CABLES FOR A MOVING WORLD

TRATOS

Europe's Urbanisation and Net Zero Economy Drive.

What are the opportunities for subsea and land interconnections, and the use of HV, EHV and HVDC cables.

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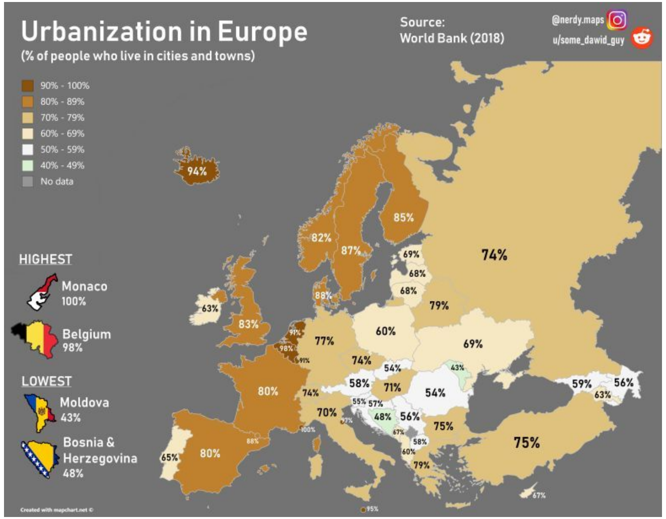
Europe’s transformation

European continent is undergoing a dual transformation:

- **Rapid urbanization**
  - Over the past five decades, Europe has transformed from an industrial and rural continent to one that is predominantly urban and metropolitan
  - Europe's level of urbanisation is expected to increase to approximately 83.7% in 2050 (EU Commission).
- **Resolute commitment to achieving climate neutrality by 2050**
  - This ambitious "Net Zero" drive necessitates a radical shift towards renewable energy sources, often located far from densely populated urban centres.
  - Interconnections - physical links between disparate energy systems - emerge as a critical solution, enabling efficient transmission of clean energy and unlocking a host of opportunities.



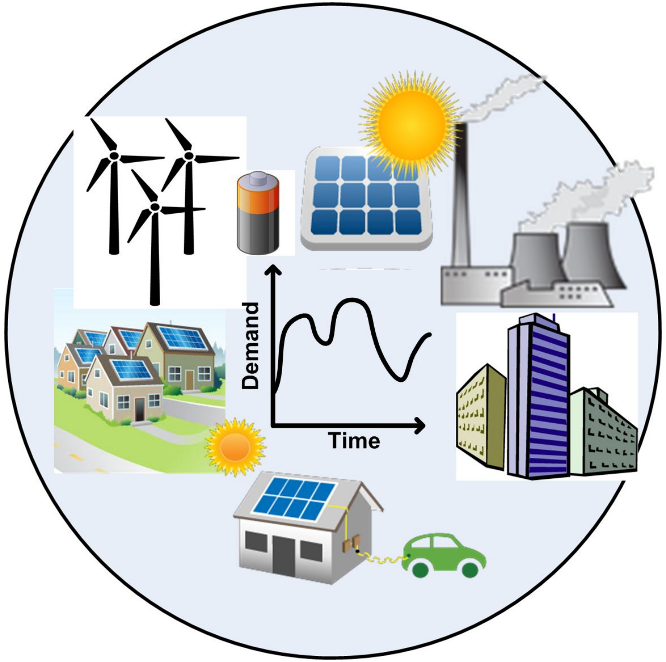
Urbanisation and Energy Demand

Cities, hubs of economic activity and innovation, **concentrate populations with ever-growing energy needs.**

Interconnections bridge this gap, ensuring a reliable energy supply for urban populations.

However, **limited space** restricts local renewable energy generation, necessitating access to diverse, geographically distant sources.

- Urban Areas: Urban regions require an uninterrupted supply of energy and consume approximately 75% of global primary energy.
- Population Growth: Increasing population growth and rapid urbanization put pressure on limited energy resources.
- Supply-Demand Mismatch: Annual energy demand growth is around 7% in developing countries, while supply remains stable, leading to frequent power rationing in cities. (UN HABITAT)



Enhancing Grid Stability and Security

Each country faces unique challenges based on its context, existing generation mix, and grid infrastructure.

