Technology is fundamental for the power system evolution

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The market to support the energy transition is booming

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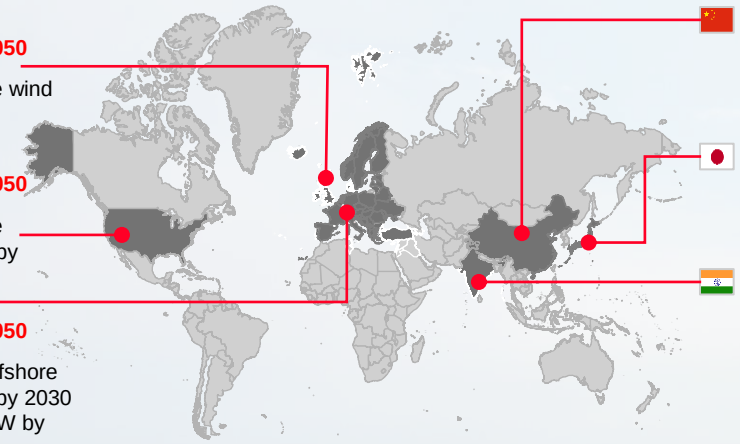


UK
Net zero by 2050

50GW offshore wind ambition

US
Net zero by 2050

30GW offshore wind ambition by 2030

EU
Net zero by 2050

109-112GW offshore wind ambition by 2030 and 281-354GW by 2050

China
Net zero by 2060

1.2TW solar and wind ambition by 2030

Japan
Net zero by 2050

45GW offshore wind by 2030

India
Net zero by 2070

500GW renewables by 2030 (~ 50% of energy mix)

Installed power outlook Spain

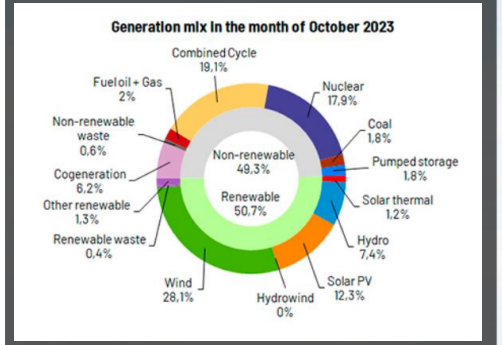
Tabla 2.4. Evolución de la potencia bruta instalada de energía eléctrica (MW)

Parque de generación del Escenario PNIEC 2023-2030. Potencia bruta (MW)				
Años	2019	2020	2025	2030
Eólica	25.583	26.754	42.144	62.044
Solar fotovoltaica	8.306	11.004	56.737	76.387
Solar termoeléctrica	2.300	2.300	2.300	4.800
Hidráulica	14.006	14.011	14.261	14.511
Biogás	203	210	240	440
Otras renovables	0	0	25	80
Biomasa	413	609	1.009	1.409
Carbón	10.159	10.159	0	0
Ciclo combinado	26.612	26.612	26.612	26.612
Cogeneración	5.446	5.276	4.068	3.784
Fuel y Fuel/Gas (Territorios No Peninsulares)	3.660	3.660	2.847	1.830
Residuos y otros	600	609	470	342
Nuclear	7.399	7.399	7.399	3.181
Almacenamiento*	6.413	6.413	8.828	18.543
Total	111.100	115.015	166.939	213.963

*Incluyendo el almacenamiento de solar termoeléctrica llega a 22 GW.

Fuente: Ministerio para la Transición Ecológica y el Reto Demográfico, 2023

Generation mix[2]



Decarbonization of traditional fossil fuels sectors drives additional demand of green energy

Industries doubling to **>20 PWh**

Buildings growing **~50% to >15 PWh**

Transportation growing **>30x to ~10 PWh**

Electrification is ongoing using both green electricity and H2 as fluid energy media

How do we comply with our green commitments while solving the evolving challenges in today´s and tomorrow´s grid?

