
WEBINAR
CURRENT
Enabling Network Technology throughout Europe
SPAIN'S POWER NETWORK TOWARDS A ZERO EMISSIONS FUTURE
THE ROLE OF THE GRID AND INNOVATIVE TECHNOLOGIES
18 NOV | 13-14:30 CET

MODERATOR

CURRENT
Enabling Network Technology throughout Europe

ALICIA CARRASCO

CEO at olivoENERGY
& Executive Director at
entra Agregación y Flexibilidad

SPAIN'S POWER NETWORK TOWARDS A ZERO EMISSIONS FUTURE:

CONCHA SÁNCHEZ
RED ELÉCTRICA

RICARDO RENEDO WILLIAMS
DG ENER

NORELA CONSTANTINESCU
ENTSO-E

MARIO PATIÑO
SMART WIRES

DINC MEMIS
AMPACIMON

DR SUSANNE NIES
CURRENT EUROPE

ANDRÉS RAMOS GALÁN
COMILLAS UNIVERSITY

Agenda

Welcome by currENT Board Chair, **Susanne Nies**

Keynote speech by **Concha Sánchez**, Red Eléctrica de España

Ricardo Renedo Williams, DG ENER

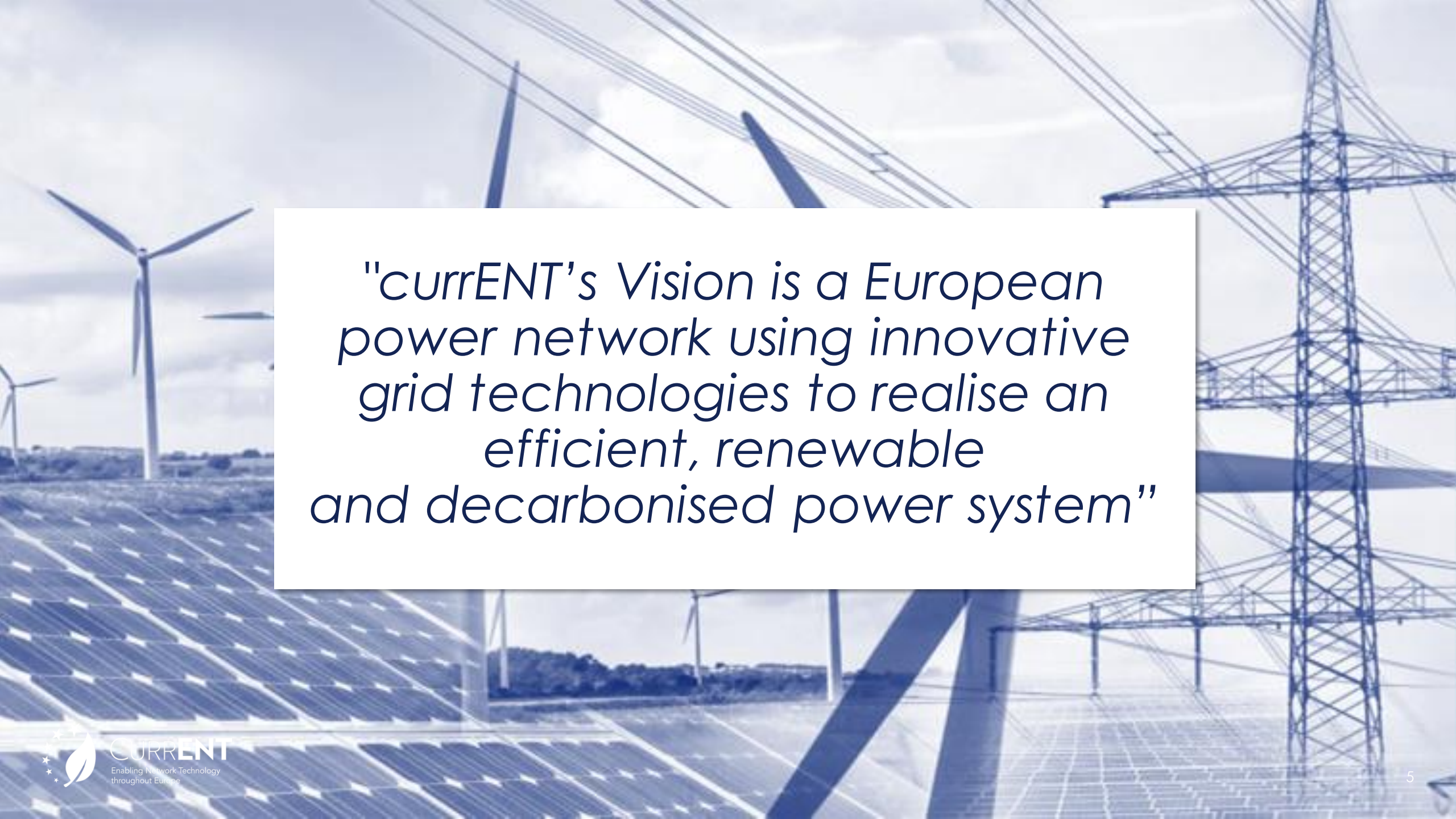
Andrés Ramos Galán, Comillas University

Norela Constantinescu, ENTSO-E

Mario Patiño, Smart Wires

Dinc Memis, Ampacimon

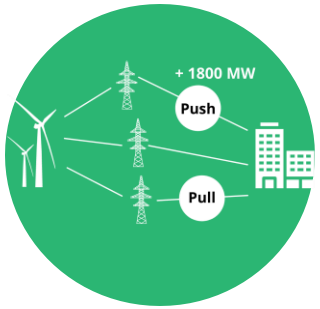
Roundtable and Q&A moderated by **Alicia Carrasco**



"currENT's Vision is a European power network using innovative grid technologies to realise an efficient, renewable and decarbonised power system"

currENT Technologies

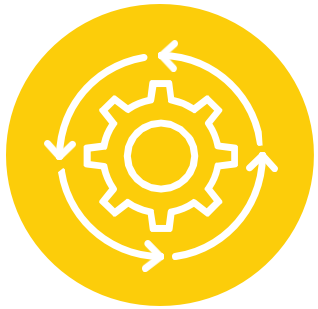
Hardware, software and associated protocols applied to existing and new transmission facilities that increase the network's operational transfer capacity, and maximise the efficiency of grids



Modular Power Flow Control

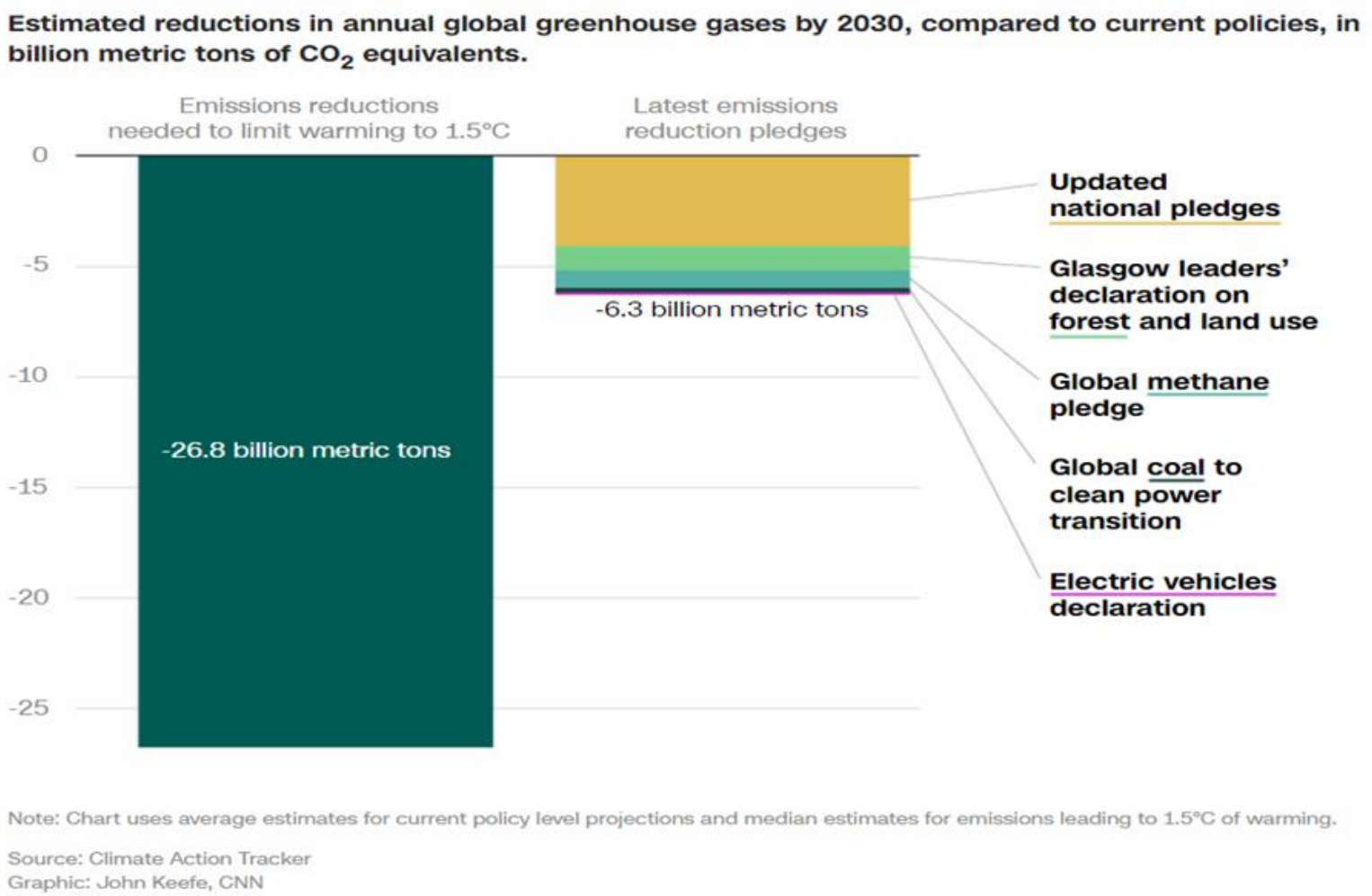
Dynamic Line Rating

Superconductor Cable Systems



Innovative Sensors

Major commitment needed to reach Net Zero



KEYNOTE

CONCHA SÁNCHEZ

Manager
System Development Area
Red Eléctrica de España

‘THE RED ELÉCTRICA STRATEGY UNTIL 2026 AND 2030 FOR ACHIEVING THE GREEN DEAL: NEW NETWORK NEEDS, REINFORCEMENTS AND THE POTENTIAL OF INNOVATION.’

