Energy transition: new technologies, resilience, flexbility

CNO event: Energy Transition, 27 October 2021

Dr. Susanne Nies,

Board Chair currENT

General Manager Germany Smart Wires

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The potential of Grid Enhancing Technologies

By COP26 we aim to reach Breakthrough Ambition (20% of key actors committed) for at least 10 sectors.

Benefits of Intelligent Power Grid Design Tools

Study commissioned by CurrENT

Executive Summary

01 June 2021

consentec

Grid Enhancing Technologies (GETs) provide for the needed solutions

A vast toolbox: Superconductors, Dynamic Line Rating, FACTS devices, netboosters…

A challenging time for utilities

Rapidly Changing Generation

Need to integrate intermittent resources

Shifting Consumption Patterns

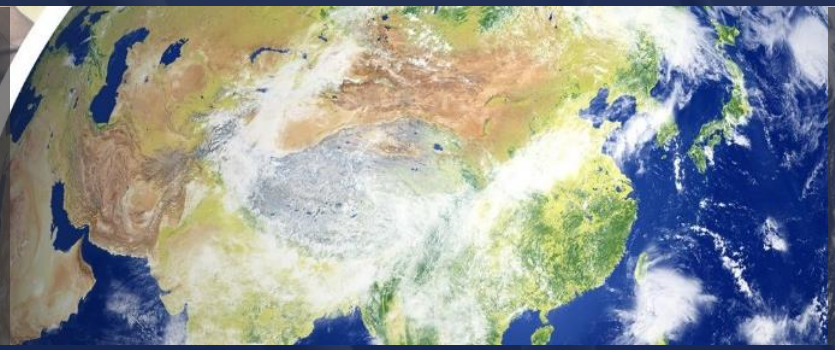
Driven by customer-sited generation, electric vehicles, etc.

Difficulty Permitting

Limited political capital

Global Policy & Action

- GHG emission reduction targets
- Electrification of transportation, heating, industry
- Desire to avoid negative financial impact for consumers



Political Shift has caught up to Renewable Economics

- Bipartisan support for jobs and economic recovery
- Savvy firms will utilize all available tools to make the most of this opportunity

Implications for networks

Smart Wires global customers share consistent messages

- They are worried about **security of supply**
- They are under pressure to invest in the grid and to **keep costs down**
- The are under intense **political pressure** to resolve ongoing delays in delivery of large-scale grid projects
- It is challenging to attract and retain **staff**
- End user dissatisfaction
- Grid reliability penalties
- Asset operation at thermal limits

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Transition to a digital grid

TODAY'S GRID

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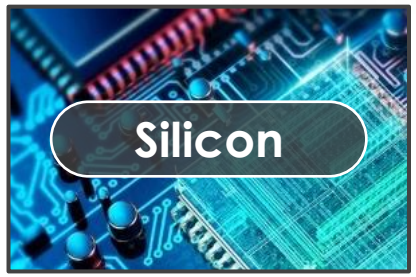
and costs rise! Copper ca € 14000, + 1000 in a month..

FUTURE GRID



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Glasgow UNFCCC: Deploy what we have!

Deploy what we have

- **Tom Burke from the climate think tank E3G told BBC News:**
- *"John Kerry, Bill Gates, et al. are wrong about the importance of R&D: Deployment of what we already have is what matters and for which we need big bucks."*

