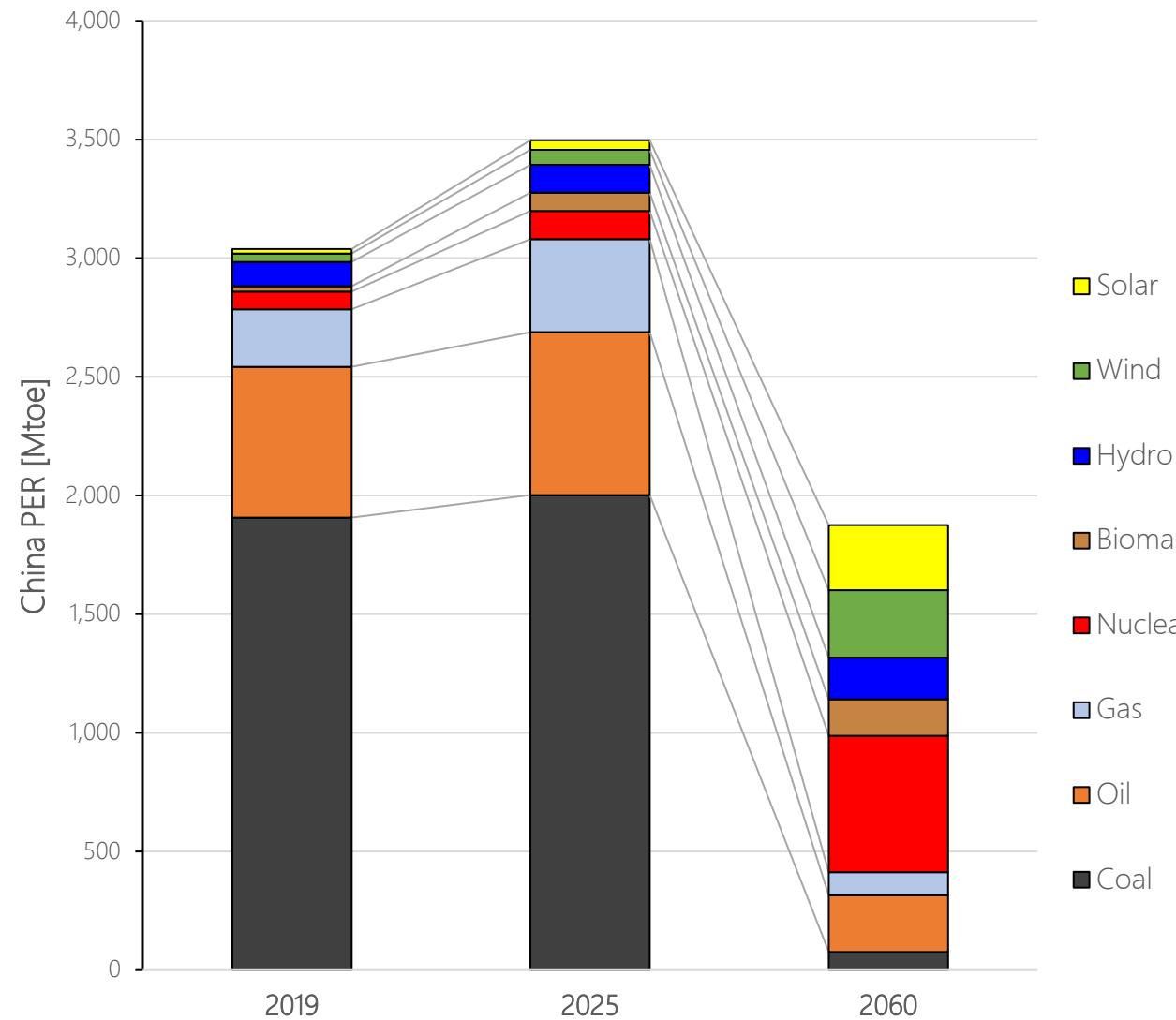
Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>



Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>



One potential pathway

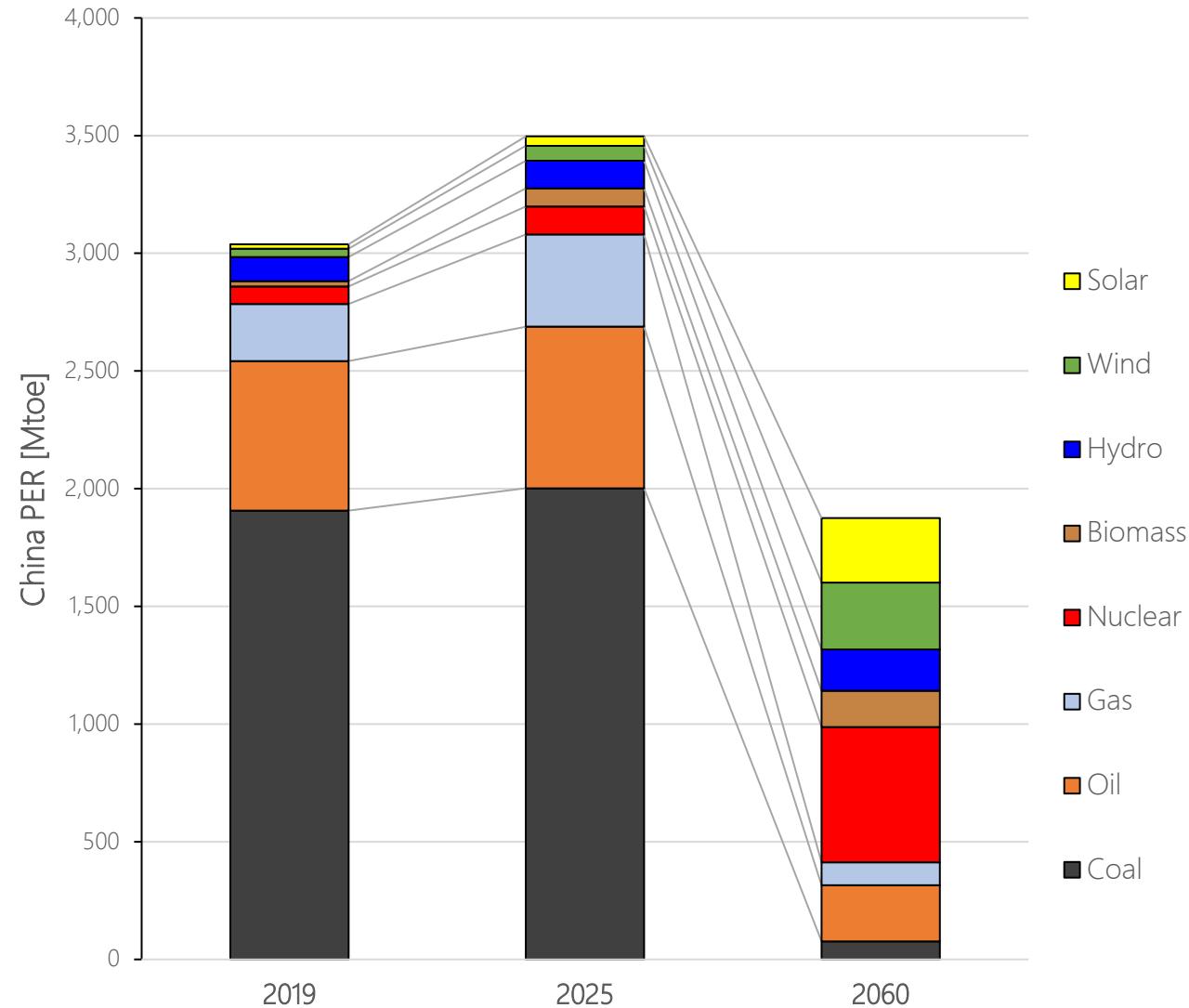


ENERGY SOURCE	2025	2060	PERCENT CHANGE
Coal	2.86 billion tons of coal equivalent	110 million	-96%
Natural gas	560 million	140 million	-75%
Oil	980 million	340 million	-65%
Hydro	440 million	660 million	+50%
Biomass	110 million	220 million	+100%
Wind	240 million	1.07 billion	+346%
Nuclear	170 million	820 million	+382%
Solar	150 million	1.03 billion	+587%

<https://www.bloomberg.com/news/articles/2020-09-28/china-s-top-climate-scientists-lay-out-road-map-to-hit-2060-goal>



One potential pathway



(Some) big challenges:

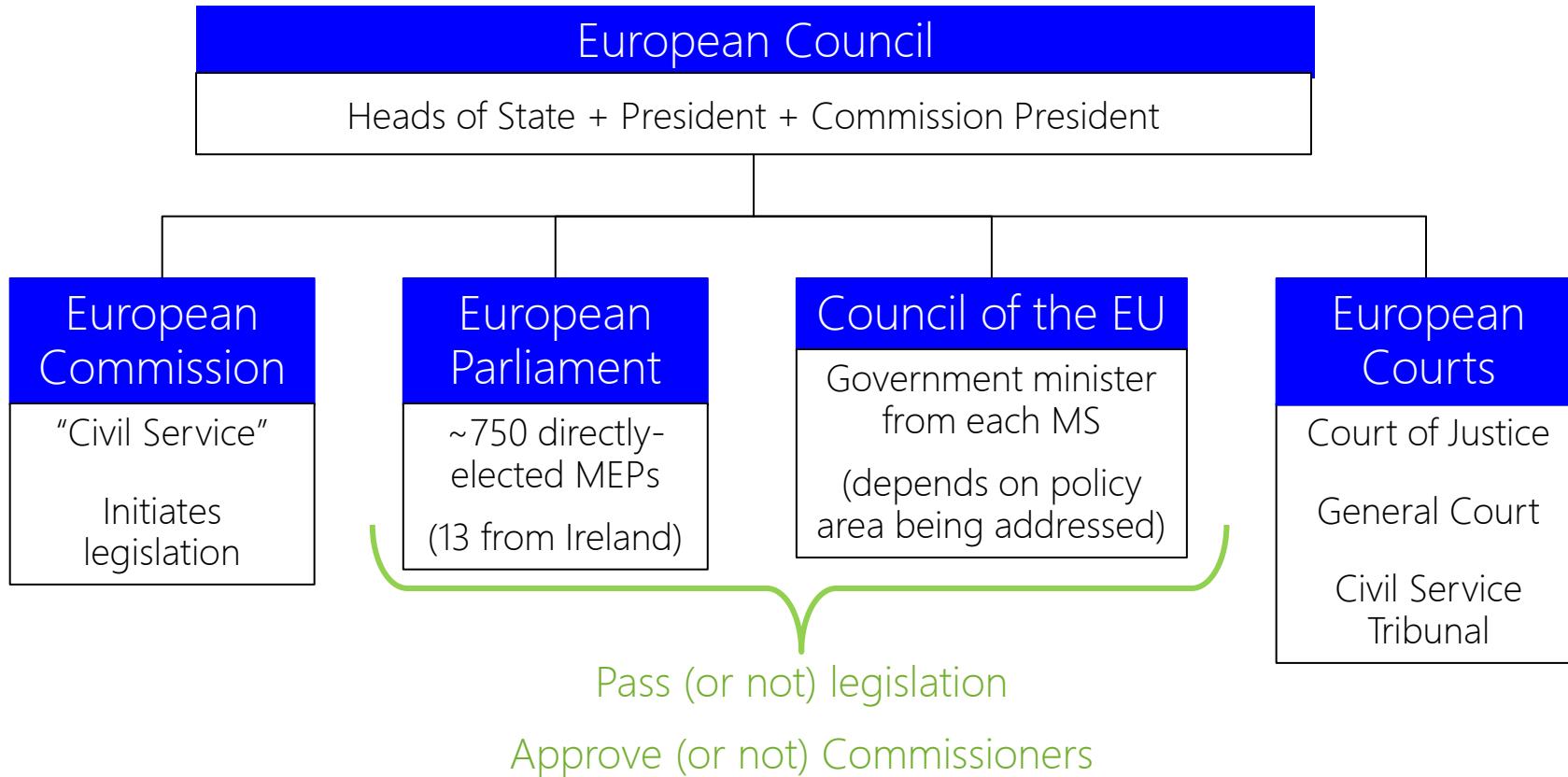
- Stranded assets (vested interests)
- Electricity market reform
- Resistance to nuclear..?