Towards Zero Emissions

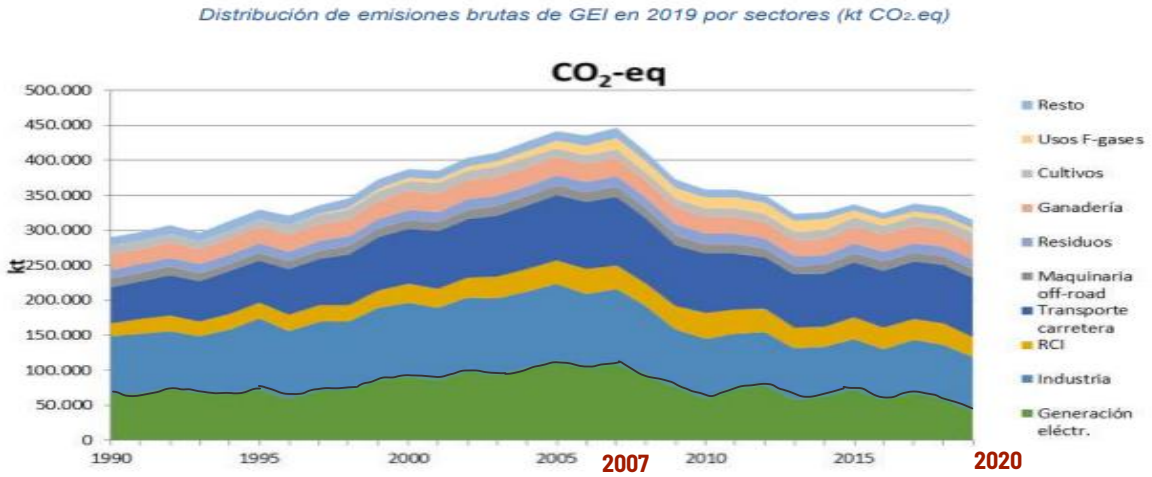
Transmission Grid Development

November 2021

RED ELÉCTRICA DE ESPAÑA

Grupo Red Eléctrica

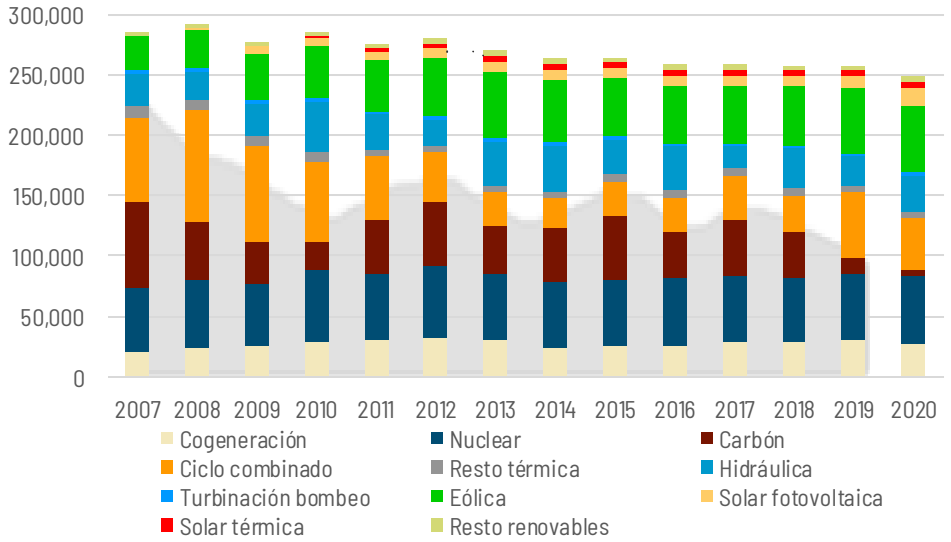
Situación actual …



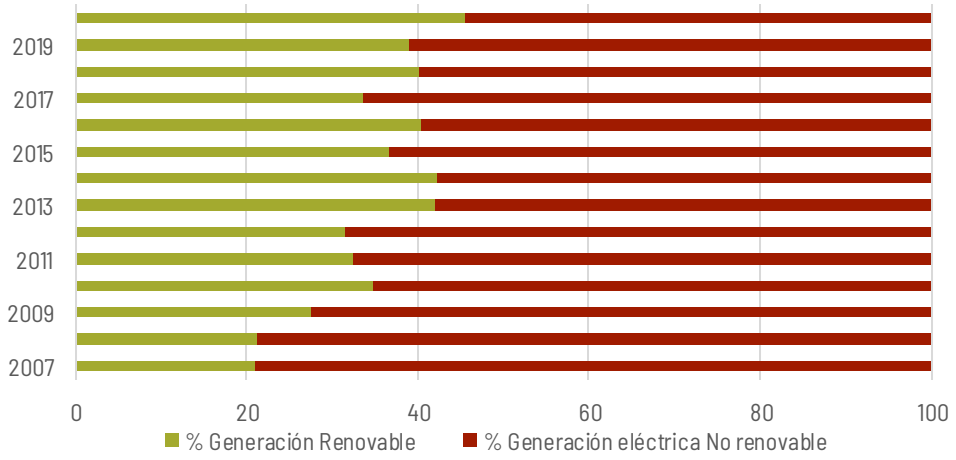
Fuente: Inventario nacional de emisiones de gases de efecto invernadero. Informe resumen Abril 2021

El centro de control de energías renovables de Red Eléctrica de España en funcionamiento desde 2006 es único en el mundo y ha permitido alcanzar valores de generación renovable en el sistema eléctrico español en el entorno del 40%

Producción anual energía eléctrica en España (GWh)



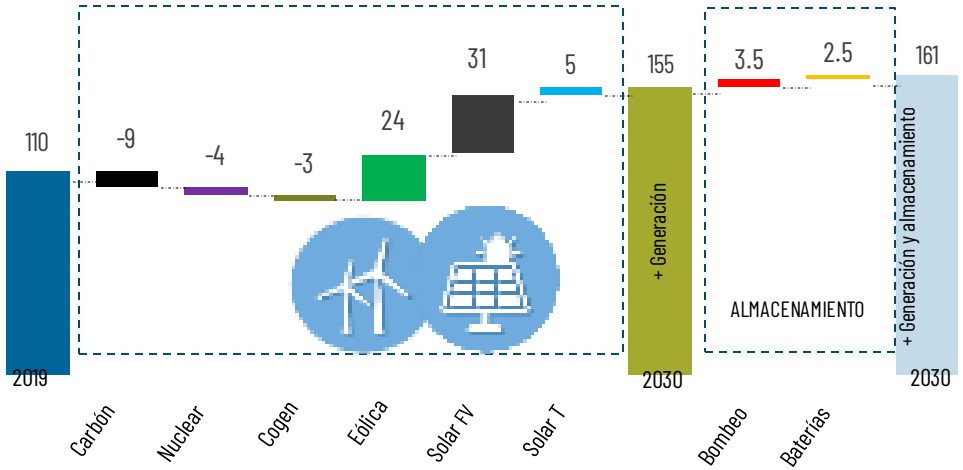
% Participación generación renovable en la producción de energía eléctrica peninsular

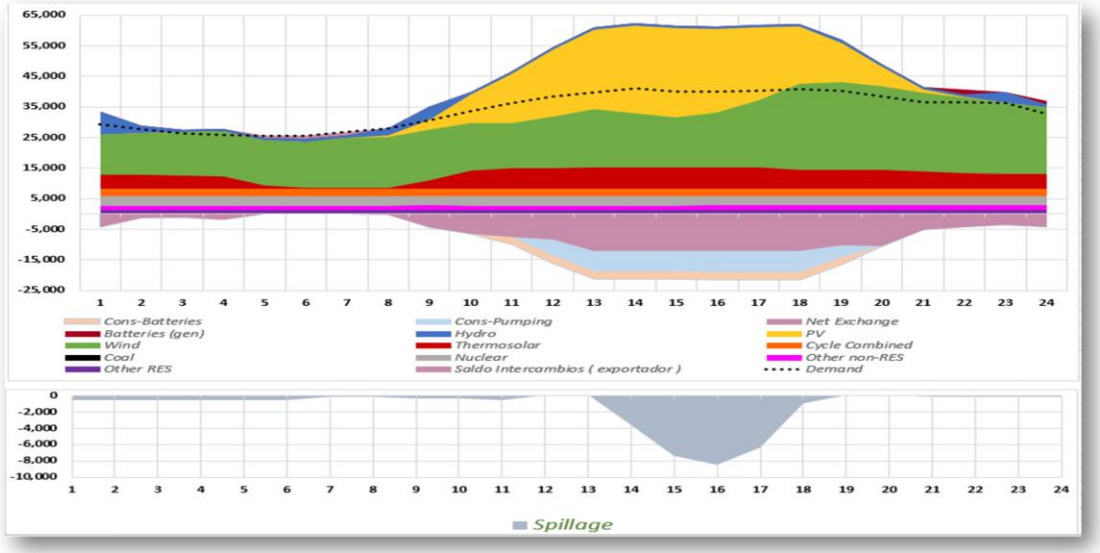


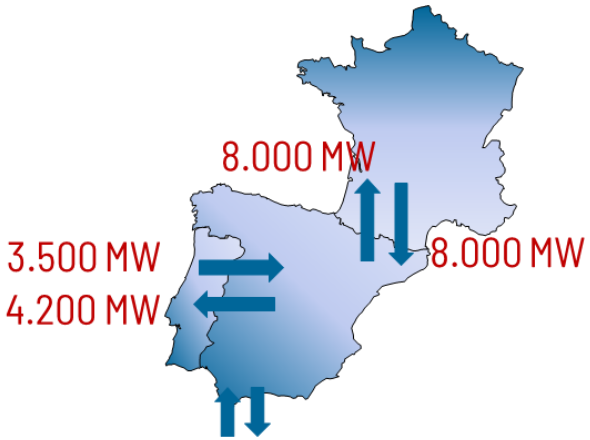
Plan nacional integrado de energía y clima

Escenario Objetivo H2030

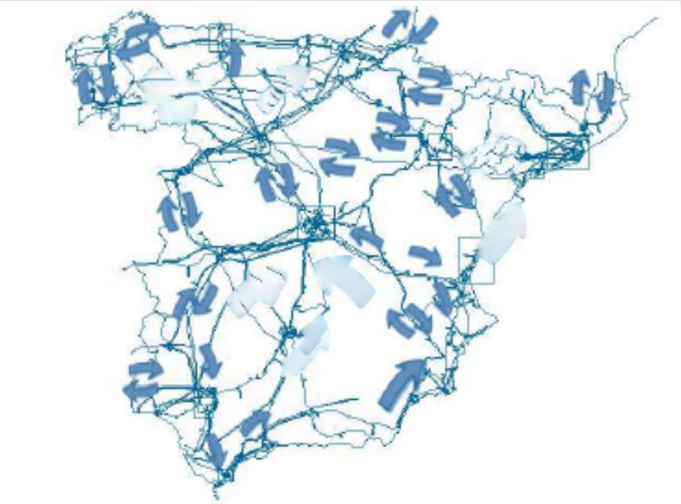
Evolución del parque generador







Integración de renovables en el sistema eléctrico del 74% en 2030.

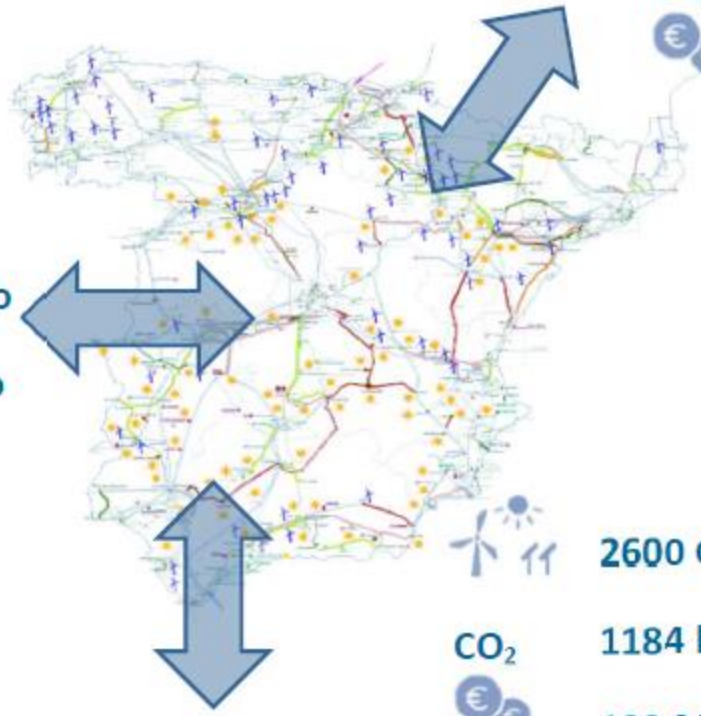


https://www.miteco.gob.es/images/es/pnieccompleto_tcm30-508410.pdf

728 - 1087 GWh/año

CO_2 61 - 196 $ktCO_2$/año

116 - 129 M€/año



5-10 GWh/año

5-102 M€/año

2600 GWh/año

CO_2 1184 $ktCO_2$/año

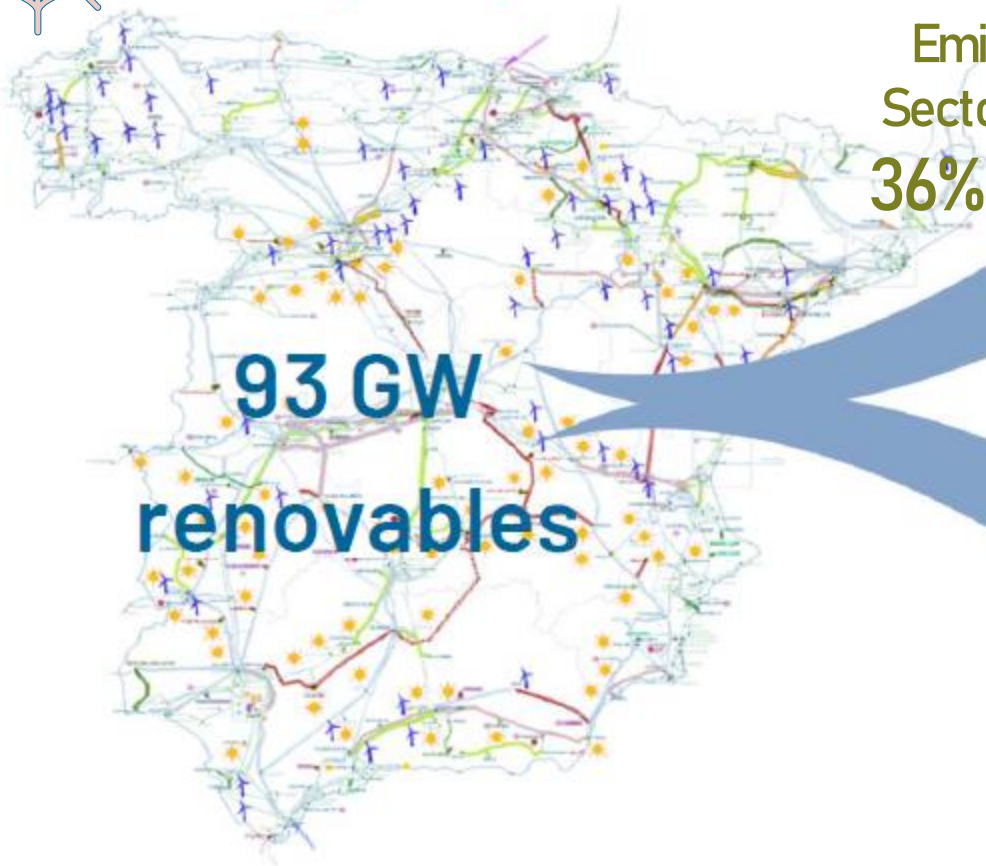
133 M€/año

otenciadas

as con DLR

Nueva actuación → *Incluida en la propuesta*

Red propuesta H2026



93 GW renovables

Emisiones de CO2 del Sector eléctrico en 2026

36% de las de 2019

Vertido renovable

≈9.100 GWh/año

(5,5 % del producible)