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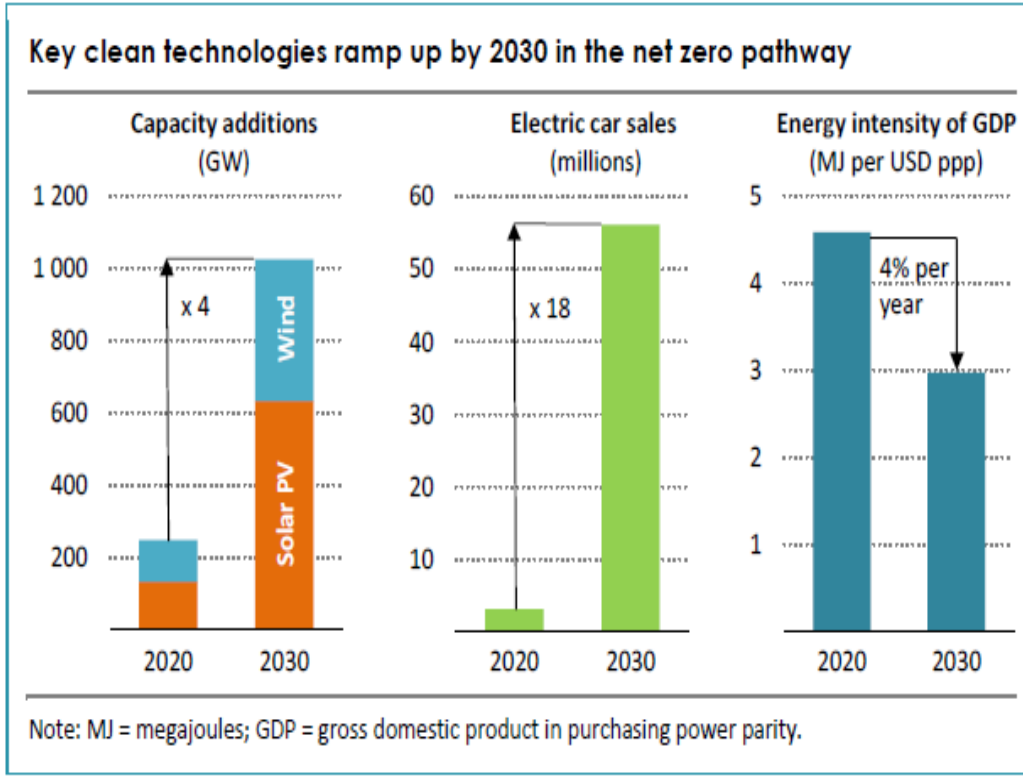
*"**Our Vision** is a European power network that is the recognised world leader in enabling decarbonisation through the efficient use of modern grid technology"*

currENT : who we are

currENT is the key industry association representing innovative grid technology companies operating in Europe.

Our members are taking Europe's power network to the next level – developing and supplying innovative technologies that optimise and maximise use of the existing grid.

IEA Net Zero 2050



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3.4.2 *Key milestones and decision points*

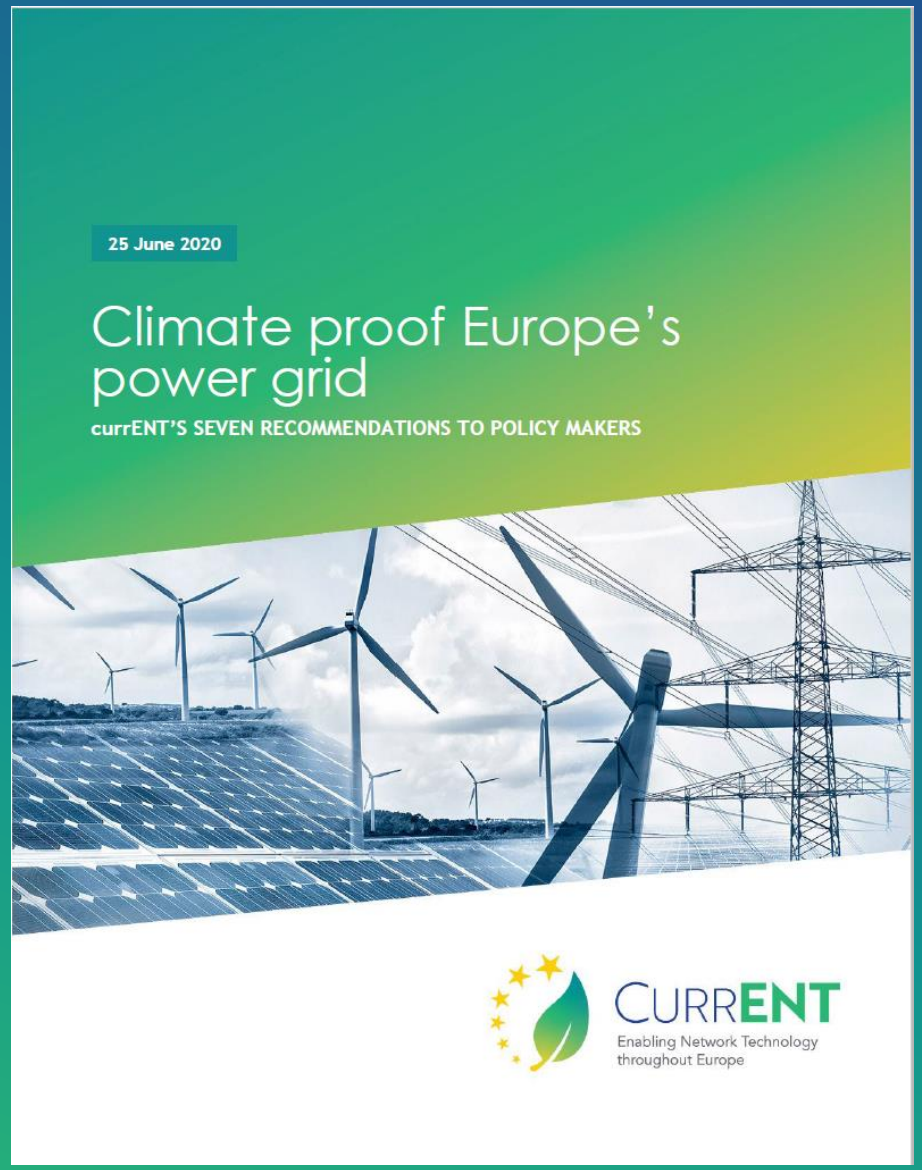
Table 3.2 ▷ Key milestones in transforming global electricity generation