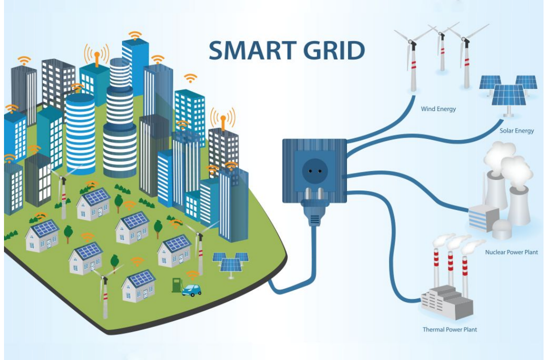
Interconnected grids benefit from a wider distribution of energy sources, mitigating the risk of localized outages and blackouts.

Diverse generation sources increase system resilience against supply disruptions, fostering a more robust and reliable energy landscape.

Renewable energy sources (RES) play a crucial role in our transition toward a sustainable future. However, **integrating a large share of renewables into power grids** presents challenges for grid stability.

Many **grids lack sufficient capacity to accommodate RES supply** and demand connections. Optimizing grid capacity for decentralized RES remains a challenge.

RES output fluctuates due to weather conditions (e.g., wind and solar). This volatility impacts grid stability.



Types of Interconnections and Technologies

Subsea Cables: Ideal for long-distance connections across water bodies, particularly for accessing offshore wind farms. It offers high capacity and low transmission losses, but installation and maintenance are complex and expensive.

Land Interconnections: Overhead or underground cables connecting regions within a country or across borders. More cost-effective for shorter distances, but face environmental and aesthetic concerns, as well as permitting challenges.

High Voltage (HV) AC Cables: Traditional technology with limitations in long-distance transmission capacity and increased line losses.

Extra High Voltage (EHV) AC Cables: Offer higher capacity and reduced losses compared to HV, but are more expensive and complex.

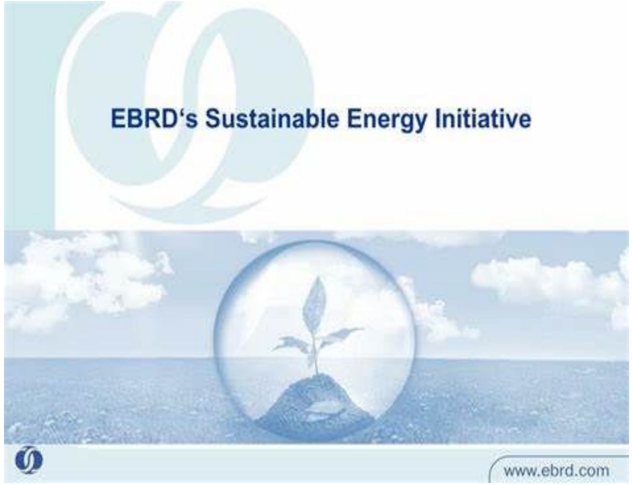
High Voltage Direct Current (HVDC) Cables: Ideal for long distances and underwater connections due to lower transmission losses and higher capacity. However, requires converter stations with additional costs.

EBRD Sustainable Energy Initiative

EBRD invests in renewable energy via its Green Economy Transition approach. Since 2006 EBRD has signed **€49 billion in green investments** and financed over **2,600 green projects**, which are expected to **reduce 124 million tonnes of carbon emissions yearly.**

In supporting the uptake of renewable energy projects, the EBRD:

- Provides project finance and technical assistance;
- Engages in policy dialogue with energy market stakeholders;
- Supports governments in developing favourable regulatory frameworks.



To incentivise investments in renewable energy, the EBRD supports eligible clients in obtaining finance and technical support through bilateral and multilateral donor finance, such as:

- Climate Investment Funds (CIFs)
- Global Environment Facility (the GEF).

Challenges

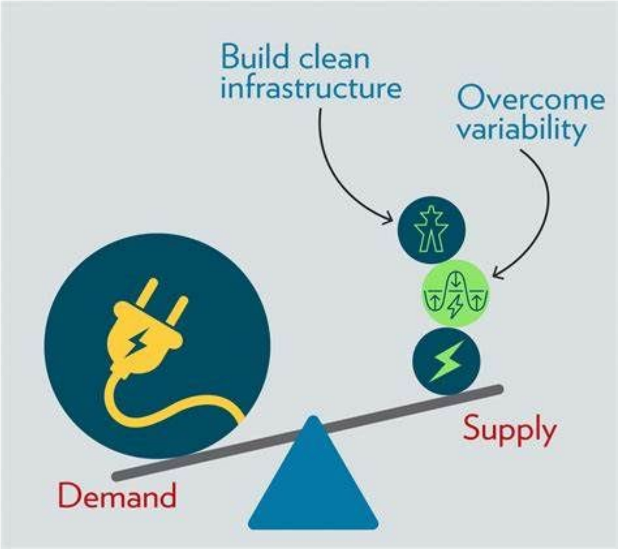
Europe's urbanization and net zero ambition present a unique opportunity to leverage subsea and land interconnections with HV, EHV, and HVDC cables. This opportunity comes with some challenges:

High Investment Costs: Building new infrastructure requires significant upfront investment, necessitating innovative financing models and public-private partnerships.