Integración renovable 67 %

Objetivo 68 %

La red de transporte propuesta proporciona el 70-80% de las ventajas

que proporcionaría una red sin limitaciones

Gracias por su atención

RED ELÉCTRICA DE ESPAÑA

www.ree.es

SPEAKER

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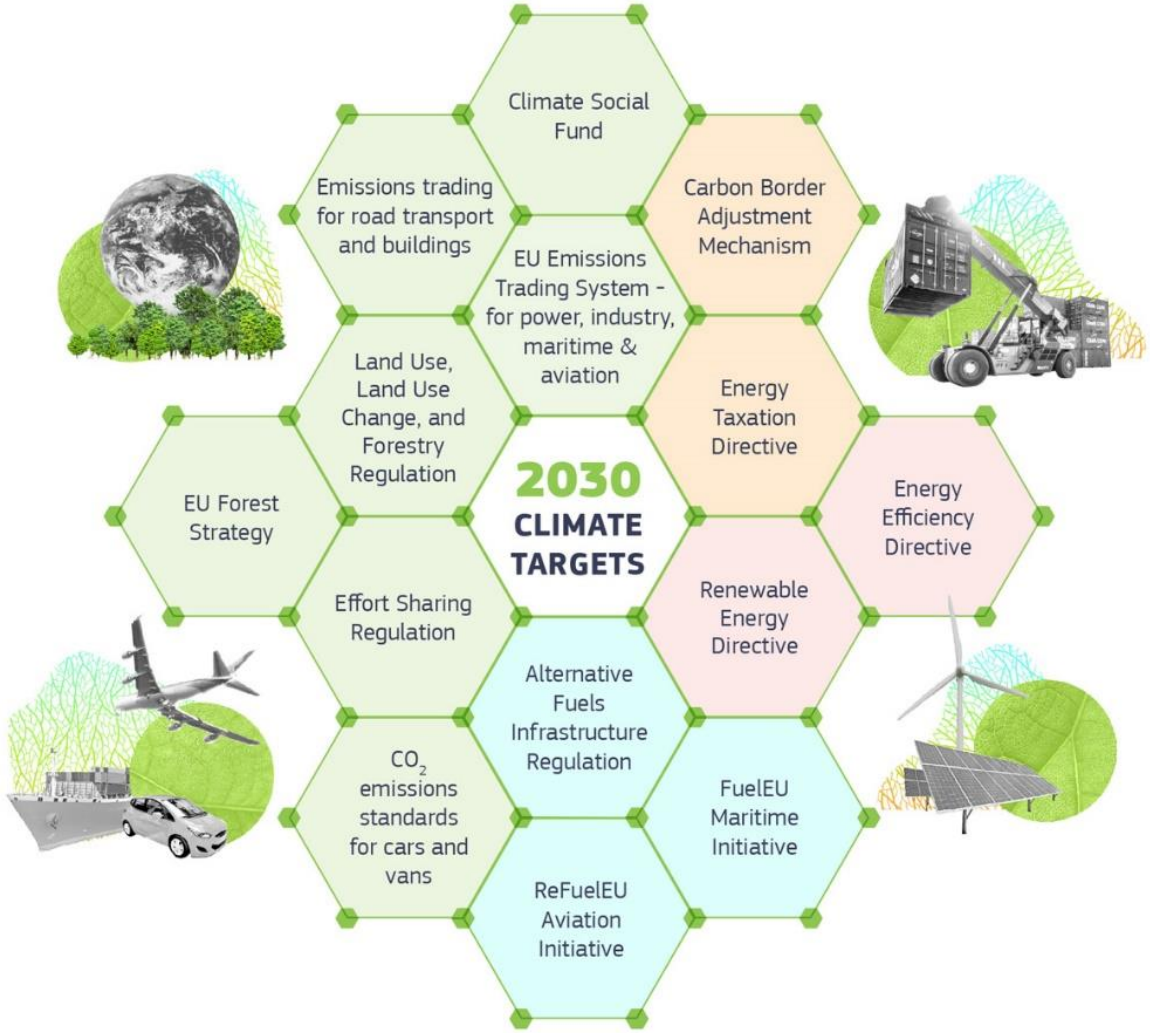
RICARDO RENEDO WILLIAMS

DG ENER

INSIGHTS ON THE FIT FOR 55% PACKAGE AND THE ROLE OF POWER NETWORKS AND TECHNOLOGIES

The Fit for 55 Package – Overview



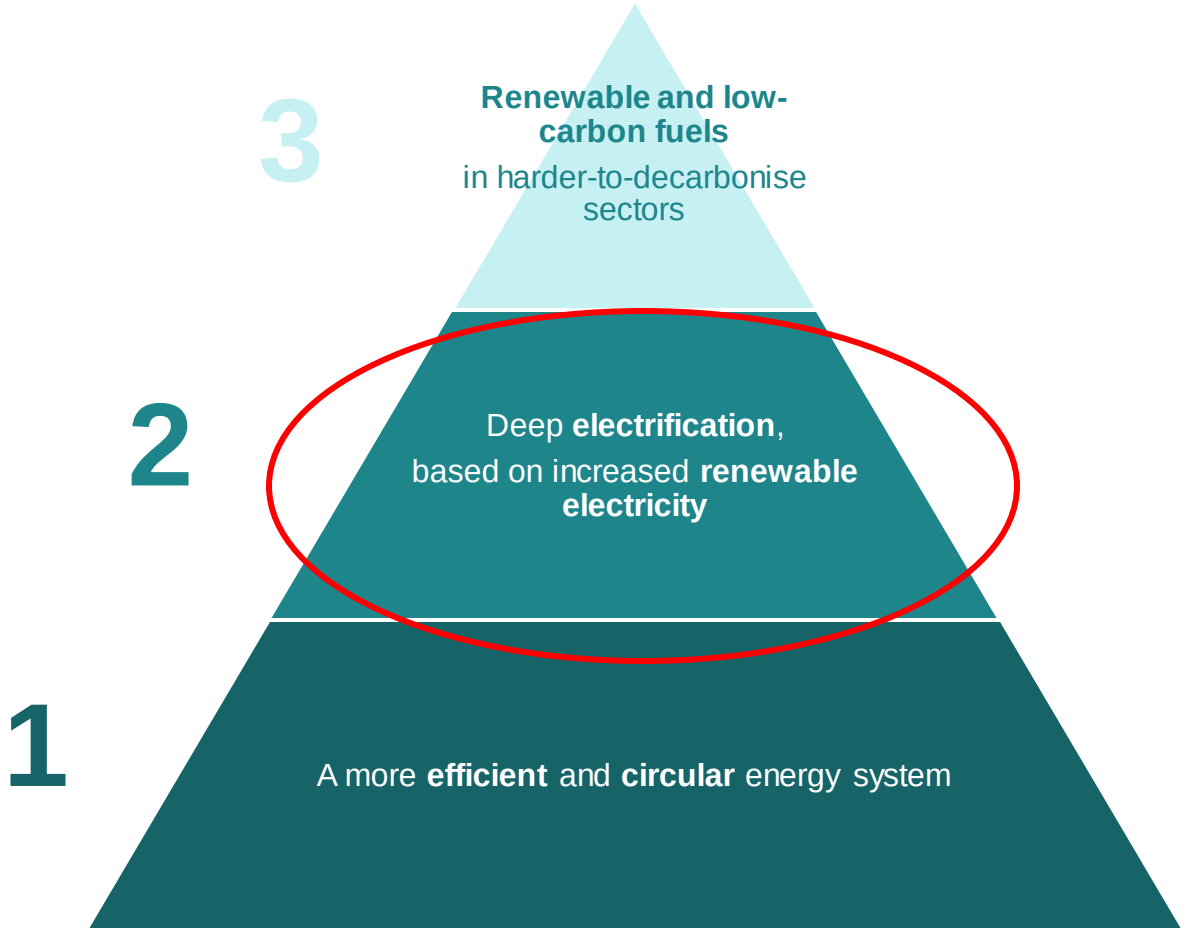
The package aims to make the EU 'fit for 55' and **deliver the transformational change** needed in a

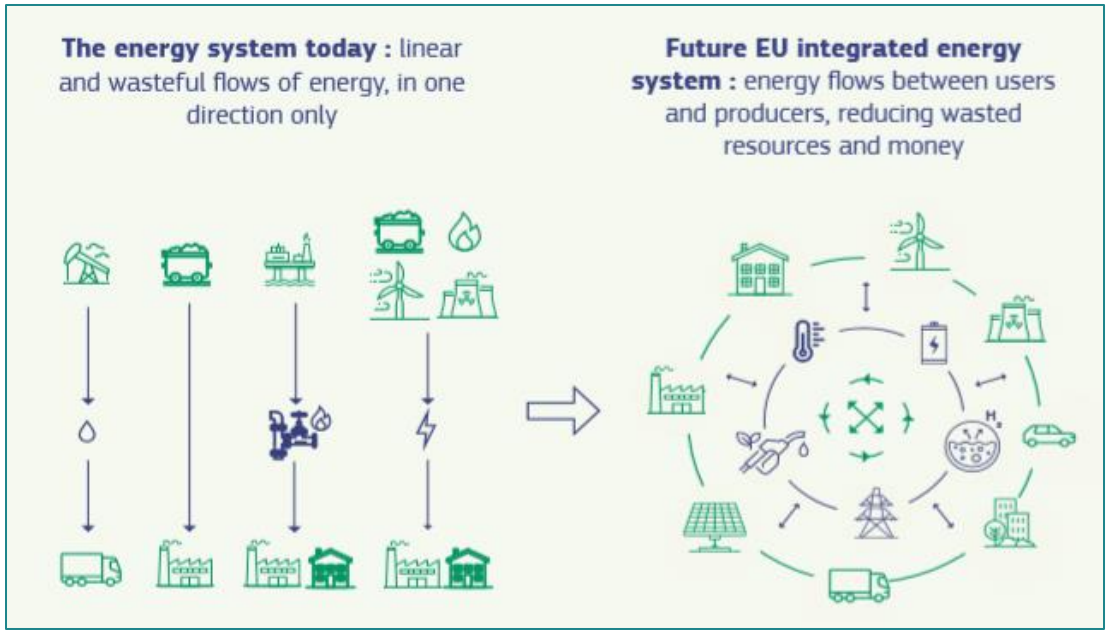
- **fair,**
- **cost-efficient** and
- **competitive**

way.