Category	
Decarbonisation of electricity sector	• Advanced economies in aggregate: 2035. • Emerging market and developing economies: 2040.
Hydrogen-based fuels	• Start retrofitting coal-fired power plants to co-fire with ammonia and gas turbines to co-fire with hydrogen by 2025.
Unabated fossil fuel	• Phase out all subcritical coal-fired power plants by 2030 (870 GW existing plants and 14 GW under construction). • Phase out all unabated coal-fired plants by 2040. • Phase out large oil-fired power plants in the 2030s. • Unabated natural gas-fired generation peaks by 2030 and is 90% lower by 2040.

Category	2020	2030	2050
Total electricity generation (TWh)	26 800	37 300	71 200
Renewables			
Installed capacity (GW)	2 990	10 300	26 600
Share in total generation	29%	61%	88%
Share of solar PV and wind in total generation	9%	40%	68%
Carbon capture, utilisation and storage (CCUS) generation (TWh)			
Coal and gas plants equipped with CCUS	4	460	1 330
Bioenergy plants with CCUS	0	130	840
Hydrogen and ammonia			
Average blending in global coal-fired generation (without CCUS)	0%	3%	100%
Average blending in global gas-fired generation (without CCUS)	0%	9%	85%
Unabated fossil fuels			
Share of unabated coal in total electricity generation	35%	8%	0.0%
Share of unabated natural gas in total electricity generation	23%	17%	0.4%
Nuclear power	*2016-20*	*2021-30*	*2031-50*
Average annual capacity additions (GW)	7	17	24
Infrastructure			
Electricity networks investment in USD billion (2019)	260	820	800
Substations capacity (GVA)	55 900	113 000	290 400
Battery storage (GW)	18	590	3 100
Public EV charging (GW)	46	1 780	12 400

Note: GW = gigawatts; GVA = gigavolt amperes.

Transforming the electricity sector in the way envisioned in the NZE involves large capacity additions for all low-emissions fuels and technologies. Global renewables capacity more than triples to 2030 and increases ninefold to 2050. From 2030 to 2050, this means adding more



1. Align regulation with European long term (2050) energy, climate and social policy
2. Accelerate near-term investments that future proof and strengthen resilience of power grids
3. Optimise existing grids and build new ones where needed
4. Use Social Cost Benefit Analysis when assessing power network investments
5. Increase transparency in network development and operational procedures
6. Opt for an output-based regulatory approach, and incentives and obligations for license holders to trial and implement new technologies
7. Develop a structured, transparent, and collaborative approach to qualification of innovative solutions.

