

A Global Grid being built ...



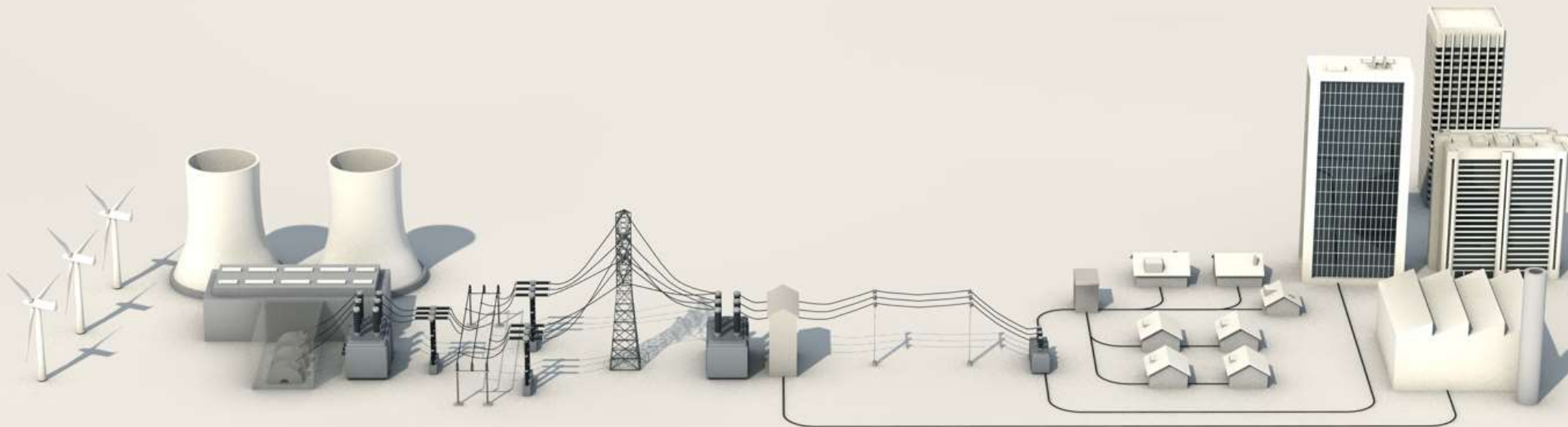
L'infrastructure des réseaux électriques de transport et de distribution amènent les électrons produits par les centrales et parcs de production chez les consommateurs

