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# Welcoming Address

**Jukka Ruusunen**
CEO of Fingrid

**Riku Huttunen**
Director General, Ministry of Economic Affairs and Employment of Finland

**Hervé Laffaye**
ENTSO-E President

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# Welcoming Address

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# Welcoming Address

**Riku Huttunen**

Director General, Ministry of Economic Affairs and Employment of Finland

EU2019.FI

Finland's Presidency of the Council of the European Union

# Finnish Presidency priorities in the field of Energy

13 November 2019

Riku HUTTUNEN, Director General

# PRESIDENCY PRIORITIES IN THE FIELD OF ENERGY

- **Long-term strategy** (LTS) aimed at making the EU climate neutral by 2050
- **Breaking the silos**: Discussions related to EU LTS are taking place in various Council formations (energy, environment, transport, competitiveness, etc.)
- Targets are necessary, but **tools and measures** are at least as important
- Implementation of **the Energy Union**: Legislation and Governance
- **Innovative technologies** promoting climate neutrality

# KEY ISSUES IN THE LONGER RUN

- **Cutting greenhouse gas emissions** is the primary target
- Measures must be **cost-effective** and **technology-neutral**
- **Energy policies and targets must be developed** so that they reflect the transition underway
  - Electrification
  - Smart sector integration
  - Energy conversions
  - Etc.

# EUROPEAN TSOs' ROLE IN THE TRANSITION

- Developing **electricity markets**
  - Together with other actors, e.g. DSOs
  - Electrification taking place
  - Smart grids, digitalisation
  - Cooperation between different regions

- Promoting **EU energy and climate targets**
  - Reduction of greenhouse gas emissions
  - Energy efficiency, renewable energy

- Facilitating **smart sector integration**
  - Power, gas, industries, transport, …
  - Electricity plays a key role

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# Welcoming Address

**Hervé Laffaye**

ENTSO-E President

# Who we are

- 43 TSOs in 36 countries
- 500 million citizens served
- 480 000 kilometers of power lines
- 467 000 GWh of electricity exchanges in 2018

# What TSOs deliver thanks to ENTSO-E

Ensuring real time system security through:

- Regional & global cooperation
- Long term grid planning
- Security of supply analysis
- Technical/market rules
- European platforms
- Standardisation & research


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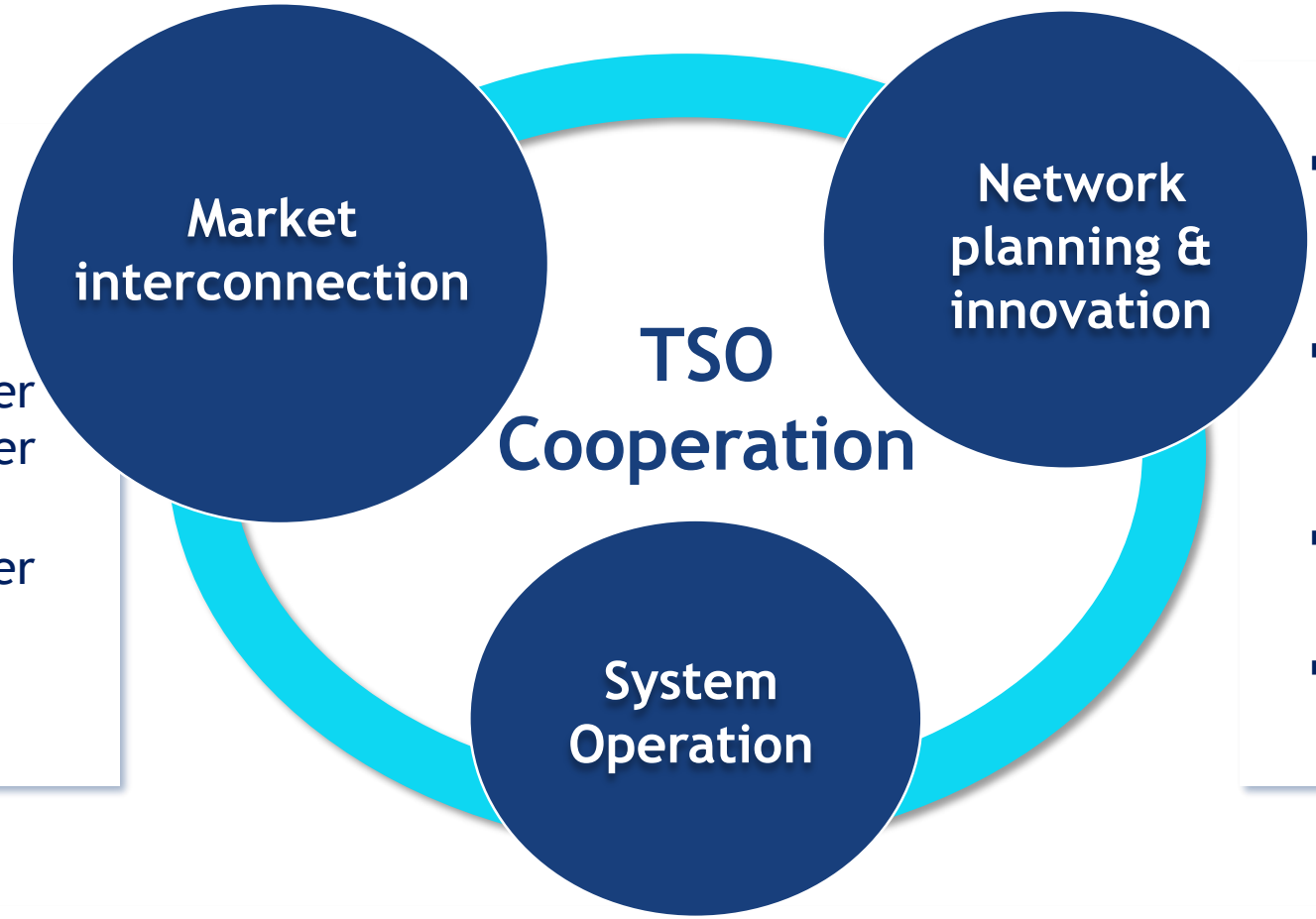
# What TSOs do for the pan-European energy system

