Breakthrough Energy

Renewables Grid Initiative

Breakthrough Energy Europe

INDUSTRY IN TRANSITION: THE ROLE OF **ELECTRICITY GRIDS** IN DECARBONISING EUROPEAN INDUSTRY

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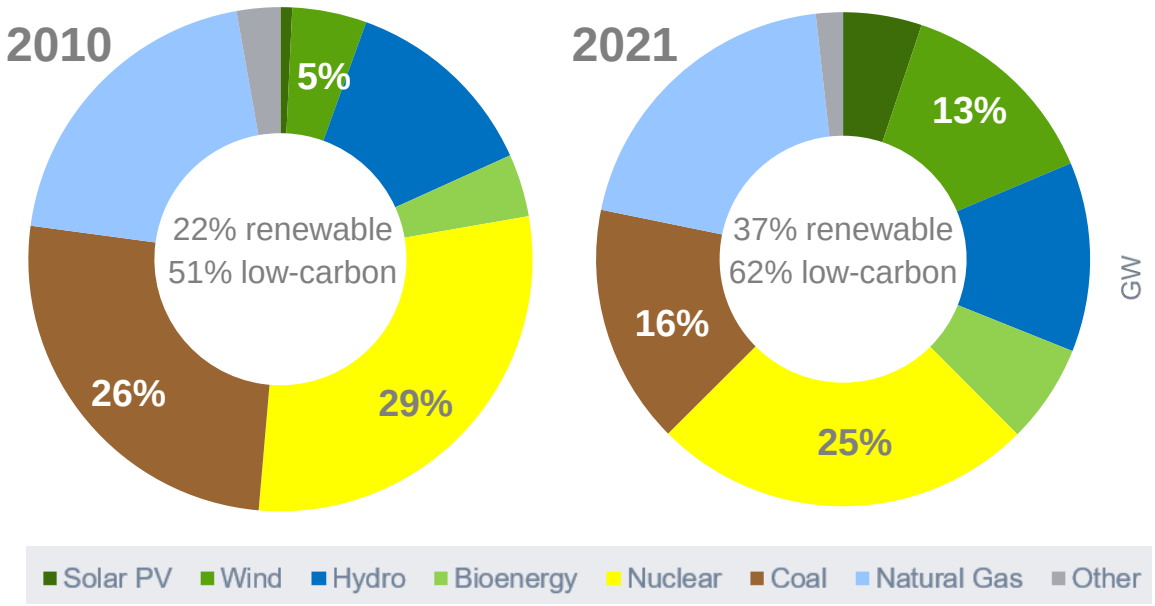
The context