Generation

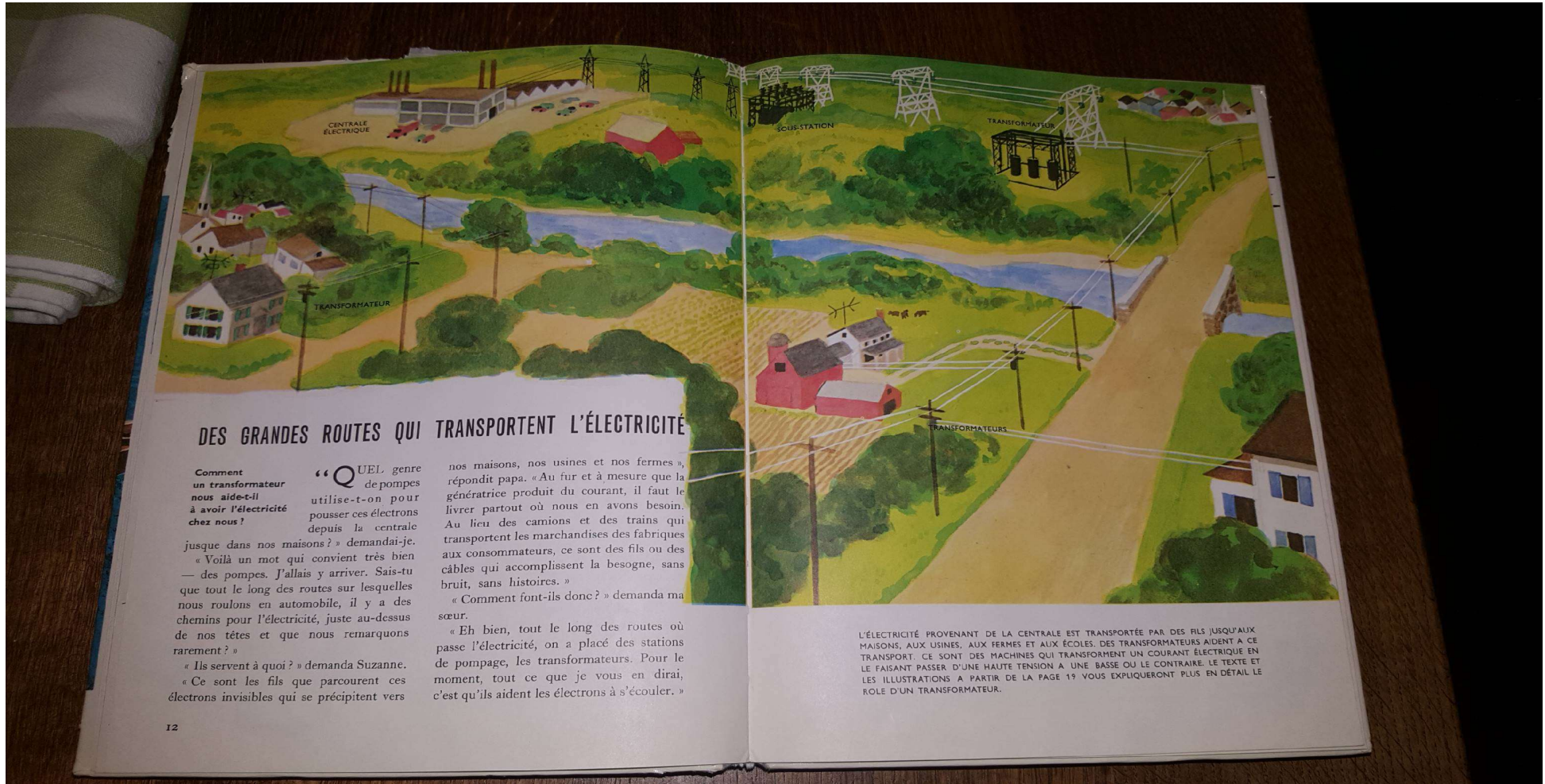
Transmission

Distribution

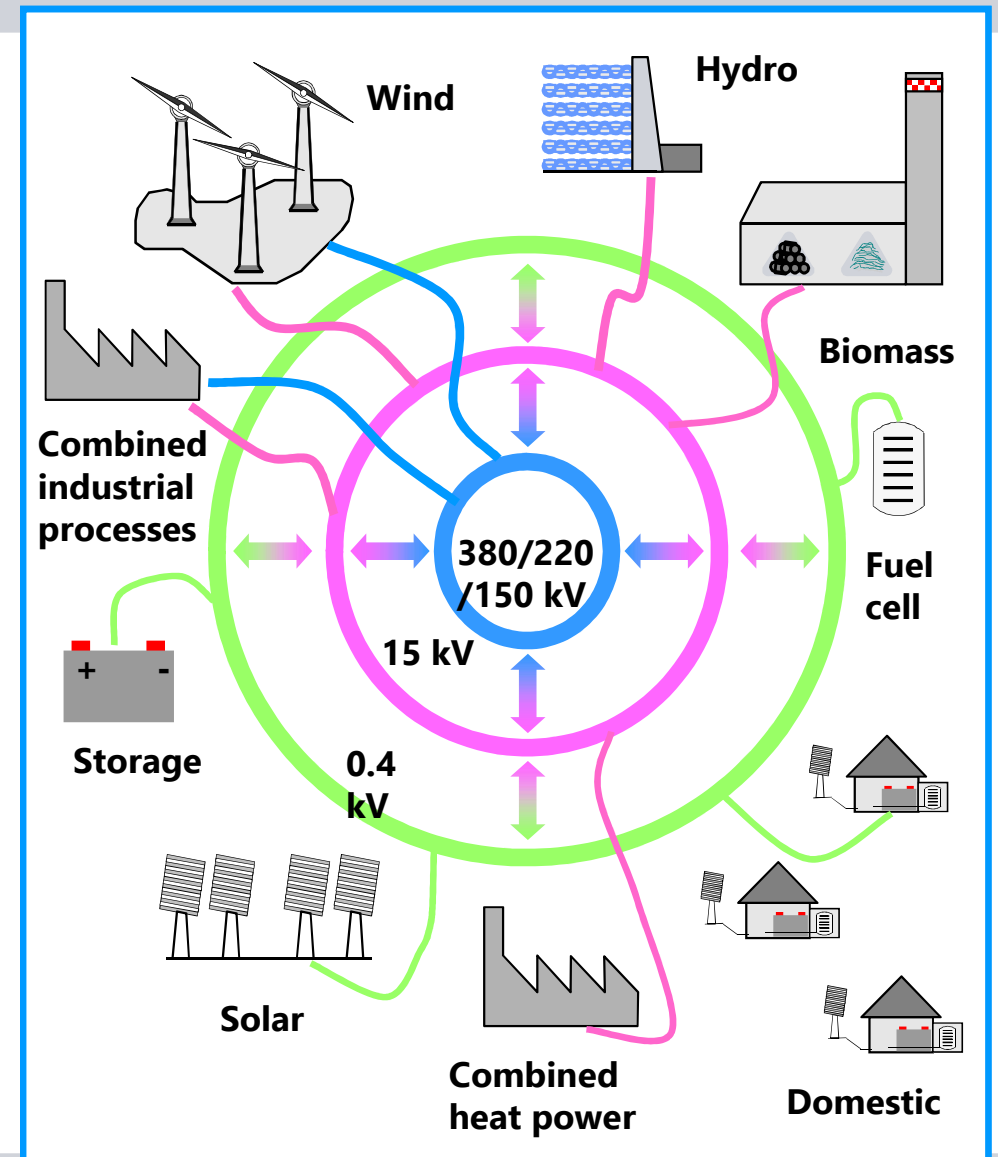
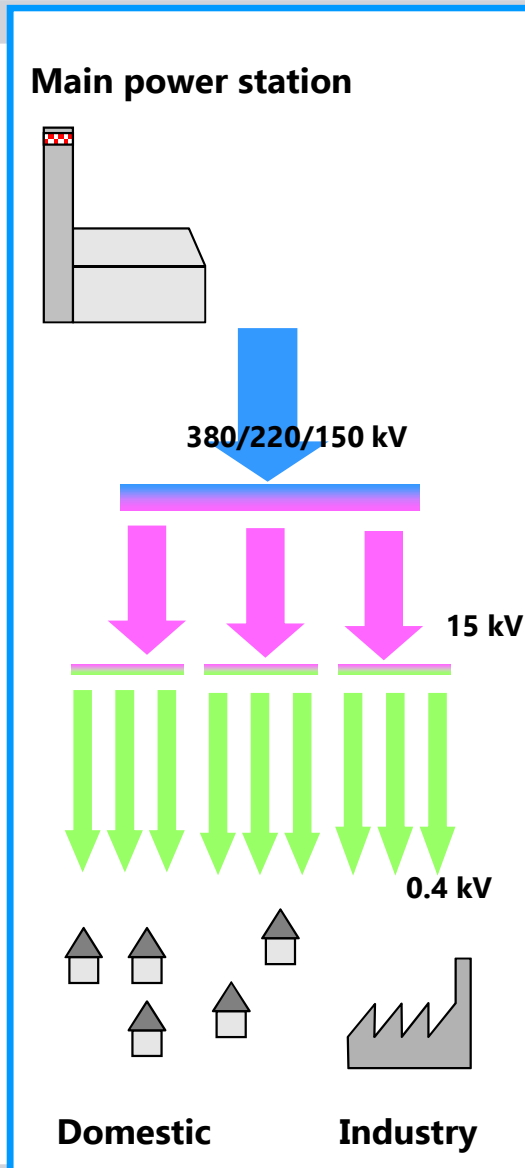
Industry



