



ORDEM
DOS
ENGENHEIROS



**WORLD
ENGINEERING
DAY**
FOR SUSTAINABLE
DEVELOPMENT



WFEO / FMOI

In support of UNESCO
World Engineering Day



Com o Alto Patrocínio
de Sua Excelência

Under the High Patronage of the
President of the Portuguese Republic



O Presidente da República

Lisbon

March 4th 2024

The reinforcement of the energy interconnections and the optimization of energy markets in Europe

Marie-Line Vaiani



Engineering Solutions for a Sustainable World

Ordem dos Engenheiros

International Panel on Climate Change - Sixth Assessment Report



Lisbon
March 4th 2024

Engineering Solutions for a Sustainable World

The hope

Mitigation and Adaptation Options across Systems

- C.3** Rapid and far-reaching transitions across all sectors and systems are necessary to achieve deep and sustained emissions reductions and secure a liveable and sustainable future for all. These system transitions involve a significant upscaling of a wide portfolio of mitigation and adaptation options. Feasible, effective, and low-cost options for mitigation and adaptation are already available, with differences across systems and regions. (*high confidence*) {4.1, 4.5, 4.6} (Figure SPM.7)

Finance, Technology and International Cooperation

- C.7** Finance, technology and international cooperation are critical enablers for accelerated climate action. If climate goals are to be achieved, both adaptation and mitigation financing would need to increase many-fold. There is sufficient global capital to close the global investment gaps but there are barriers to redirect capital to climate action. Enhancing technology innovation systems is key to accelerate the widespread adoption of technologies and practices. Enhancing international cooperation is possible through multiple channels. (*high confidence*) {2.3, 4.8}

International Panel on Climate Change - Sixth Assessment Report

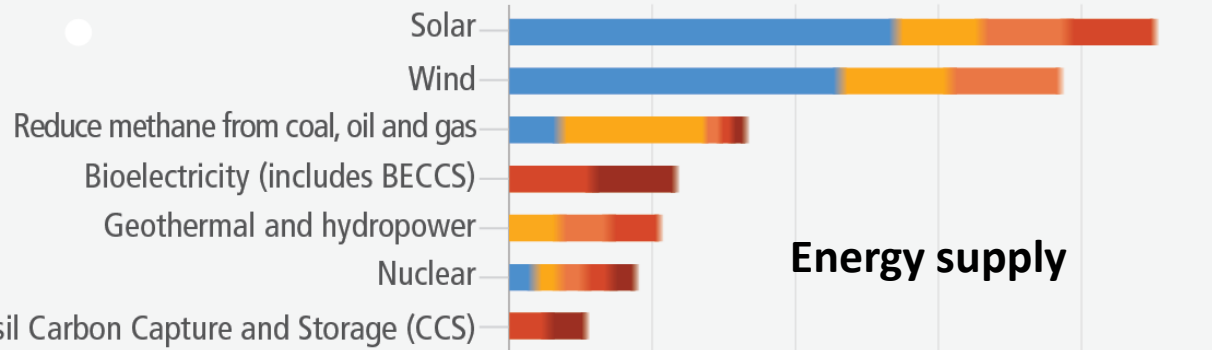


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Potential contribution to net emission reduction, 2030
GtCO₂-eq/yr

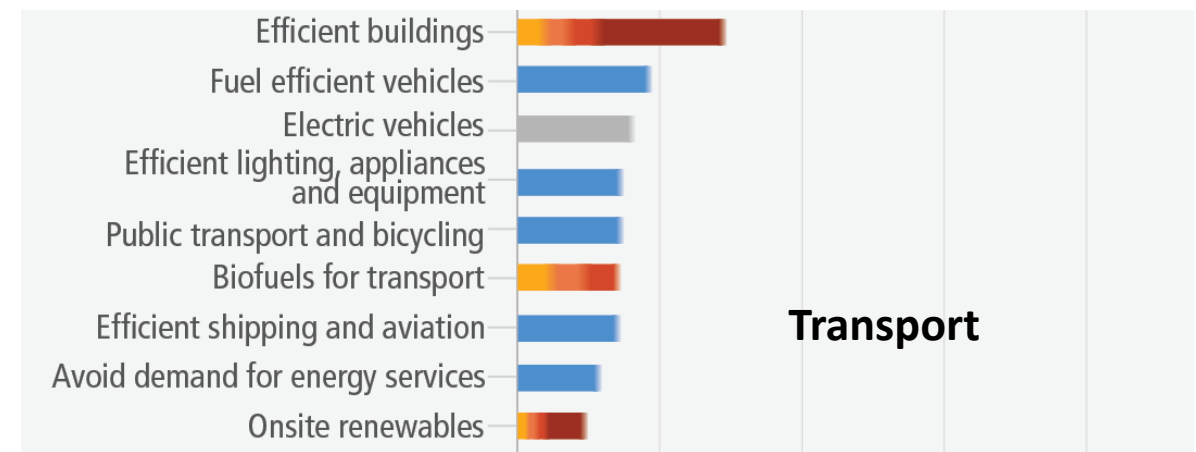
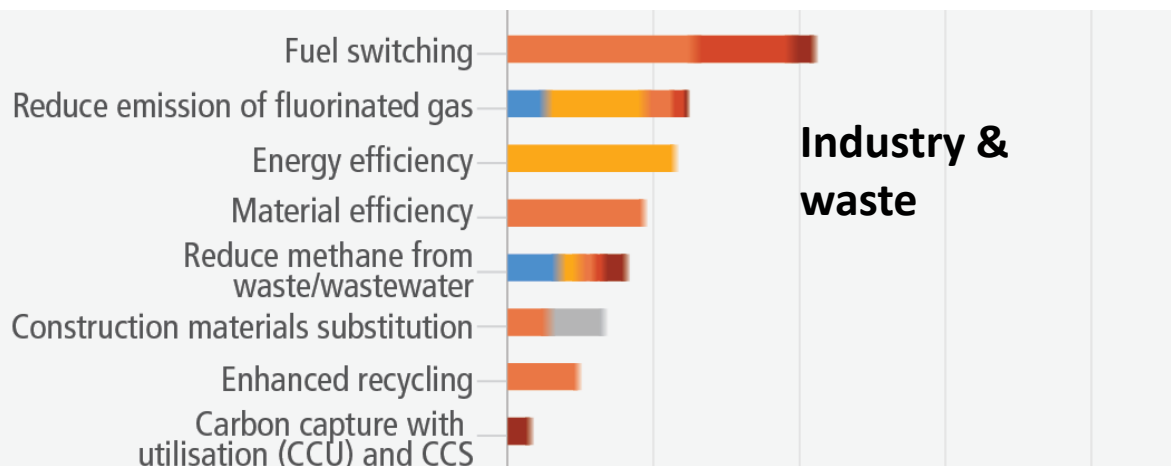
0 1 2 3 4 5