The market is growing largely to secure renewable energy and to drive electrification in high energy intensive segments

1) Source: Estimations based on Hitachi Energy analysis of recently published IEA Net Zero by 2050, 2022-2023 Energy Outlook studies such as IEA, BNEF, DNV and IRENA. 1 PWh = 1,000 TWh
2) Data from REE Nov 2023

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Grids with a large share of green energies require additional flexibility

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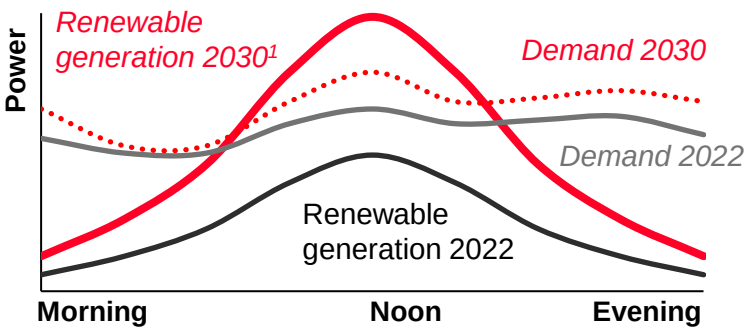
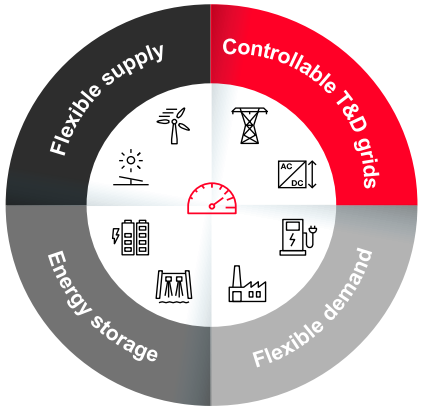
Enhanced flexibility is needed today and in the future grid



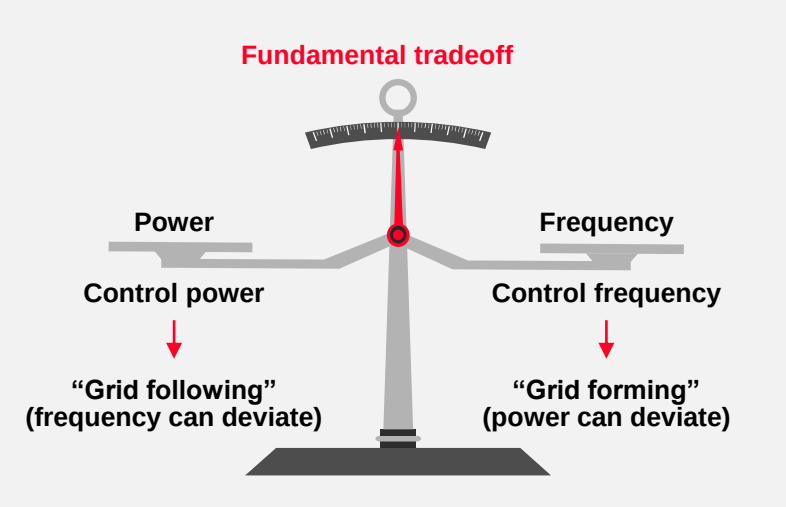
Power electronics wheel to manage the energy transition



Large share of RES[2] and low inertia needs to be addressed

Networks with a high degree of power electronic-interfaced renewable generation will face problems with low inertia and will require robust smart control functions

Grid-forming capability provides stable operation and robust control

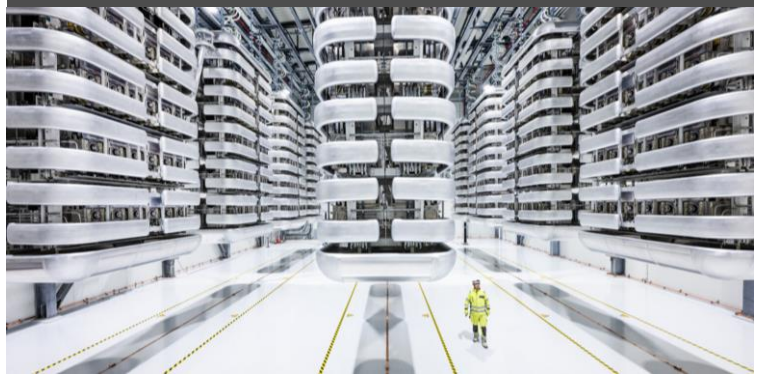


Technology is fundamental for the power system evolution

Power electronics solutions are strategic to enable bulk integration of renewables through **HVDC systems** and a more circular energy system supported by **STATCOM and BESS** solutions