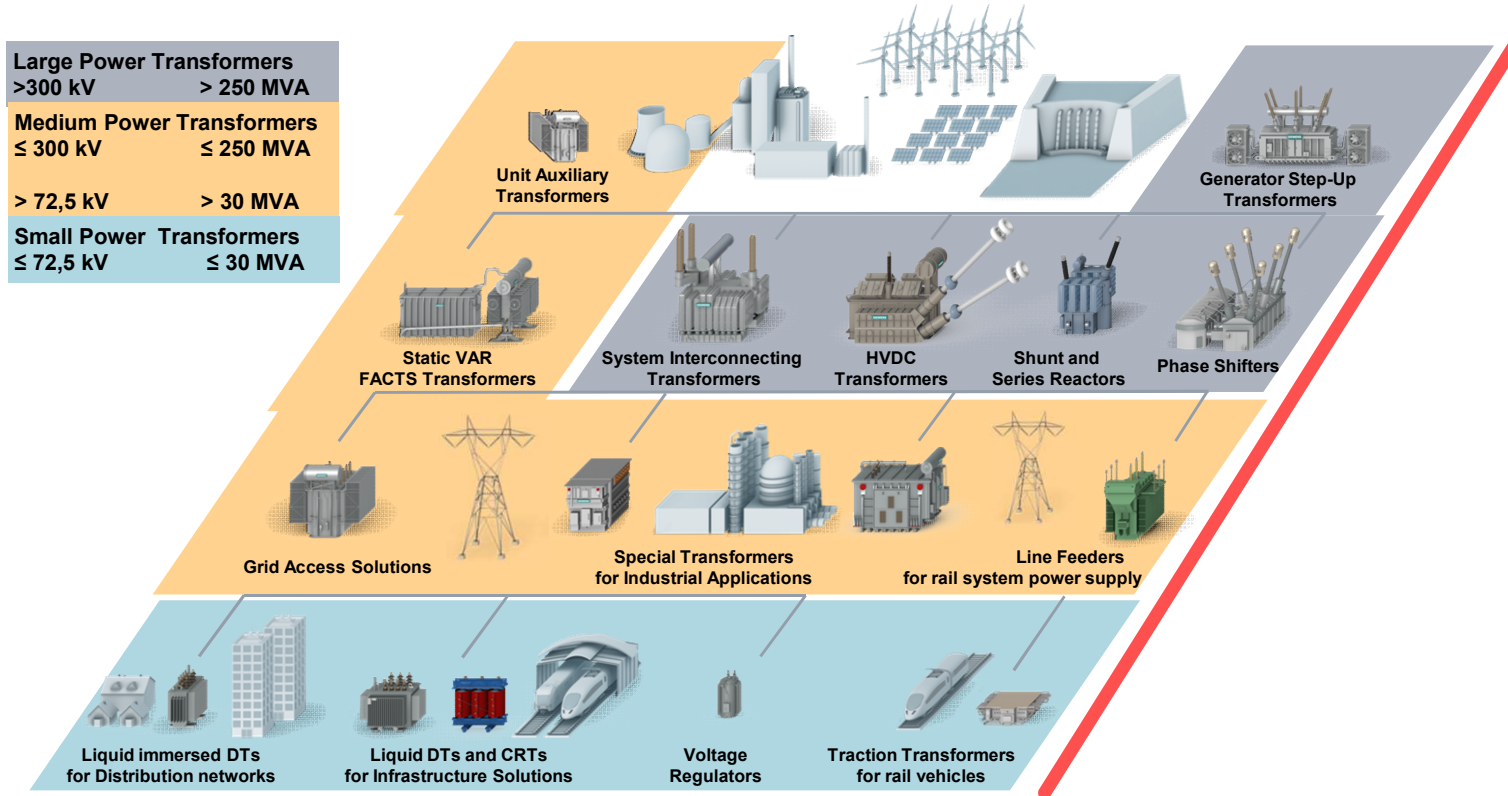
Le réseau électrique de bon-papa



Métamorphose des réseaux électriques : flux d'énergie bidirectionnels



Power transformers at all levels of transmission and distribution

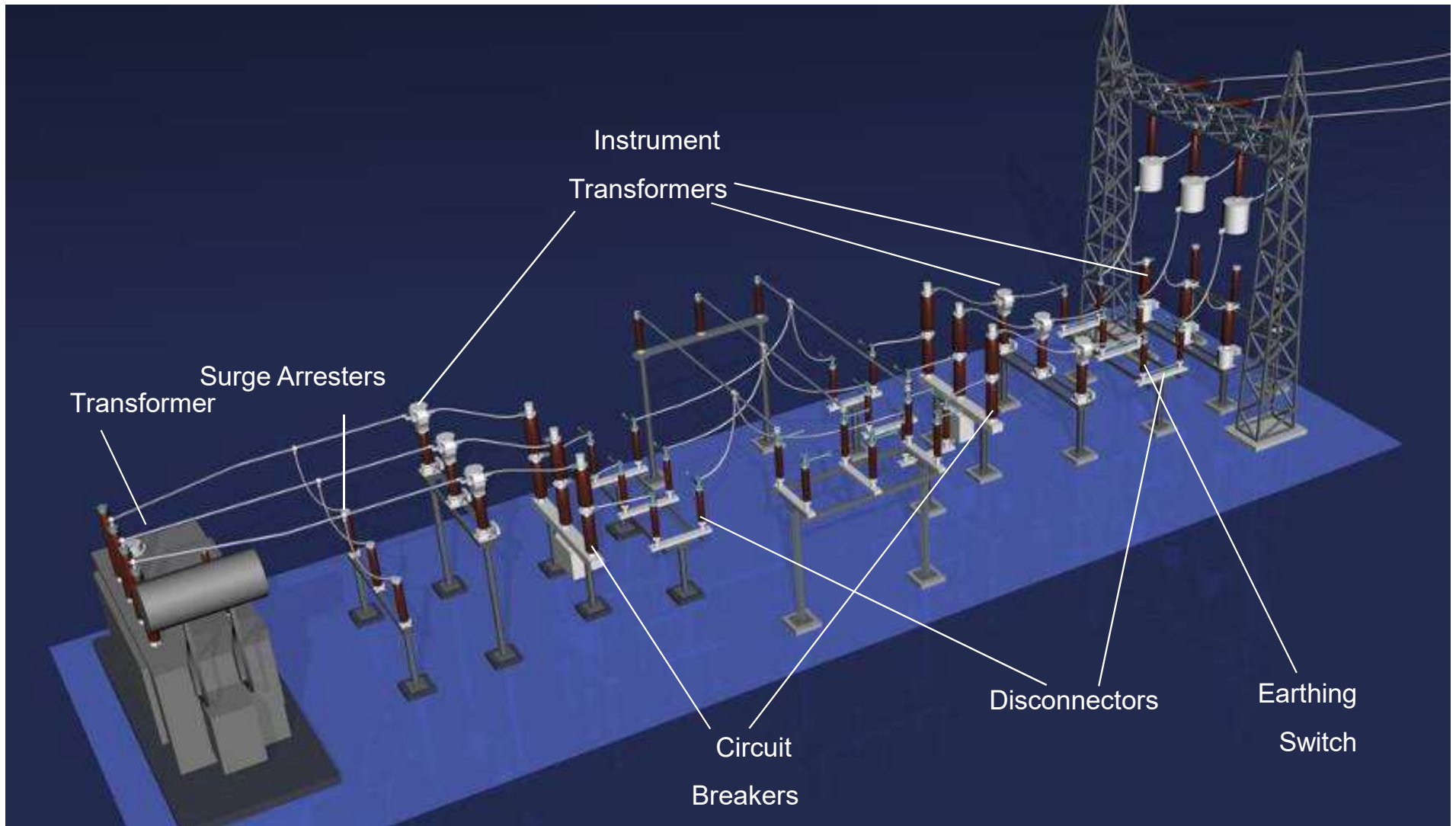


Aubange , rue de la Linalux , un poste 220 kV en plein air

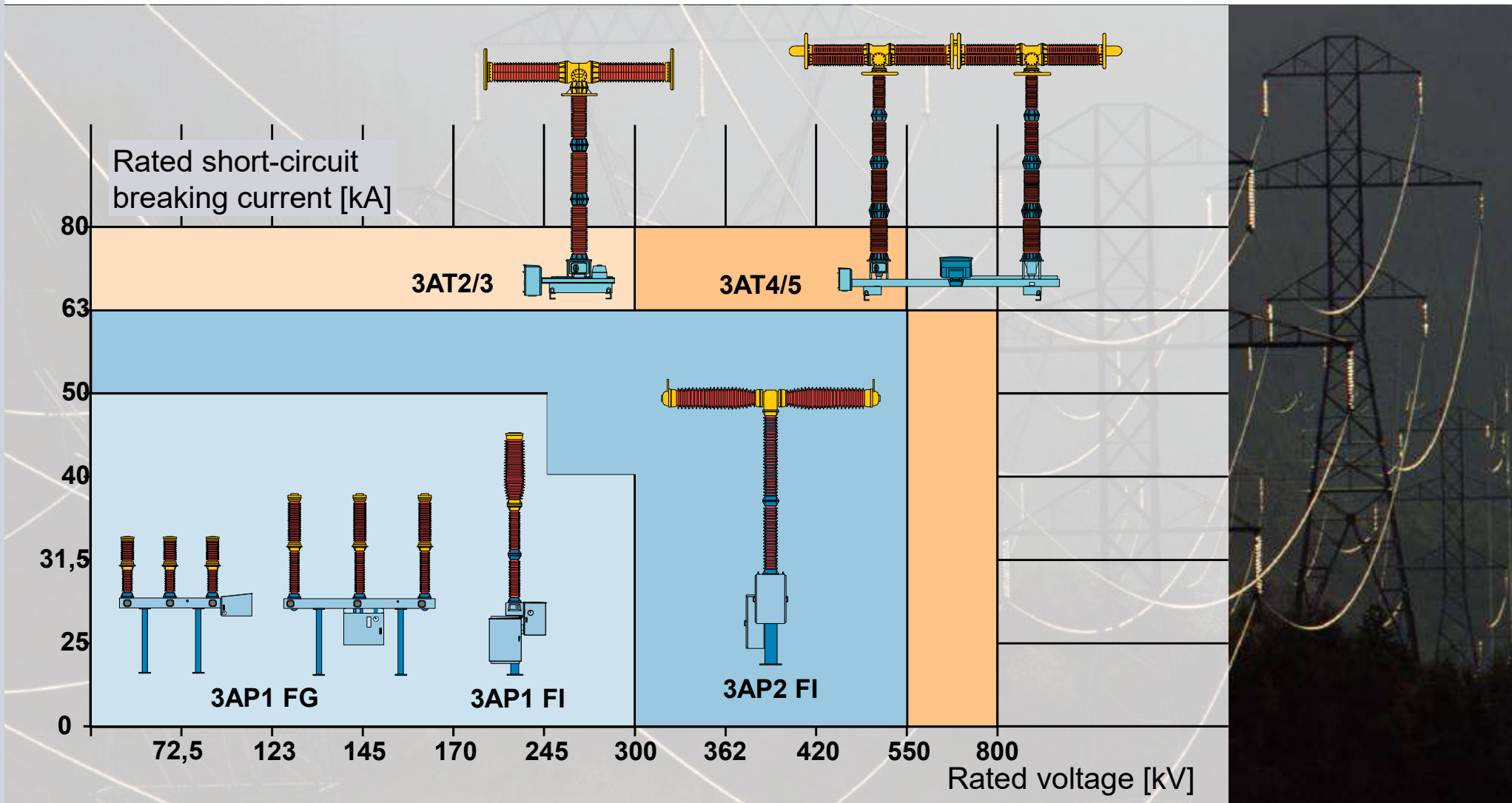
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High Voltage Air-Insulated Substations



SF6 Circuit breakers



Vacuum circuit breakers

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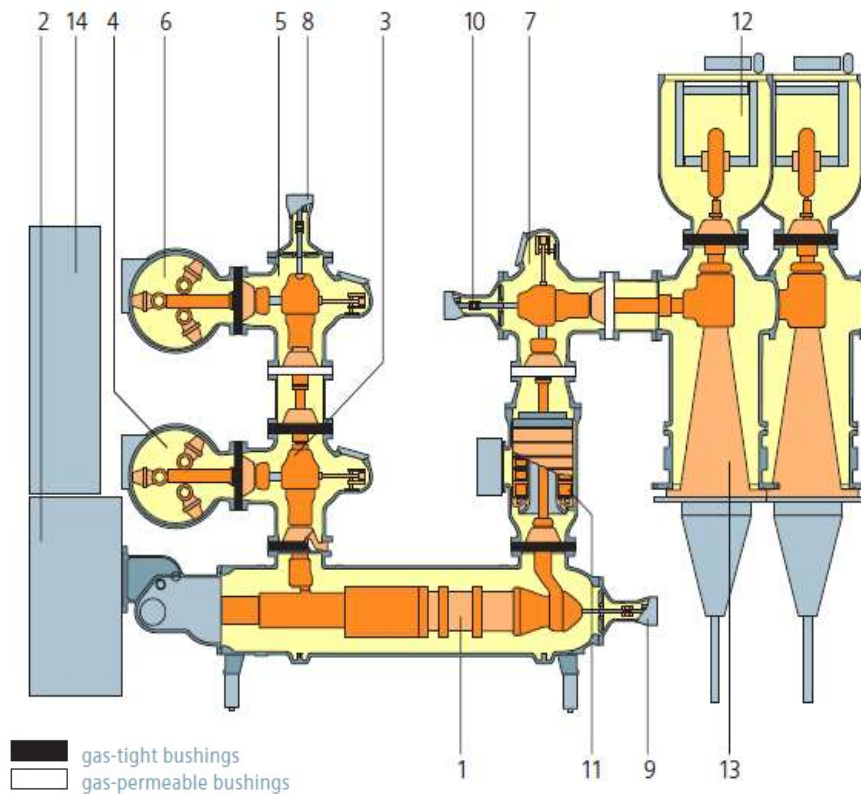
SF6 Gas-insulated Switchgear