- TSOs help interconnecting the markets
- TSOs' initiatives foster increased cross-border trade
- TSOs' initiatives foster price convergence




- TSO coordinated planning generates welfare gains
- TSOs actively engage in innovation/new technologies
- TSOs couple distant markets
- TSOs share know-how to foster acceptance

- TSOs anticipate need for cooperation
- TSOs efficiently respond to new challenges
- TSO Regional Cooperation is a success story
- TSOs ensure a high level of security despite the on-going transitions

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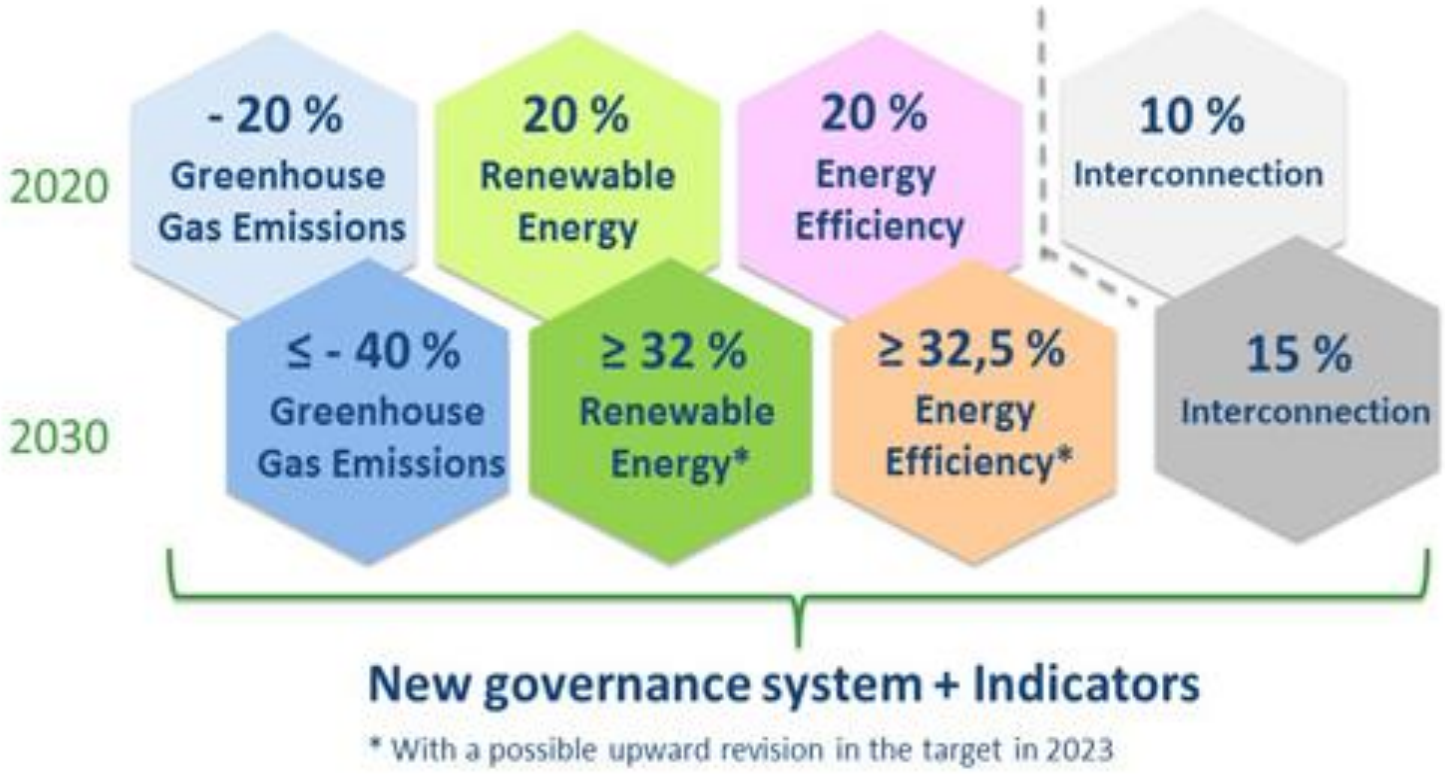
# 2020, 2030 & beyond