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Recent Policy Work

- ✓ National Development Plans (Germany, Spain, Portugal, Austria, Italy)
- ✓ Consultation response on TYNDP2022
- ✓ Revision of TEN-E Regulation
- ✓ Response on new EU DSO Entity
- ✓ ENTSO-E RDI Roadmap 2020-30
- ✓ currENT's contribution on EC Technology & Innovation Report
- ✓ EC Consultation on Offshore Renewable Energy Strategy
- ✓ Open Letter to ENTSO-E on the Power System Needs Report
- ✓ Ofgem Consultation Response on RIIO-2

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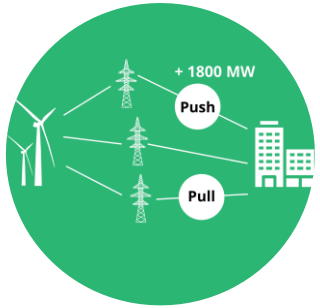
Technologies

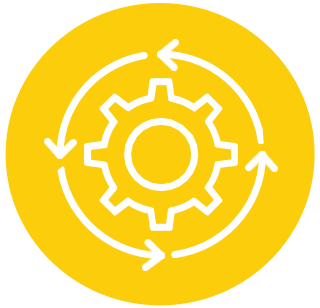
Hardware, software and associated protocols applied to existing and new transmission facilities that increase the network's operational transfer capacity, and maximise the efficiency of grids



Modular Power Flow Control

Dynamic Line Rating

Superconductor Cable Systems



Innovative Sensors

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What technologies?

ENTSO-E Technopedia

Welcome to ENTSO-E's new tool, the Technopedia!

Energy transition is underway, we help you to keep up with the new technologies related to the Transmission System Operators. Below you will find factsheets of different innovative and state-of-the-art technologies covering the fields of transmission assets, system operations, digital and flexibility solutions. These up-to-date sheets will help you to understand each technology and their advantages, and also to show their readiness level.

Dynamic Line Rating	Modul Static Synchronous Series Compensator	Superconductors
TRL 9	TRL 7 – TRL 9	AC: TRL 7 – TRL 8[6] DC: TRL 5 – TRL 6[7]

Table 1: Source: ENTSO-E Technopedia

Technology Readiness Levels (TRL):

- TRL 1 - Basic research: basic principles are observed and reported
- TRL 2 – Applied research: technology concept and/or application formulated
- TRL 3 – Critical function, proof of concept established
- TRL 4 – Laboratory testing of prototype component or process
- TRL 5 – Laboratory testing of integrated system
- TRL 6 – Prototype system verified
- TRL 7 – Integrated pilot system demonstrated
- TRL 8 – System incorporated in commercial design
- TRL 9 – System ready for full scale deployment

Obvious benefits

48 SmartValves

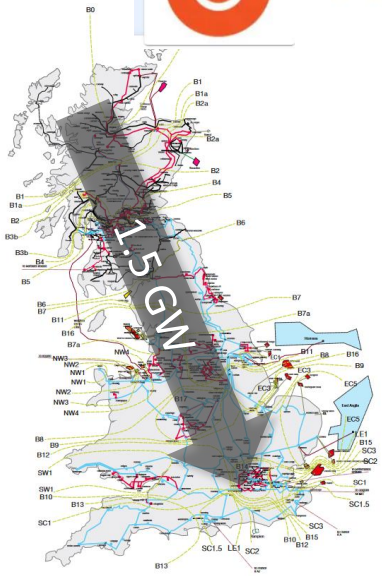
5 Circuits

3 Sites

< 18 months Manufacturing to commissioning

< 12 months For delivery of expansion

£387 M Savings for UK consumers



500 MW across 3 boundaries

#	Circuit	SmartValves	Voltage	Status	Commissioning
1	Harker – Stellar West	6	275 kV	Operational	March 2021
2	Harker – Fourstones	9/6	275 kV	Installed / Manufacturing	June 2021
3	Lackenby – Norton[1]	6	400 kV	Operational	March 2021
4	Penwortham Ckt#1	6	275 kV	Installed	May 2021
5	Penwortham Ckt #2	15	275 kV	Manufacturing	June 2021