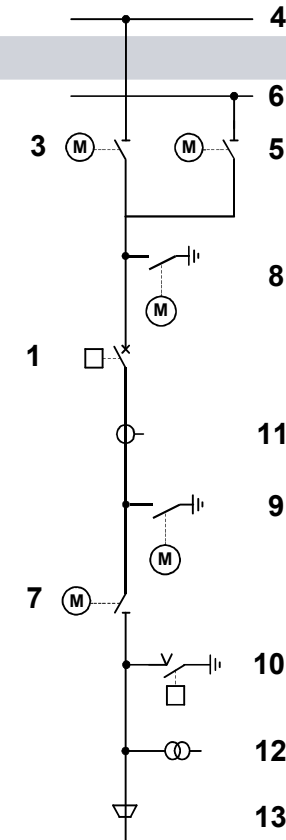
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- **Gas-Insulated Switchgear (GIS) integrates all necessary functions like switching, disconnecting, earthing, measurement and surge protection, required for ensuring a reliable and safe supply of electricity in a very compact and highly efficient way.**
- **All of the above mentioned components are housed in a grounded metal enclosure and filled with SF6 (Sulphur Hexafluoride), a gas known for its good insulation and arc-quenching properties.**
- **The modular structure of the switchgear permits flexible designs and problem-free extension.**

SF6 Gas-Insulated Switchgear

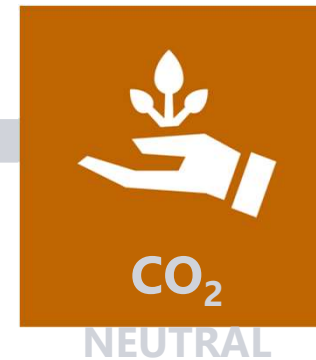


- | | | | |
|---|---|----|----------------------------------|
| 1 | Circuit-breaker | 5 | Busbar disconnector II |
| 2 | Circuit-breaker control unit
with spring operating mechanism | 6 | Busbar II |
| 3 | Busbar disconnector I | 7 | Outgoing disconnector |
| 4 | Busbar I | 8 | Earthing switch |
| | | 9 | Earthing switch |
| | | 10 | High-speed earthing switch |
| | | 11 | Current transformer |
| | | 12 | Voltage transformer |
| | | 13 | Cable sealing end |
| | | 14 | Integrated local control cubicle |



Clean air insulated switchgear

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The blue GIS uses clean air as insulation medium. Clean air is a composition of **80% N₂ and 20% O₂, cleaned and free from humidity (technical air)**. The clean air Global Warming Potential GWP is 0. Clean air is and will not be part of the EU-F-gas regulation



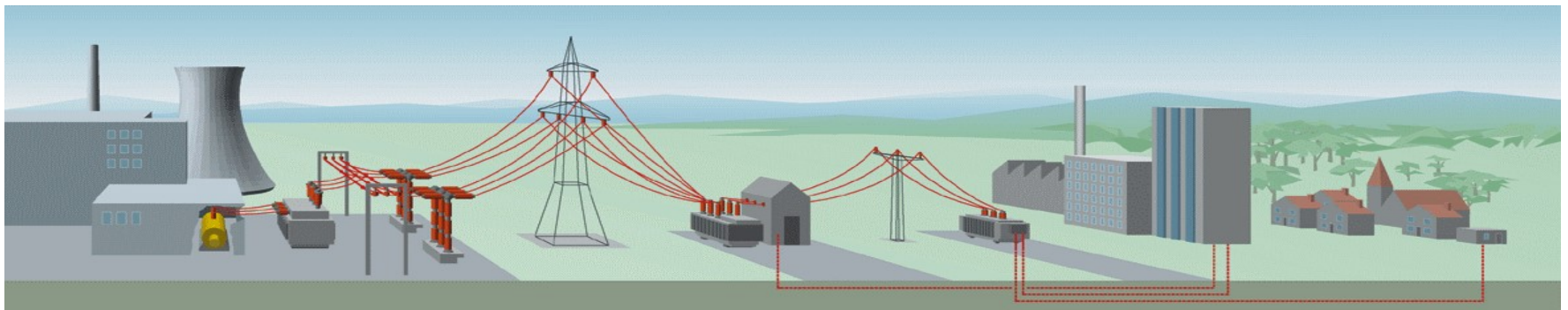
Clean air insulation technology

- No Global Warming Potential: GWP = 0
- No Ozone Depletion Potential: ODP = 0
- Non-toxic (no known toxicological effects: LC50, TLV-TWA, CMR)
- Non-flammable
- High stability
- Low boiling point and no liquefaction of insulation medium
- Clean air with well-known and proven material compatibilities
- F-gas free insulation with lowest requirements on training, transport, installation, operation, reporting and recycling
- C-gas free with no risk of C-decomposition
- No documentation and reporting duties for clean air gas
- No CO₂ compensation costs or risk of future tax or compensation
- No gas recycling required

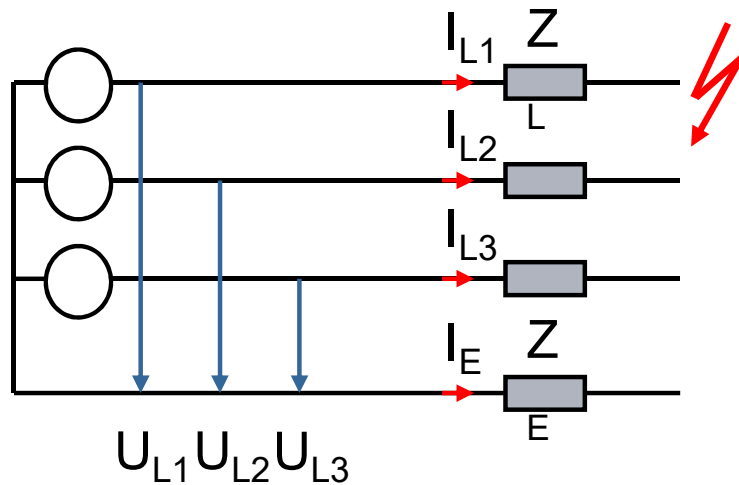


Protective relaying of the grids

- detect fault and isolate only the faulted part of the power system
- ensure the greatest possible level of the grid and supply reliability
- limit the effect of faults on the equipments (cable , transformer,..)