Net lifetime cost of options:



options costing 100 USD tCO₂-eq or less could reduce global emissions by at least half of the 2019 level by 2030

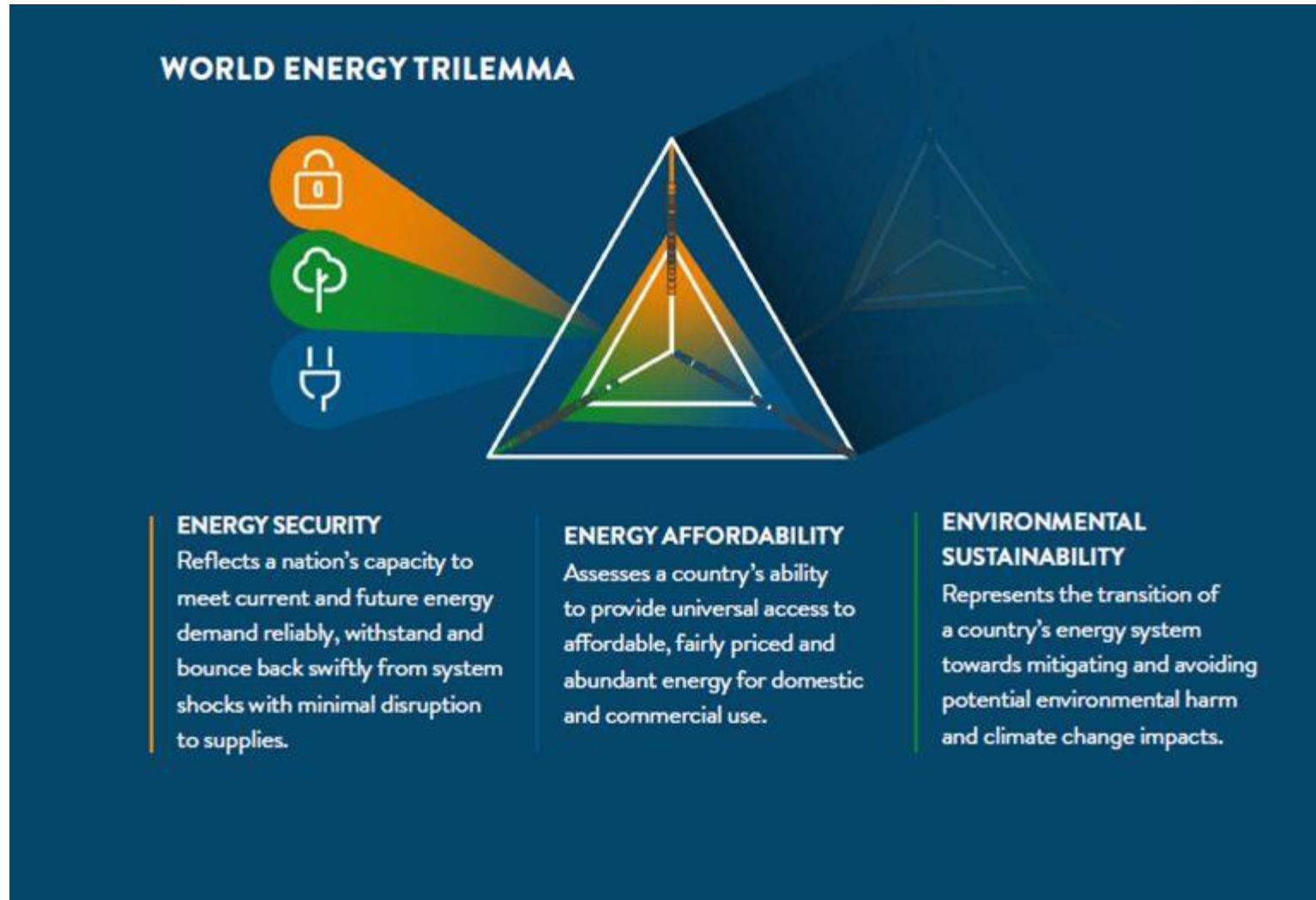


Energy Trilemma

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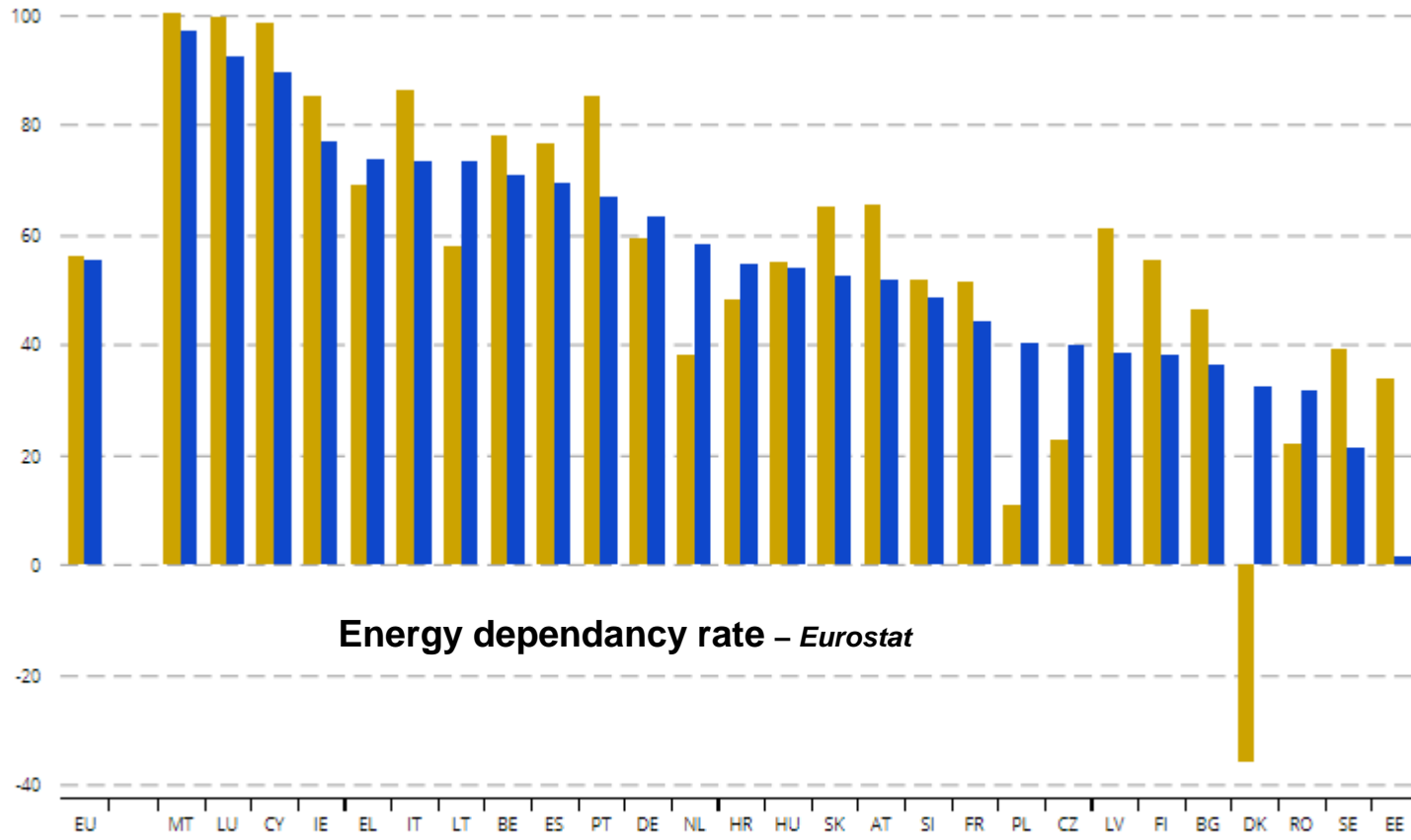
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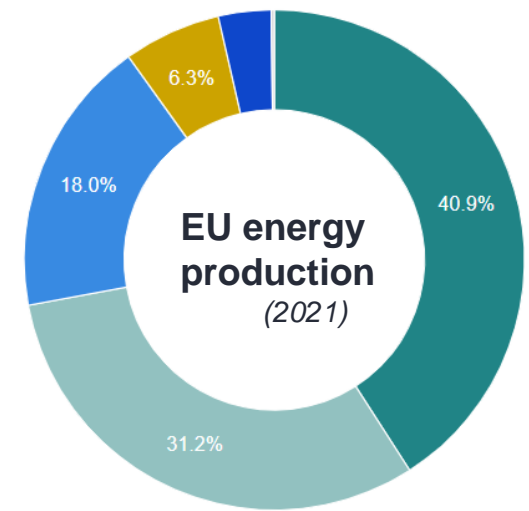
**WORLD
ENERGY
COUNCIL**

Europe : energy mix

In 2021, the EU produced around 44% of its own energy, while 56% was imported.