<https://www.bloomberg.com/news/articles/2020-09-28/china-s-top-climate-scientists-lay-out-road-map-to-hit-2060-goal>





The EU legislative framework in a nutshell



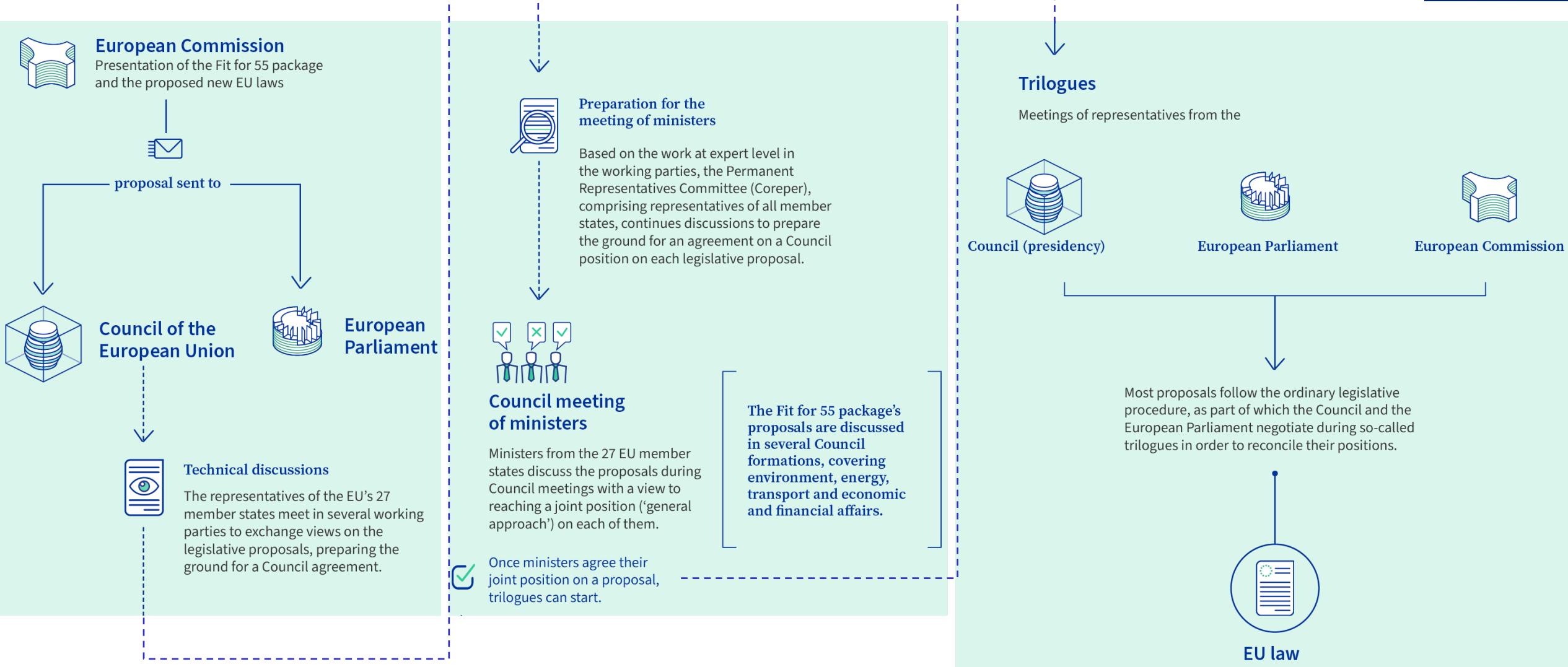
Regulations: Law in all MS, immediately they come into force; Regulations over-ride national law.

Directives: Specify results, not methods; Member States (MS) transpose Directives into national law.

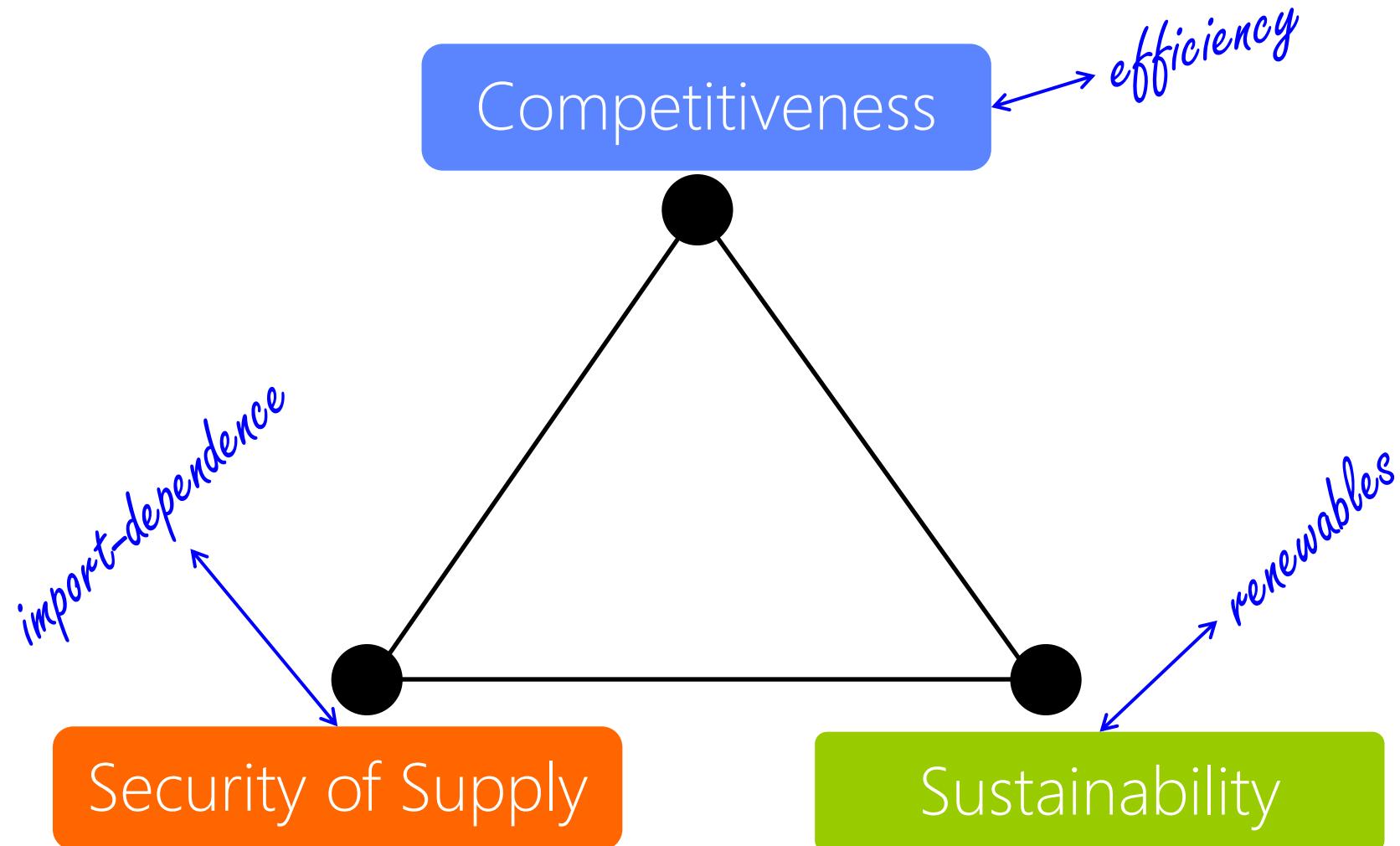
Decisions: Legal acts, which apply only to specified individuals, companies, or MS. Typically used in Competition Law or State Aid.



The EU legislative framework in a nutshell





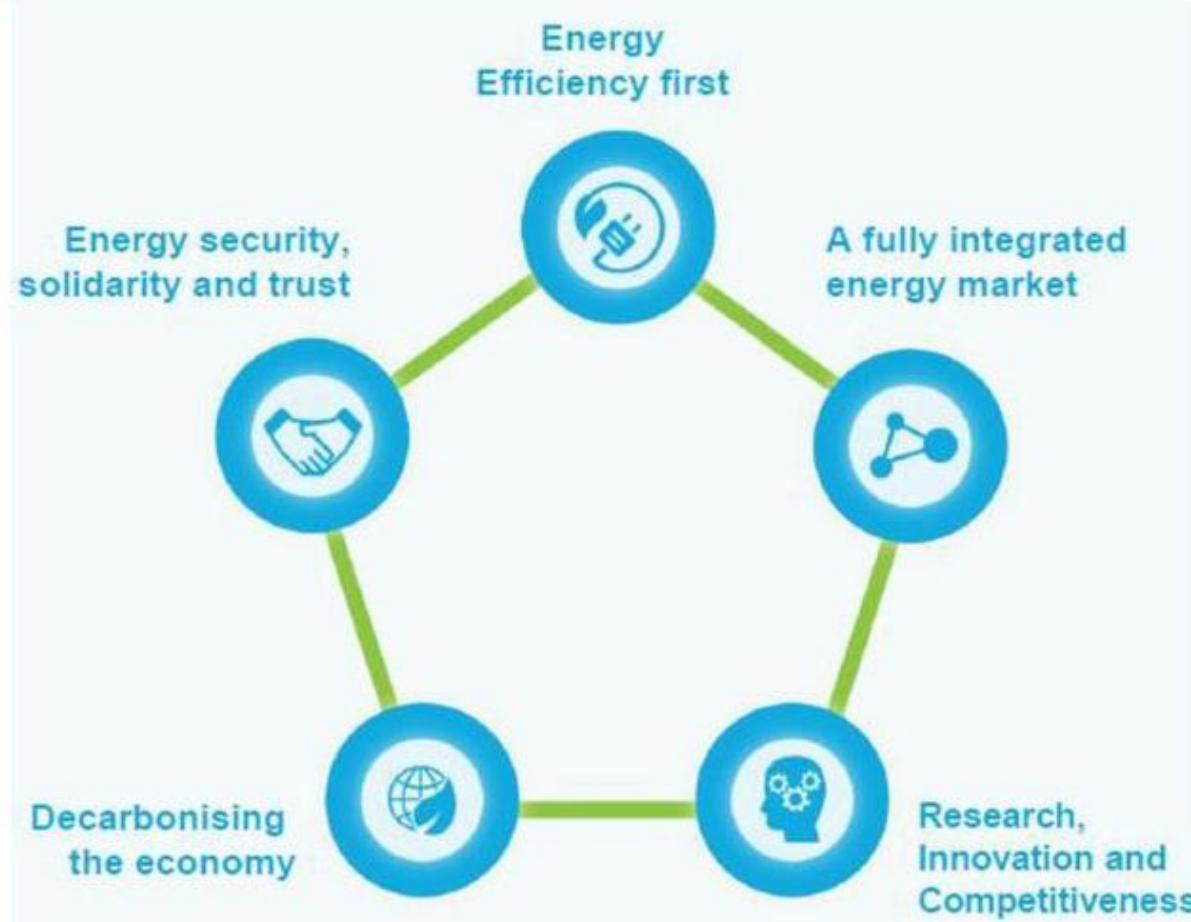


For detailed information, see: http://ec.europa.eu/energy/strategies/2010/2020_en.htm



