Electricity grids at the heart of the energy transition

The EU has committed to cut greenhouse gas emissions by 55% by 2030 and deliver climate neutrality in 2050. Direct electrification powered by renewables is the most cost-effective and energy efficient way to cut emissions to net-zero by 2050. Some sectors need to be electrified indirectly through renewable hydrogen (i.e. by using electrolysers powered by renewables). This renewables-based electrification of the economy is possible and affordable.

To meet its ambitions, Europe needs to step up investments in grid expansion and optimisation. We should plan to replace and restructure existing infrastructure as soon as possible. Current lead times for permitting and the development of grid projects are close to ten years before the expected commissioning date. With current procedures in place, we will not have the required grid capacity operational by 2030.

Grid replacement is also an opportunity to modernise distribution grids and enhance their capabilities in matching increased electricity demand with more locally produced renewable energy. Large parts of the regional transmission and distribution grids will reach the end of their service life by 2050. Up to half of all low-voltage lines would be over 40 years old by 2030. Getting grid replacement right will reduce the need for grid build-out and will help keep the energy transition affordable.

That transition to climate neutrality will require an EU-coordinated strategy and adequate governance to ensure proper plans are drawn-up and implemented. Political decisiveness, market visibility and social acceptability are essential to (re)building grid infrastructure. Industry and policymakers need to make a monumental effort to plan for and deliver the energy system that Europe needs. This brochure lays out four key building blocks for a renewables-based energy system that is fit-for-55 and set for climate-neutrality.

Recommendations

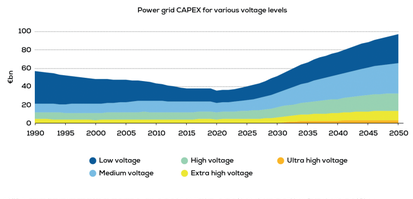
Policy Recommendations

- Ensure the upcoming ten-year network development plan (TYNDP) clearly accounts for the benefits of offshore hybrid projects and reflects the volumes needed to deliver on Europe's 55% climate target.
- Develop integrated offshore network development plans for each sea basin.
- Update the investment framework for system operators, moving away from CAPEX-based remuneration to a TOTEX-based approach to leverage grid optimisation technologies and increase the efficiency of new grid infrastructure.
- Set binding targets to build and upgrade energy infrastructure. This mainly concerns electricity grids and e-charging stations. Hydrogen infrastructure and e-fuelling stations come second.
- Put in place a coordinated approach for planning the long-term development of the electricity and hydrogen networks, ensuring a cost-driven optimisation of resources.
- Put in place policies and processes that maximise interoperability and connectivity of grid assets, including HVDC converters.
- Remove barriers to scaling up combined renewables' power plants and collocation of renewables with storage.

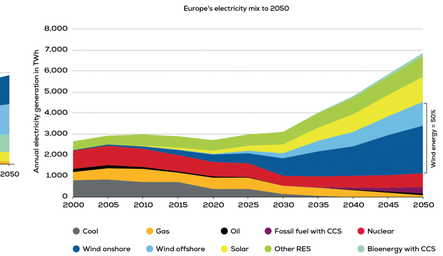
Funding Recommendations

- Double annual investments on grid infrastructure over the next thirty years to €80bn on average.
- Invest in new grid technologies to ensure maximum flexibility of available resources with a cost-driven approach.
- Direct public R&I funding towards enabling technologies of the future energy system including grid technologies, short- and long-term storage, demand-response and other fossil-fuel free flexibility assets.
- Make offshore hybrid projects eligible for funding from the Connecting Europe Facility in the updated TEN-E Regulation.
- Create synergies between R&I, education, and training to strengthen European competitiveness.
- Use the Recovery and Resilience Plans to promote R&I in electricity infrastructure and to support anticipatory investments.
- Invest in tools to increase cyber resilience and the digitalisation of the electricity sector, including grids, renewable generation and storage assets.
- Invest in designing new protection and operating principles for a future energy grid powered by renewables and power electronic devices.

Decarbonising the economy by 2050



NOTE: All power lines values are reflected as average. Low Voltage 0.4 kV. Medium Voltage 20 kV. High voltage 130 kV. Extra High Voltage 350 kV. Ultra High Voltage 800 kV



Grid investments need to double from the current €40bn a year by 2025 at the latest. Efforts are needed at all voltage levels driven especially by the exponential growth of distributed assets at low and medium voltage. The European Commission expects that investments in the electricity grids will make up 18% of all necessary investments in the energy system.

According to the European Commission electricity will directly cover 57% of final energy uses and provide another 18% indirectly through renewable hydrogen and its derivatives. The EU's electricity system will more than double by 2050. It will grow to 6,800 TWh up from 3,000 TWh today. Wind energy will be 50% of the EU's electricity mix.

Building blocks for the future energy system

Grid development

The power grid will remain the backbone of the energy system and the best platform to build upon for accelerating Europe's decarbonisation targets. Offshore transmission networks will unlock large volumes of offshore wind energy. And improved onshore distribution networks will better connect local energy consumers with local electricity producers.