[1] SmartValves installed mid-circuit at Saltholme

1

2

3

4

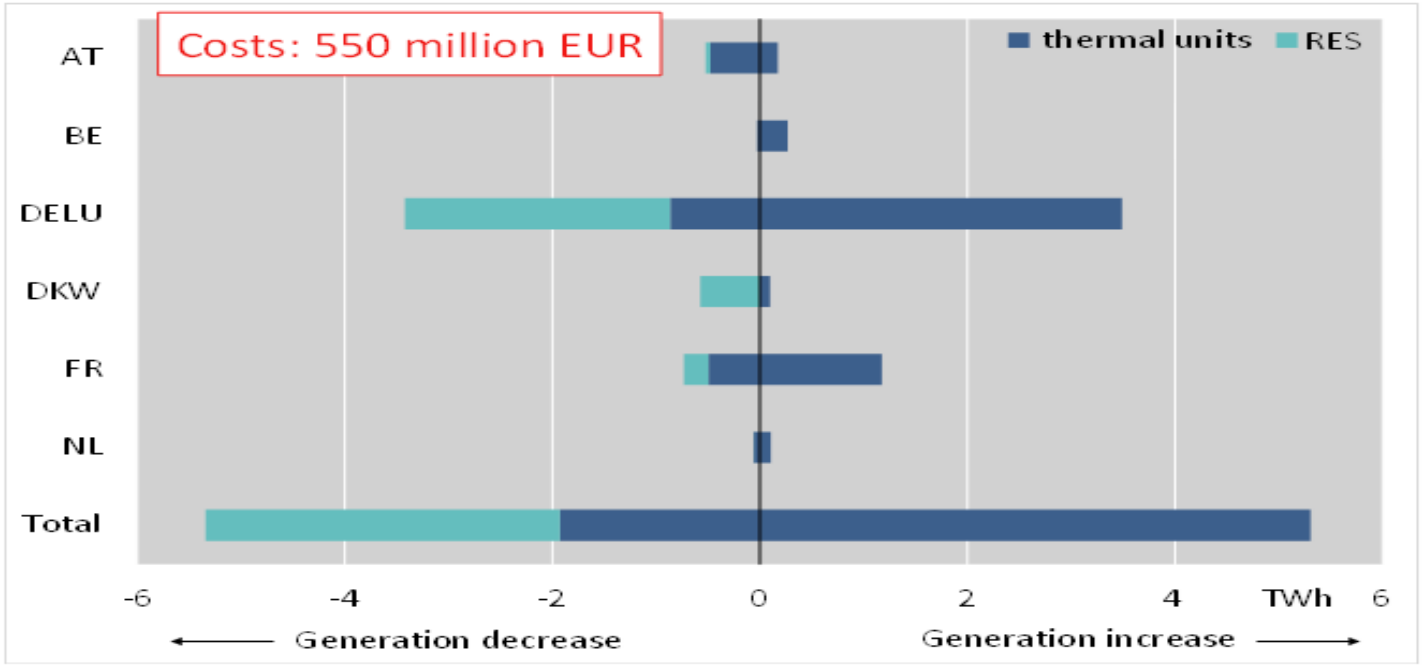
5

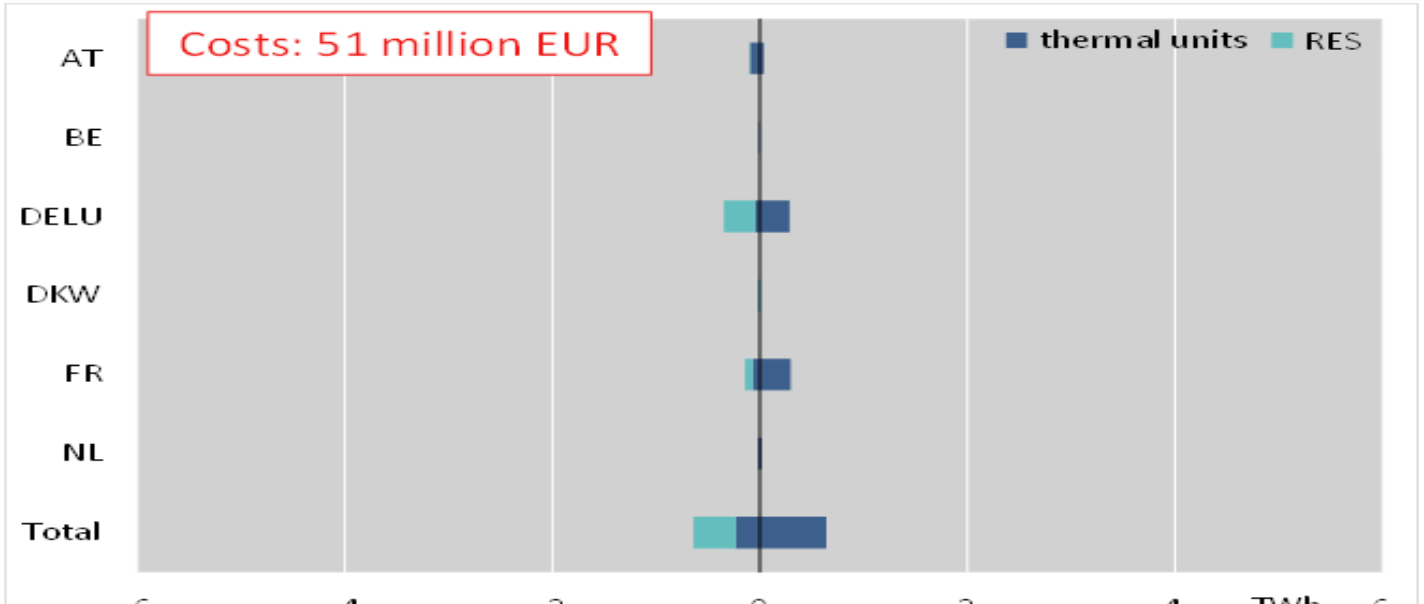
Smart Wires: Global projects underway

- **South America –** Installation at EPM
  - Picture shows installation underway in Colombia at 110 kV presently
  - This is Phase 1 of a larger project and is Smart Wires first installation in South America
  - Smart Wires is very active in Colombia, Chile, and Peru with a number of large projects planned for 2022-2024

- **Australia**
  - Picture shows installation recently commissioned in Australia at 330 kV presently
  - This is our first SmartValve installation in Australia and we have a second one later this year facilitating increase in cross border transfer capacity
  - Smart Wires technology was incorporated into the Integrated System Plan by AEMO in 2020