Ohm's law



$$\underline{Z}_L = R_L + j X_L$$

$$\underline{Z}_E = R_E + j X_E$$

6 loops: 3 phase- phase loops and 3 phase- ground loops

phase- phase -loop:

$$\underline{U}_{L1-L2} = \underline{Z}_L (\underline{I}_{L1} - \underline{I}_{L2})$$

Measured current
measured voltage

The same applies to the remaining loops

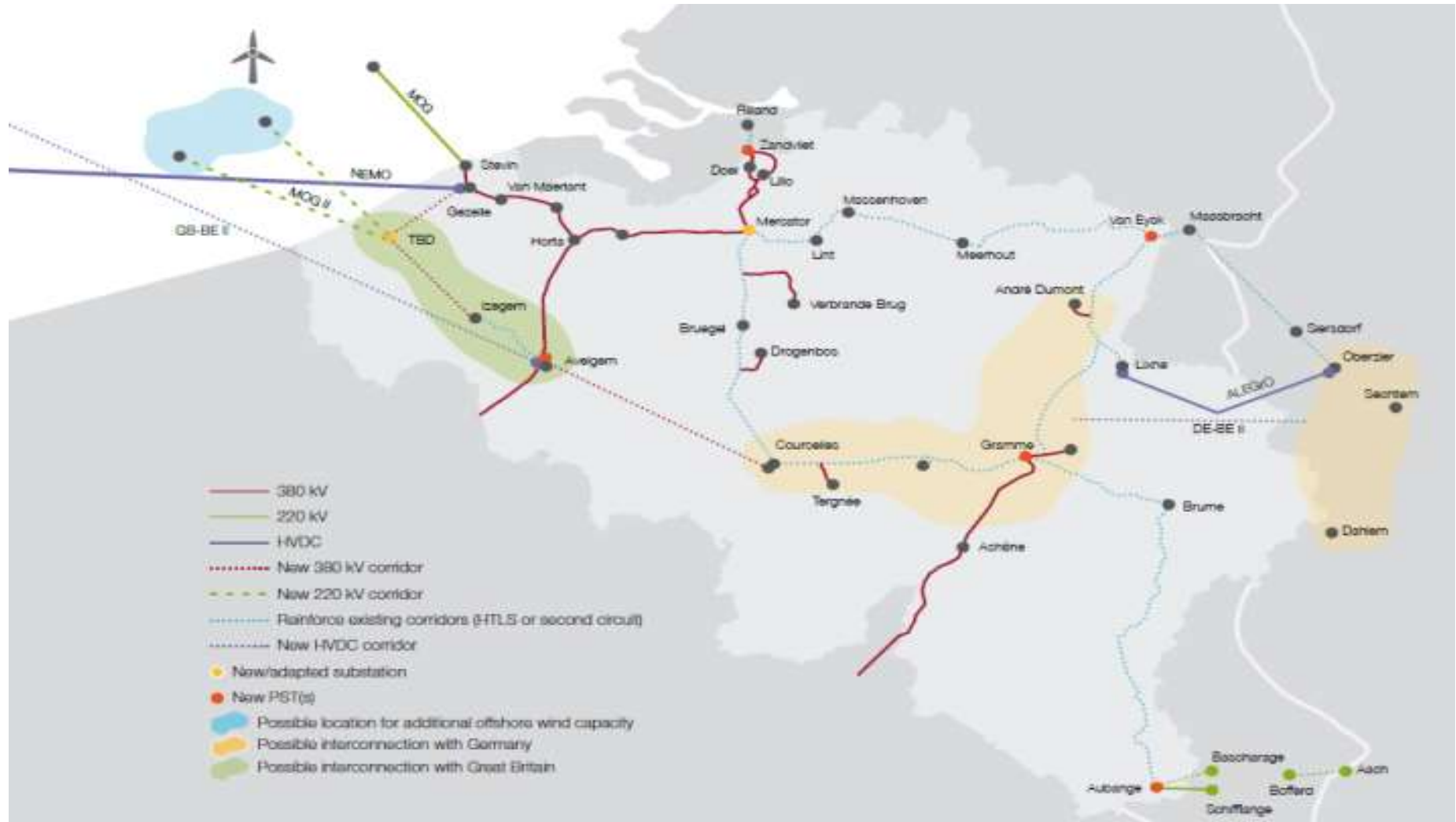
Reliability of the protection relays



1. Fast operation \Rightarrow Limit damages
2. High accuracy \Rightarrow High selectivity
3. Signal distortion does not cause delay or maloperation

L'arrivée des énergies renouvelables suscite le développement d'un réseau pan-européen constitué de corridors permettant le transport de grande puissance que ce soit en courant alternatif ou à courant continu , que ce soit onshore ou offshore

Global overview of new investments shaping the future grid (in Belgium)



ALEGrO = Aachen Liège Electric Grid overlay

• Herderen

Oberzier

• Aachen

Lixhe

Canal

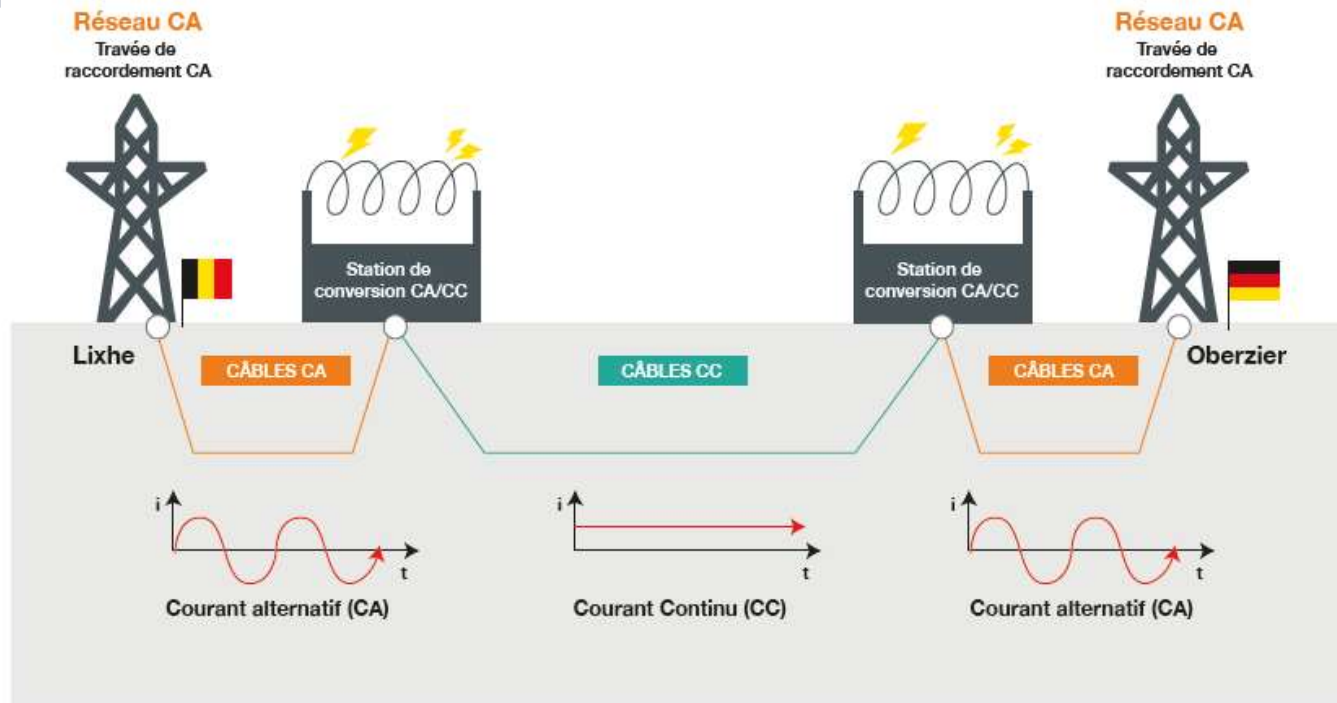
Autoroute E40

Domaine Infrabel

• Liège

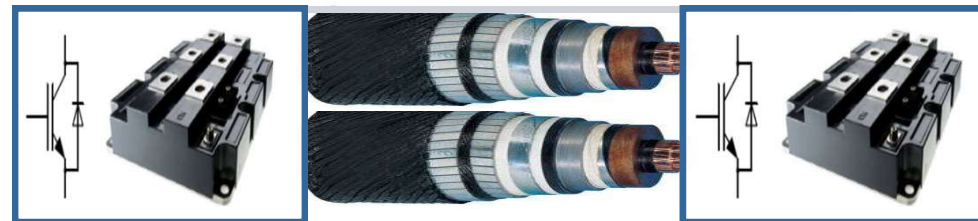
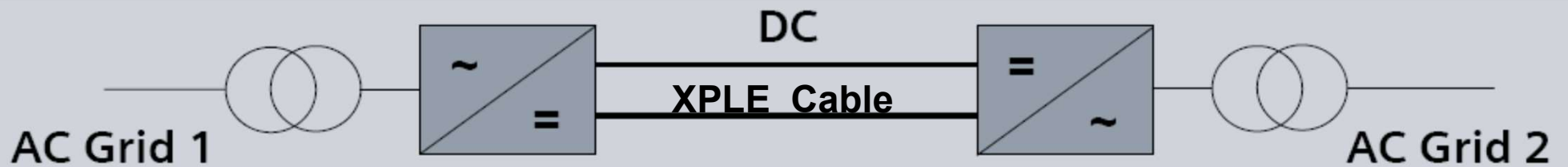