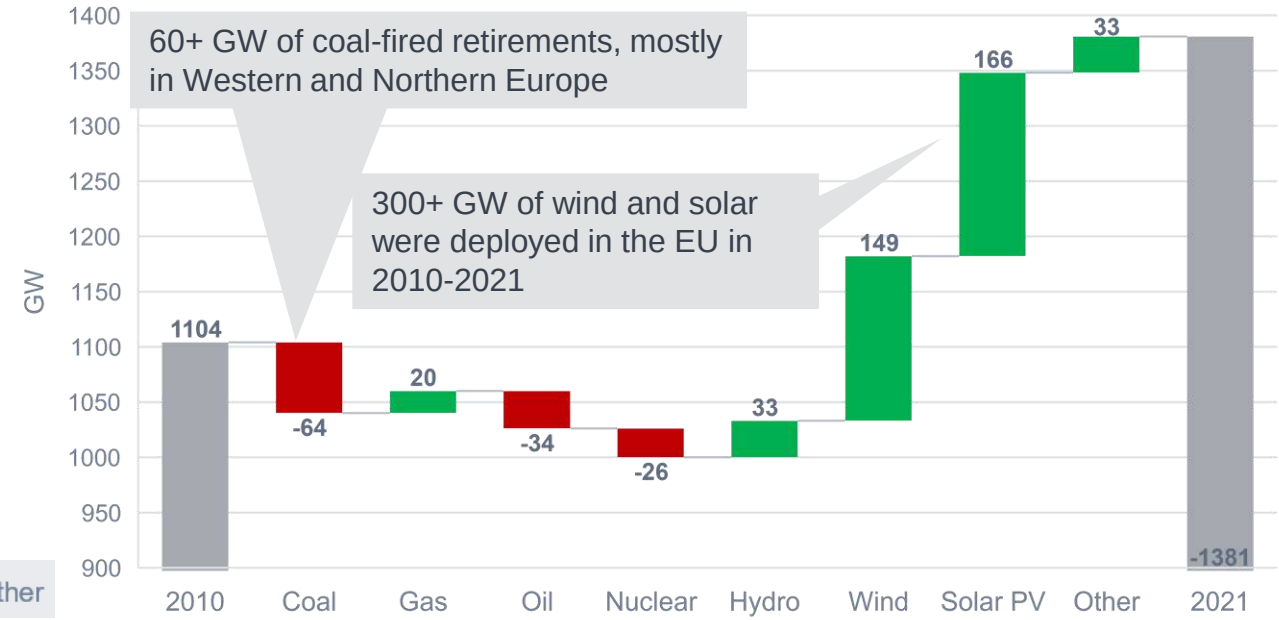
Megatrends in Europe

Renewables are rapidly gaining ground in Europe

EU27 Power Generation mix (2010-2021)



Net change in installed capacity, EU27 (2010-2021)

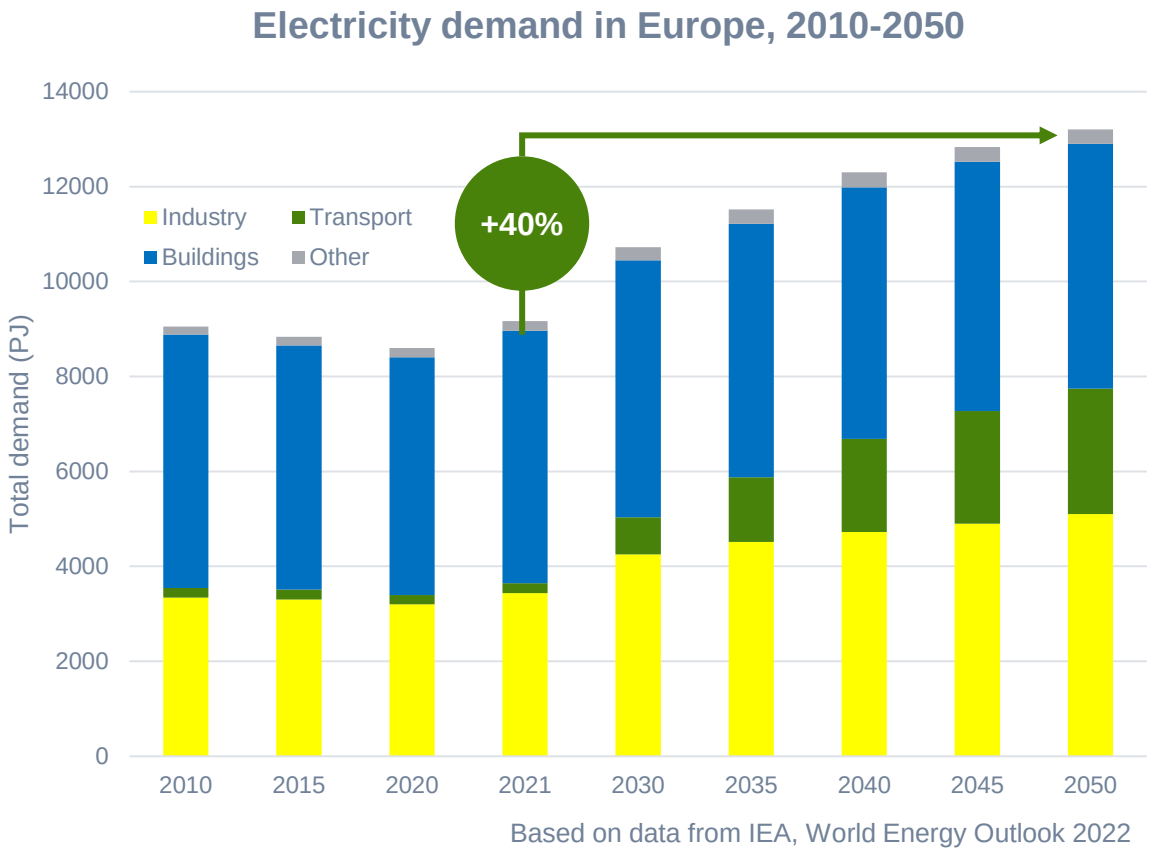


Source: BE, based on data from IEA, World Energy Outlook 2022

***Europe was the first to develop and scale up wind and solar technologies**, but now imports most of their technological components from China. This first deployment was achieved through country-level subsidies schemes like feed-in tariffs and premiums, that were ultimately paid by consumers in the form of higher energy prices.*

Europe deployed more than 300GW of renewable generation capacity between 2010 and 2021 – increasing the share of renewables by 15%. Fossil-fuel fired capacity retirements reached almost 100GW.