EU Energy Union
(2015)

AN ENERGY UNION BASED ON 5 MUTUALLY SUPPORTIVE AND INTERLINKED DIMENSIONS





THE GOALS

CREATING JOBS AND GROWTH, REDUCING GREENHOUSE GAS EMISSIONS, SECURING ENERGY SUPPLY



Putting energy
efficiency first



Making the EU
world leader in
renewables



Delivering a
fair deal for
consumers

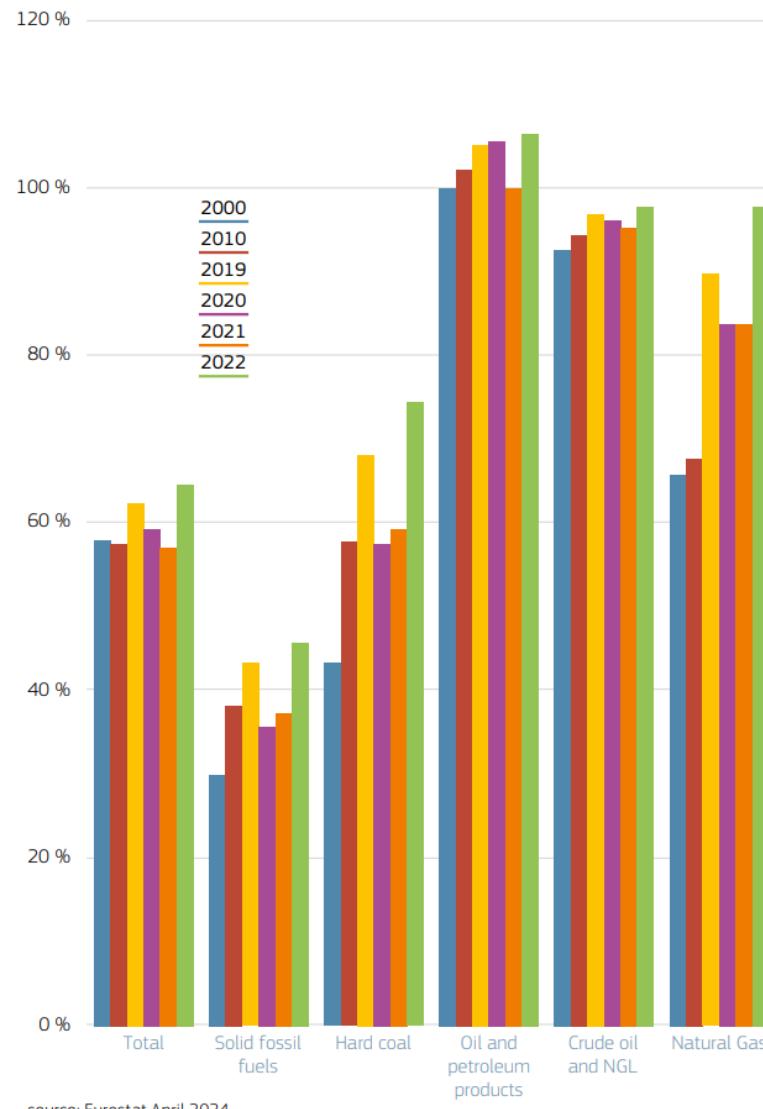
3 #EnergyUnion



https://ec.europa.eu/inea/sites/inea/files/02_energy_efficiency_policy_info_days_20171025.pdf



EU-27 import dependence



EU: World No. 1 gas importing region

World No. 2 oil importing region

Dependence on imports is likely to increase

**Clean energy for Europeans:
Key for driving forward the Energy Union**

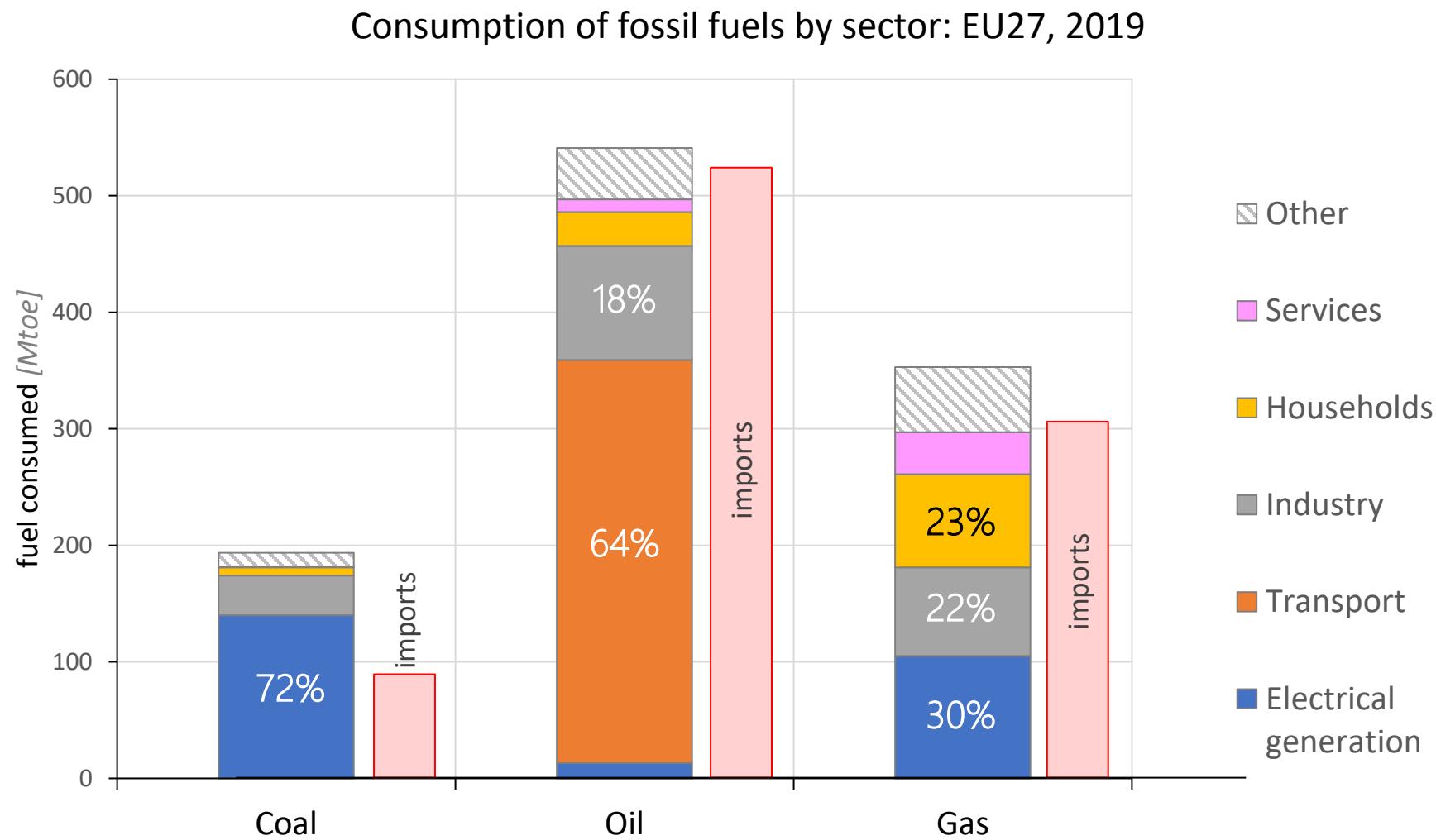
The Energy Union is the EU's strategy to ensure affordable, secure and sustainable energy for European citizens and businesses.

WHY?

- spends **€350 billion** every year to import energy
- buys from third countries more than **half** of what it consumes
- THE EU... is the **largest** energy importer in the world
- relies heavily on a **limited number** of suppliers



EU-27 import dependence: what are coal, oil, and gas used for?



Raw data: Eurostat.





December 2008: 2020 Climate & Energy targets agreed

September 2016: EU ratifies Paris Climate Agreement

December 2018: 2030 Climate & Energy targets agreed



$\text{CO}_2 \downarrow$ by 40%
re 1990

$\text{RES} \uparrow$ to 32%
of GFC

$\text{EE} \uparrow$ 32.5%
re 2007 baseline



December 2008: 2020 Climate & Energy targets agreed



September 2016: EU ratifies Paris Climate Agreement

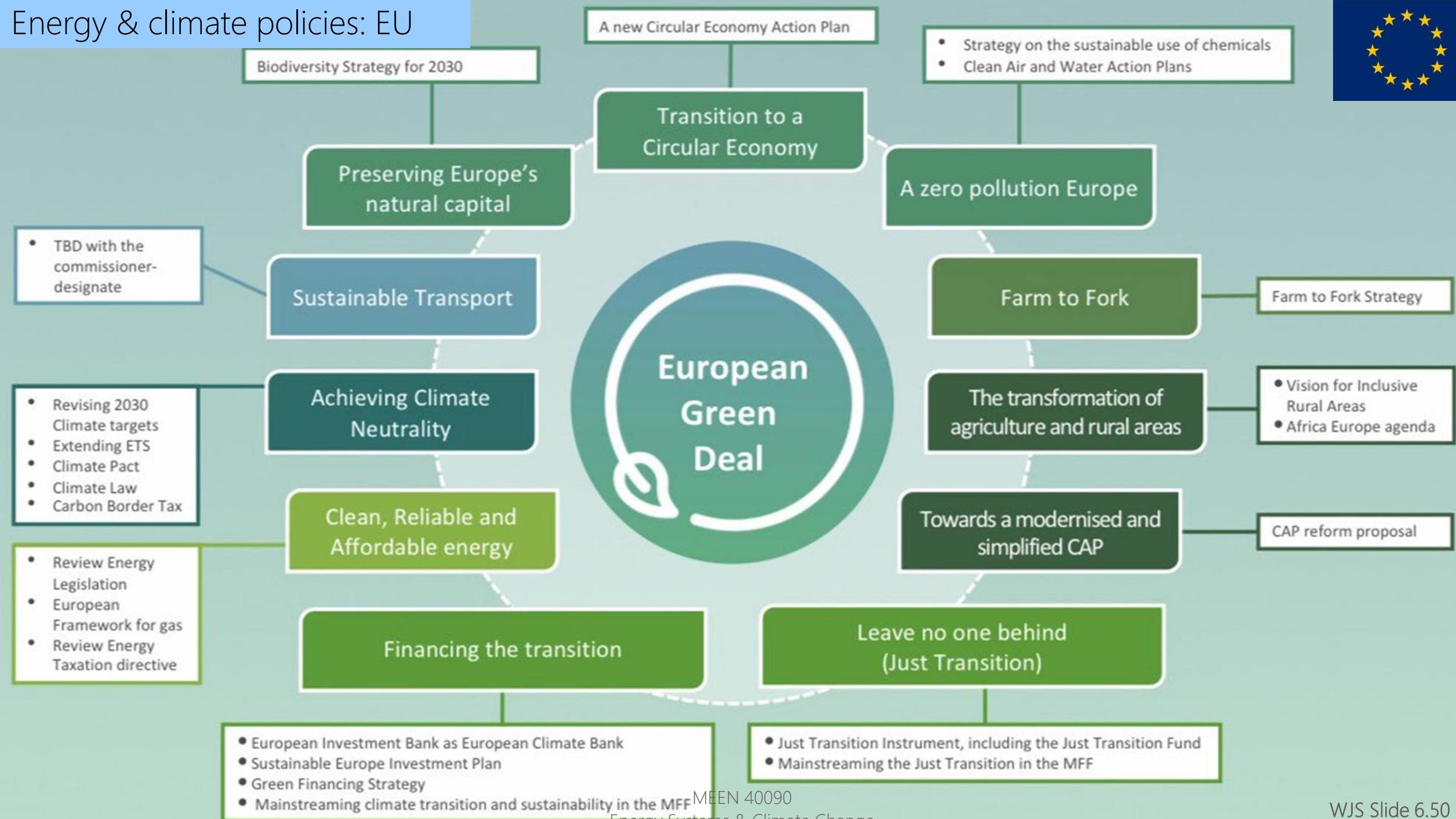
December 2018: 2030 Climate & Energy targets agreed