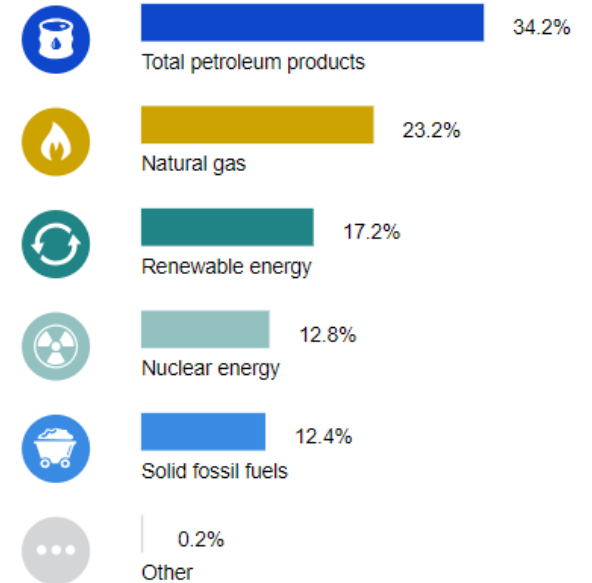


2000 2021



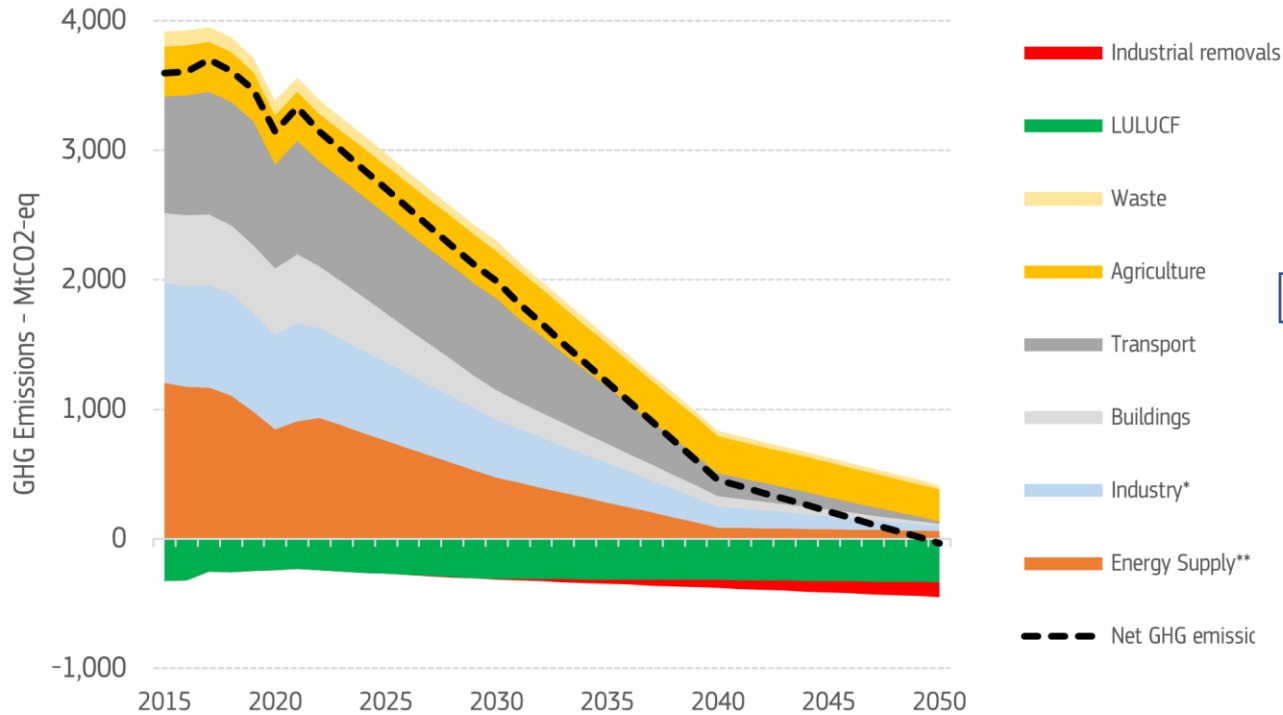
Renewable energy
 Nuclear energy
 Solid fuels
 Natural gas
 Crude oil
 Other

Energy mix for the European Union



Europe, a climate-neutral continent by 2050

Historical and projected sectoral greenhouse gas emissions in the period 2015-2050



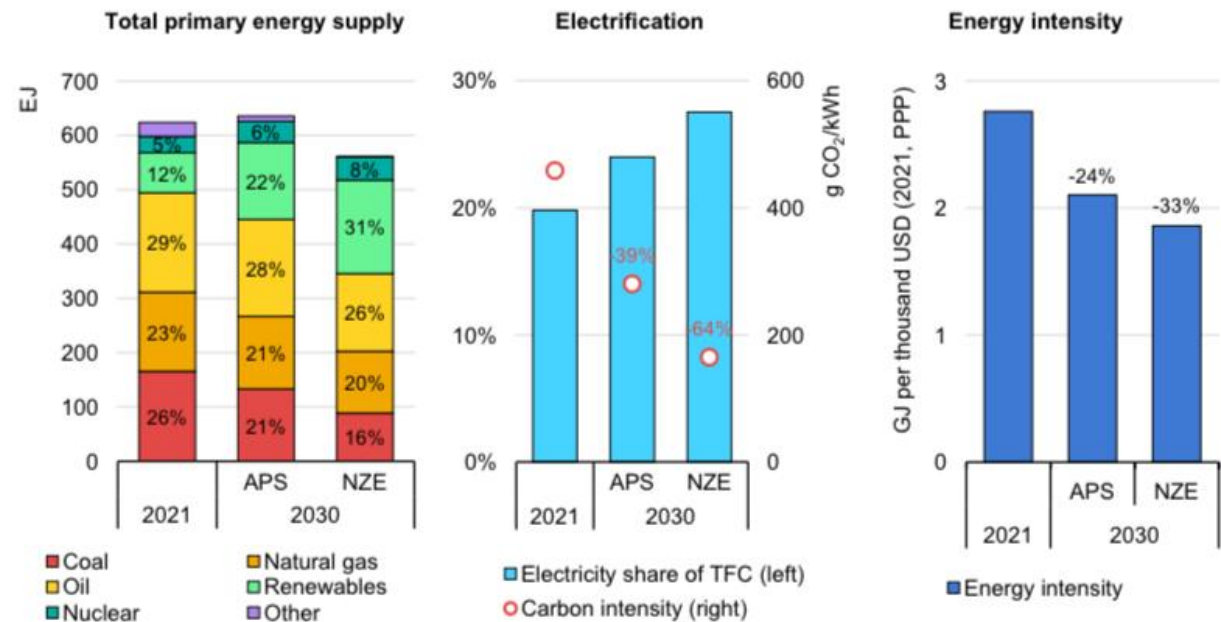
*Excluding non-BECCS industrial removals

**Including bioenergy with carbon capture and storage (BECCS)

EU



Total primary energy supply, electrification rates and energy intensity in 2030 in the APS and NZE Scenario