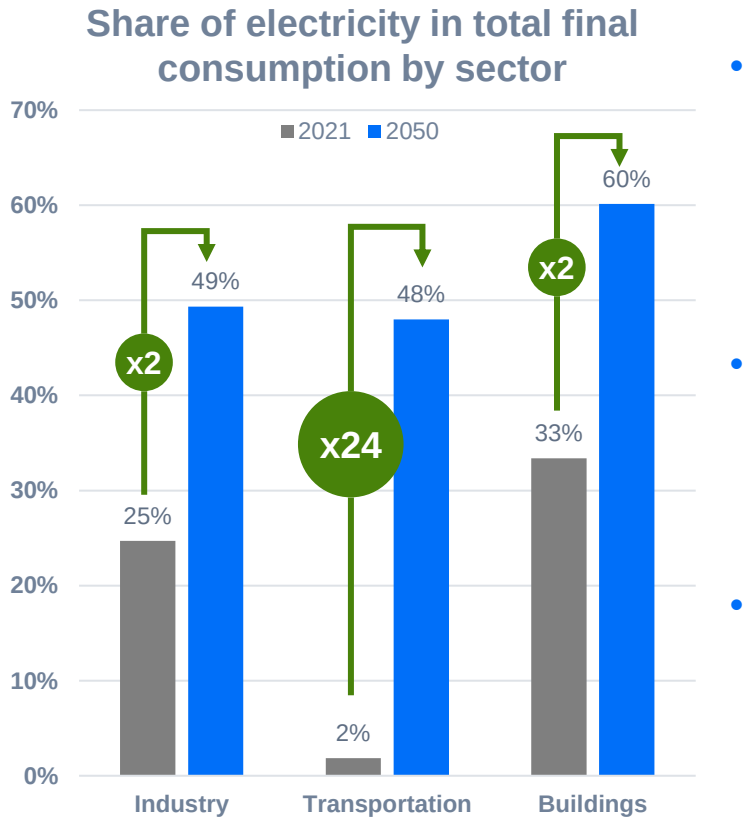
Electricity demand will continue growing despite efficiency gains



- **Electricity demand in Europe will increase by more than 40% by 2050 to meet announced targets** according to IEA assumptions.
- Transportation is responsible for over 60% of the total demand growth to 2050.
- In buildings, power demand is set to decrease despite a switch from gas to power for heating. This is due to the higher efficiency of heat pumps compared to gas or electric heaters, as well as improvements in energy efficiency in buildings.
- Industry accounts for the remaining growth in power demand (around 40% of the total), but the growth will be sharper in countries where natural gas was used extensively in industry – including Italy and Germany.

Electrification of end-uses is a key enabler to meet the EU's climate and energy targets. This will drive increase for power demand in Europe, which should increase by at least 40% by 2050.

Electrifying sectors requires many technologies



Based on data from IEA, World Energy Outlook 2022

- **In transportation**, based on IEA assumptions, the share of electricity will need to increase 24-fold by 2050. This will require an **accelerated rollout of EVs** and supporting infrastructure. This is already underway in many countries – especially in the Nordics – and is set to accelerate with the potential ban on ICE car sales from 2035.
- **In buildings**, electricity is expected to meet 60% of total demand – the highest share among major consumption sectors. **Heat pumps will play a major role** in meeting this target, but the models currently in the market are not suitable for many old European buildings.
- **In industry**, **electricity is set to meet almost half of sectoral demand by 2050.** This will require deploying technologies to **electrify low, medium and high-temperature heat**. Some fossil fuel uses, will require low-carbon molecules, such as hydrogen and derived fuels, which in Europe, will mostly be produced from low-carbon electricity.

Electricity use will need to increase in all end-use sectors to meet the EU's climate and energy security goals, requiring the deployment of both existing and new technologies.