December 2019: [European Green Deal](#) launched





Energy & climate policies: EU





December 2008: 2020 Climate & Energy targets agreed

September 2016: EU ratifies Paris Climate Agreement

December 2018: 2030 Climate & Energy targets agreed

December 2019: European Green Deal launched

July 2021: European Climate Law enters into force:

- Legal objective for EU to be [climate neutral by 2050](#)

[Revised 2030 targets](#), and updated legislation, proposed by Commission in "Fit for 55" package:



$\text{CO}_2 \downarrow$ by 55%
re 1990

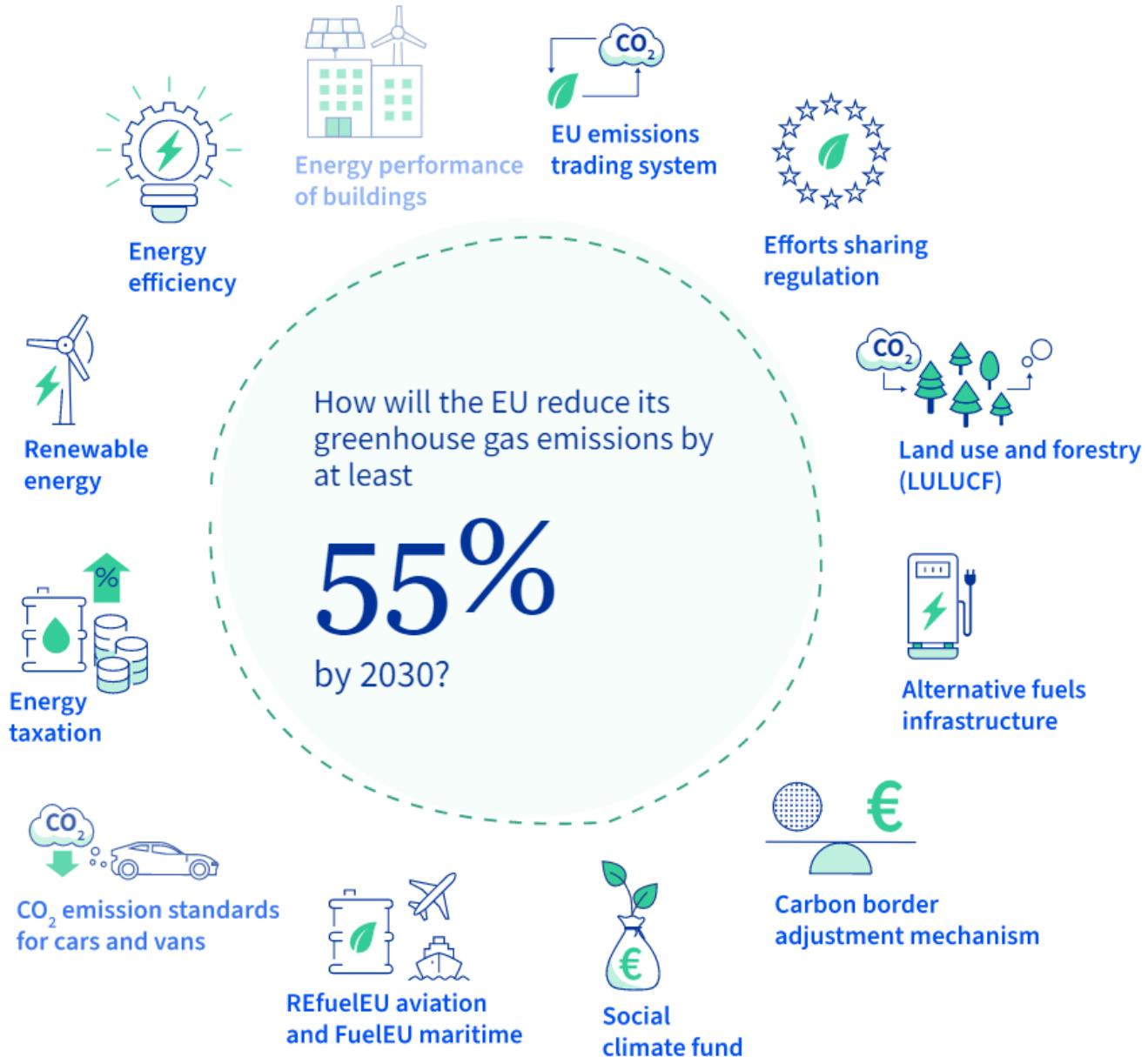
$\text{RES} \uparrow$ to 40%
of GFC

$\text{EE} \uparrow$ 9%
of GFC
(2020 baseline)

FIT
FOR
55

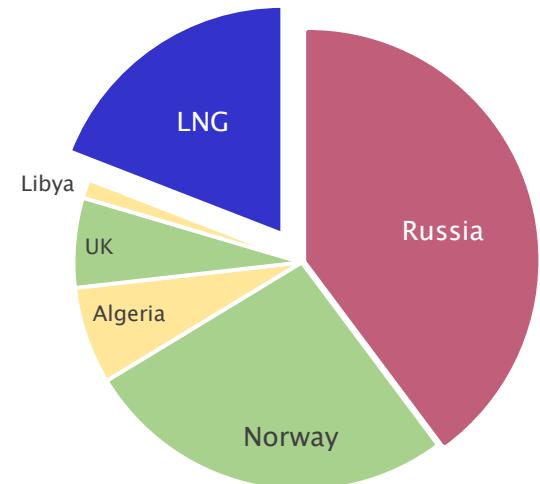


What is included in the "Fit for 55" package?

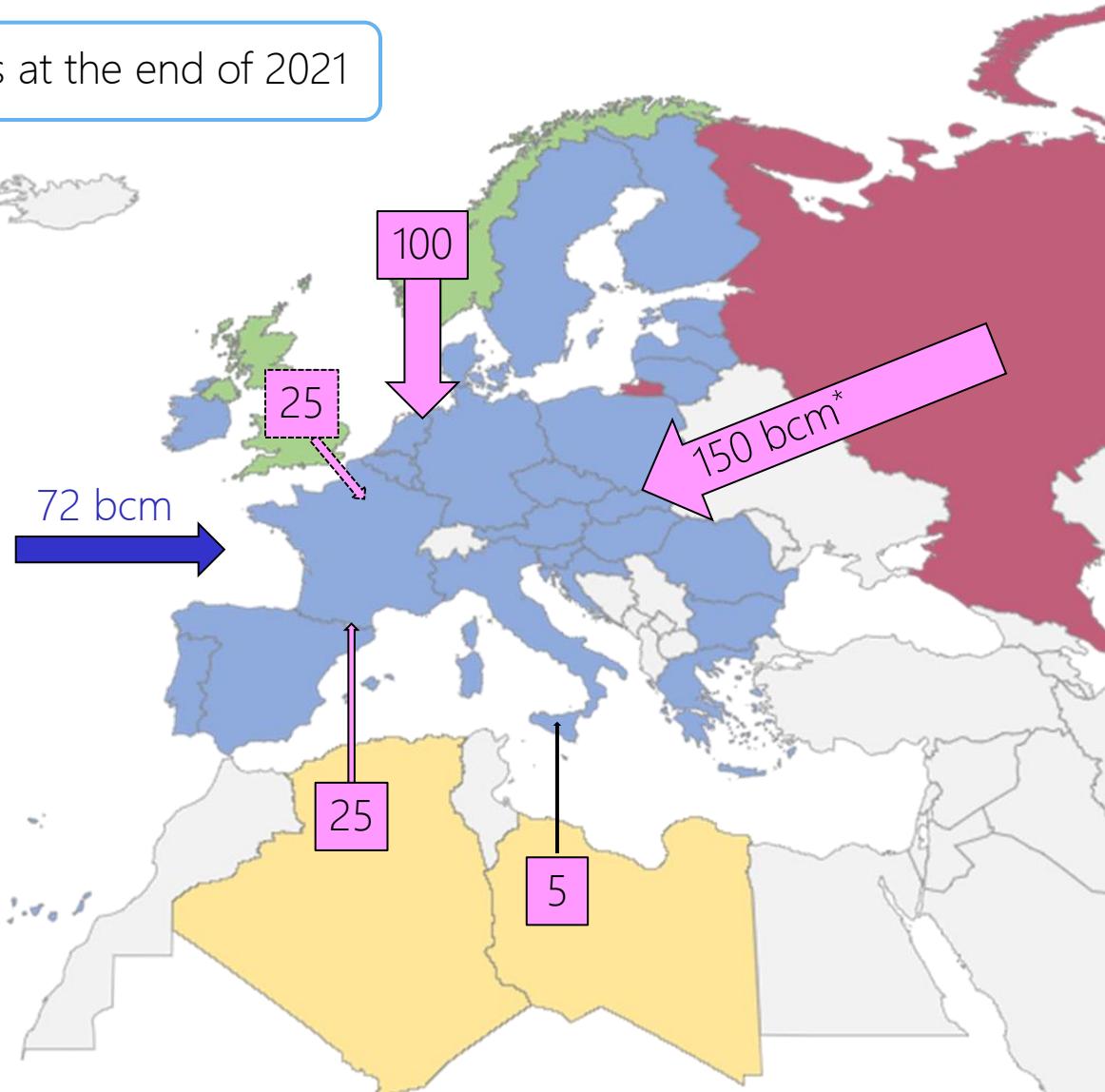


24th Feb 2022...





EU gas supplies at the end of 2021



* bcm = billion cubic metres per year

Raw data: Eurostat Data Browser (<https://ec.europa.eu/eurostat/databrowser/explore/all/envir?lang=en&subtheme=nrg&display=list&sort=category>)

See also ENTSO-G dashboard: <https://gasdashboard.entsog.eu/>



December 2008: 2020 Climate & Energy targets agreed

September 2016: EU ratifies Paris Climate Agreement

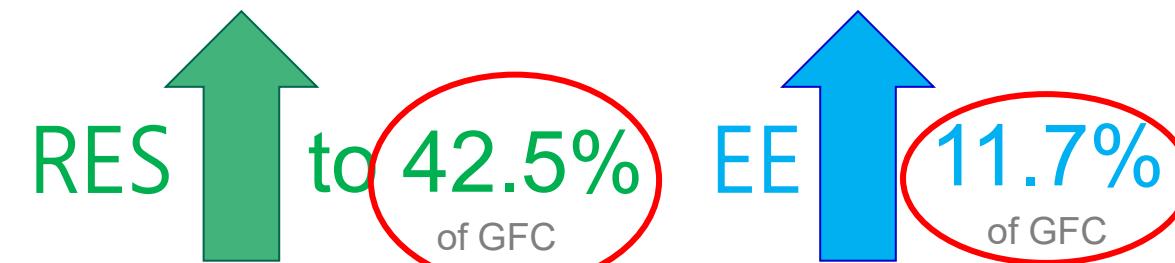
December 2018: 2030 Climate & Energy targets agreed

December 2019: European Green Deal launched

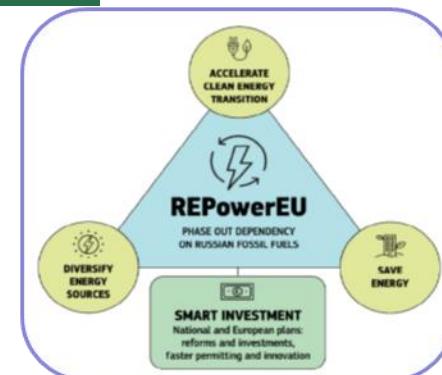
July 2021: European Climate Law enters into force.