European Electricity interconnections

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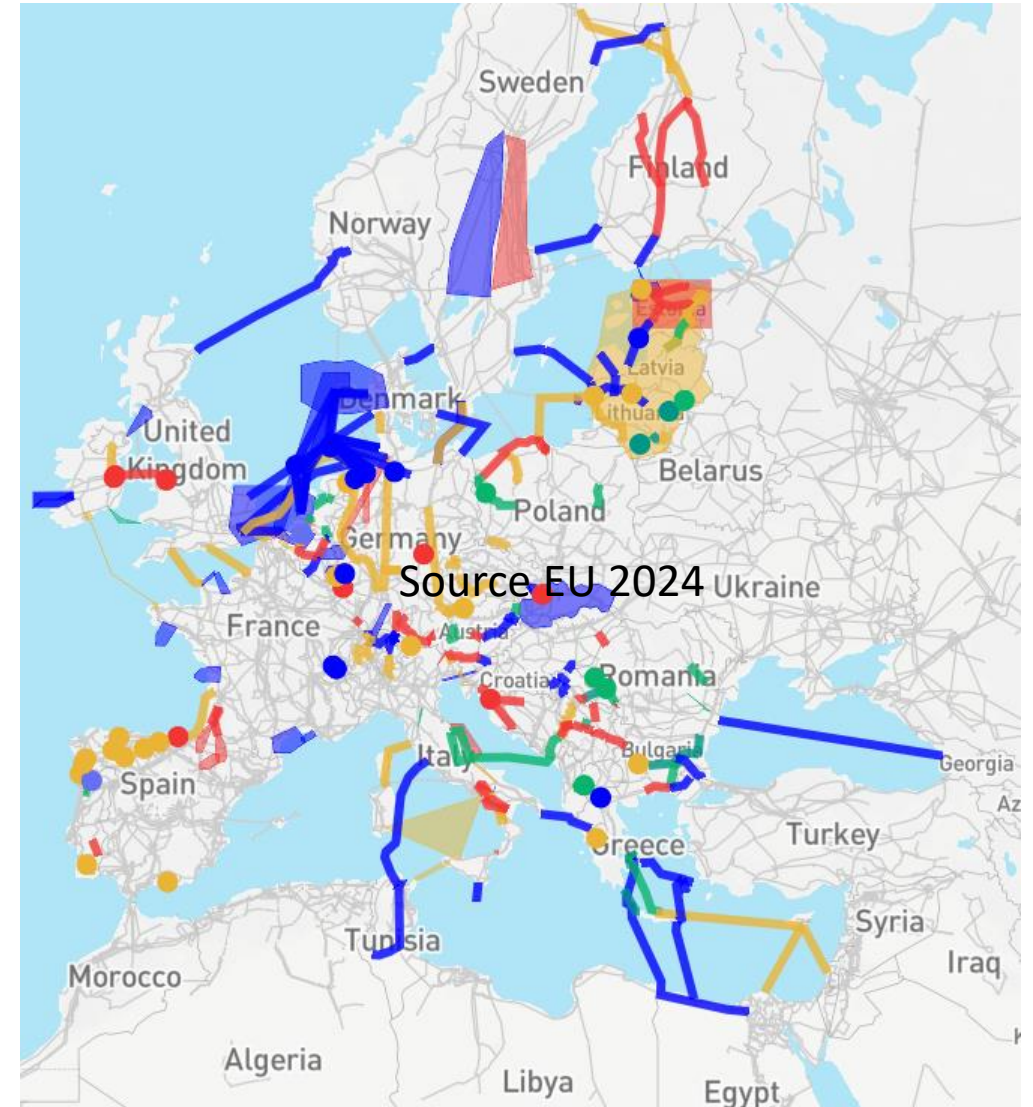
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Interconnections are key for european electricity market(s)

- 305 000 km of power lines operating at the same frequency (50 Hz), more than 400 interconnections linking nearly 600 million European citizens
- Managed in real time by TSO, interdependence provides security of supply across the continent with each operator having access when needed to power-generation capacities located outside of its borders

Growing electrification, development of renewables, increasing flexibility challenges => development of electricity interconnections are a priority for Europe

141 projects in TYNDP 2022 of ENTSO-E



European gas interconnections

KEYS

cross-border points, fully owned or fully belonging to one party

- yellow circle: cross-border interconnection point with 100% or 100% owned by one country
- orange circle: cross-border interconnection point with 100% or 100% owned by one country under construction or planned
- red circle: cross-border interconnection point with 100% or 100% owned by one party
- pink circle: cross-border interconnection point with 100% or 100% owned by one party
- white circle: virtual point

non-member areas

- triangle: collection can field

countries

- EU countries
- other countries

transport for pipeline

existing infrastructure

- blue line: gas
- orange line: oil
- green line: electricity
- yellow line: other

project categories

- red dashed line: no projects
- orange dashed line: non-revised projects
- green dashed line: non-revised projects
- blue dashed line: non-revised projects
- purple dashed line: non-revised projects
- pink dashed line: non-revised projects
- grey dashed line: non-revised projects

project to part of 2+ projects

- red solid line: no projects
- orange solid line: non-revised projects
- green solid line: non-revised projects
- blue solid line: non-revised projects
- purple solid line: non-revised projects
- pink solid line: non-revised projects
- grey solid line: non-revised projects

project identification

- red circle: ENTSOG project code
- orange circle: ENTSOG project code
- green circle: ENTSOG project code
- blue circle: ENTSOG project code
- purple circle: ENTSOG project code
- pink circle: ENTSOG project code
- grey circle: ENTSOG project code

storage facilities

- yellow triangle: storage
- orange triangle: storage
- green triangle: storage
- blue triangle: storage
- purple triangle: storage
- pink triangle: storage
- grey triangle: storage