What's ALEGrO



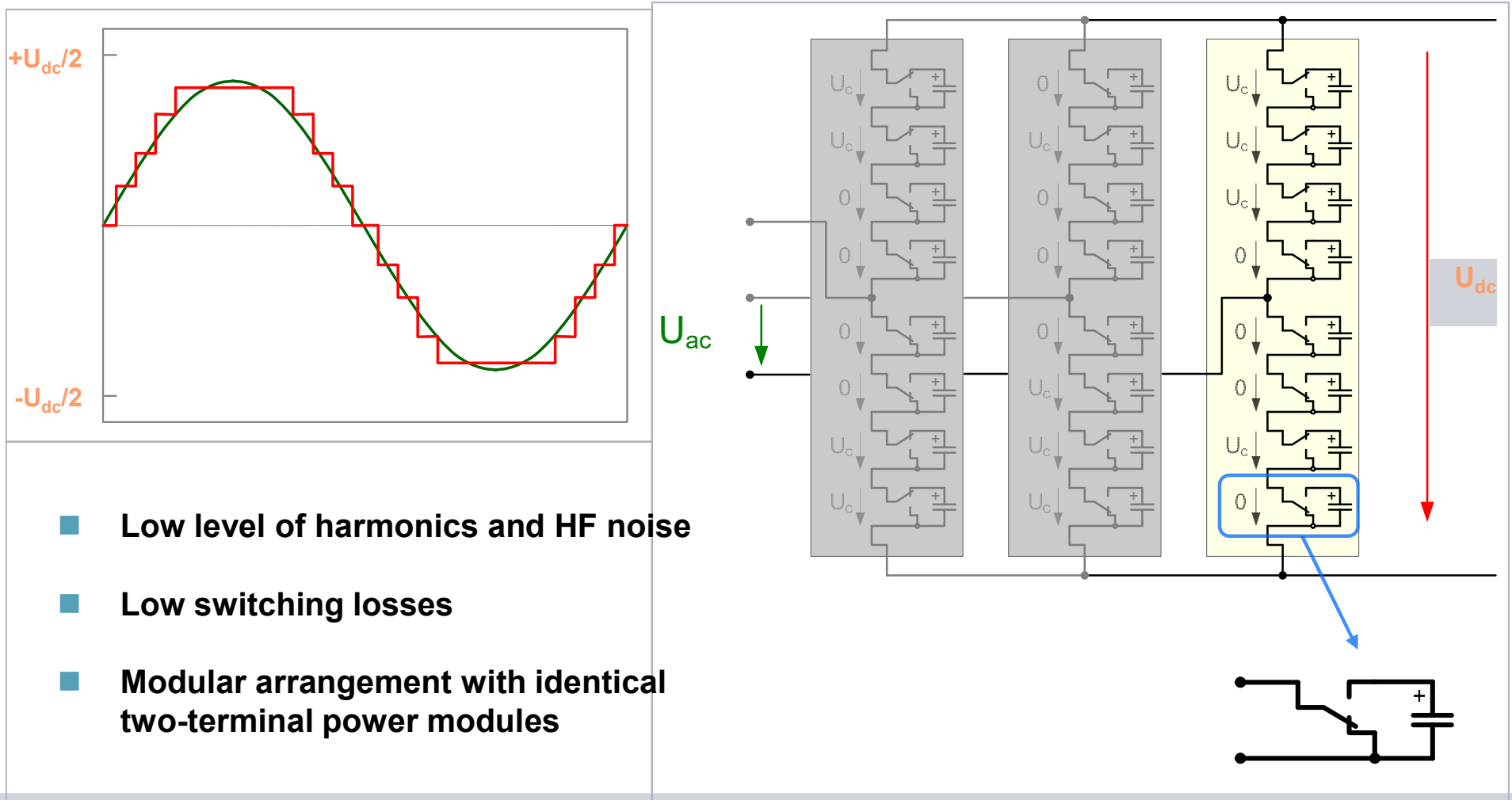
Power Rating	1000 MW, Symmetrical Monopole
Type of Plant	HVDC PLUS in half-bridge topology
Voltage Levels	DC : ± 320 kV DC AC : 400 kV, 50 Hz
Semiconductors	IGBT

Voltage Sourced Converter (VSC) technology

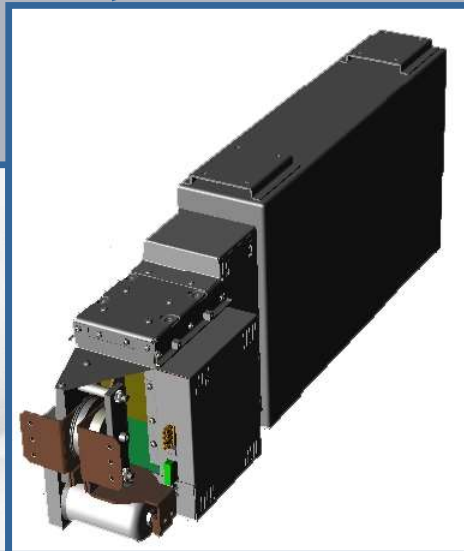
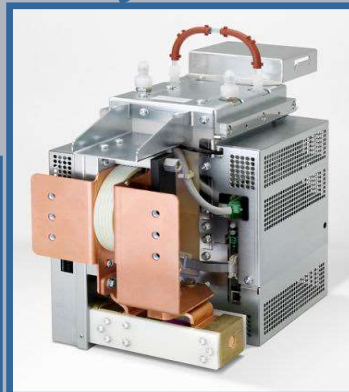


IGBT : Semiconductor Switches with turn-on and turn-off Capability

Modular Multilevel Converter – MMC Technology



- Compact Design
- Modular Design
- Lower Space Requirements
- Advanced VSC Technology
- Maintenance friendly