European Commission

Transforming our energy system

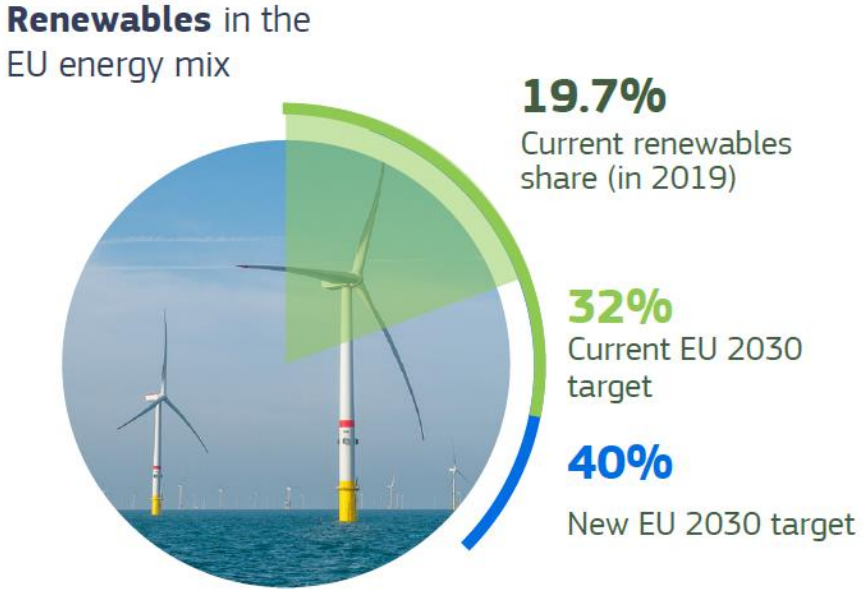




European Commission

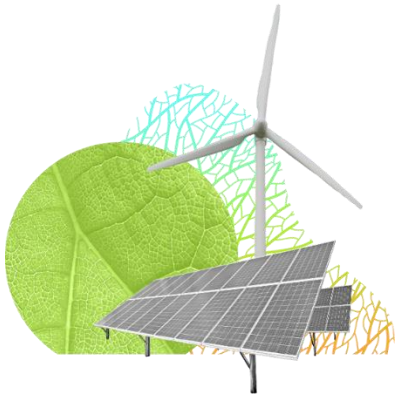
Revising the Renewable Energy Directive

- Increased renewables ambition in key sectors (heating and cooling, transport, industry, buildings)
- Boosting the deployment of and the investment in renewable energy
- Sustainable bioenergy reinforced



European Commission

Revising the TEN-E



- More cross-border energy networks!
- Innovation and digitalisation
- Offshore
- Hydrogen
- PMIs

SPEAKER

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ANDRÉS RAMOS GALÁN

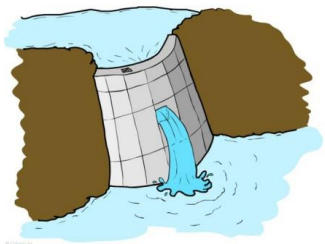
Comillas University

MATHEMATICAL MODELS FOR TRANSMISSION EXPANSION PLANNING

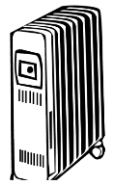
Challenges for Transmission Expansion Planning (TEP)

SPATIAL complexity: *Europe to smart cities*

TEMPORAL complexity: *msec. to decades*

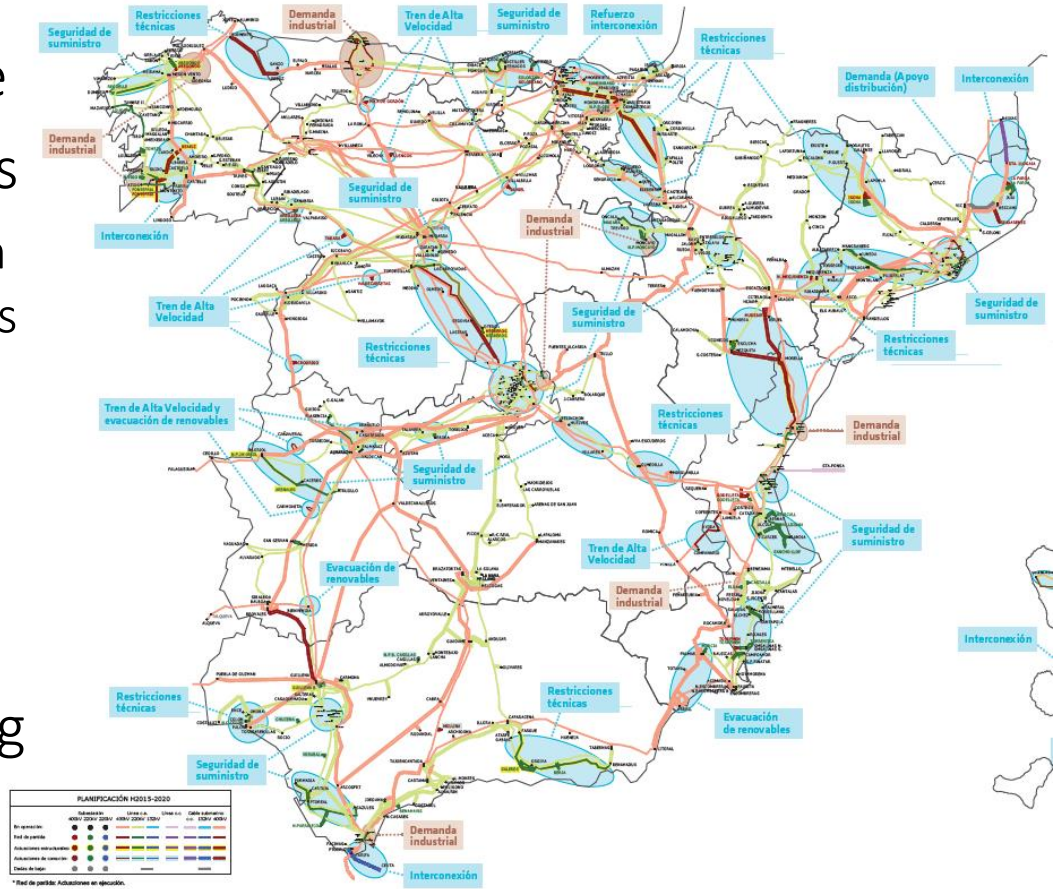


STOCHASTIC complexity: *weather conditions and human behavior*



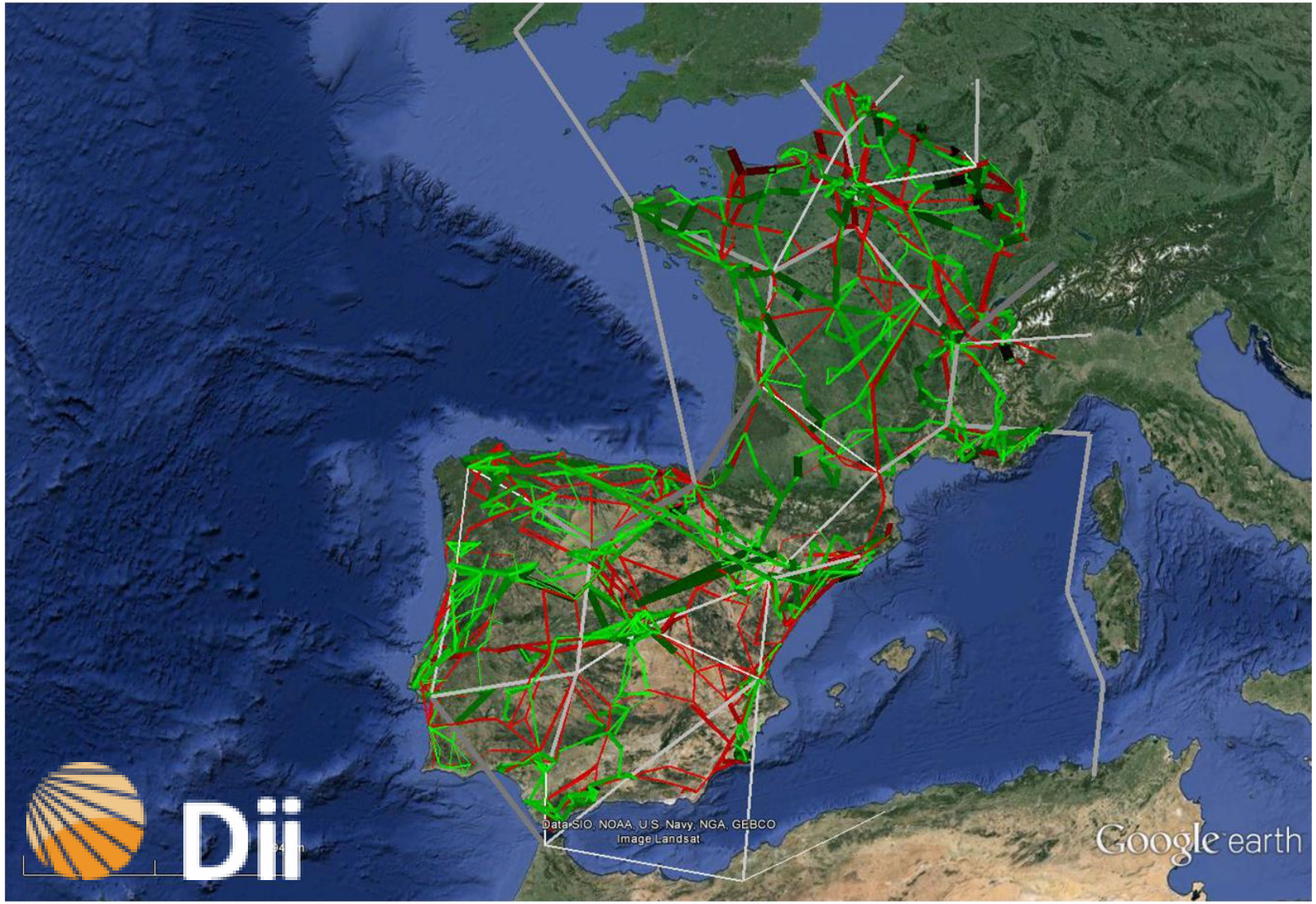
Current modelling challenges

- Generation flexibility: storage
- Grid flexibility devices/actions
  - FACTS (Flexible AC Transmission System), DLR, line switching, bus splitting, line repowering
- DC → AC
- Overhead vs. submarine vs. underground connections
- Static vs. dynamic vs. planning
- Zonal → nodal



http://ree.es/en/activities/grid-manager-and-transmission-agent/grid-planning-an-development

Pre-feasibility analysis on power highways for the Europe-MENA region integration in the framework of the Dii Rollout Plan 2050



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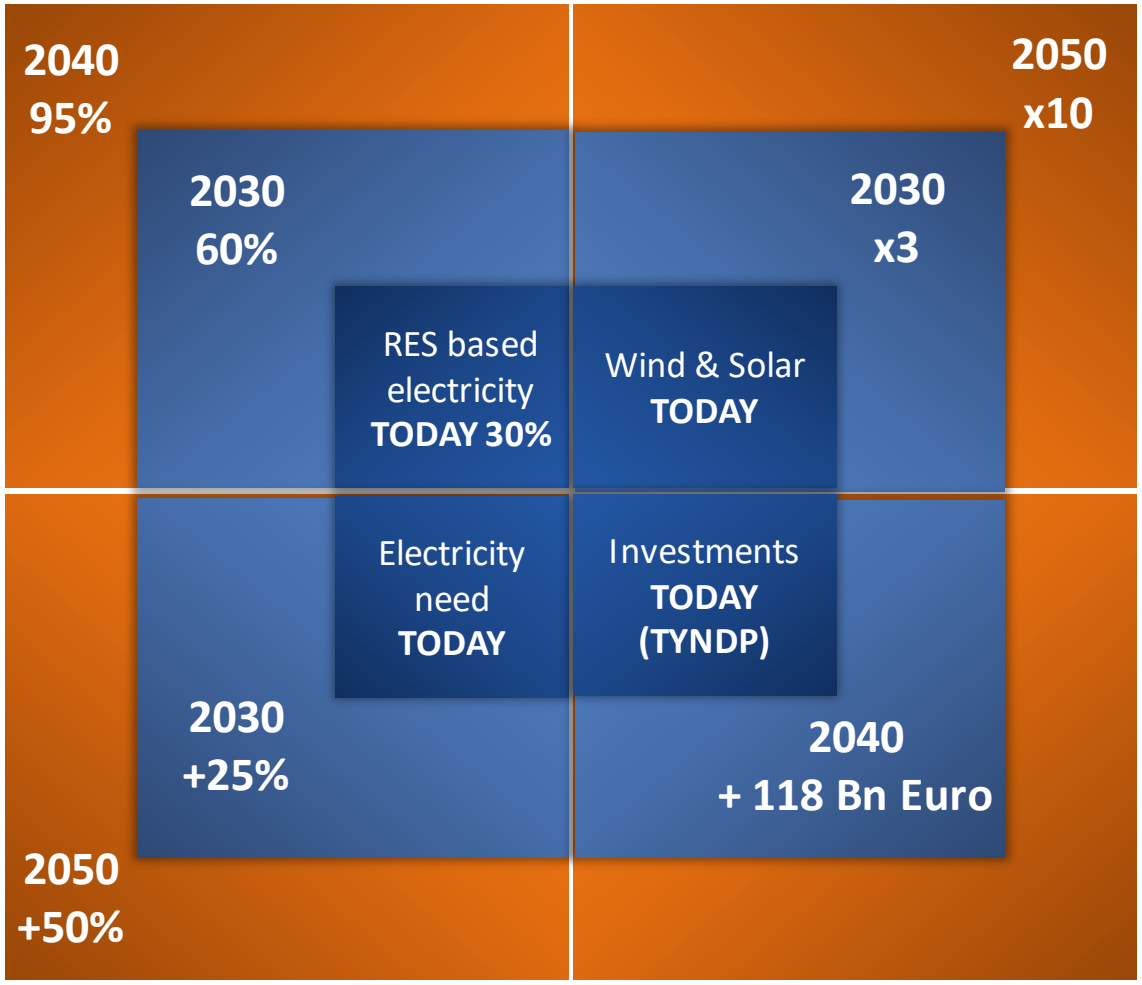
NORELA CONSTANTINESCU