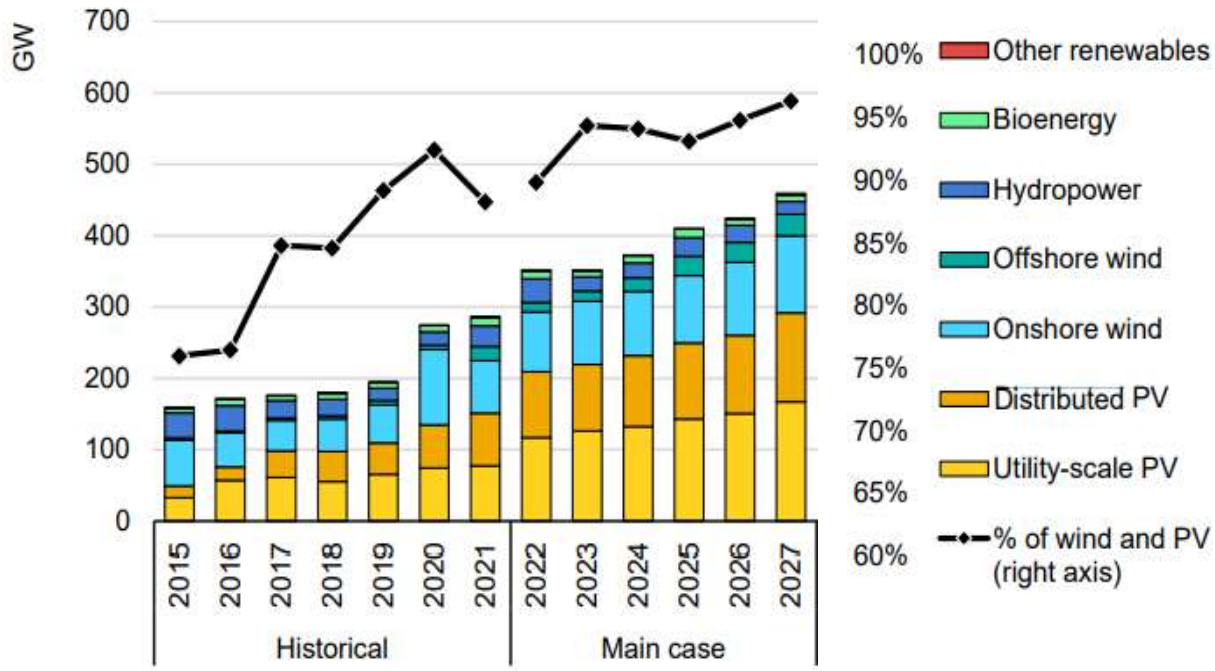
Europe’s power systems are becoming more decentralized

Power systems are becoming increasingly decentralized, **with distributed energy resources (DER) leading capacity additions in many EU countries:**

- In Germany: distributed PV will make up for 70% of the solar deployment to 2027.
- In Italy: distributed PV additions in 2022 will reach almost 2 GW, the highest growth since 2012.

New regulation and incentives are expected to accelerate distributed solar PV deployment. This includes new feed-in tariffs, auto-consumption with remuneration for excess generation, as well as through corporate PPAs, revenues from the spot market, or a mixture of both.

Renewable annual net capacity additions by technology, 2015-2017



Source: IEA, Renewables 2022

Europe’s power systems are becoming more decentralized, due to the rise of distributed solar PV and the increased roll out of EV, heat pumps, residential storage solutions, and grid digitalization technologies.

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The reality check

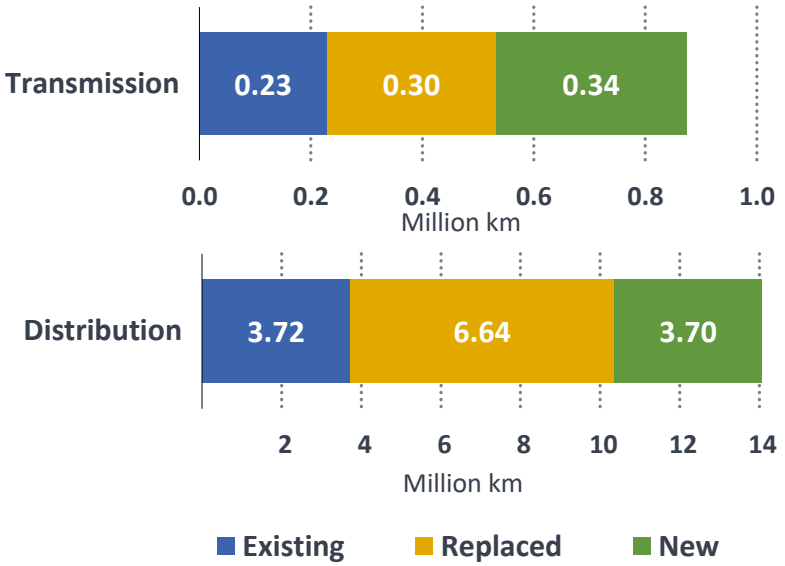
State of play of EU electricity infrastructure

Europe’s power grid will need to be modernized and expanded

The EU’s transmission grid stretches over 530.000 km and features 93GW of cross-border interconnection capacity.