compression stations

- red circle: no projects
- orange circle: non-revised projects
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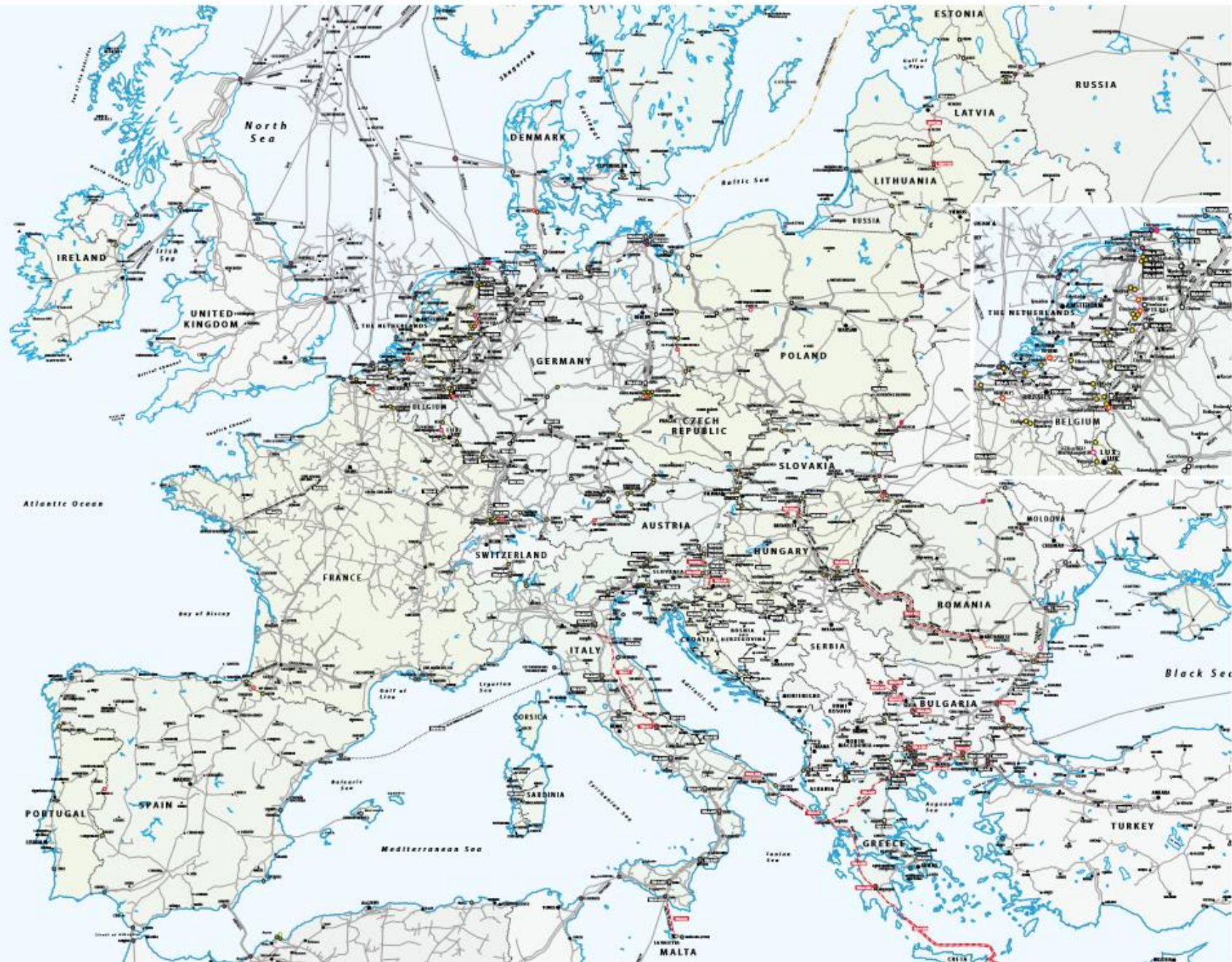
ENTSO-G interconnection studies

ENTSO-G currently comprises 43 TSO members, 2 Associated Parties from 27 European Countries and 10 Observers.

When the same point is affected by several projects, the point is shown with the highest project status (operational, IAD, advanced) over IAD, the status from single projects always has first.

All data provided on this map is for information purposes and shall be treated as indicative and non-contractual in nature, and that any emerging different outcomes in any possible discussion forum at regional level under no circumstances shall be regarded as interconnection intended for construction.