ENTSO-E

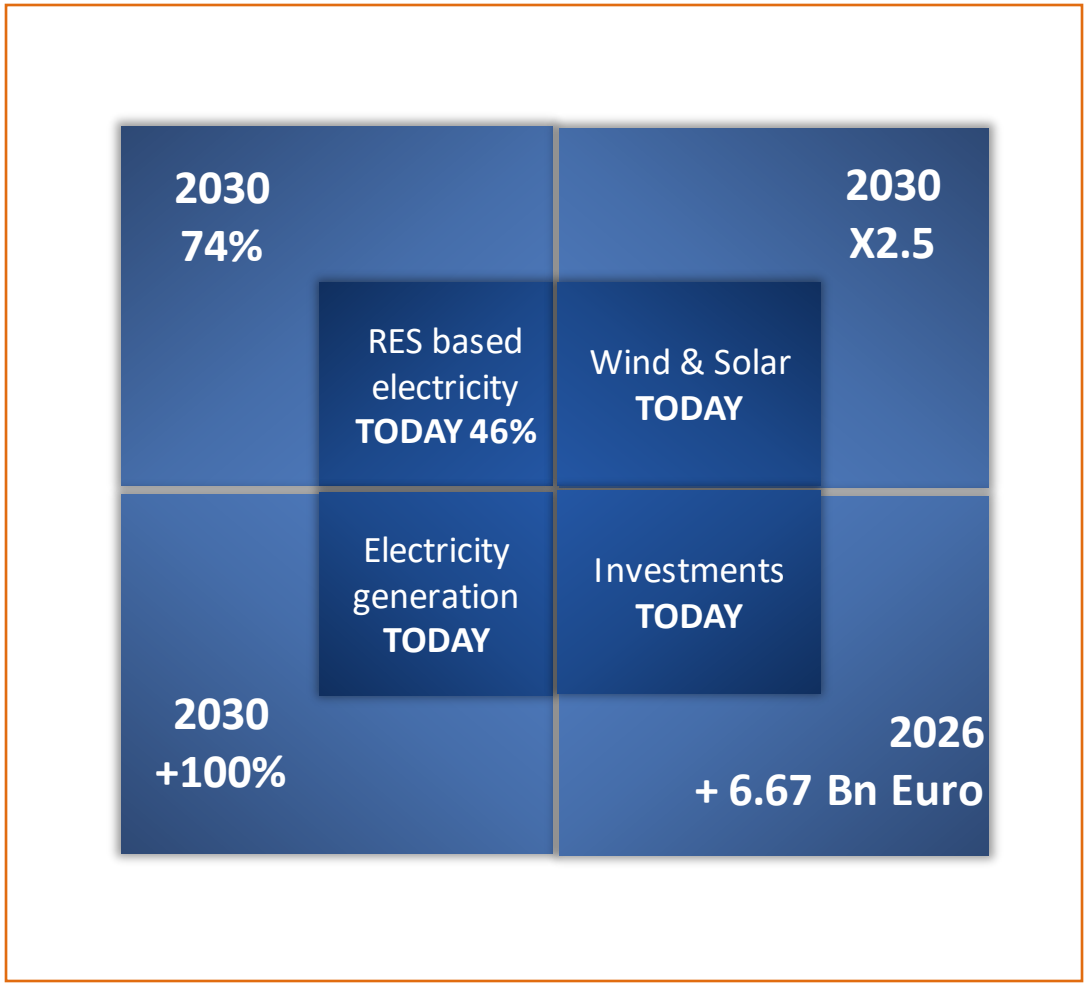
THE ENTSO-E TECHNOPEDIA AND WHAT THE TOOLBOX CONTAINS

Towards zero emission future : electricity, RES, investments - 2030 milestones

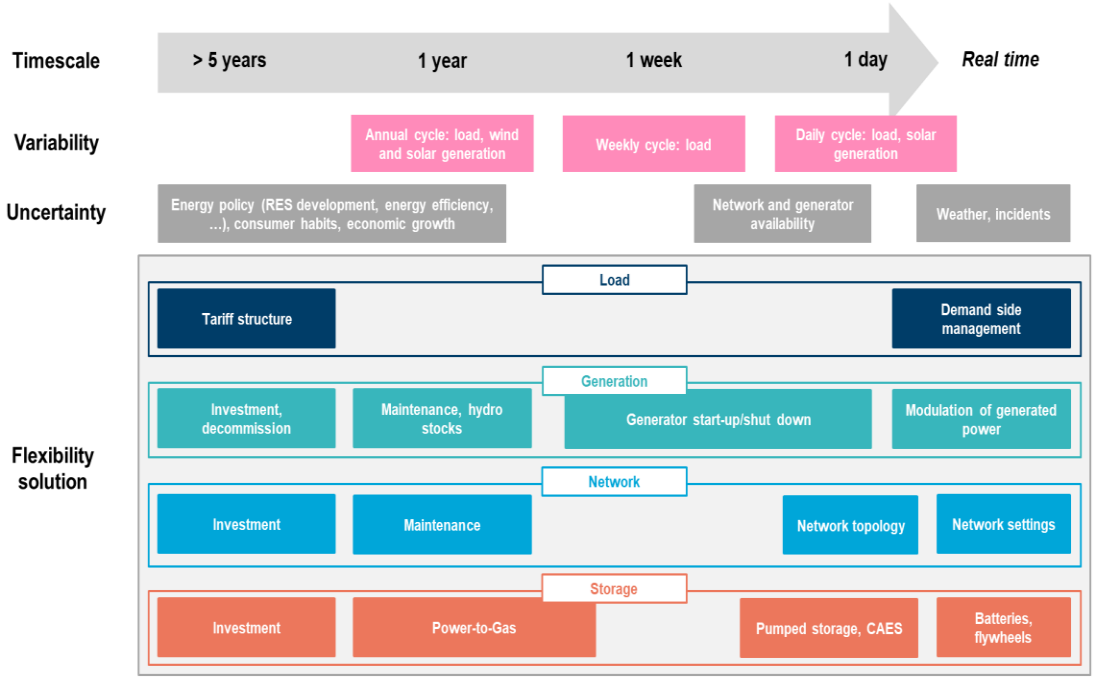
Europe



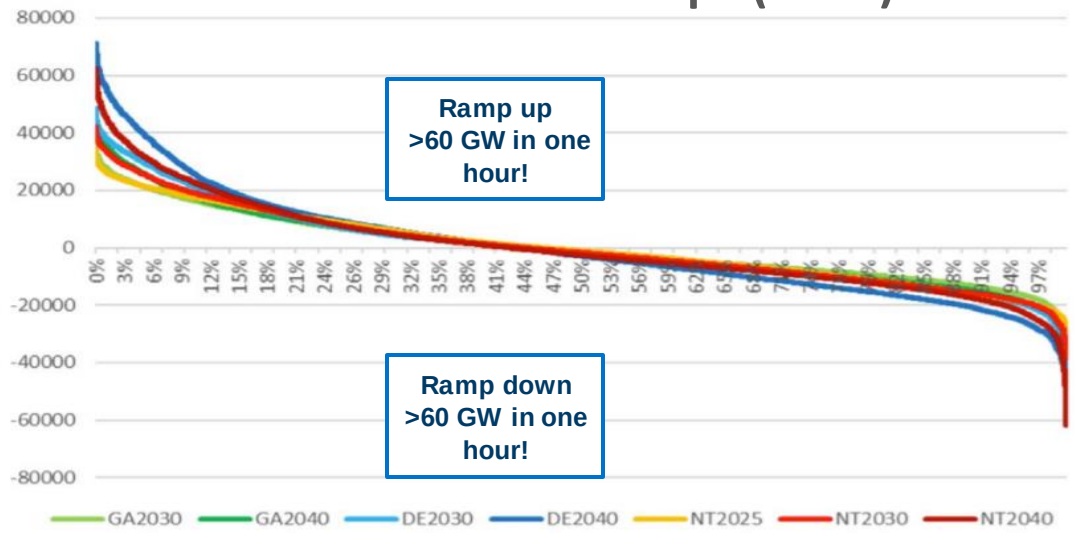
Spain



Flexibility needs will increase in the future



Hourly ramps of residual load* (MW/h) in Continental Europe (2030)



Flexibility solutions :

Loads – DR from from industrial consumers, electric vehicles, small scale demand

Storage – batteries , thermal storage , LAES/CAES , Flywheels

Grid/Assets : DLR, Power control & Voltage control devices System protection schemes, system storage, ynamic grid connection agreement

Interconnections

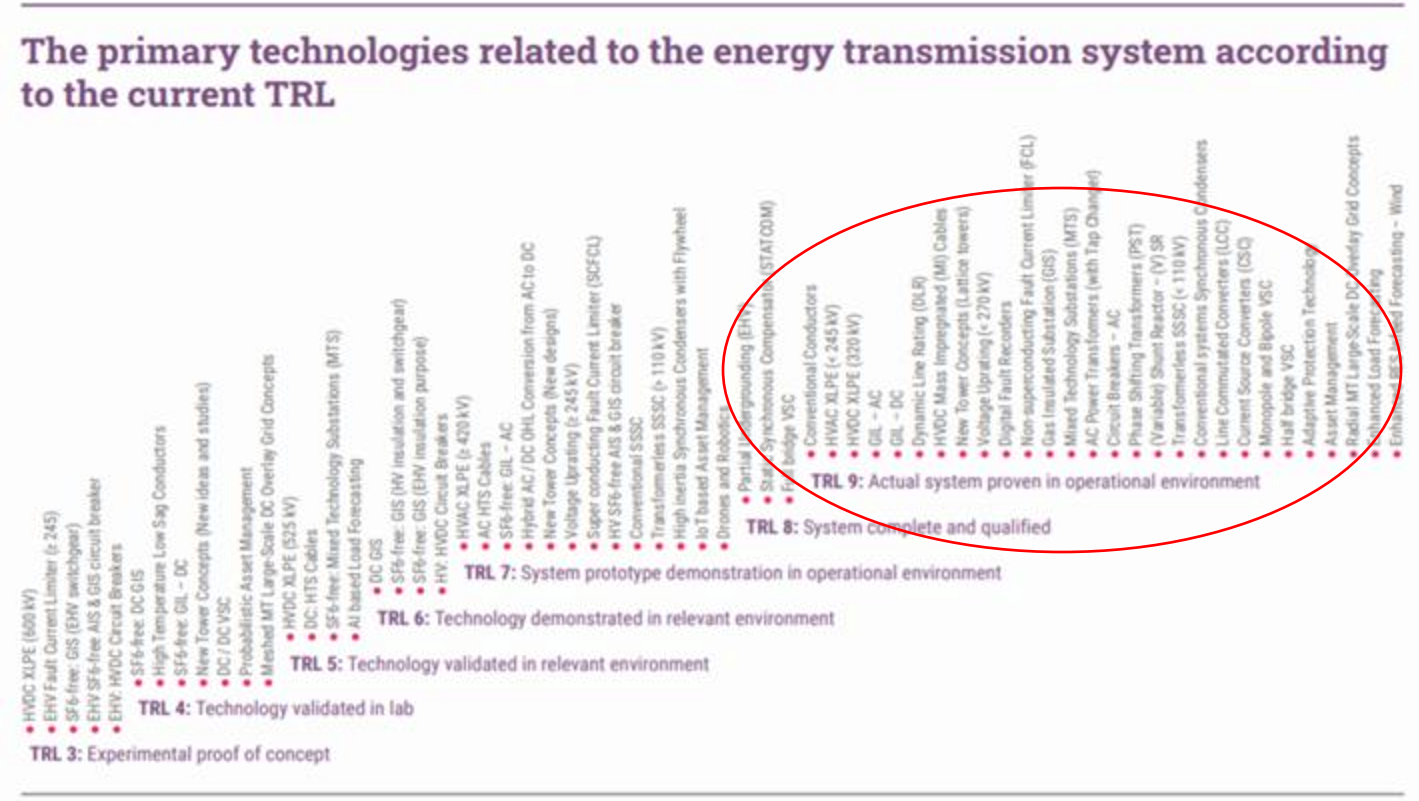
Flexibility needs increase due to variability and **uncertainty** in:

- **Demand:** electrification of heating, transport and industries
- **Generation:** more VRE and less dispatchable generation
- **Grids:** Power electronics dominance (less predictable flows, lack of inertia)

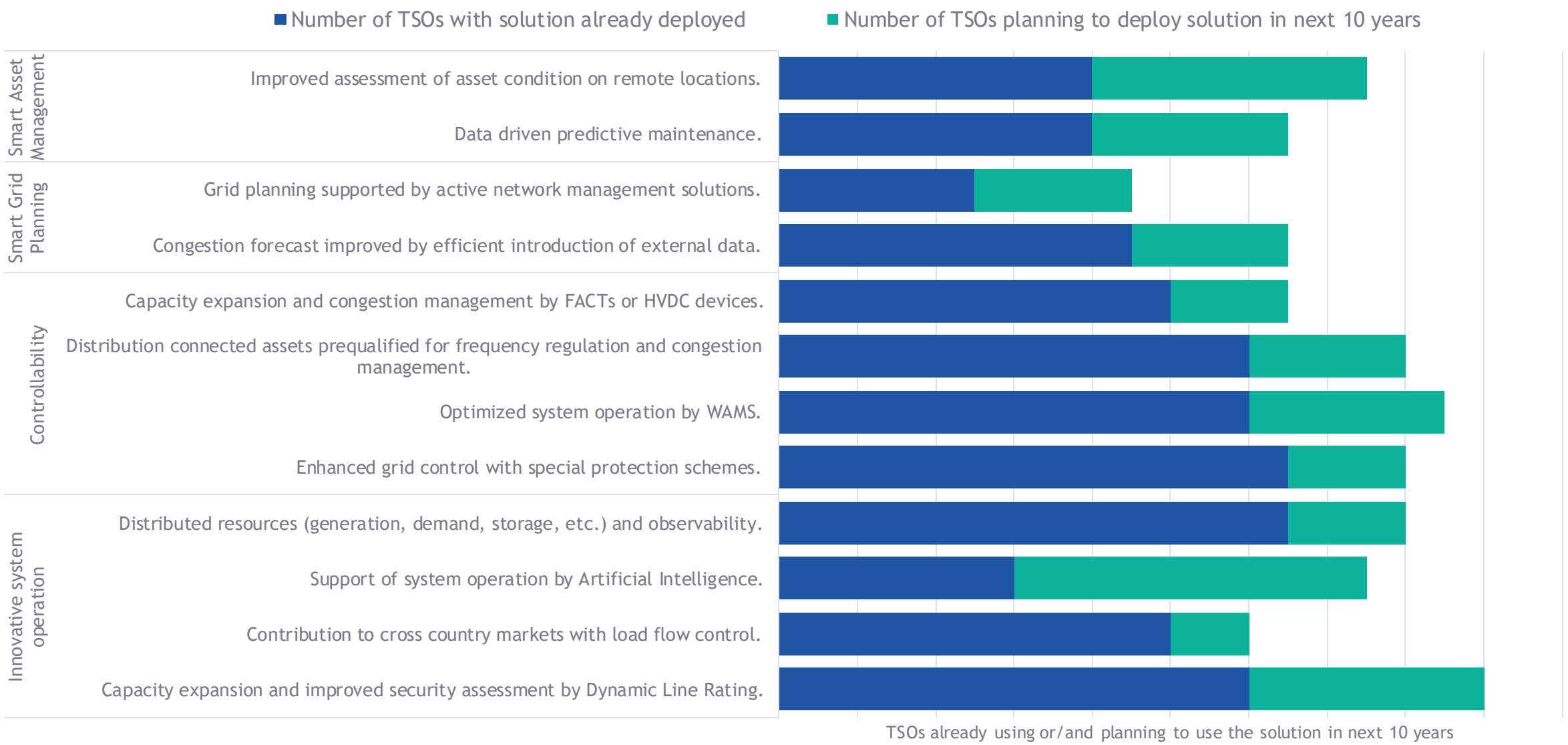
ENTSO-E: Technopedia

Tool to guide through innovative & state-of-the-art technologies related to the world of TSOs as reference for all the related stakeholders

Assets and smart solutions 34 Factsheets	Flexibility 23 Factsheets	Digital 8 Factsheets



Deployment of innovative solutions at transmission level



Thank you for your attention!

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https://www.entsoe.eu/Technopedia/

SPEAKER

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MARIO PATIÑO

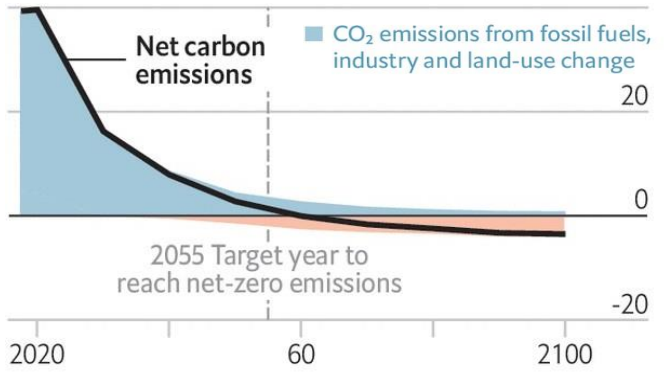
Smart Wires

POWER NETWORK OPTIMIZATION: EXAMPLES FROM US, UK AND COLOMBIA

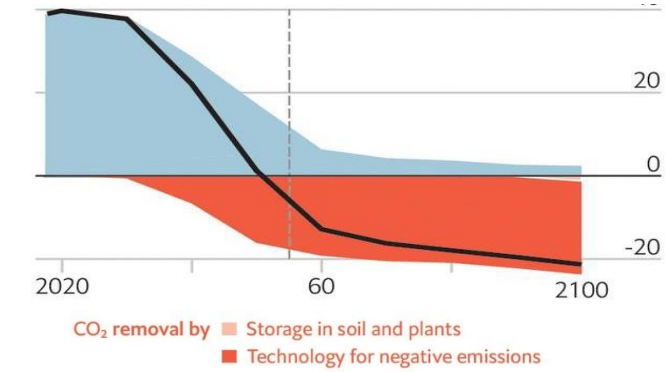
Global Trends and Challenges
Next Decade is Crucial

Decarbonisation Trajectories

Early Measures



Late Reduction



Energy Sector Trends

Renewables Development

Uncertain Load Profiles

GLASGOW COP26

1. **Next then years are crucial**
2. Need for solutions that support **CO2 reduction in the near term**.
3. Use of **complementary near-term Grid Enhancing Technologies** symbiotic to long term infrastructure development.

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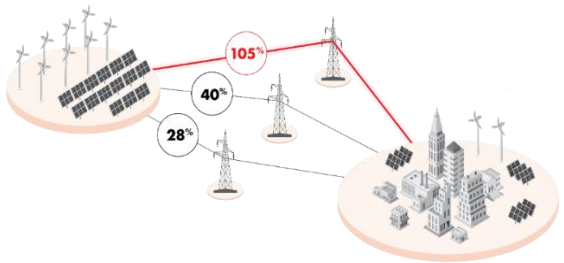
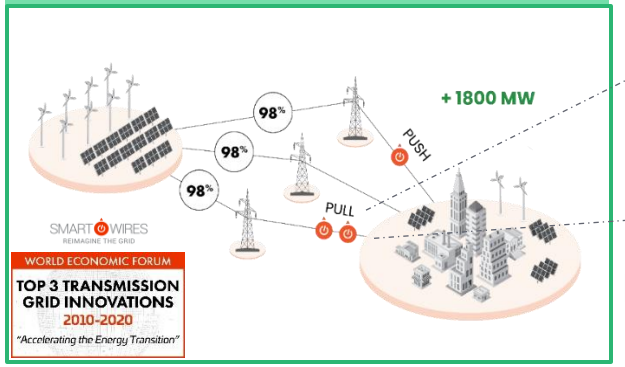
Grid Enhancing Technologies – **Modular Power Flow Control**

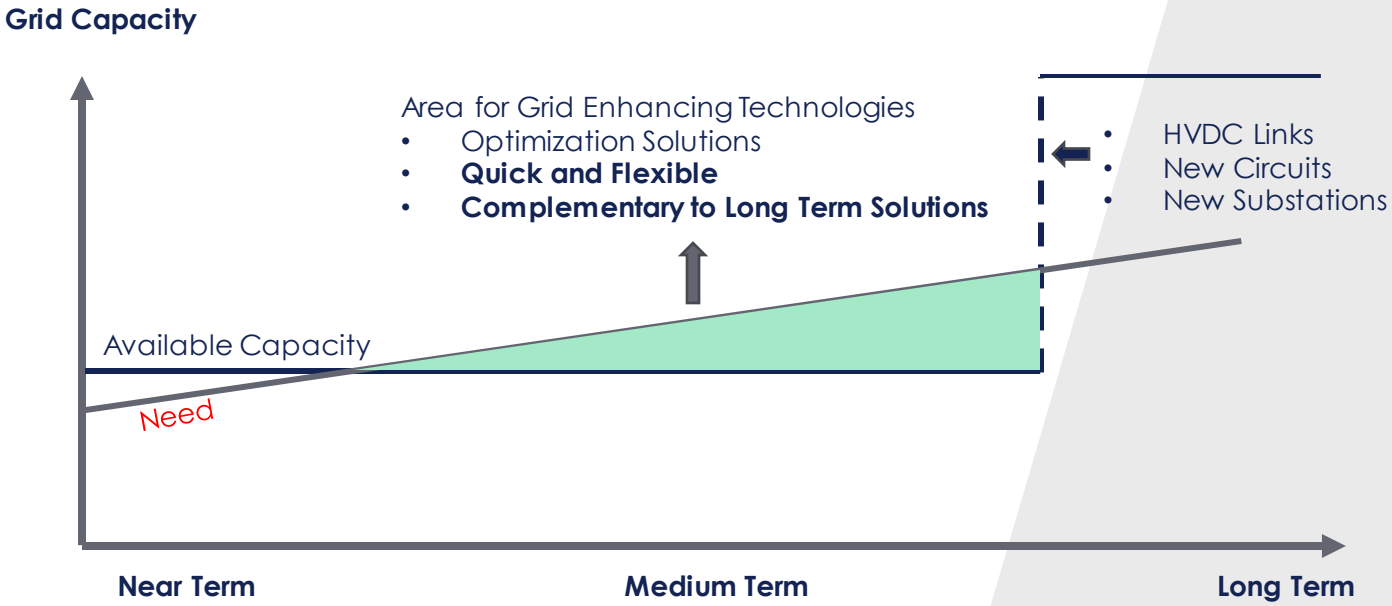
Grid Restrictions



Modular Power Flow Control



- **Risk mitigation for Uncertain Planning Scenarios**
- **Re-deployable Technology**
- **Full Control and Flexibility**
- **Quick delivery and installation**
- **Scalable Technology**
- **Interoperability**



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Success Stories

Advancing Energy goals with Energy Transition Leaders

Colombia: Renewable Integration in 8 months

+ 200 MW Interregional Capacity

4 years faster than the planned infrastructure project

Additional +1GW once the bank is partially reinstalled after a new line is energized

-300 $\frac{kt_{CO2}}{yr}$

UK: Capacity Release for new Interconnection in less than 1 year

+ 1.5 GW additional capacity

3-4 years faster than the next preferred alternative

$490 M savings for end customers

-1000 $\frac{kt_{CO2}}{yr}$

Australia: Congestion Management in Real Time

+ 270 MW additional capacity

Environmentally friendlier alternative avoiding a disruptive project crossing a protected national park.

$20 M in savings for end customers

-400 $\frac{kt_{CO2}}{yr}$

SPEAKER

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DINC MEMIS

Ampacimon

THE BENEFITS OF DYNAMIC LINE RATING ACROSS EUROPE

What is sensor-based DLR – Dynamic Line Rating?