Planning and Permitting Processes: Navigating complex regulatory frameworks and obtaining permits can be time-consuming and challenging, potentially delaying project timelines.

Public Acceptance: Addressing concerns about visual impact, potential health risks, and land use is crucial for project approval and ensuring social sustainability.

Grid Integration and Flexibility: Integrating diverse and intermittent renewable sources requires advanced grid management technologies to ensure stability and reliability.



The way forward

Are wind, solar, nuclear energy the solution?

The capital costs for producing 1 kilowatt (kW) of energy vary by energy source. Here are the approximate capital costs per kW:

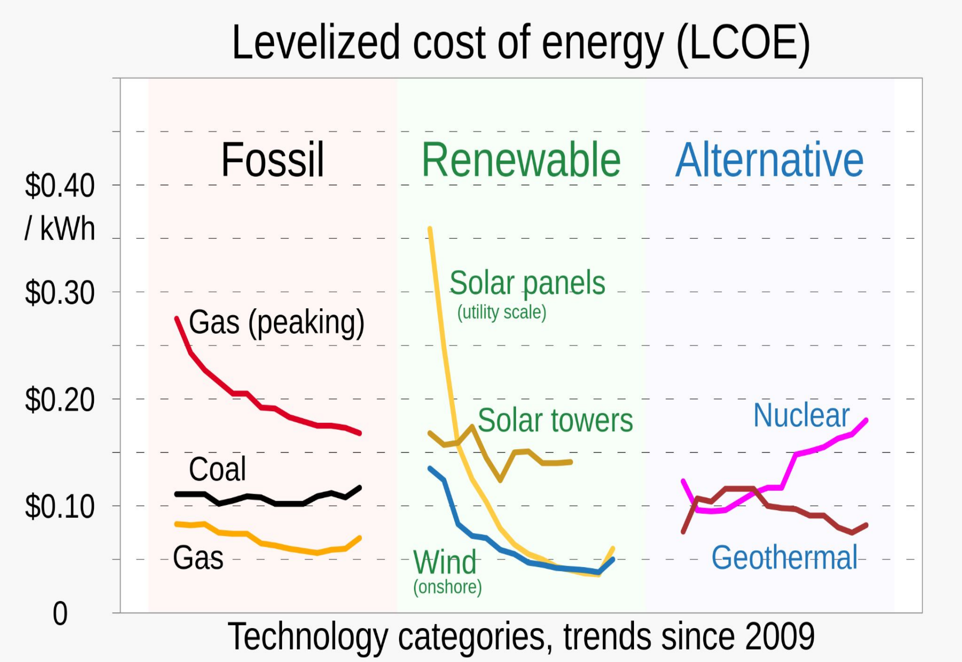
Gas/Oil Combined Cycle Power Plant: $1000/kW

Solar PV (Fixed): $1060/kW (utility), $1800/kW (tracking)

Onshore Wind: $1600/kW

Nuclear: Estimated to be between $60 and $70 per megawatt-hour (MWh)

NB
These costs can vary based on location and other factors.

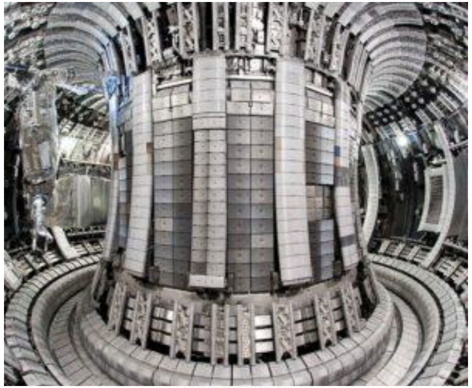


The way forward

IS SUPERCONDUCTIVITY THE WAY FORWARD?

All present systems used for both the generation and transmission of ELECTRICITY incur unacceptable I^2R LOSSES.

These I^2R LOSSES can be greatly reduced by adopting SUPERCONDUCTIVITY technology, in the process of generation and transmission of electricity.



This is applicable to both AC and DC systems.