Grid efficiency

Grids will become more efficient by using innovative grid technologies that maximise interoperability and the flexibility of all resources. These technologies will reduce total system costs. And accelerate the integration of renewable energy. Digitalisation will be a key enabler.

System flexibility

The load of the future energy system will become more variable across all time horizons and all resources will need to contribute to flexibility. Variable renewables should primarily enable this and should be complemented with demand response, vehicle-to-grid, hydropower, storage, and power-to-X.

Renewables-based electrification

Wind energy is the perfect partner for many energy consumers, be it industrial installations or owners of electric vehicles. Europe's industry for example can electrify 76% of its energy demand for heat and power with commercially available technologies. This would lower their CO_2 emissions by at least 40%.

ETIPWind®, the European Technology and Innovation Platform on Wind Energy, connects Europe's wind energy community. Key stakeholders involved in the platform include the wind energy industry, political stakeholders and research institutions.

ETIPWind was established in 2016 to inform Research & Innovation policy at European and national level. It provides a public platform to wind energy stakeholders to identify common Research & Innovation priorities and to foster breakthrough innovations in the sector.

Its recommendations highlight the pivotal role of wind energy in the clean energy transition. They inform policymakers on how to maintain Europe's global leadership in wind energy technology so that wind delivers on the EU's Climate and Energy objectives. The platform will be key in supporting the implementation of the Integrated SET-Plan.

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ETIP Wind
EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON WIND ENERGY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 826042

ELECTRICITY GRIDS FOR A CLIMATE-NEUTRAL EUROPE

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ETIP Wind
EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON WIND ENERGY

Four building blocks to enhance the electricity grids.

They will be the backbone of a reliable cost-effective and climate-neutral energy system.

GRID CODES ALIGNED ACROSS EUROPE

Interoperability and cybersecurity

Interoperability and cybersecurity are the key pillars of a resilient and efficient EU-wide smart grid.

HVDC Interoperability

HVDC interoperability will be key to a cost-effective, expandable and resilient offshore grid.

Grid efficiency

Technologies for better grid efficiency will help reduce total system costs and accelerate renewables' integration.

Grid optimisation technologies

- Synchronous condenser
- Advanced monitoring
- Advanced system operation control devices (incl. active power flow distribution)
- Advanced converter technologies (incl. Grid forming)
- Line and voltage upgrades

Grid optimisation includes innovative grid technologies and operating strategies that enable maximum flexibility and coordination of available resources.

Interconnectors

Transmission grids need to expand, both between and within countries.

Offshore hybrid projects

Offshore hybrids are essential to the successful deployment of offshore wind in Europe. They save space and money by optimising the use of offshore and onshore transmission infrastructure. And they help to balance the energy system as shares of variable renewables increase.

Offshore grids

Europe needs regional cooperation to design and develop the **offshore grids** needed to efficiently deliver large volumes of offshore renewable energy to end-users.

Energy islands

Grid development

Europe needs better grids in greater numbers to deliver the energy transition. This includes building new integrated high voltage networks offshore and more low voltage lines onshore. Europe's cross-border capacity also needs to triple in the next ten years.

Reinforced onshore distribution grids

EU-wide governance is essential for o**ptimal and integrated planning of electricity and hydrogen networks**.

Renewable hydrogen infrastructure

incl. pipelines and storage (e.g. salt caverns).

Renewable-based electrification

By 2050 electricity, mostly backed by renewables, will supply 75% of the final energy demand. Electricity will directly cover 57% of final energy demand while indirectly renewable e-fuels (e.g., hydrogen) will provide another 18%.

Maritime shipping (ammonia)

Hydrogen electrolyser

Renewable hydrogen

To decarbonise hard-to abate sectors where direct electrification is not viable.

System flexibility

The residual load (total load minus renewable energy generation) of the future energy system will become more variable across all time horizons. All resources will need to contribute to system flexibility.

Ancillary services by wind

Smart EV charging and Vehicle-to-grid services

Smart EV charging infrastructure helps to balance renewables. Vehicle-to-grid services allow for the use of storage capacity from e-vehicles. Physically coupling EV charging points and wind farms will help to reduce grid congestion.

Storage

Storage solutions will add flexibility across all timescales. Battery storage for example can provide for short-term flexibility needs. Thermal energy and pumped hydro-storage cover the medium term and power-to-X and hydropower can cover long-term seasonal flexibility.

Combined renewable power plants

Demand-side response

By electrifying energy demand large energy consumers can provide demand-side response services. This way they can contribute to the overall stability of the energy system and benefit maximally when renewable energy is abundantly available.

Direct electrification of industry demand for power and heat

Direct electrification of heating & cooling in buildings and district networks

e.g. heat pumps

Direct electrification of road transport

incl. private cars, public transport and light-duty freight transport.

Aviation (e-kerosene)