Version: March 2023
WGS 84 Pseudo Mercator projection

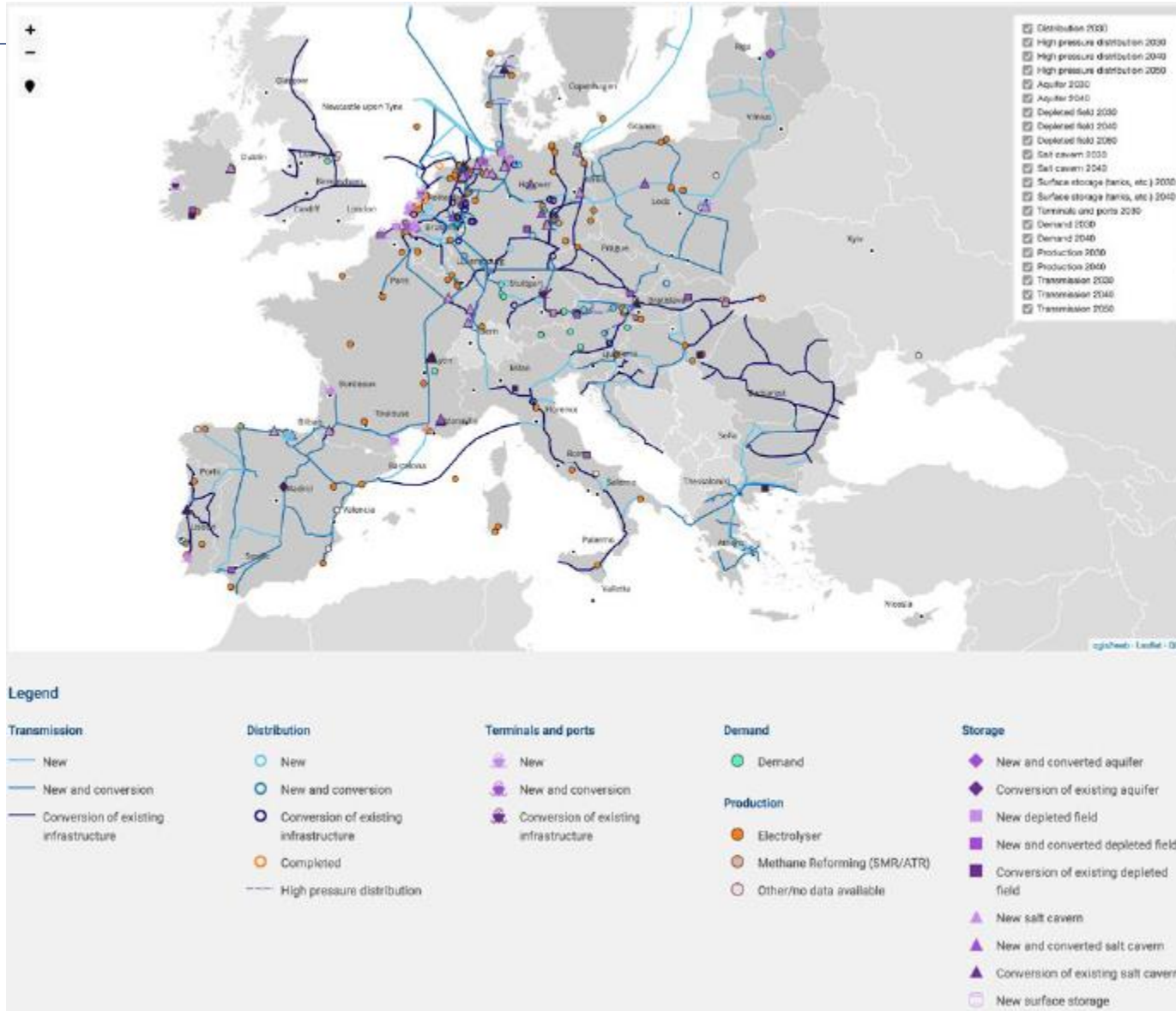


Projected CO2 infrastructures – 2030



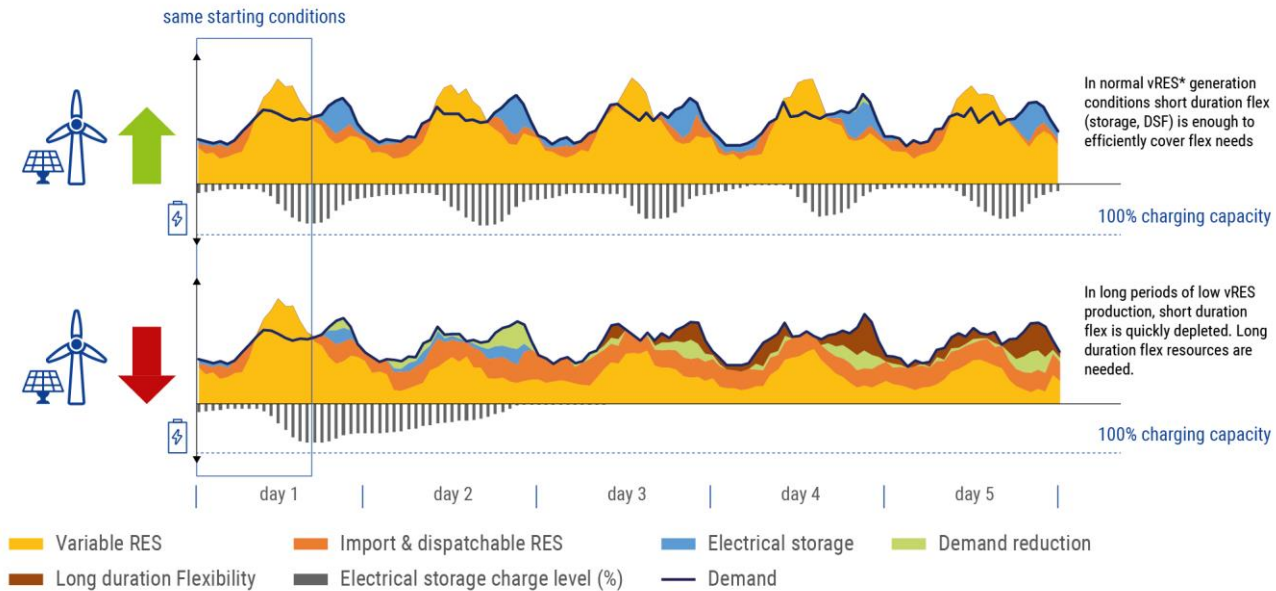
Source EU 2024

European H2 interconnection projects

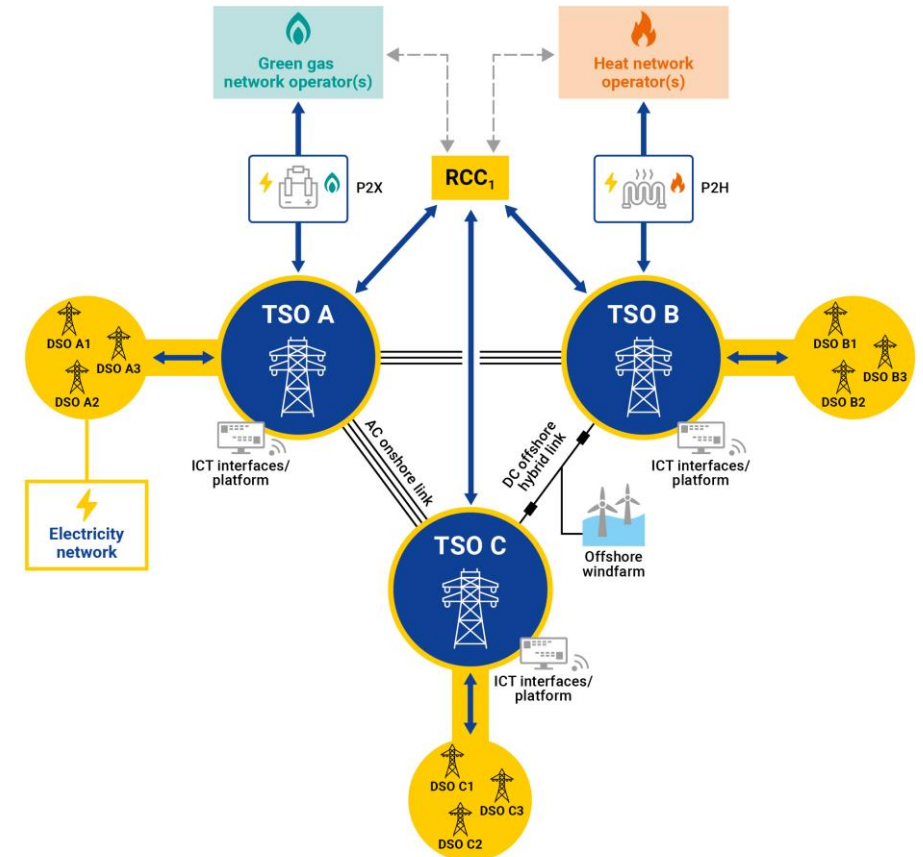


Source European Clean Hydrogen Alliance

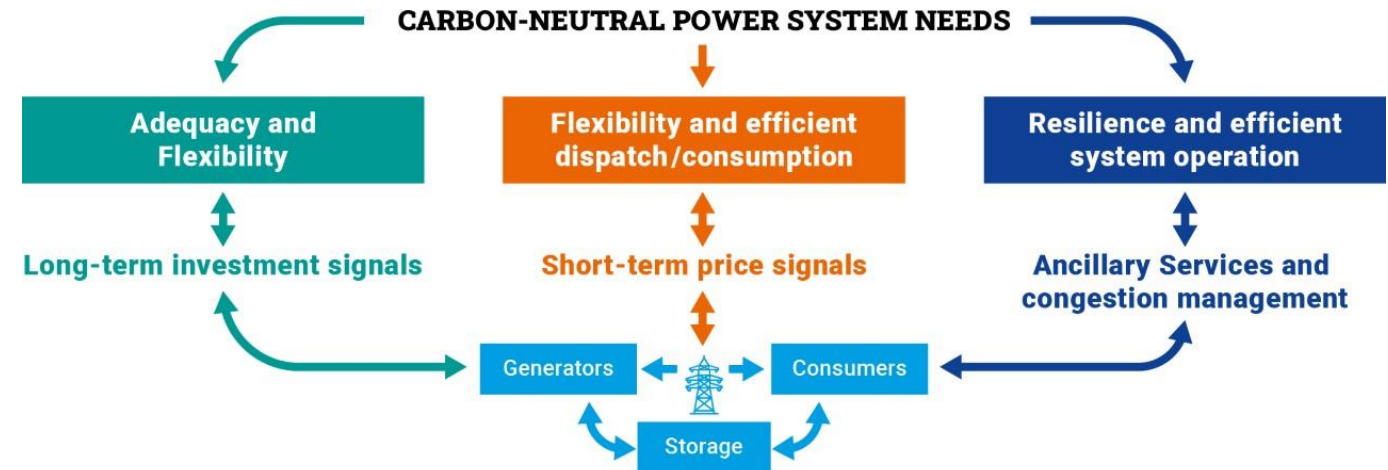
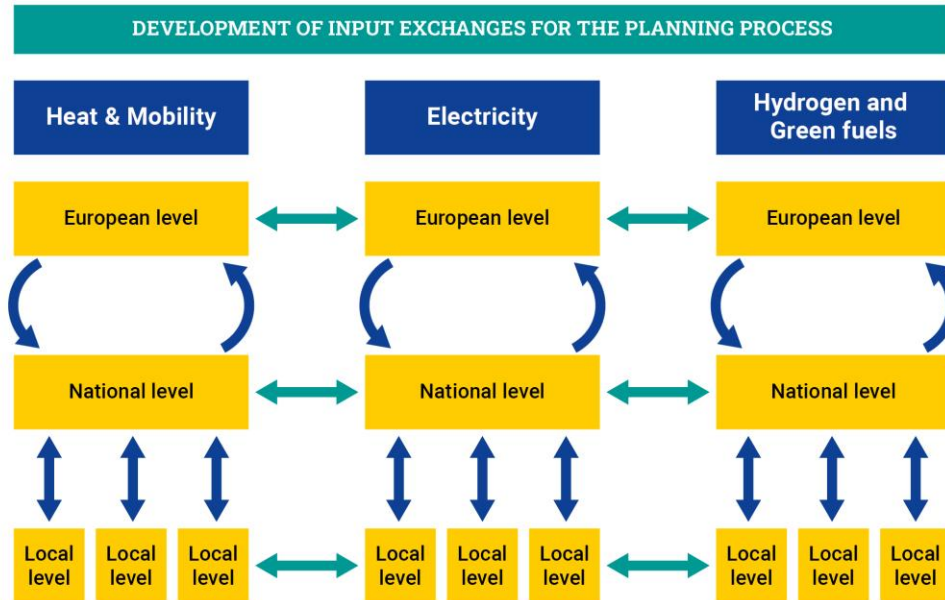
Energy interconnections : challenges



* vRES = Variable Renewable Energy Sources, characterised by their intermittent and weather-dependent nature



Energy market optimizations



Renaissance of european industrial policy

Green deal Industrial Plan

- Launched 1 February 2023
- Complements the Green Deal and the REPowerEU packages, to support the EU's ambitions to reduce net greenhouse gas emissions by at least 55% by 2030
- Substantial funding available
- Four pillars:
 - i) a predictable and simplified regulatory environment
 - Net-Zero Industry Act, including simplified and fast-track permitting
 - Critical Materials Act
 - Reform of electricity market
 - ii) speeding up access to funding
 - including relaxing of state aid rules
 - iii) enhancing skills
 - Net-Zero Industry Academies
 - iv) open trade for resilient supply chains
 - Free Trade Agreements and Clean-Tech Net Zero Industrial partnerships

Renaissance of industrial policy

European industrial Alliances

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2024 : Facilitate and accelerate the development, demonstration, and deployment of SMRs in Europe by the early 2030s.

European Solar Photovoltaic
Industry Alliance

2022 : Scaling up EU manufacturing of competitive, innovative, and sustainable solar PV products as well as diversifying international PV value chain components and supply raw materials.



2022 : boosting production and supply of renewable and low-carbon fuels in the aviation and waterborne sectors



2021 : build resilience and strategic autonomy for Europe's rare earth and magnet value chains. Identify investment possibilities in raw materials value chain, while addressing sustainability and social impact.

European Clean
Hydrogen Alliance

Kick-starting the EU Hydrogen industry to
achieve the EU climate goals



2020 : support large-scale deployment of clean hydrogen technologies by 2030. Promote investments and stimulate clean hydrogen production and use.

EUROPEAN
BATTERY
ALLIANCE | EBA250

2017 : creating a competitive and sustainable battery cell manufacturing value chain in Europe



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Thank you

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