Features

- Fast voltage/frequency support
- Synthetic inertia
- Fault current generation
- System strength support



1) Data related to Germany
2) Excl. hydro

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Technology is key to enable a secure, reliable and resilient future grid

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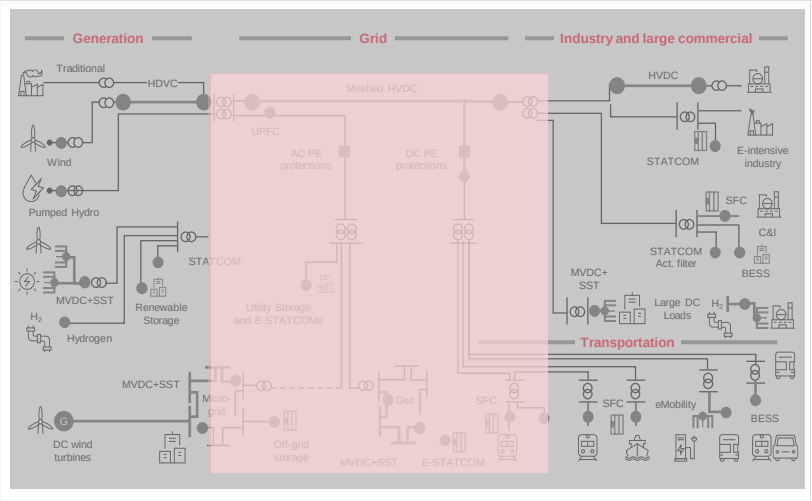
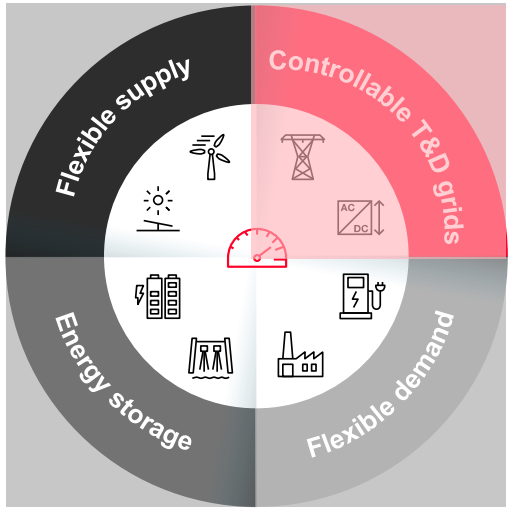




Power electronics wheel to manage the energy transition

Power electronic solutions will provide the required flexibility and controllability to the future grid

HVDC technology

Enhanced STATCOM tech.

DC Grids & Grid Interties

SFC converters

Hydrogen Power Generator

EV and V2G

BESS

STATCOM

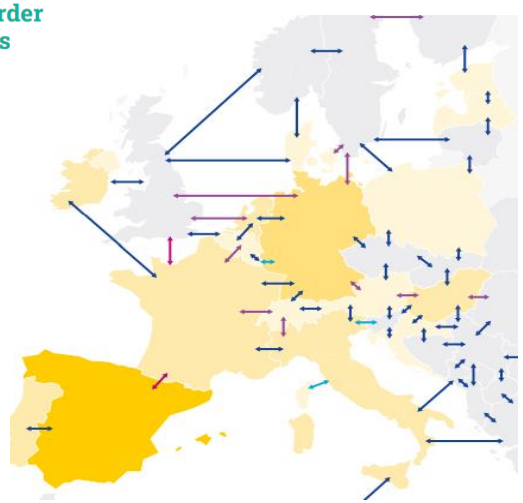
Opportunities for increases in cross-border transmission, storage and peaking units capacity in 2040

CROSS-BORDER CAPACITY INCREASES NEEDS IN MW (ADDITIONAL TO THE STARTING GRID 2025)