Generation of Electricity

Current focus is:

- **Non-renewables** – Coal, Gas
- **Renewable** – based upon Nuclear (Fission), Wind, Solar

The future is FUSION FOR ENERGY

Nuclear Fusion based upon Superconductivity technology

the commercialisation of unlimited fusion energy.

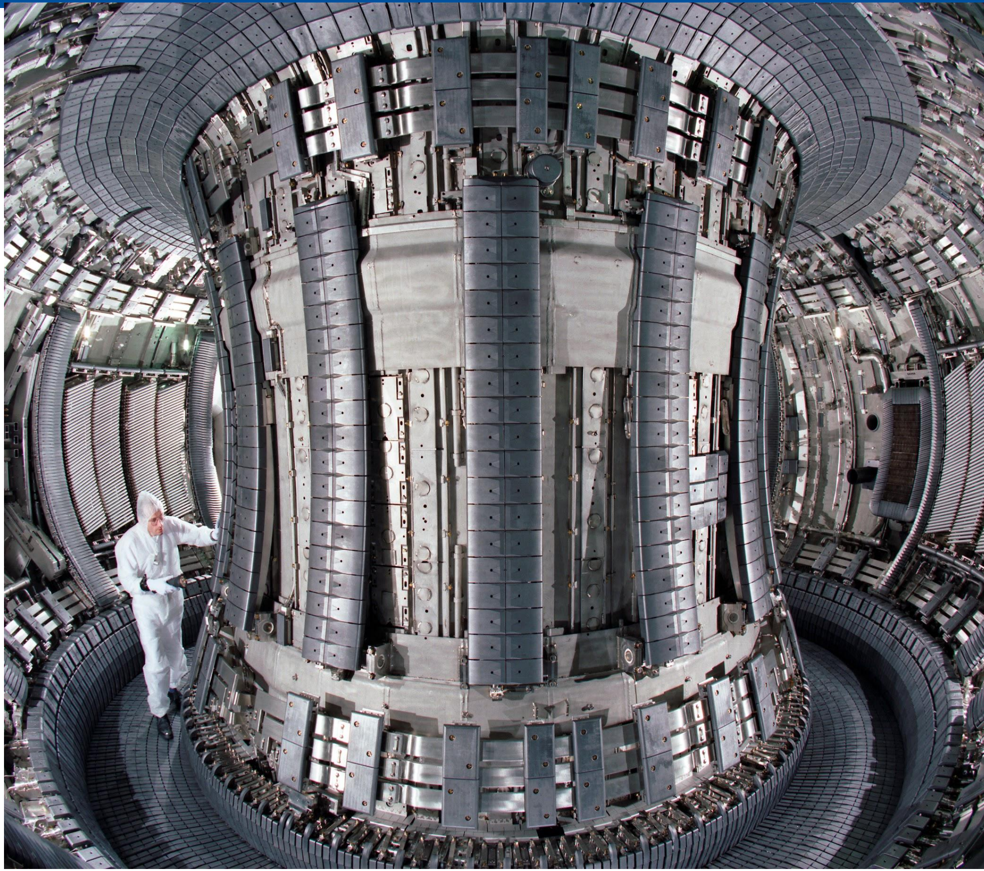
Superconducting Magnets

Superconducting magnets contain the plasma in the Toroid, to allow the fusing of hydrogen atoms, generating enormous amounts of energy. (**Tratos** have the experience, being members and suppliers of Superconductors to the **ITER**

- A Korean team now claim to have maintained the reaction for an increasing length of time.
- A US team now claim to have extracted more energy from the controlled nuclear fusion reaction than has been used to initiate it.

Practical fusion is coming!

ITER is a global collaboration of 35 nations to build the largest tokamak, aiming to prove the feasibility of fusion as a large-scale fusion as a large-scale, carbon-free energy source based on the same principle that powers our Sun and stars.



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High Temperature Superconducting (HTS) Cables

Overhead

- Existing proven HTLS technology

Underground cables

- Conventional - Existing proven technology

High Temperature Superconducting (HTS) Cables for high-capacity power transmission. The technology is proven, it requires commercialisation, the current maximum length being 1.1 km. (although there are claims of 5, 10 or even 15km lengths from China)

Lifetime of Plant and Equipment?

Solar Farm = 20-30 years

Wind Farm = 20 -35 years

Coal Fired Power Station = 30-40 years

Existing Fission Power Station = 40-50 years

Estimated Fusion Power Station = **40-50 years**

What needs to be done?

Thank you!

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