Converter Hall

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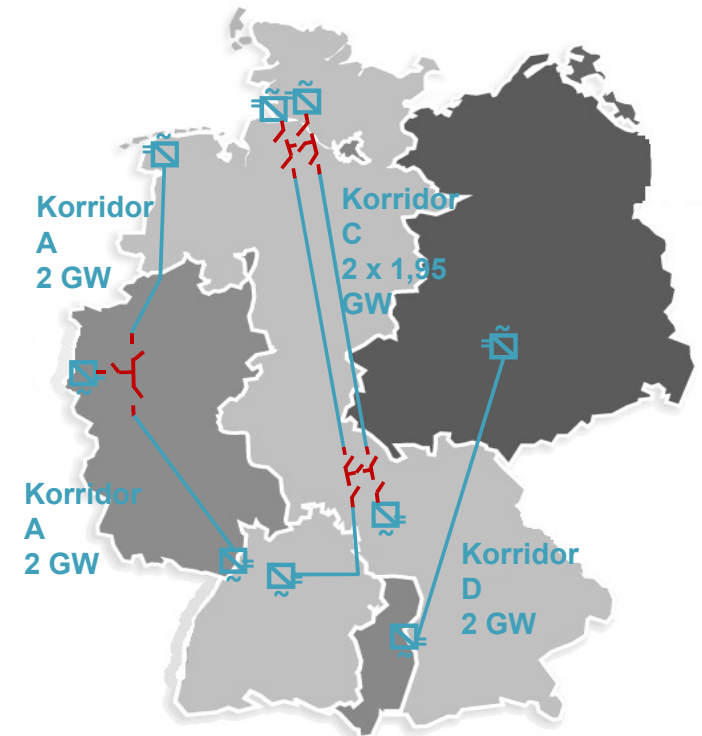
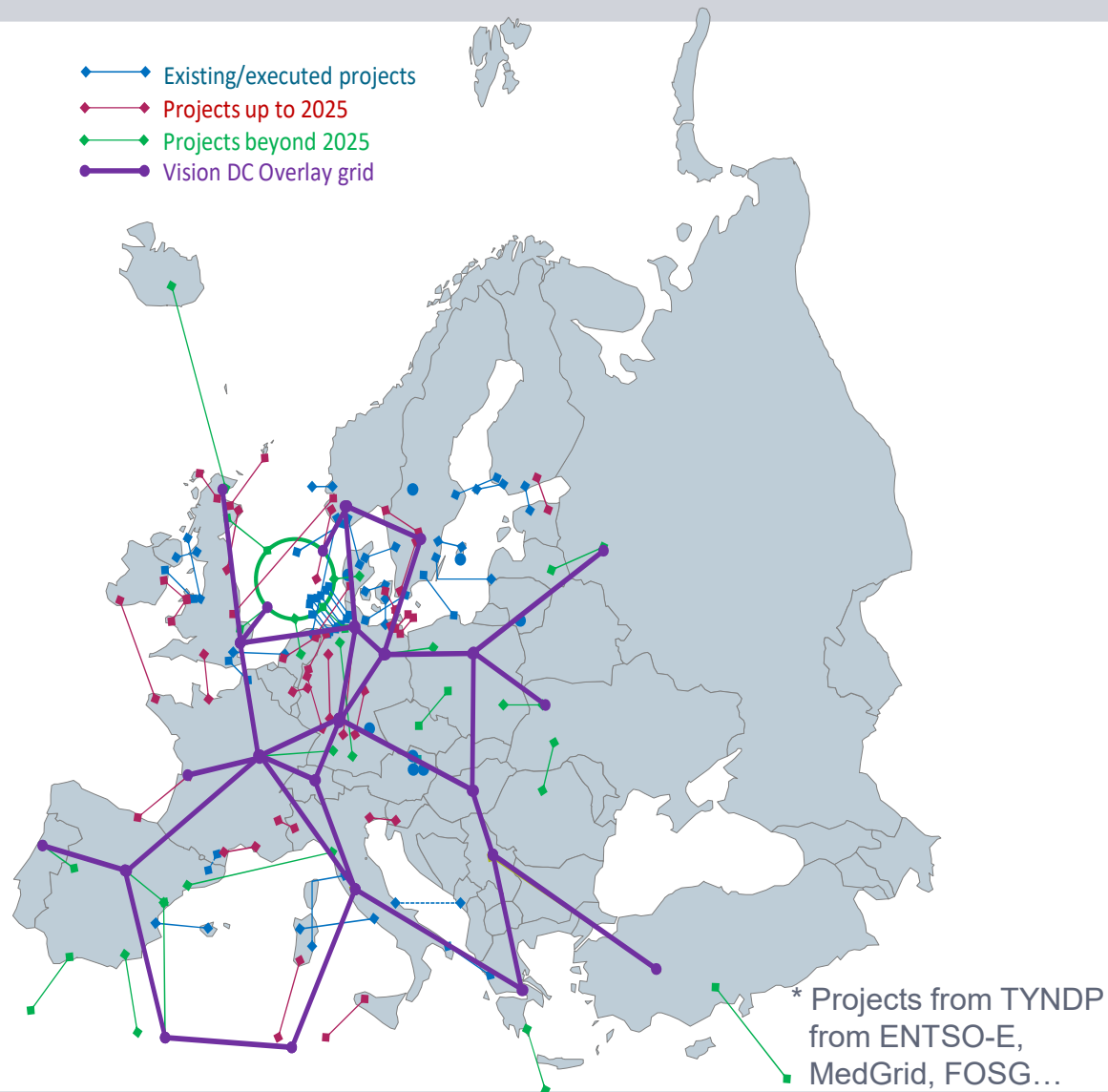


Much better performance of the grid with HVDC transmission

- Supporting the integration of renewable generation and enhance the transmission grids (grid stability, voltage support, losses reduction)
- Improving the security of supply (re-energizing of blacked-out networks)
- Contributing to the public acceptance (lower visual impact , less space requirements , constant magnetic field)
- Facilitating the operation of the electricity market (impact on the price) by independent control of active and reactive power in both directions

HVDC Grids

Look into the future

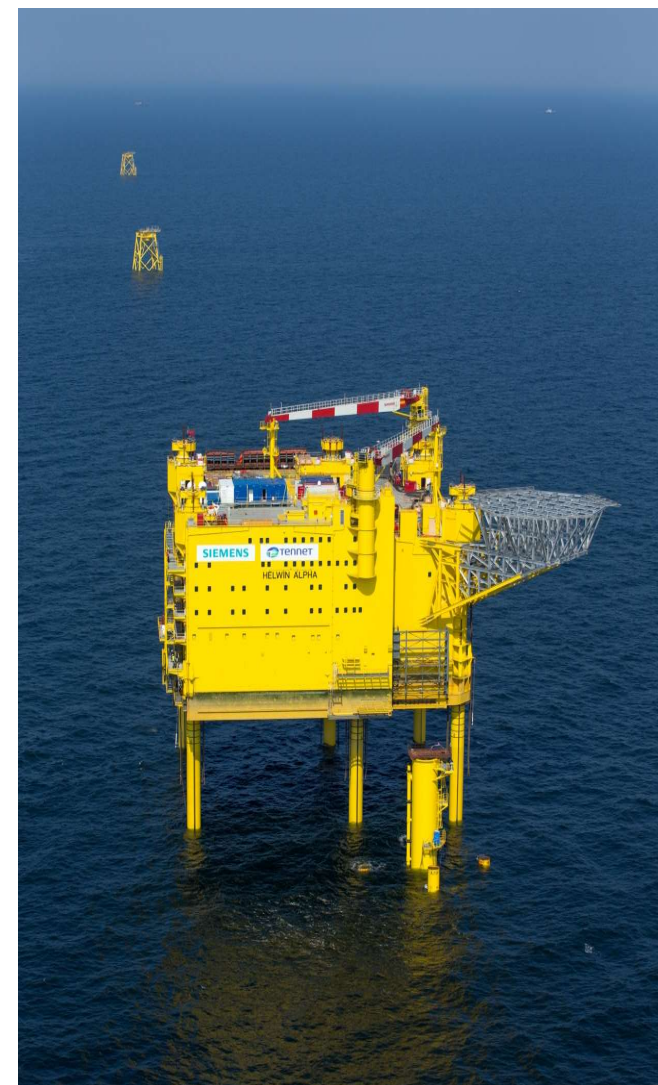


Offshore global grid

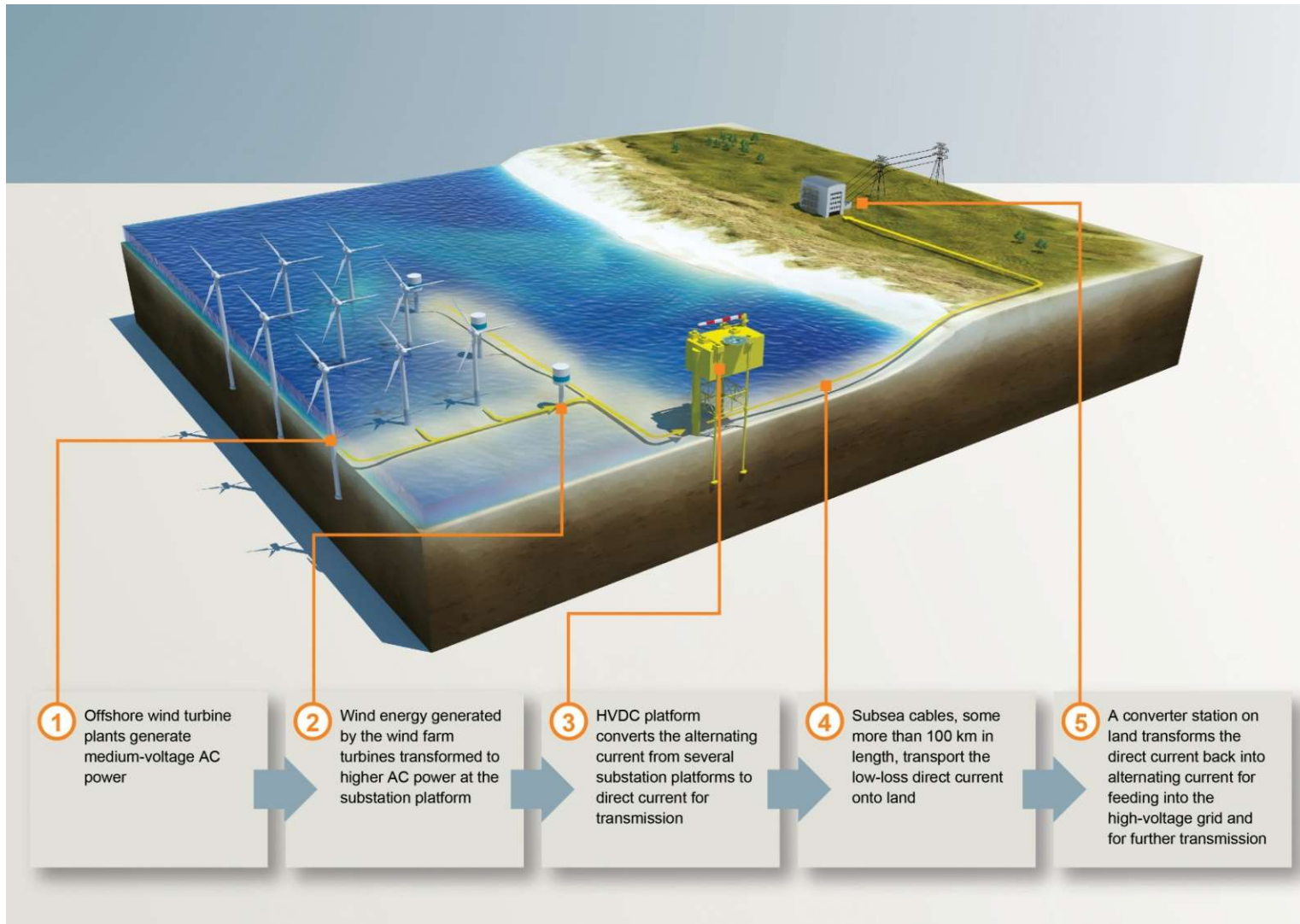
L' éolien offshore contribuera de manière certaine à l'atteinte des objectifs en matière d'intégration du renouvelable dans le mix énergétique européen.