May 2022: REPowerEU plan launched:

- Eliminate dependence on Russian fossil fuels



**FIT
FOR
55**





24 February 2022: Russia invades Ukraine

8 March 2022: REPowerEU outline proposal¹ is launched

23 March 2022: Proposal to enforce mandatory minimum level of gas storage²

18 May 2022: Finalised REPowerEU plan³ is announced

REPowerEU

- Vision: eliminate dependence on Russian gas well before 2030
- Strategy:
 - Increase gas storage capacity and levels
 - Diversify supplies
 - Reduce gas demand

Getting rid of Russian fossil fuel

REPowerEU



¹ https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511

² https://eur-lex.europa.eu/resource.html?uri=cellar:2f3116bc-aaa3-11ec-83e1-01aa75ed71a1.0001.02/DOC_1&format=PDF

³ https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511



Figure 14 – Quarterly share of gas imports within the total, combining both pipeline and LNG imports

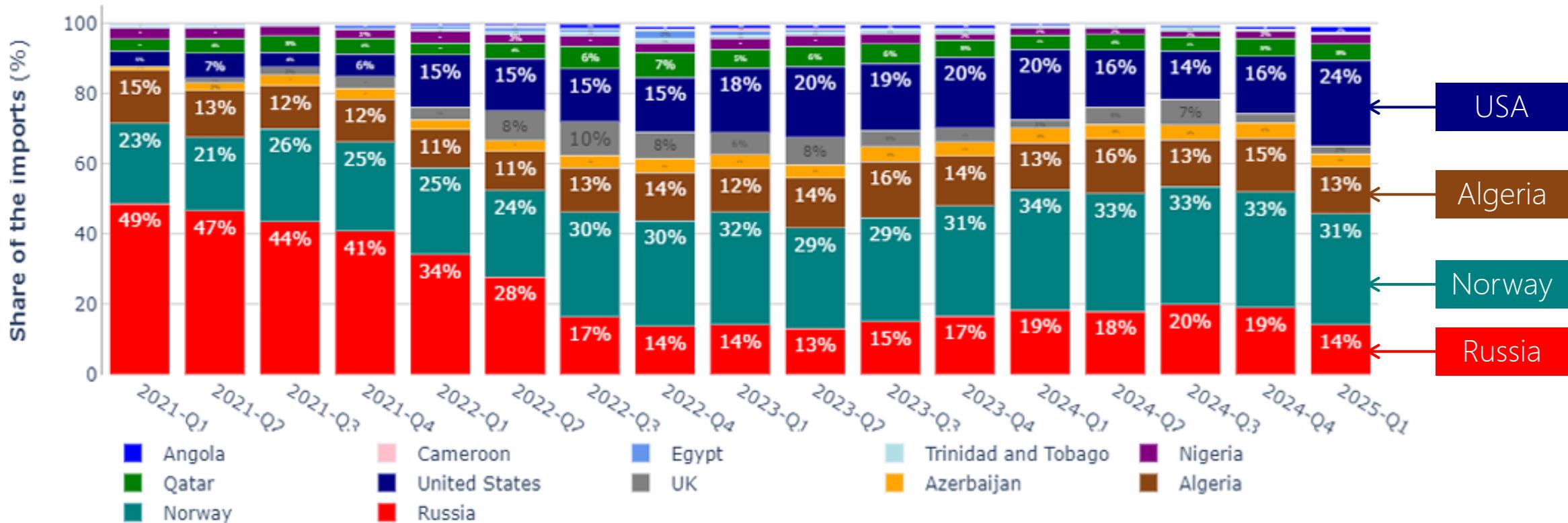
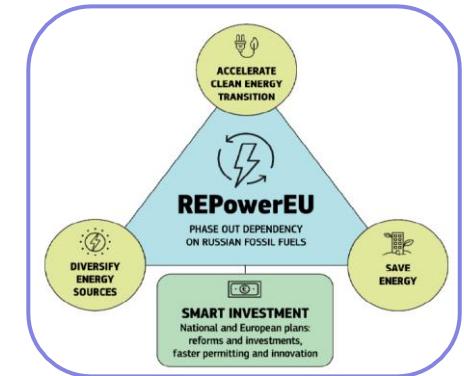


Image source: Quarterly Report on European Gas Markets, Q1 2025. European Commission, (2025) <https://energy.ec.europa.eu/>





Until recently, we lived in a "VUCA" world:

Characteristics of VUCA environments		The Antidote
V	Volatility The nature and dynamics of change	V
U	Uncertainty Lack of predictability	U
C	Complexity Multiplex of forces, confounding issues and chaos	C
A	Ambiguity The haziness of reality; cause and effect confusion	A





That seems to have changed...



RTE NEWS SPORT ENTERTAINMENT BUSINESS LIFESTYLE CULTURE PLAYER

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Trump moves nuclear submarines to 'appropriate regions' after Medvedev statements

Updated / Friday, 1 Aug 2025 20:02

[Share](#)

China says it is ready for 'any type of war' with US

5 March 2025

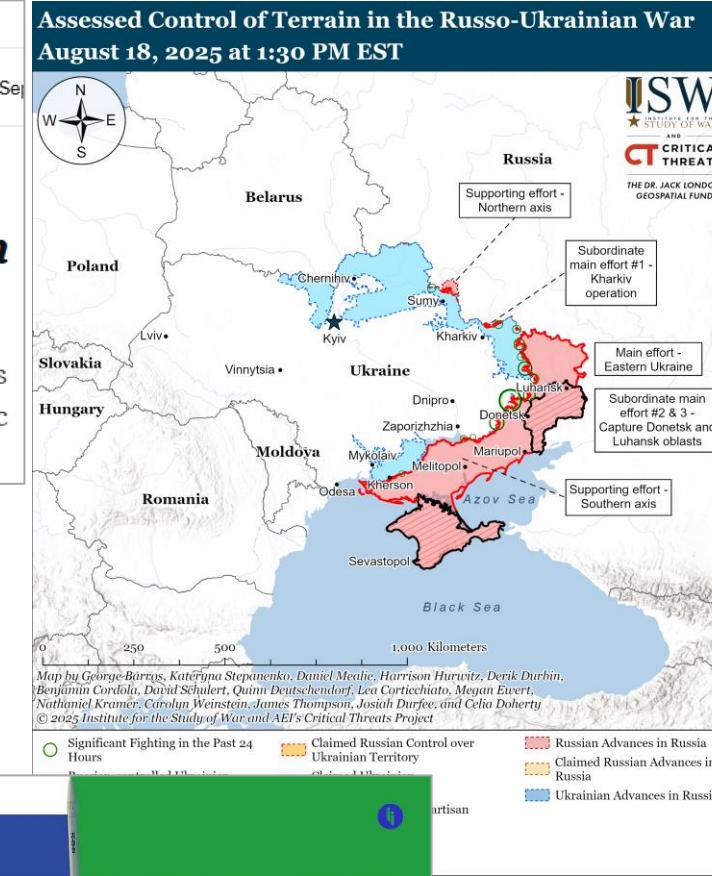
Laura Bicker
BBC News, Beijing

The New York Times

Updates LIVE Trump-Zelensky Meeting 13m ago Tariff Tracker National Guard in D.C. Sep 18, 2025

Suddenly, the Trump Administration Tightens the Vise on Wind Farms

Federal agencies have recently issued a barrage of restrictions that could halt construction of solar and wind farms on public





That seems to have changed...

VUCA vs BANI

A NEW ACRONYM TO DESCRIBE THE WORLD

V

VOLATILE

U

UNCERTAIN

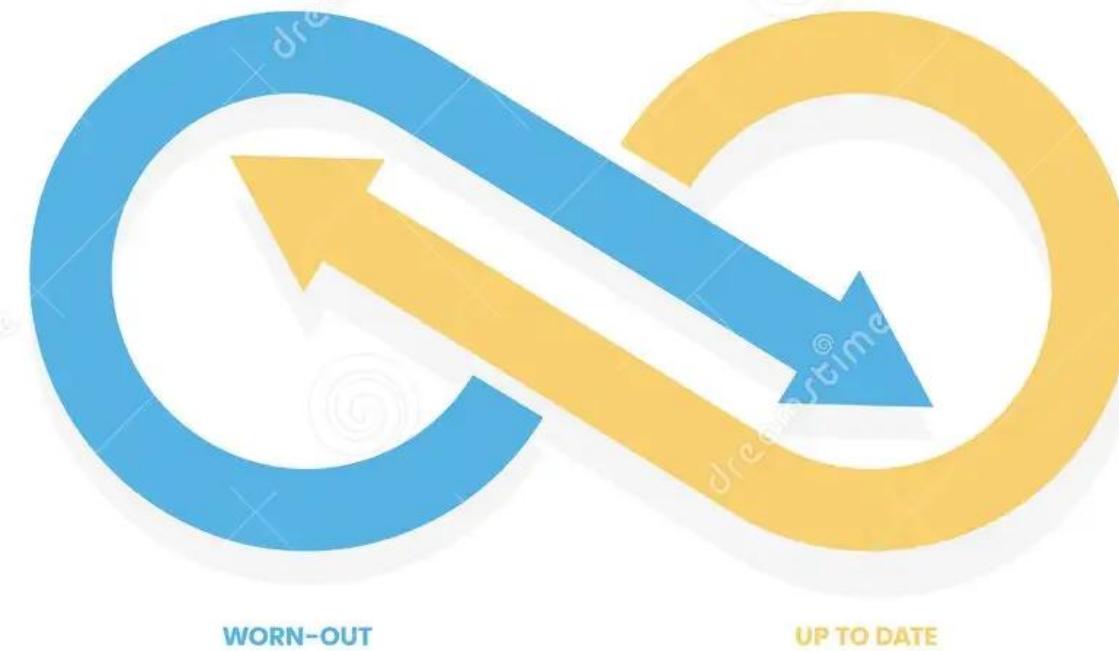
C

COMPLEX

A

AMBIGUOUS

Serves to describe the situation of Ambiguity and Complexity



B

BRITTLE

A

ANXIOUS

N

NON-LINEAR

I

INCOMPREHENSIBLE

Serves to describe the situation of the Next Generation of Business

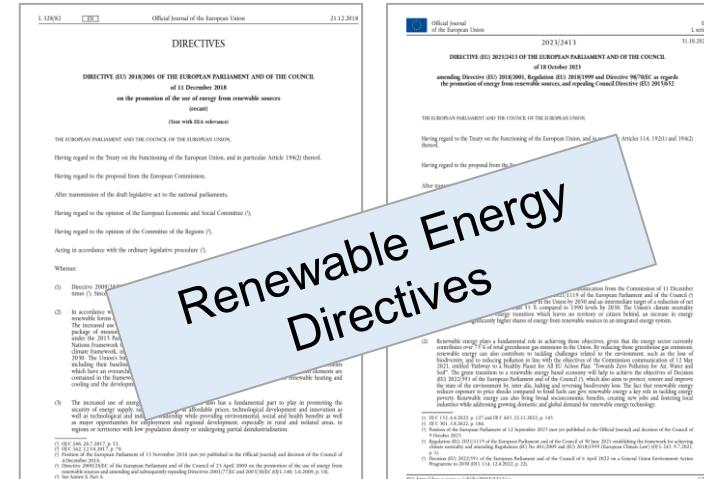


EU Energy and Climate policy has been developed in a "VUCA" world.