Consentec study: +90% decrease of congestion costs

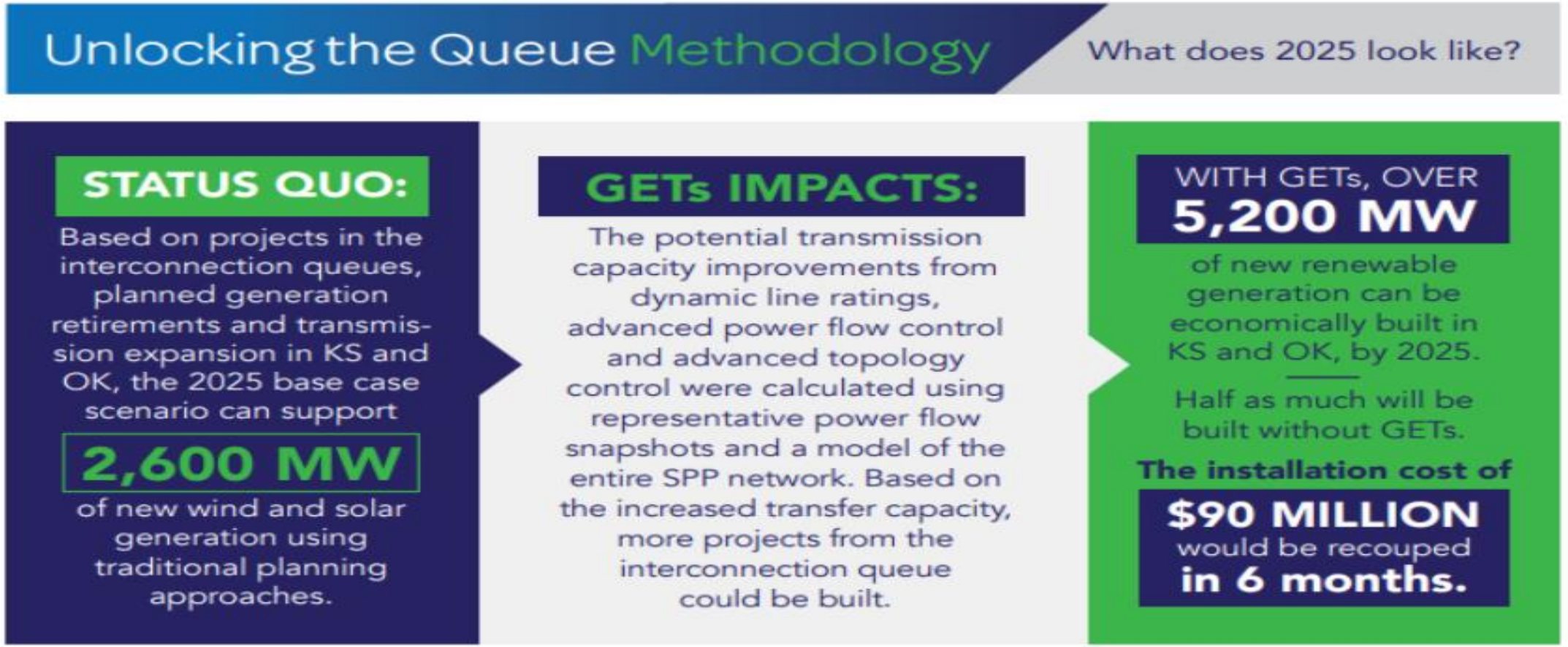




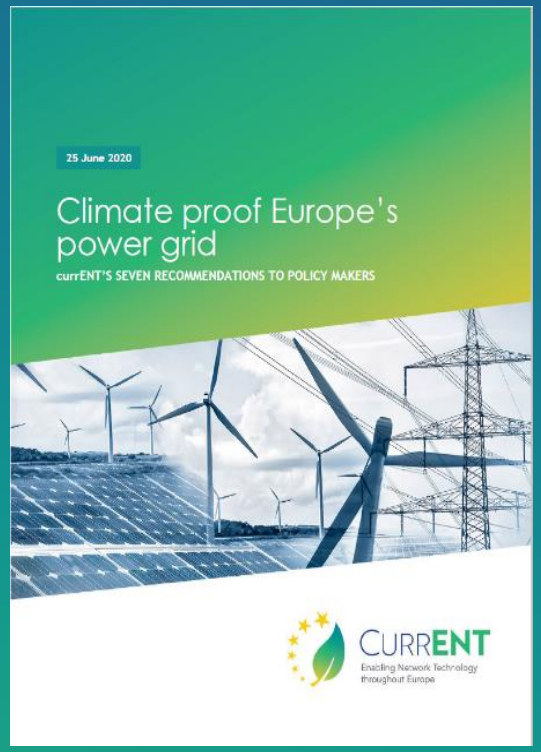
Benefits of Intelligent Power Grid Design Tools

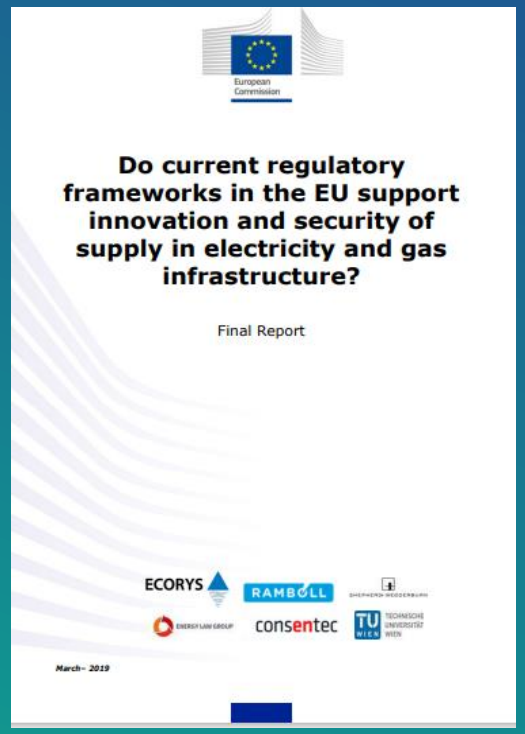
Scenario	DLR	M-SSSC	Superconductors
Base	Inactive	Inactive	Inactive
DLR only	Active	Inactive	Inactive
M SSSC only	Inactive	Active	Inactive
SC only	Inactive	Inactive	Active
DLR and SV and SC	Active	Active	Active