- **Rising demand, increasingly variable generation and decentralization** pose specific challenges for Europe’s grids.
- **The grid will need to transport large volumes of power across the continent.** Much of the new generation will come from offshore wind, located far from demand centers.
- **The transmission grid will need to expand by 2/3rds** according to the IEA. N**ot considering more efficient grid technologies, the IEA forecasts that Europe will need to** install 340.000 km of new transmission lines – over 100 times the distance from Tallinn to Madrid, and an additional 3.7 million kilometers of distribution grids.
- **Long permitting processes** (up to 13 years for transmission lines) risk delaying the rollout of the infrastructure needed.

Grid expansion in the EU, 2022-2050

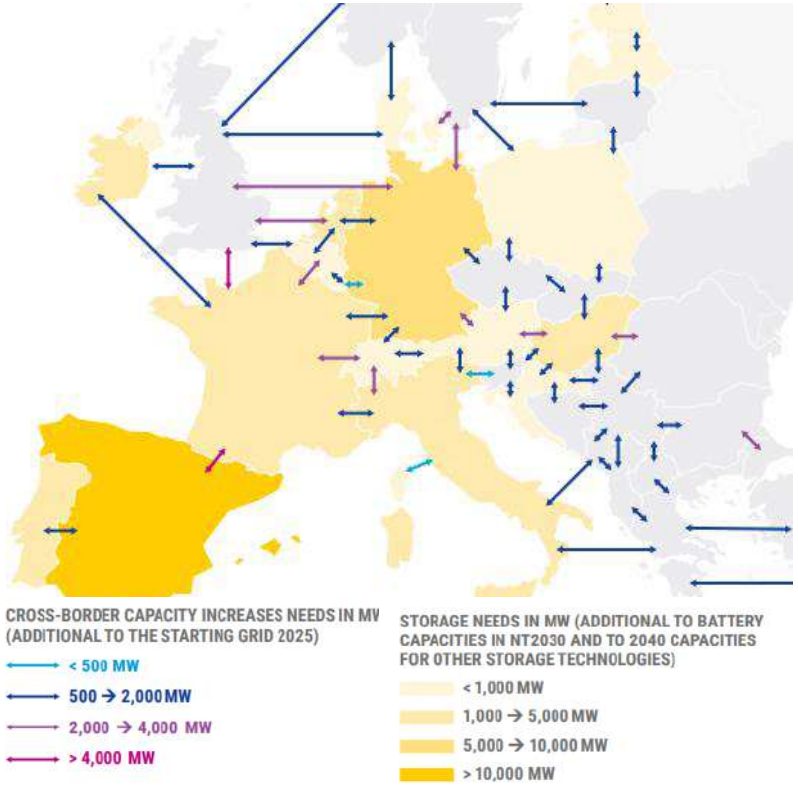


Source: IEA, WEO 2022

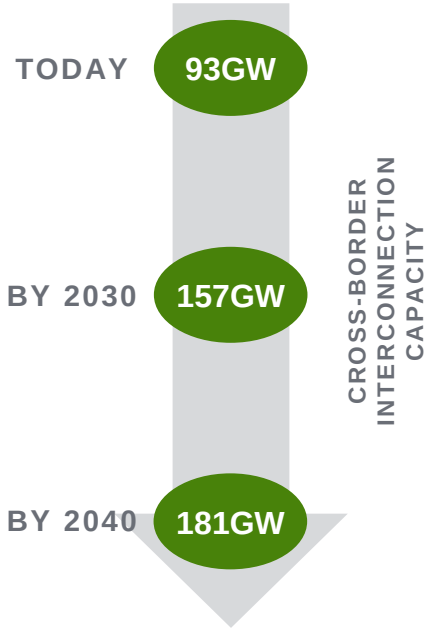
European electricity networks will need to be expanded and replaced in all regions. Permitting bottlenecks must be addressed; regulation should promote innovative, more efficient grid technologies.