EU ambition:



EU strategy
and
legislation:





However...



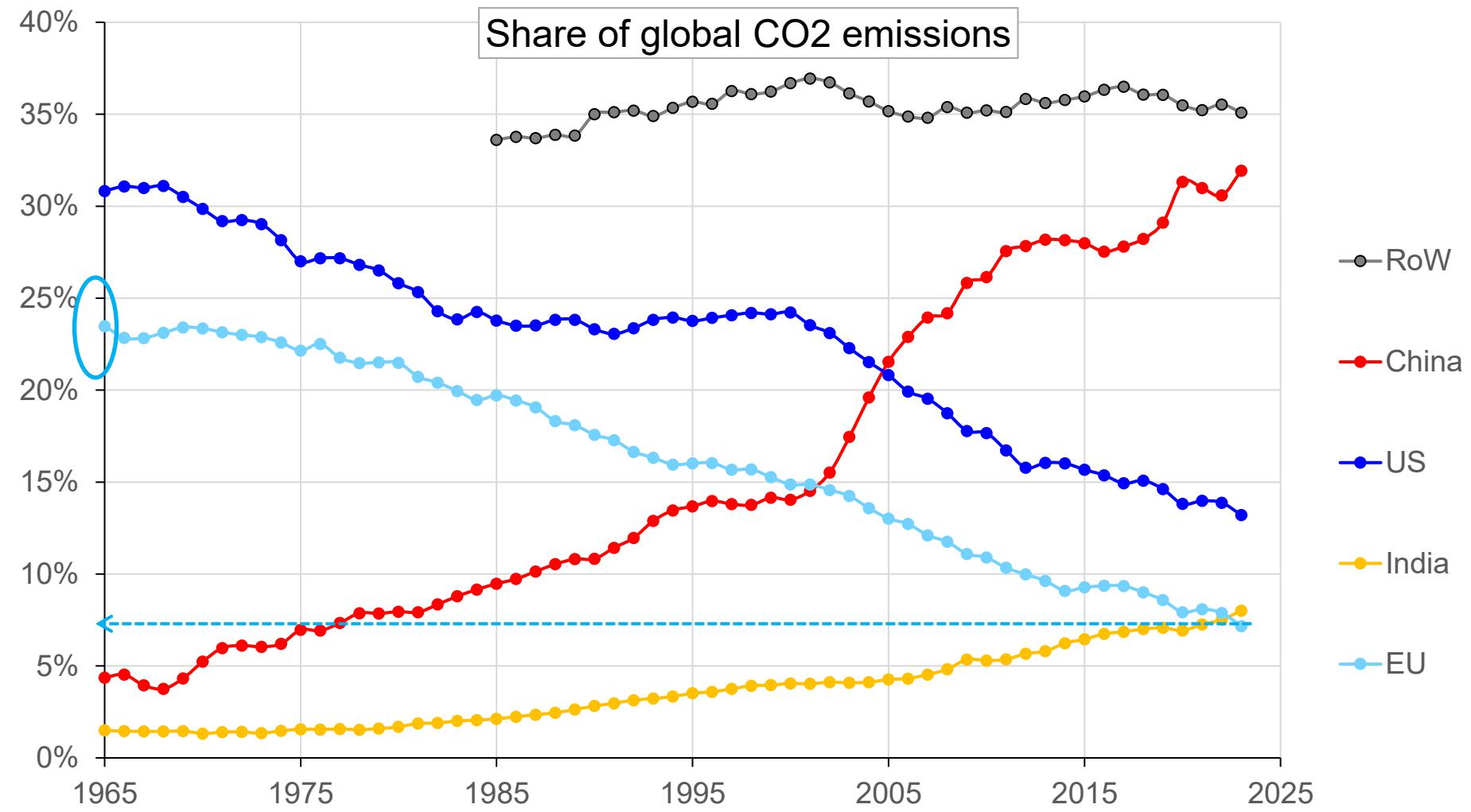
As noted in the [2024 Draghi Report](#), three external conditions – in [trade, energy and defence](#) – which supported growth in Europe after the end of the Cold War, have been fading:

- World trade under multilateral rules (globalisation) is coming to an end.
- Cheap energy (from Russia) has now disappeared, at huge cost to Europe.
- The era of [geopolitical stability](#) under US hegemony is over.

Image source: Quarterly Report on European Gas Markets, Q1 2025. European Commission, (2025) <https://energy.ec.europa.eu/>



The EU share of global CO₂ emissions has declined massively...



Raw data: Statistical Review of World Energy



Summary: the global context

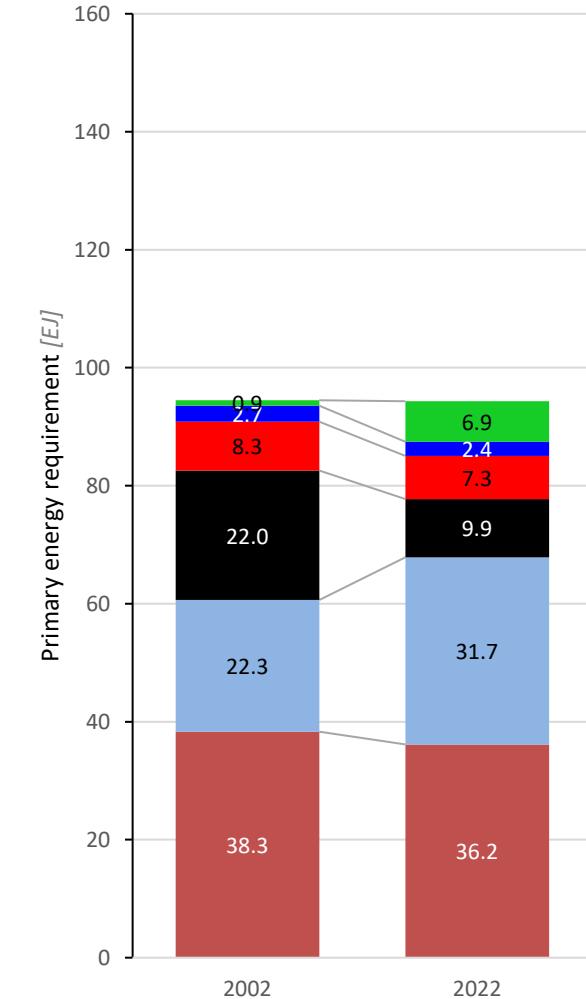
- The global environment has become increasingly capricious and siloed.
- Trade wars, tariffs, and Chinese competition are stifling the EU economy.
- Major EU governments are moving to the right.
- The EU is committed to massive increases in defence expenditure.
- High interest rates make renewables much more expensive.
- The EU share of global emissions is becoming insignificant.
- EU ambitions may moderate.



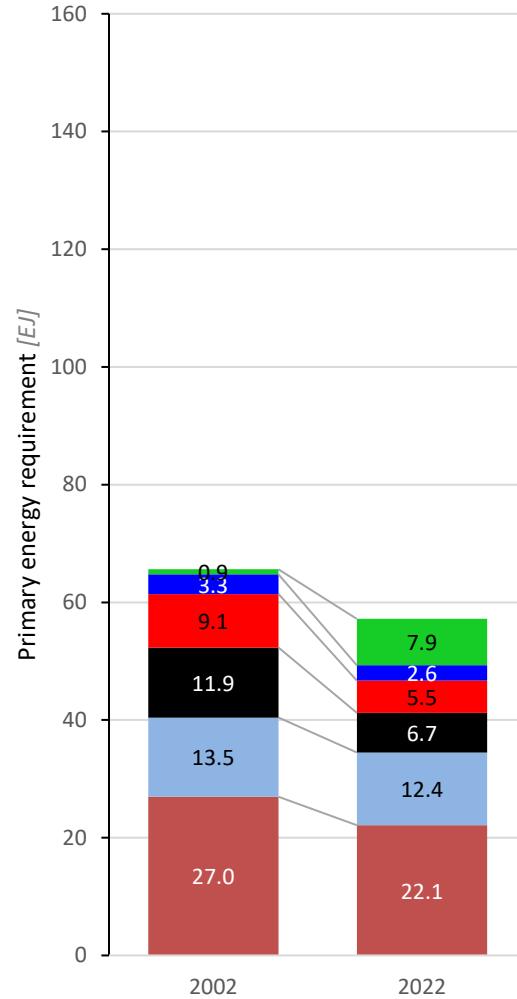


PER for key regions

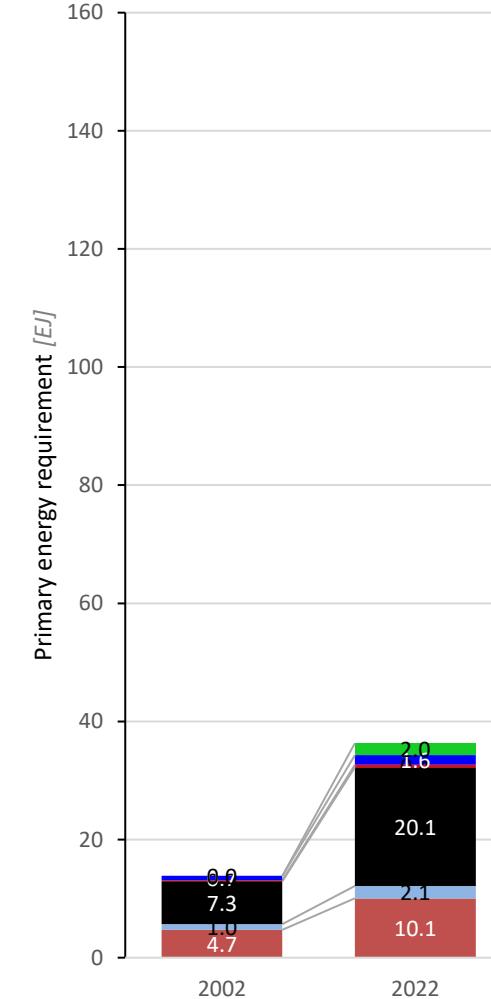
US



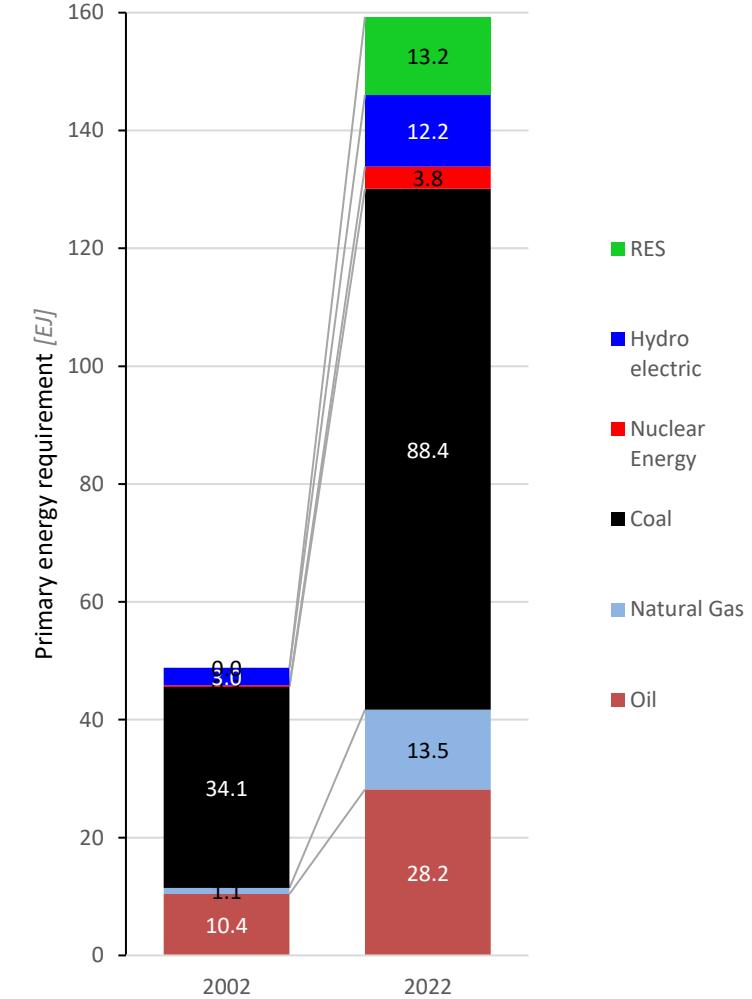
EU



India



China



Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>

*Formally rejoined Paris Climate
Agreement on 19 Feb 2021*

E.U.