Overhead power line **monitoring system**

Increases visibility of **asset condition**

Enables the **safe** use of **extra line capacity**

Key Parameters for a good quality DLR system are accuracy of assessing…

- **Risk** by monitoring conductor sag and temperature (ability to monitor infringement risk)
- **Capacity gain** through effective perpendicular **wind** speed, ambient temp, load current (to assess heating/cooling effect)
- **Forecast** values prerequisite for grid operator's processes

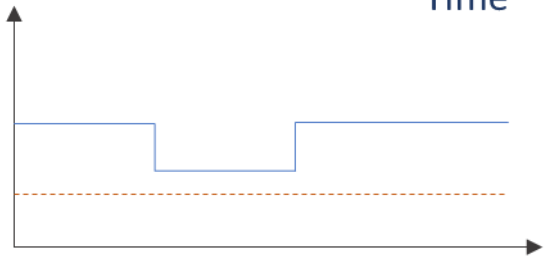
Ampacimon
Smart solutions for a dynamic grid

Type of Overhead Lines Capacity Rating

Considers worst case: least cooling

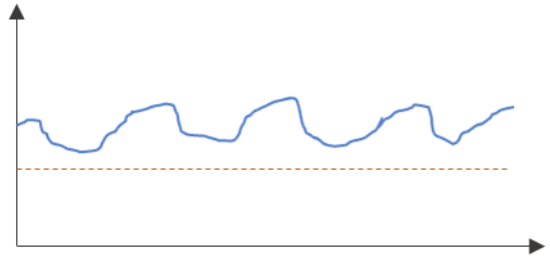
Static Line Rating (SLR)

Considers seasonal worst case



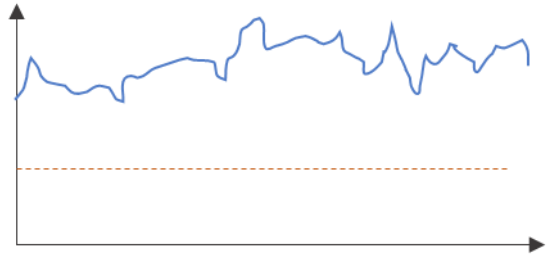
Seasonally Adjusted Rating (SAR)

Considers air temperature cooling



Ambient Adjusted Rating (AAR) → **Typically 5-10% more capacity than SLR**

+ Considers wind cooling



Dynamic Line Rating (DLR) → **Typically 40+% more capacity than SLR**

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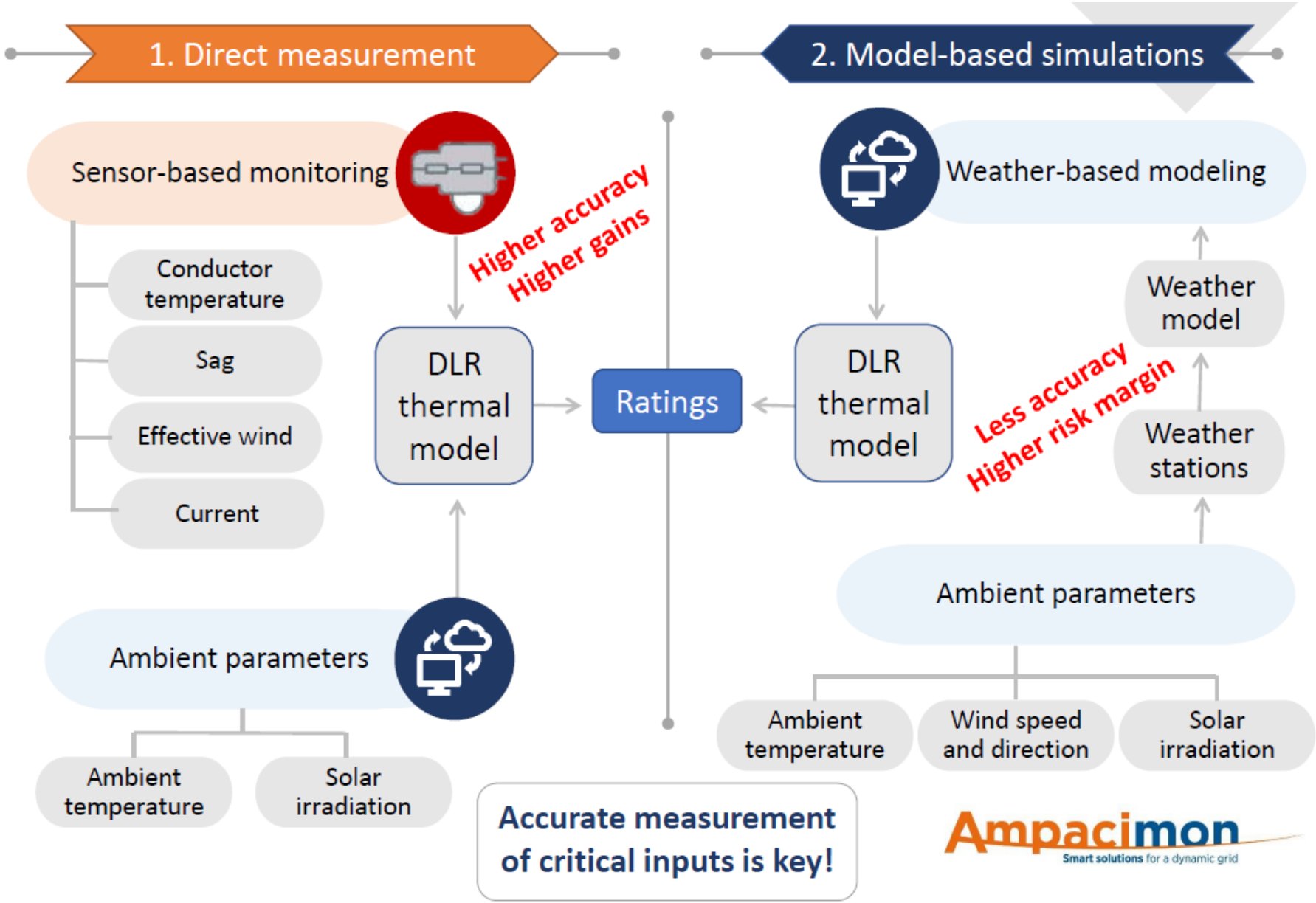
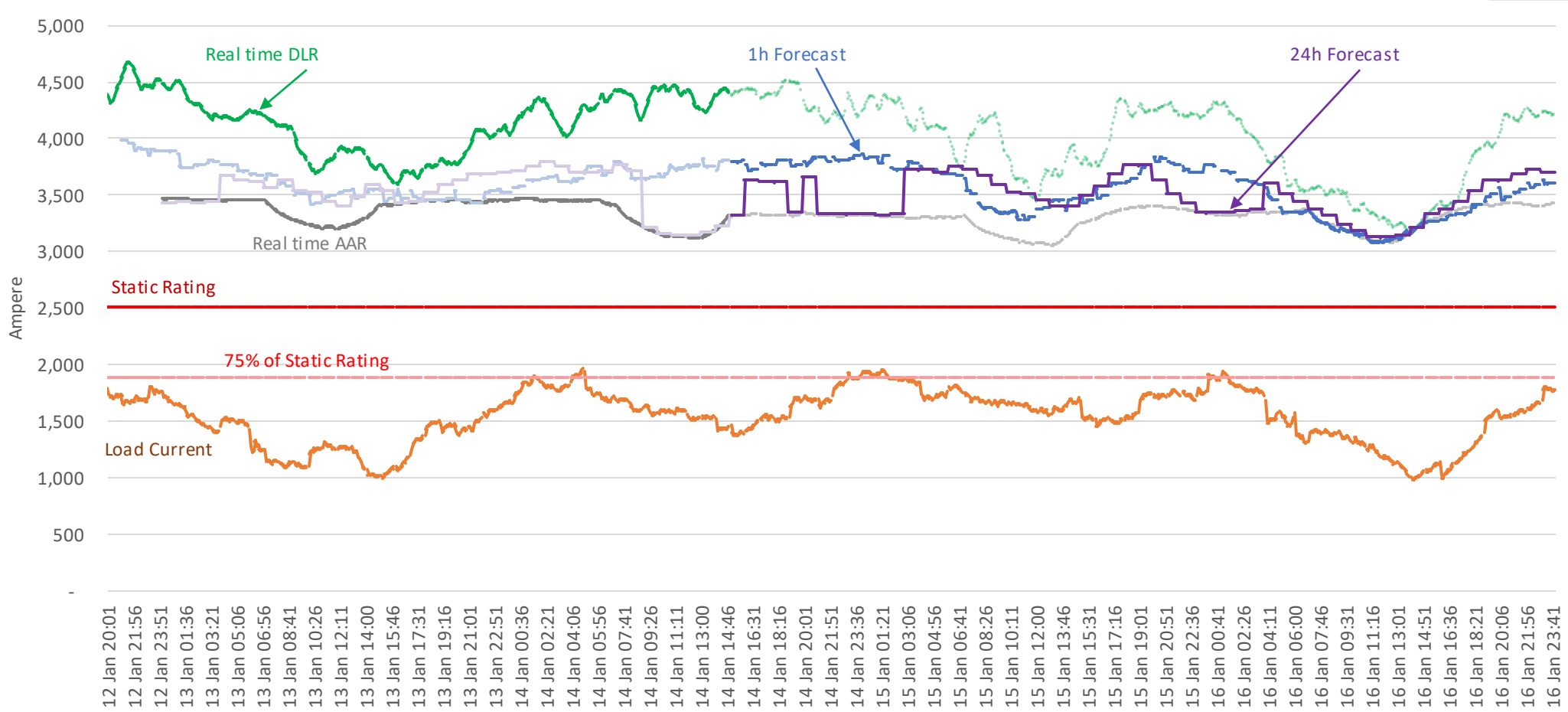
Smart solutions for a dynamic grid

Direct vs. Indirect DLR Measurement



Real-time Capacity Increase with DLR



Ampacimon
Smart solutions for a dynamic grid

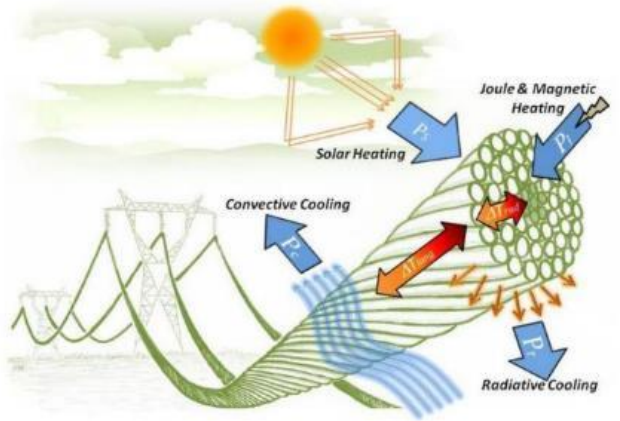
Wind most influential/least predictable capacity factor

U.S. Department of Energy | April 2014

Operating Conditions	Change in Conditions	Impact on Capacity
Ambient temperature	2 °C decrease	+ 2%
	10 °C decrease	+ 11%
Solar radiation	Cloud shadowing	+/- a few percent
	Total eclipse	+ 18%
Wind	3 ft./s increase, 45° angle	+ 35%
	3 ft./s increase, 90° angle	+ 44%

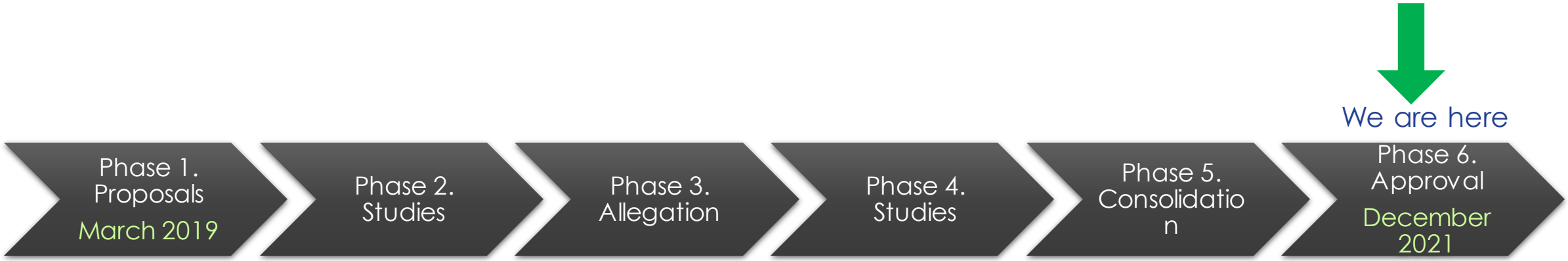
Source: Navigant Consulting, Inc. (Navigant) analysis; data from (7)

Table 1. Impacts of Changing Operating Conditions on Transmission Line Capacity



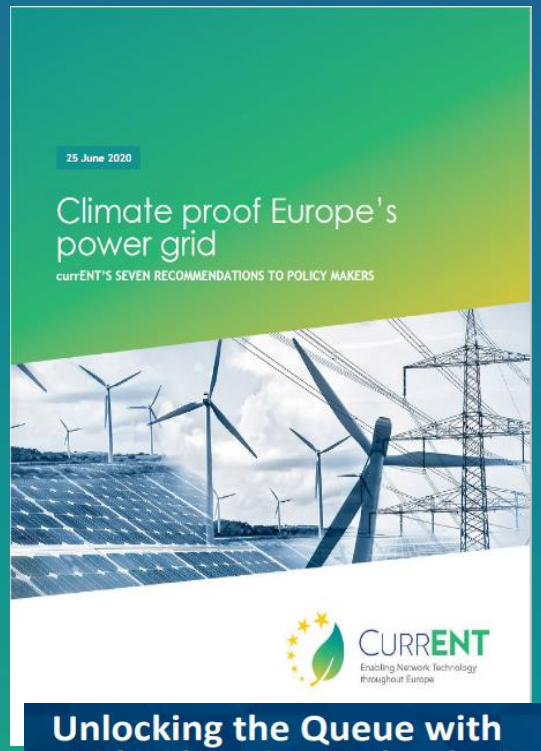
Ampacimon
Smart solutions for a dynamic grid