Les pays entourant la Mer du Nord ont mis en place une structure de concertation afin d'identifier les impacts de différents scénarios de développement de parcs à l'horizon 2030 et plus particulièrement à l'avantage qu'il y a à développer un réseau électrique maillé en mer du Nord pour interconnecter les différents pays et intégrer la puissance produite par les productions offshore .

En croisière avec la fée électricité

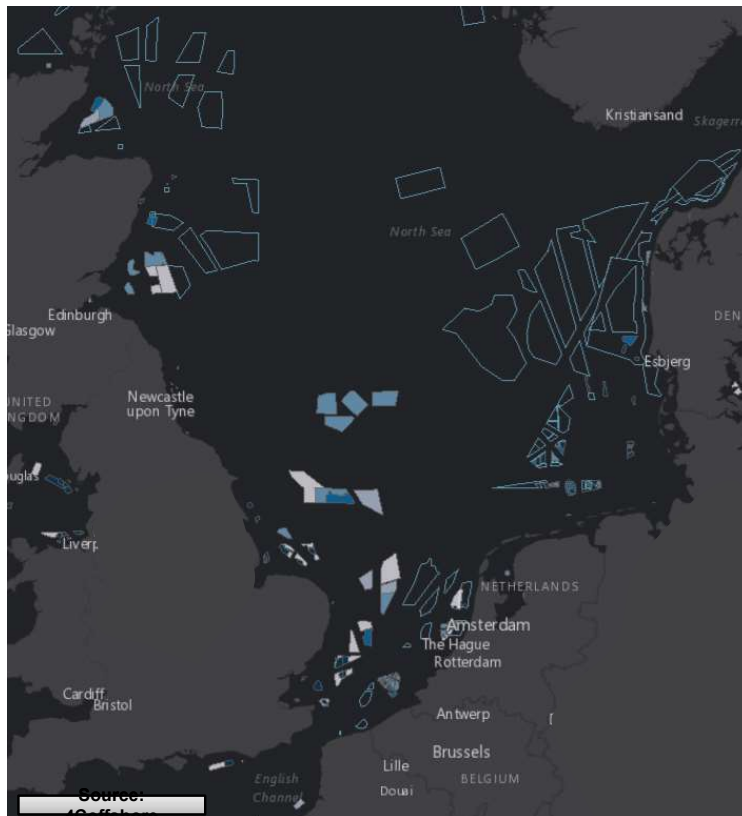


Ramener l' énergie éolienne offshore vers les réseaux onshore



The North Sea has an energetic wind potential of more than 250 GW

as indicated by several studies



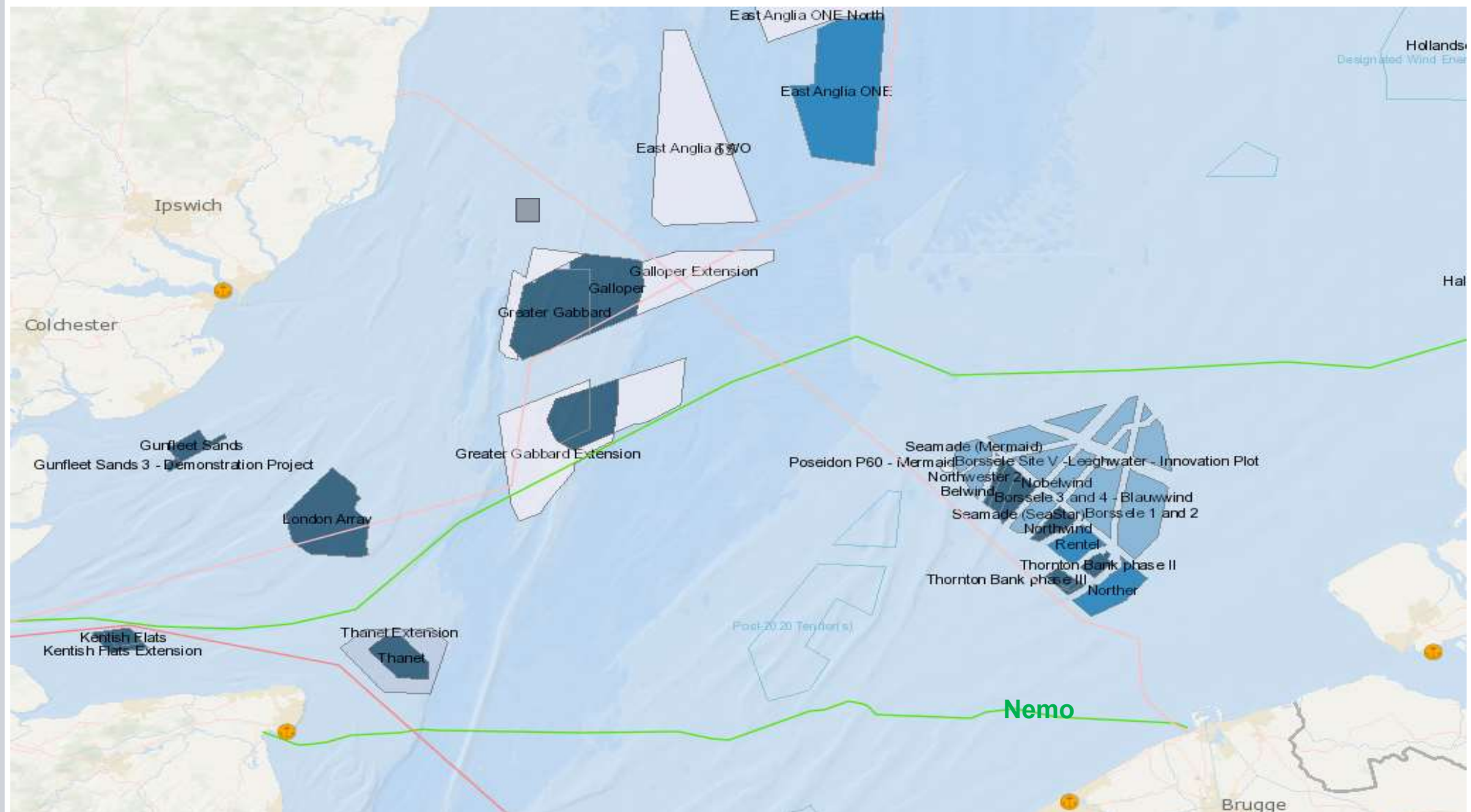
Several recent studies indicate an enormous potential

- 'Unleashing Europe's offshore wind potential': 355 – 635 GW of potential by 2030 in the North Sea
- 'Offshore Wind Capacity Dogger Bank': 80 – 100 GW on the Doggersbank
- 'The North Sea opportunity' : 250 GW of potential by 2050 in North Sea

Offshore wind capacity North Sea Installed capacity in the North Sea is increasing rapidly

							North Sea
Constructed ¹ (GW)	1.2	1.1	5.5	0.9	5.7	0	~ 15
Planned by 2030 ² (GW)	4	11.5	17	3.5	20	2.7	~ 60
Potential (GW)	250 – 600 (?)						

Haute tension en mer du Nord belge



Thank you for your attention

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