- 55% reduction in GHG, by 2030, re 1990
- Net zero by **2050**

U.S.A.*

- 50-52% reduction in GHG, by 2030, re 2005
- Net zero by **2050**

China

- CO₂ emissions to peak before 2030
- >65% reduction in CO₂ per \$GDP by 2030, re 2005
- ~25% of TPES from non-fossil sources
- Net zero by **2060**

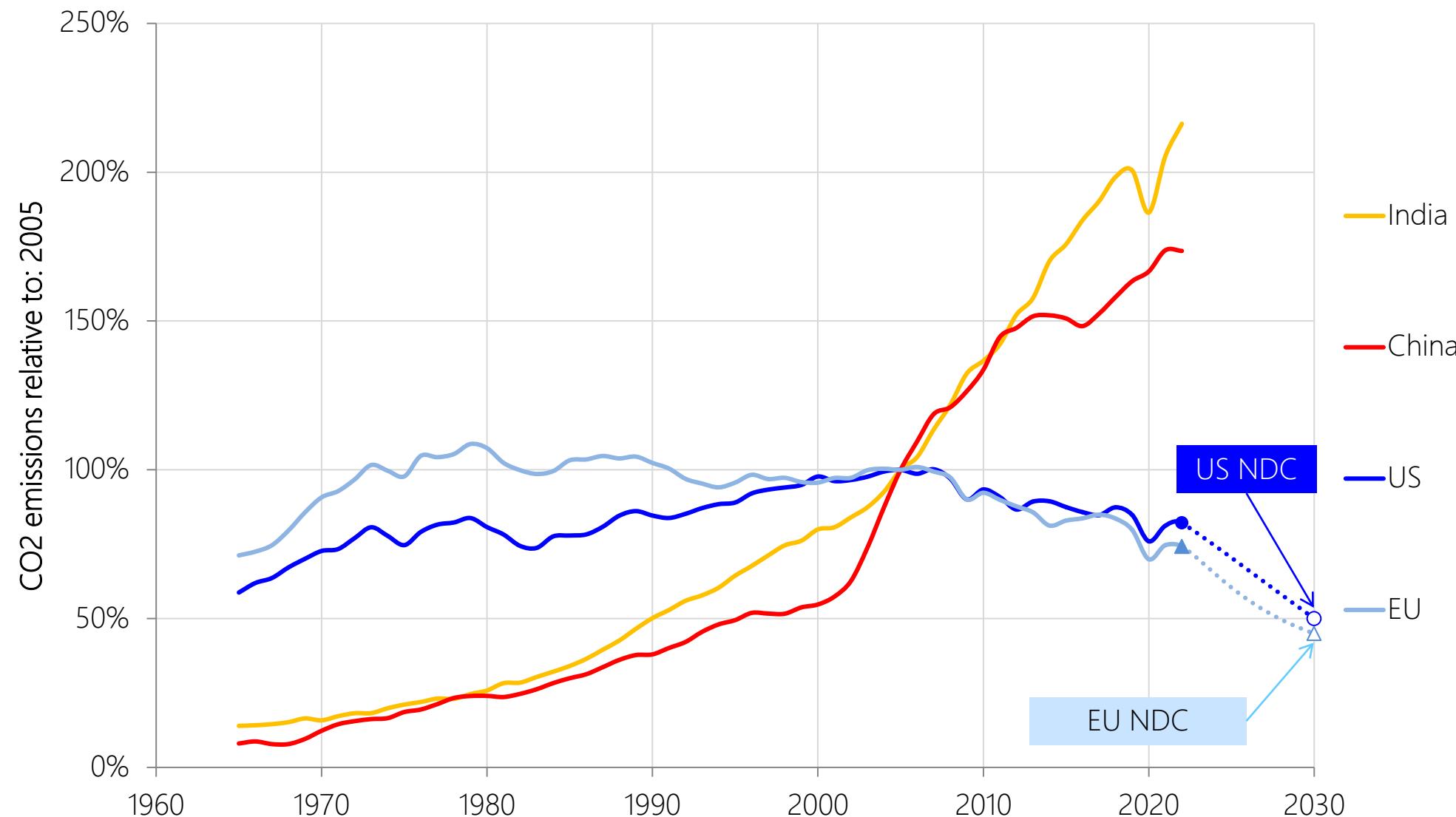
India

- 45% drop in “emissions” per \$GDP, by 2030, re 2005
- Increase non-fossil power generation capacity to 500 GW, by 2030 (with GCF¹ help?)
- Net zero by **2070**

¹GCF: Global Climate Fund

Raw data: <http://climateactiontracker.org/>

CO₂ emissions and projections for key regions



Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>

Food for thought...



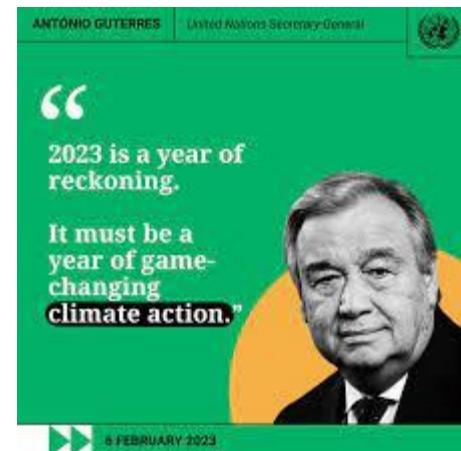
Talking the talk...

Prime Minister Modi may attend World Climate Action Summit during COP28 in Dubai

Vishwa Mohan / TNN / Updated: Nov 12, 2023, 12:56 IST



Prime Minister Narendra Modi is expected to attend the World Climate Action Summit during the UN climate conference in Dubai. He may discuss India's approach to environmental issues through Mission LIFE. The UAE, as the host of COP28... [Read More](#)