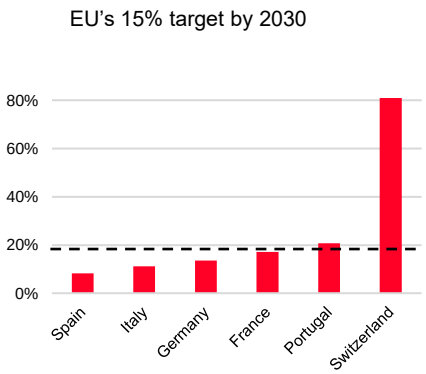
- < 500 MW
- 500 → 2,000 MW
- 2,000 → 4,000 MW
- > 4,000 MW

STORAGE NEEDS IN MW (ADDITIONAL TO BATTERY CAPACITIES IN NT2030 AND TO 2040 CAPACITIES FOR OTHER STORAGE TECHNOLOGIES)

- < 1,000 MW
- 1,000 → 5,000 MW
- 5,000 → 10,000 MW
- > 10,000 MW



Cross-Border capacity Ratio (CBR)



1) ENTSOE report "A Power System for a Carbon Neutral Europe (October 2022)"
2) CBR; capability of a country to export excess generation, when the VRES production exceeds the local demand

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Time to impact is key to deliver our commitments

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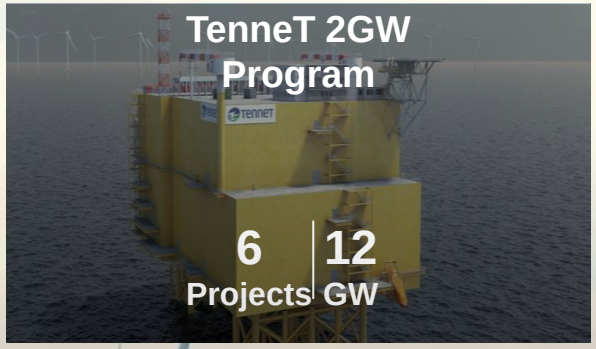
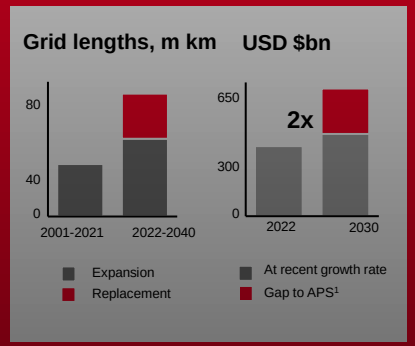
“New engagement models are needed to effectively speed up tendering and secure capacity



Go to action to ensure a green economy

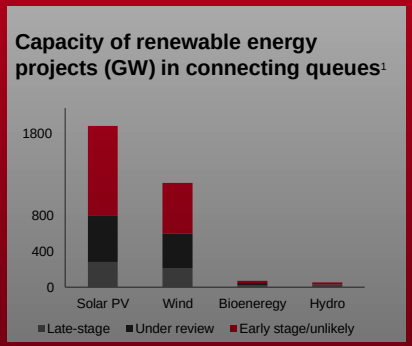
Secure energy availability where needed

Each clean GW that we add to the grid needs to be balanced with an increase in grid capacity



Time to impact is key to be addressed

Permits & planning, engagement models, regulatory frameworks for energy trading, others



Source: [1]International Energy Agency: Electricity Grids and Secure Energy Transitions. Announced Pledges Scenario

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High-voltage direct current power transmission to unlock the grid

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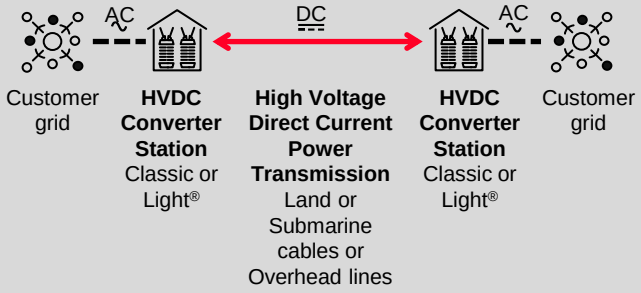
We pioneered it...

...enabling more than 150GW of HVDC worldwide

- Crucial technology and enabler for the energy transition
- Higher power, lower losses, compactness
- Full controllability for grid reliability and flexibility
- Pioneering technology leader and execution expertise
- Exponential global demand growth



Dogger Bank Wind Farm

3 systems — To connect Dogger Bank Wind Farm phases A, B and C

3.6 GW — Each system to be 1.2 GW

6 million — Homes provided with clean power

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