Grid integration across Europe is crucial to reach net-zero

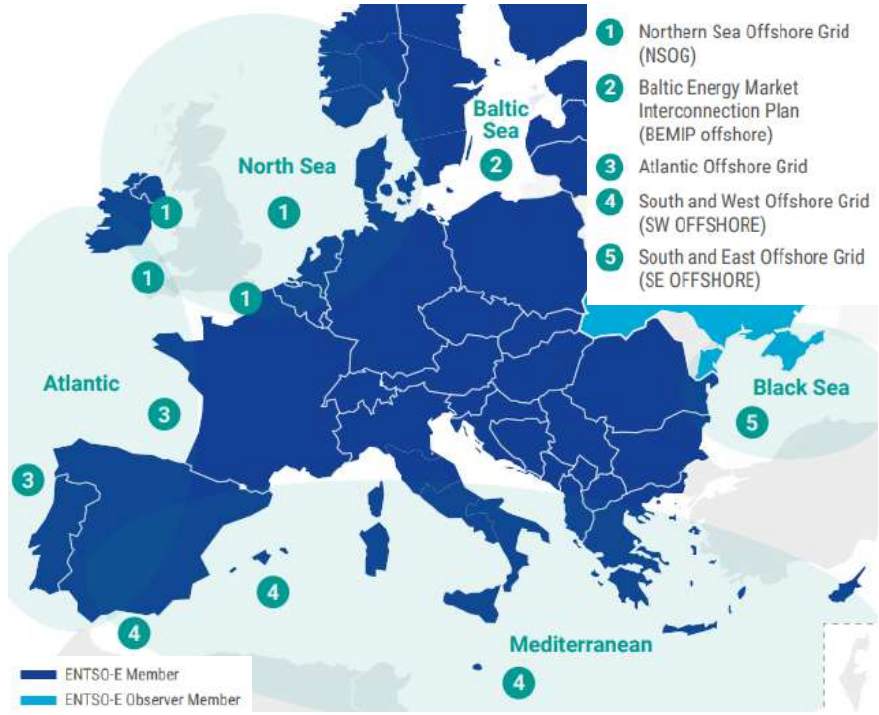
Cross-border transmission and storage infrastructure, 2040



EU cross-border interconnection needs



EU offshore wind hubs



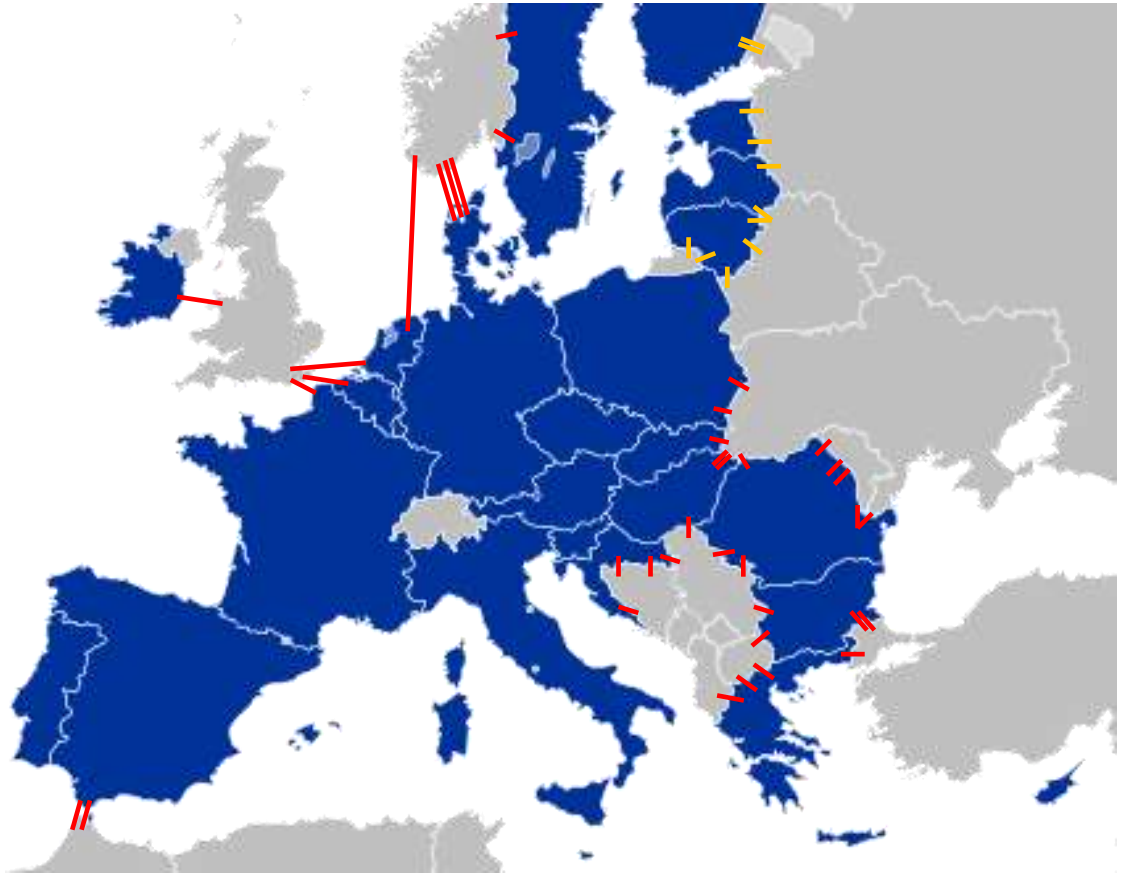
Source: ENTSO-E, A power system for a carbon neutral Europe