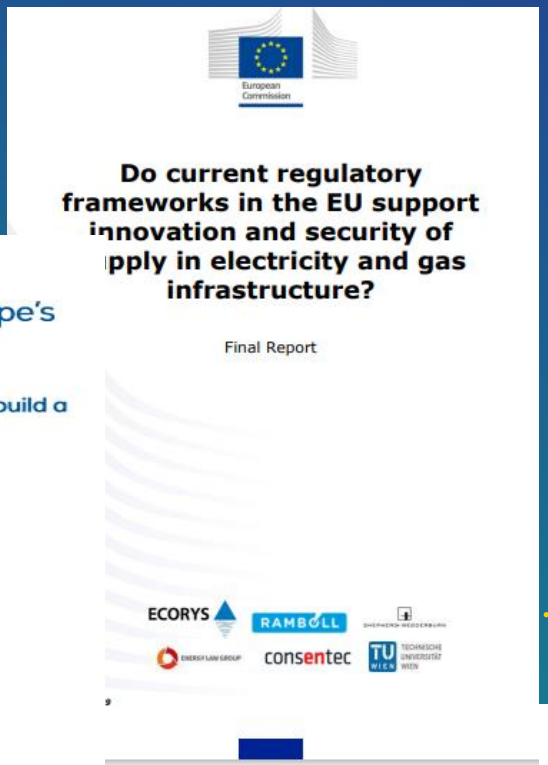
Draft Transmission Network Development Plan 2021-2026



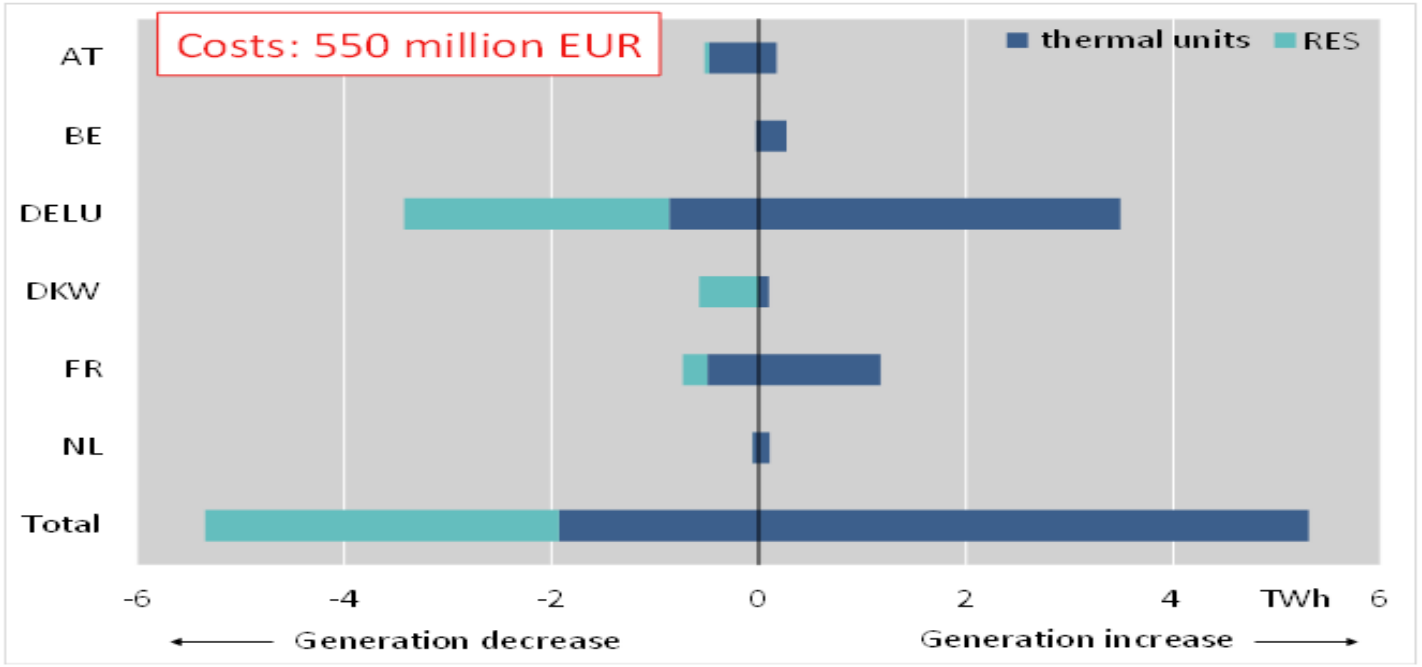
The proposed transmission grid will allow a 67% integration of renewables into the mainland electricity system.
The proposed links in the Balearic electricity system will allow 81% of its supply to be met from the mainland.
Regarding the Canary Islands' electricity systems, the proposed transmission grid will improve security of supply and reduce variable generation costs, which will fall by 30% compared to 2019 thanks to the greater integration of renewables.
In line with the principle of maximizing the use of the existing grid, 69% of the connection of new renewable generation will be made at existing or previously planned facilities, and only 31% will require new proposed actions.

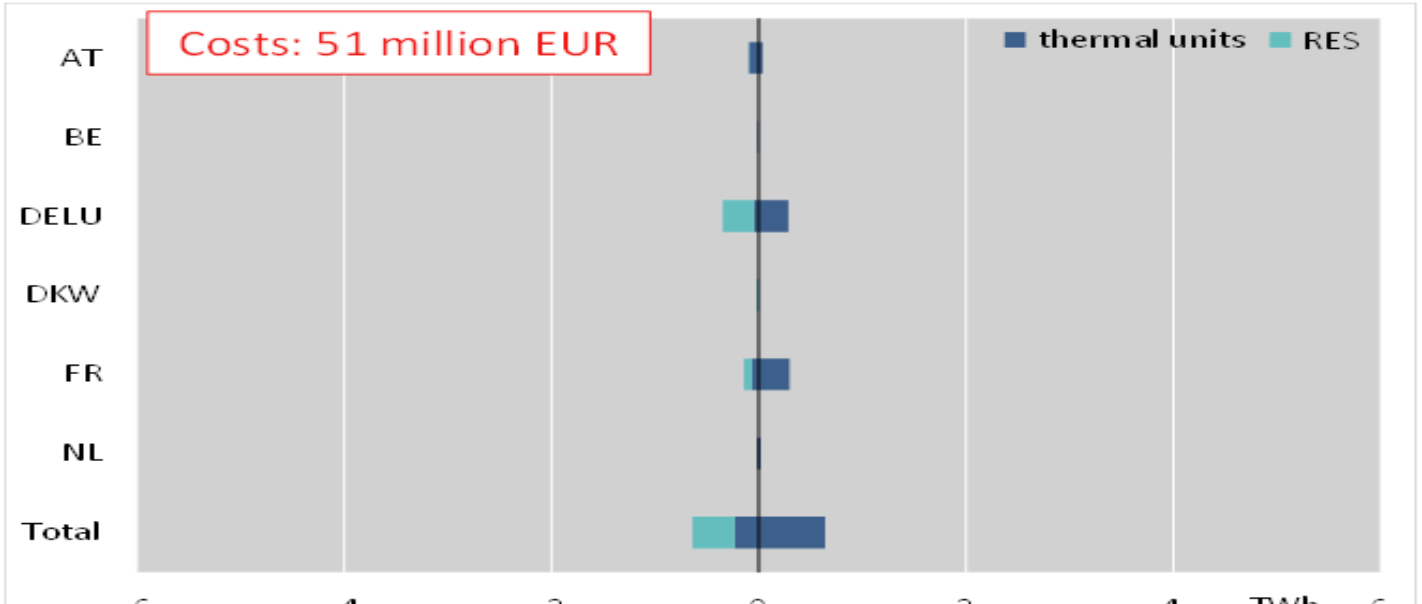
Use solutions on the shelf: reports about optimization of grid techs 2019-21



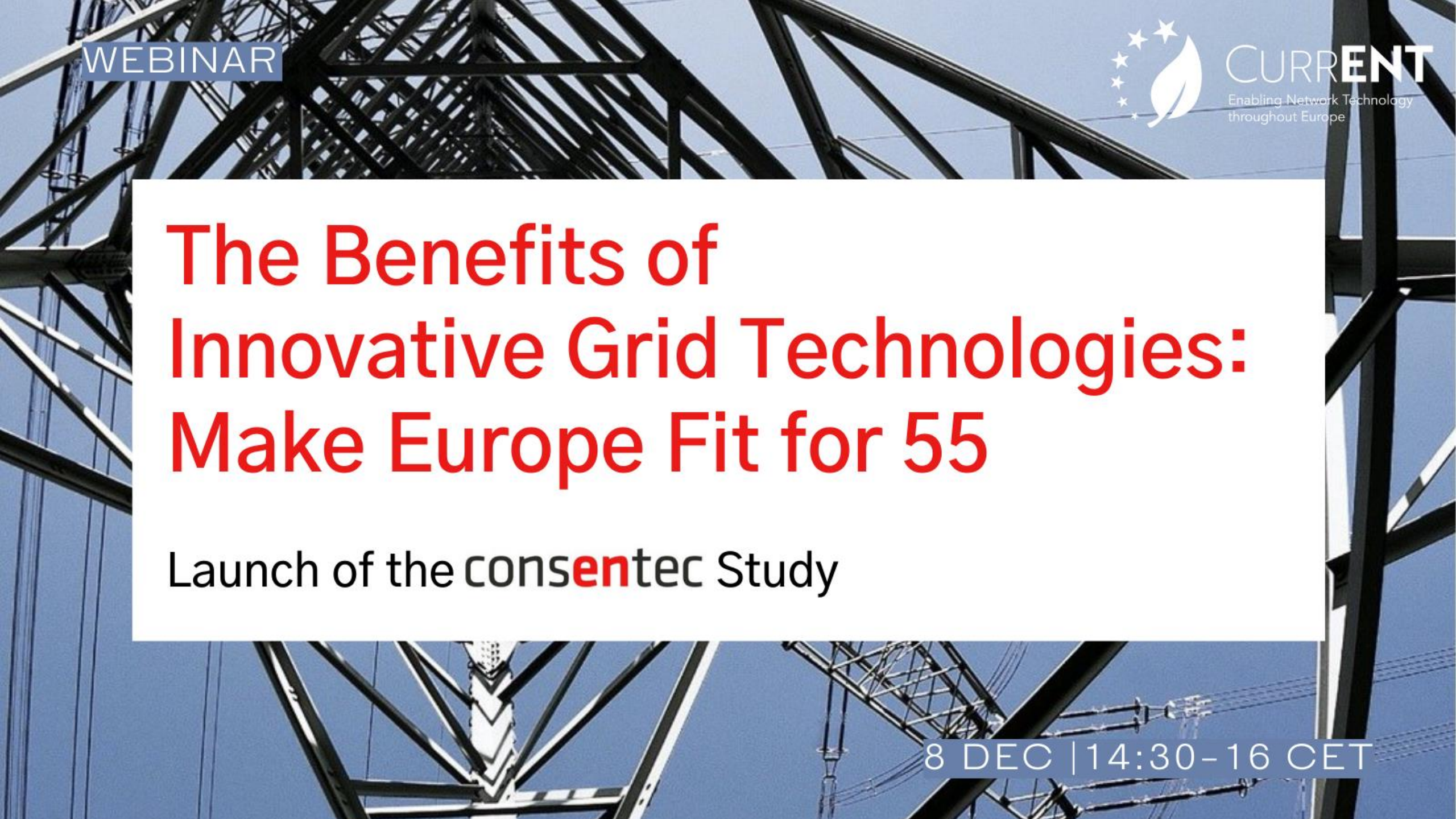


Consentec study: +90% decrease of congestion costs





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



WEBINAR

CURRENT
Enabling Network Technology throughout Europe

The Benefits of Innovative Grid Technologies: Make Europe Fit for 55

Launch of the consentec Study

8 DEC | 14:30 - 16 CET

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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The Role that Direct Current (DC) Grids Can Play

Optimised Power Grids for a Clean and Green Future

Massive Renewables Uptake through enhanced grids: A transatlantic perspective

Working Group for Optimising Power Grids: Aligning Incentive Regulation with Public Interest

Accelerating the Energy Transition: Moving towards a Coordinated Approach – TEN-E and European Grid Infrastructure