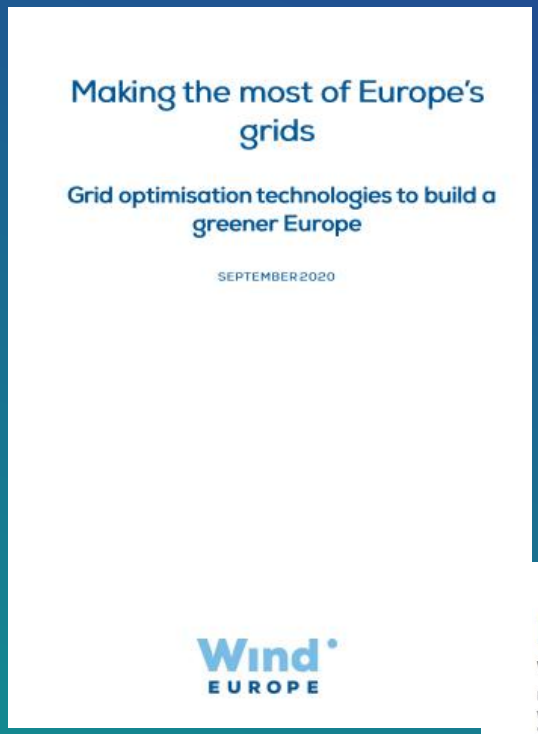
Obvious benefits: Brattle report 2021

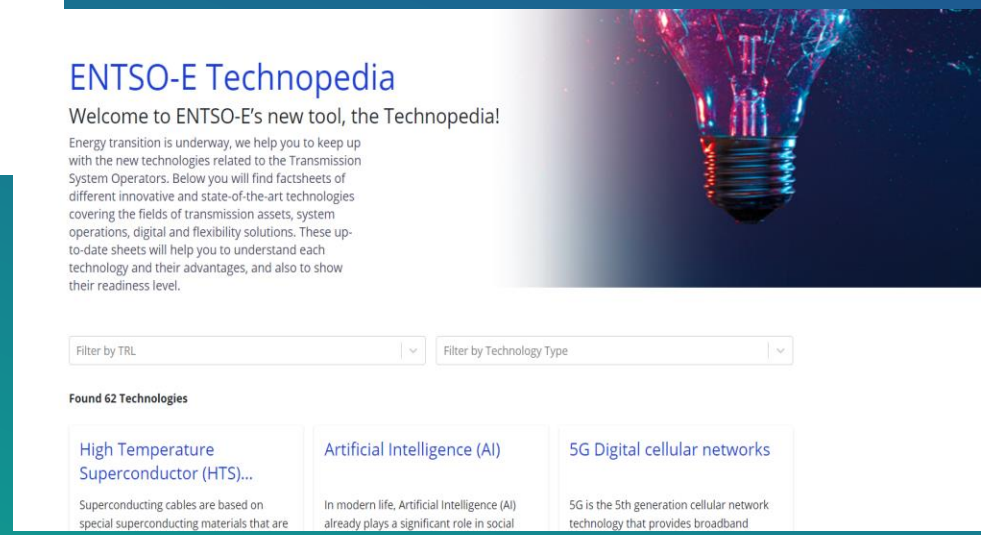


It has all been said! Why is it not happening?









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Emphasize Grid enhancement in…

The Green Deal implementation

- ✓ *Energy Efficiency Directive **(EED): Energy Efficiency First Principle!***
- ✓ *Renewable Energy Directive **(RED)** revision: focus on optimised grids for 100% Renewables by 2050*
- ✓ *European Offshore Renewable Energy Strategy implementation*
- ✓ *TEN-E: more out of grids and more grids form ONE solution towards electrification*

As part of Electrification and digitalisation

We want to promote efficient use of electricity networks through modern grid technologies:

- ✓ *Dynamic Line Ratings*
- ✓ *Superconducting Cable Systems*
- ✓ *Modular Power Flow Control technology*
- ✓ *Intelligent sensors*

Keeping the energy transition costs affordable and customers active

The use of efficient innovative technologies decreases the costs of the energy transition: Read our forthcoming report *By Consentec*

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Our recommendations: NOVA now

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7. Develop a structured, transparent, and collaborative approach to qualification of innovative solutions.

…And last but not least

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Thanks for your attention
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