Europe's grid will have to enable large volumes of low-carbon energy – mostly wind – to reach consumers across the continent. Up to 88 GW of new cross border interconnection capacity will be needed by 2040.

…while connecting additional regions unlocks opportunities

The European grid is the largest synchronous grid in the world, supplying over 400 million customers in 24 countries. Its interconnectivity exceeds the EU itself:

- **United Kingdom,** has been a net importer from France, Belgium and the Netherlands and net exporter to Ireland
- **Norway**, is fully integrated to the Nordic power grid.
- **Ukraine and Moldova** were successfully synchronized into EU´s power grid in 2022, accelerated after Russia´s invasion of Ukraine.
- **North Africa** is connected but to a limited extent with Europe through Spain.



Expanding Europe´s interconnections to additional regions, like North Africa, could unlock opportunities to underpin EU net zero goals, benefitting from the great solar potential in the region.

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The booster

Innovation can unleash more electricity flows

Innovative power grid technologies

amsc · SUPERNODE · VEIR · CTC GLOBAL

Advance & Superconductors

SMART WIRES

Modular Power Flow Control Solutions

LINEVISION · GRIDPULSE · Heimdall Power · Ampacimon

Dynamic Line Rating

enline · WeaveGrid · Plexigrid · reactive technologies

Real time measurements

GWP · Schneider Electric · Hitachi Energy

Smart Sensors

piclo

Flexibility enablers

ESS INC · form energy · KYOTO · RONDO · northvolt · MALTA · ENERGYDOME · sonnen

Energy Storage

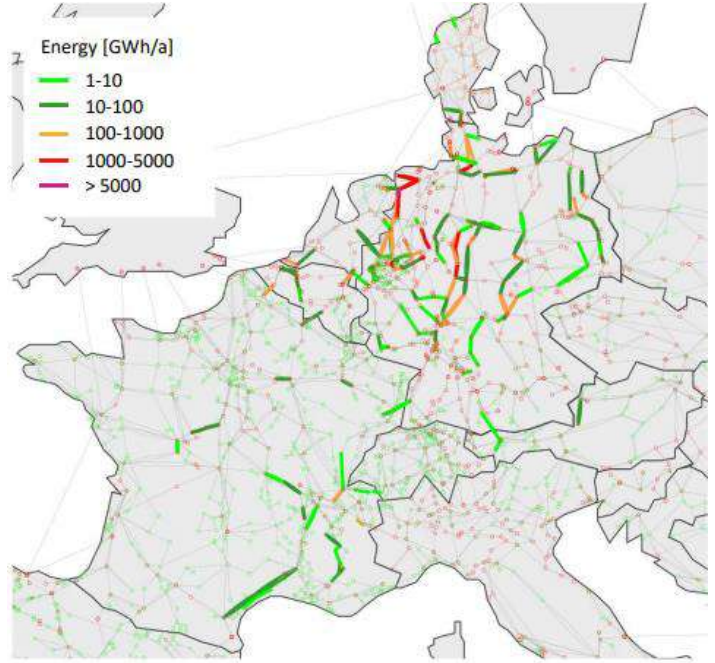
And many more….

New technologies could solve many of the grid's problems

Innovative technologies can help European power grids to address key challenges:

- **Reducing congestion, line losses and associated costs by 90% in 2030** through dynamic line rating, modular power flow control and superconducting technologies.
- **Reducing the need for new infrastructure**, including transmission lines transformers or other grid infrastructure.
- **Increasing energy security in the Baltics,** which are synchronized to the Russian grid and rely on Russia for frequency control services.