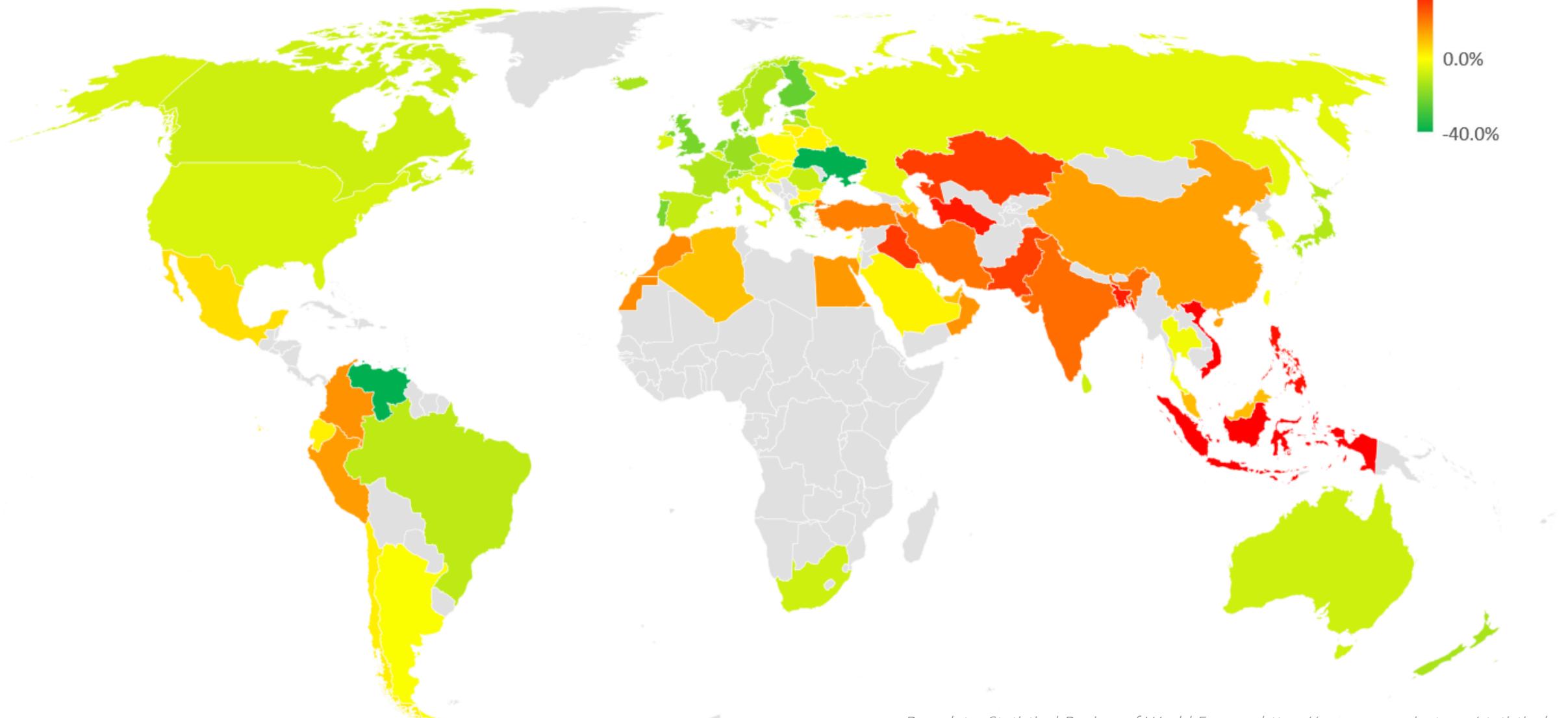


CLIMATE AMBITION SUMMIT 2023



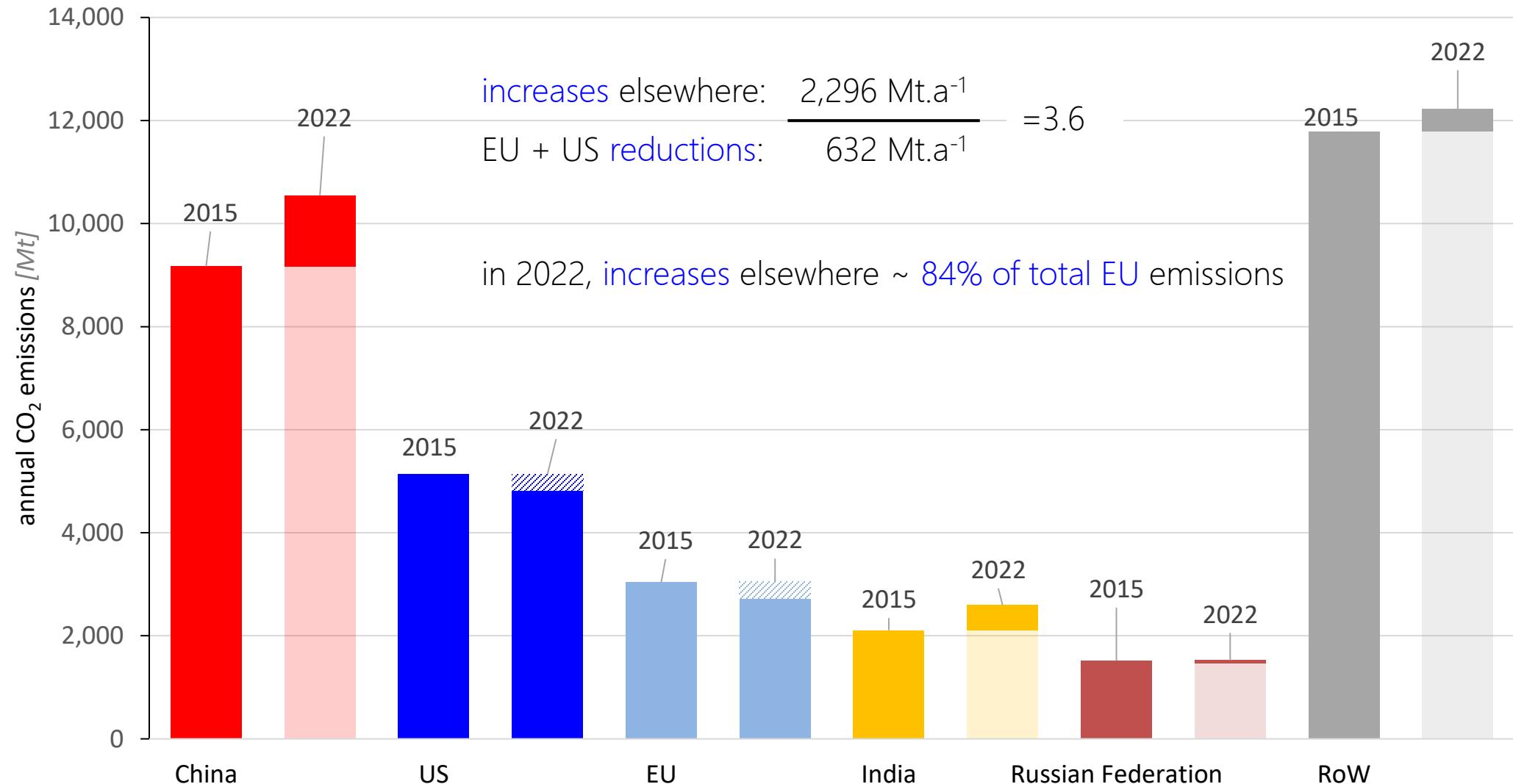
...walking the walk?

Change in annual CO₂ emissions since 2015 (Paris Climate Agreement)



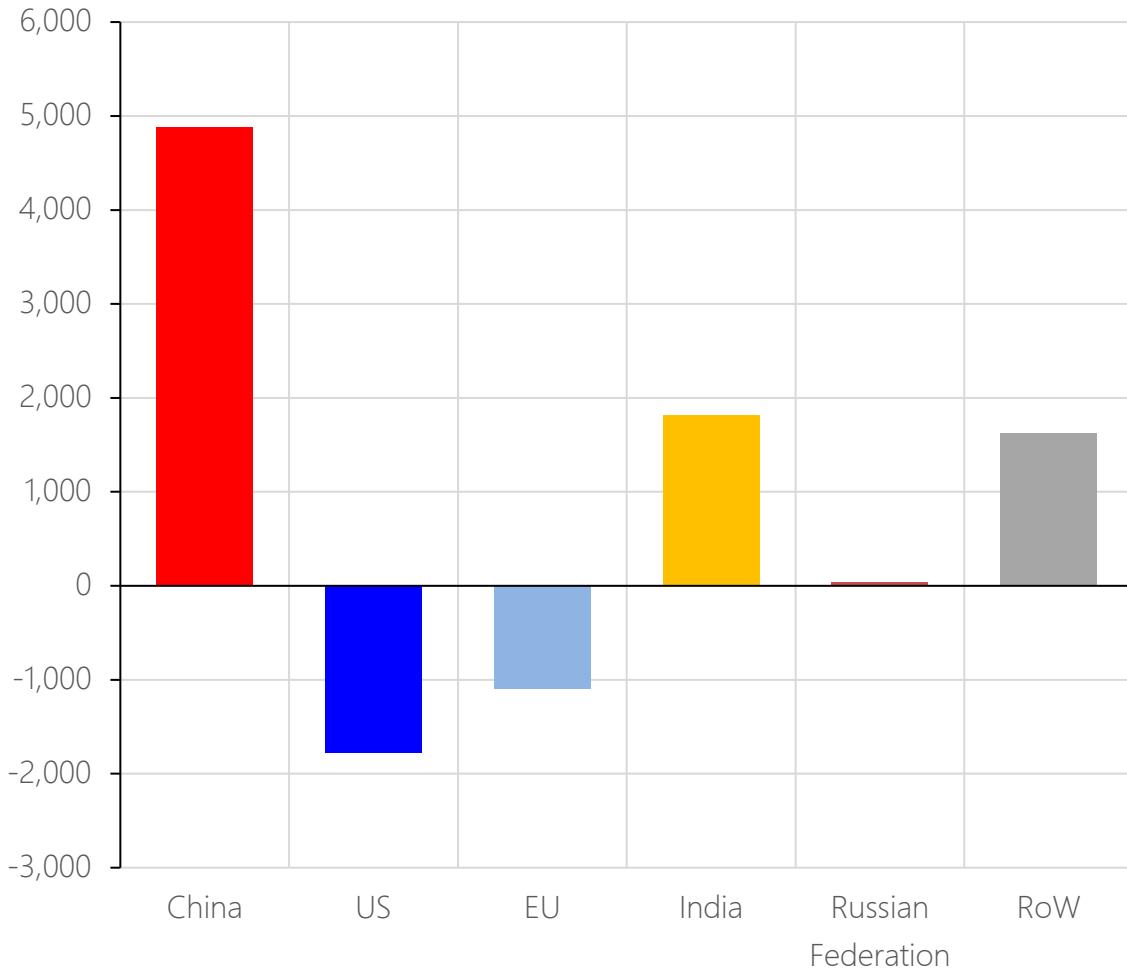
Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>

...walking the walk?

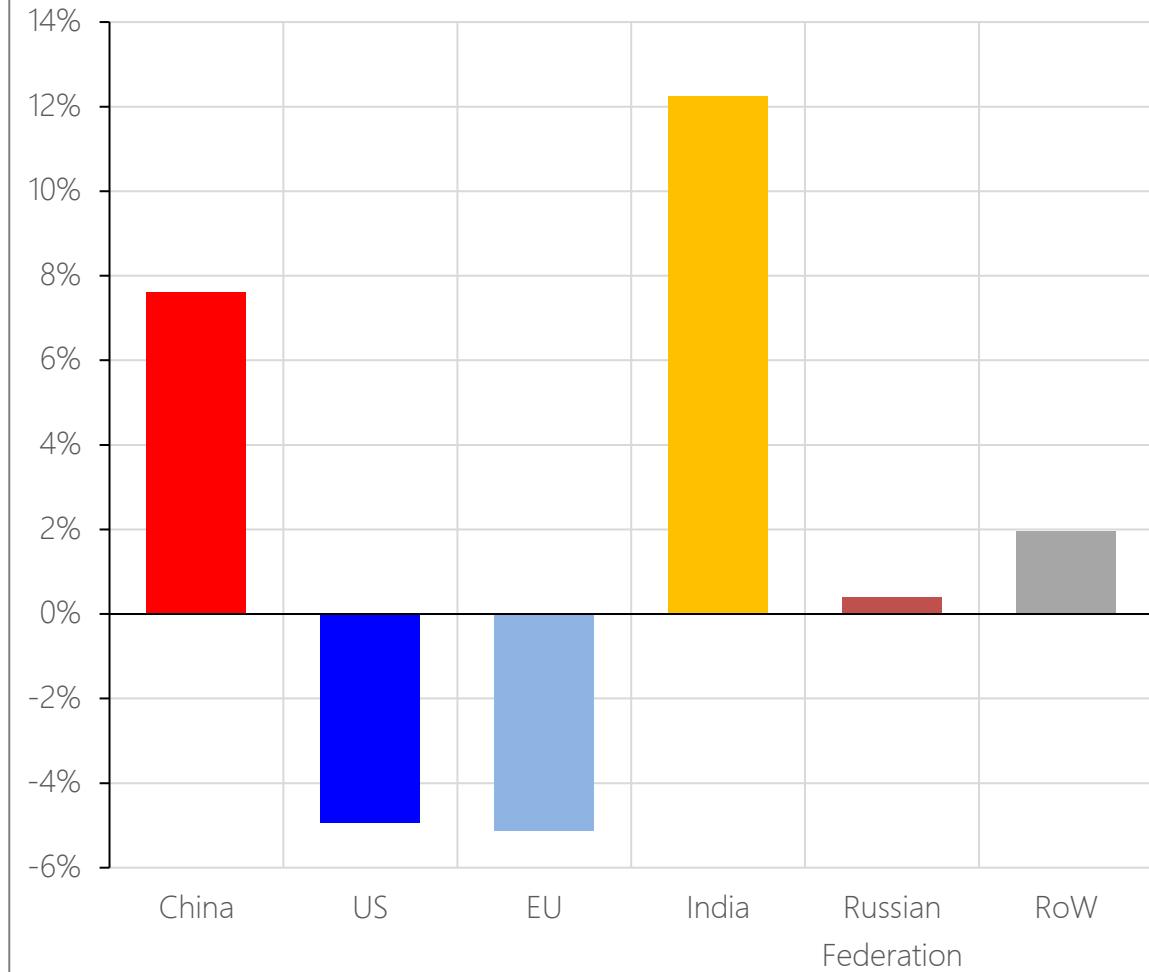
Change in annual CO₂ emissions since 2015 (Paris Climate Agreement)Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>

...walking the walk?

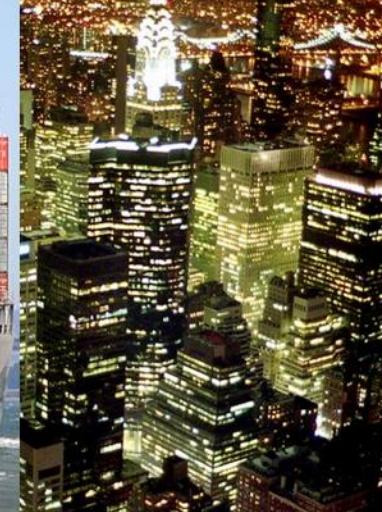
Cumulative increase in emissions, 2015 to 2022 [Mt]



Average annual percentage change in CO2, since 2015



Raw data: Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>



Energy Systems & Climate Change