Grid congestion in Western Europe, 2030



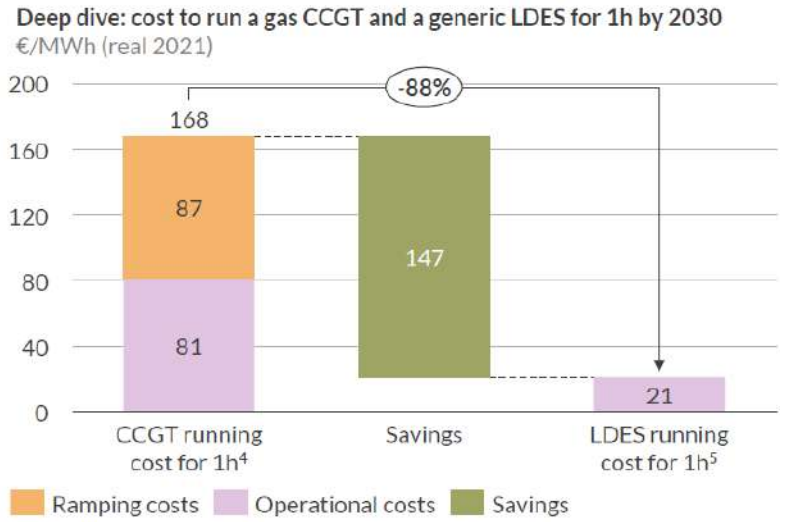
Source: Consentec, The Benefits of Innovative Grid Technologies, 2021

Upgrading existing grids is a 'no regrets' option for Europe. With increasing levels of renewable power generation, innovative power grid technologies are essential to reinforce existing power grids efficiency.

Long Duration Energy Storage analysis in the Spanish power grid (Report)

LDES can replace carbon-intensive and more expensive technologies to provide ancillary services, resulting in additional system savings

Service	Typical technologies that can provide service	
	Baseline scenario	LDES scenario[2]
Voltage control	Gas and H_2 CCGTs, battery storage, and RES (curtail)	Battery storage, LDES and H_2 CCGTs
Thermal constraints	Gas and H_2 CCGTs, battery storage and RES (curtail)	Battery storage, LDES and H_2 CCGTs
Inertia[1]	Thermal, gas and H_2 CCGTs, pumped storage and battery storage	Battery storage, LDES and H_2 CCGTs
Black start	Gas and H_2 CCGTs	LDES and H_2 CCGTs



Download: https://auroraer.com/insight/long-duration-energy-energy-storage-in-spain/

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The gameplan

EU Energy and Industrial Policy, what is coming?

Current tailwinds in energy policy files…

Electricity Market Design

- **TOTEX principle**, that accounts for both capital and operational expenditures.
- **Capacity mechanisms**, being streamlined.
- **Anticipatory investments.**
- **Peak shaving.**

Net Zero Industrial Act

- **Power grid technologies** as one of the eight strategic net-zero technologies.

Critical Raw Materials Act

-Copper is among the key materials identifed, reflecting on the amounts that will be needed for transmission and distribution cables**.**

Current energy and industrial policy files bring headwinds for the deployment of electricity grids, but much more is needed.

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Accelerating development

Recommendations to turbocharge EU electricity infrastructure

…but additional steps are required to have a power grid that is fit for purpose

BE and EIB organised a workshop focused on innovative power grid technologies and the role of finance

01

PERMITTING & SPEED

Transmission and distribution grids need to be planned together with power generation, energy storage and demand, with more speed in planning, construction and paybacks of investments.

02

PROMOTE INNOVATION, FOCUSING ON EFFICIENCY

Many innovative technologies are ready for commercial deployment, but we need to focus on efficiency in regulation to ensure sustainable revenue streams for these technologies.

03

CAPACITY, NOT JUST INFRASTRUCTURE

To ensure that we promote the reinforcement and modernisation of our existing infrastructure and the use of storage and innovative technologies, in addition to the new power lines required.

04

ANTICIPATING INVESTMENTS, EASING FINANCE

Increasing and anticipating power grid investments will be essential to ensure that bottlenecks are reduced, while financiers have a lot to say in the development of additional financing mechanisms.

05

MANUFACTURING AND SKILLS, SOCIETY CENTRED

Power grid manufacturing chains need to be strengthened to meet the EU's NZIA targets, but the only way is to develop the necessary skills and trained manpower. The goal of the energy transition is to benefit EU citizens.

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Thank you