Source: www.climat.be

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# Session 1: Looking back for looking forward

Why looking back for looking forward

**Joachim Vanzetta**

ENTSO-E Chair of the Board

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# Session 1: Looking back for looking forward

What have we achieved in the last decade?

**Pascale Fonck**

ENTSO-E Vice-Chair of the Board

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# 10 years of achievements for European customers

| | |
|---|---|
| **8 network codes** and guidelines + related methodologies & pilot projects | **Pan-European IT**<br>▪ Transparency Platform<br>▪ ENTSO-E Awareness System<br>▪ Common Grid Model |
| **5 research**, development & innovation roadmaps | **5 regional** security coordinators |
| **5** ten-year network development plans | **8 security** of supply assessments + **20** summer & winter **outlooks** |

| | |
|---|---|
| **Competitiveness** | Doubling of cross border electricity exchanges in last 20 years |
| **Security of supply** | Successful coordination of solar eclipse in 2015, cold spell 2017 |
| **Sustainability** | 30% share of renewables in the electricity mix |

# TSOs' regional coordination in markets

## Voluntary cooperation

1990s – NORD POOL

2006

2011

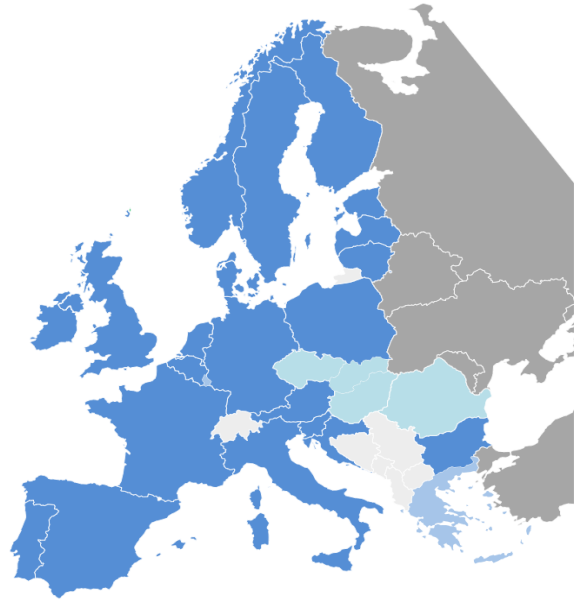
FEBRUARY 2014

MAY 2014

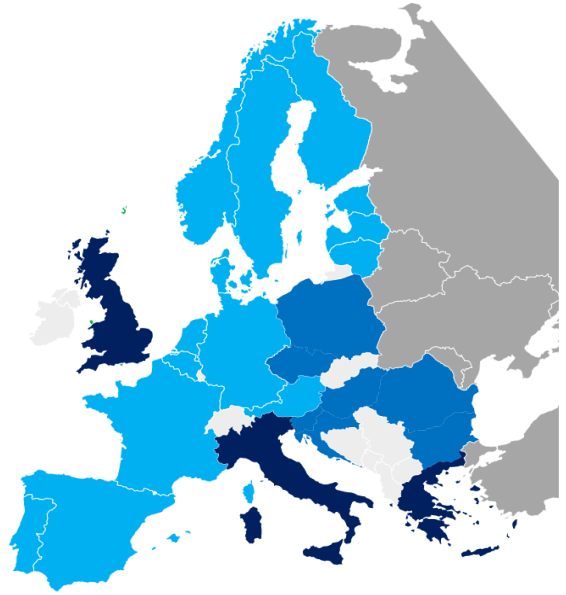
FEBRUARY 2015

Multi Regional Coupling

Single Day Ahead Coupling



Single Intraday Coupling



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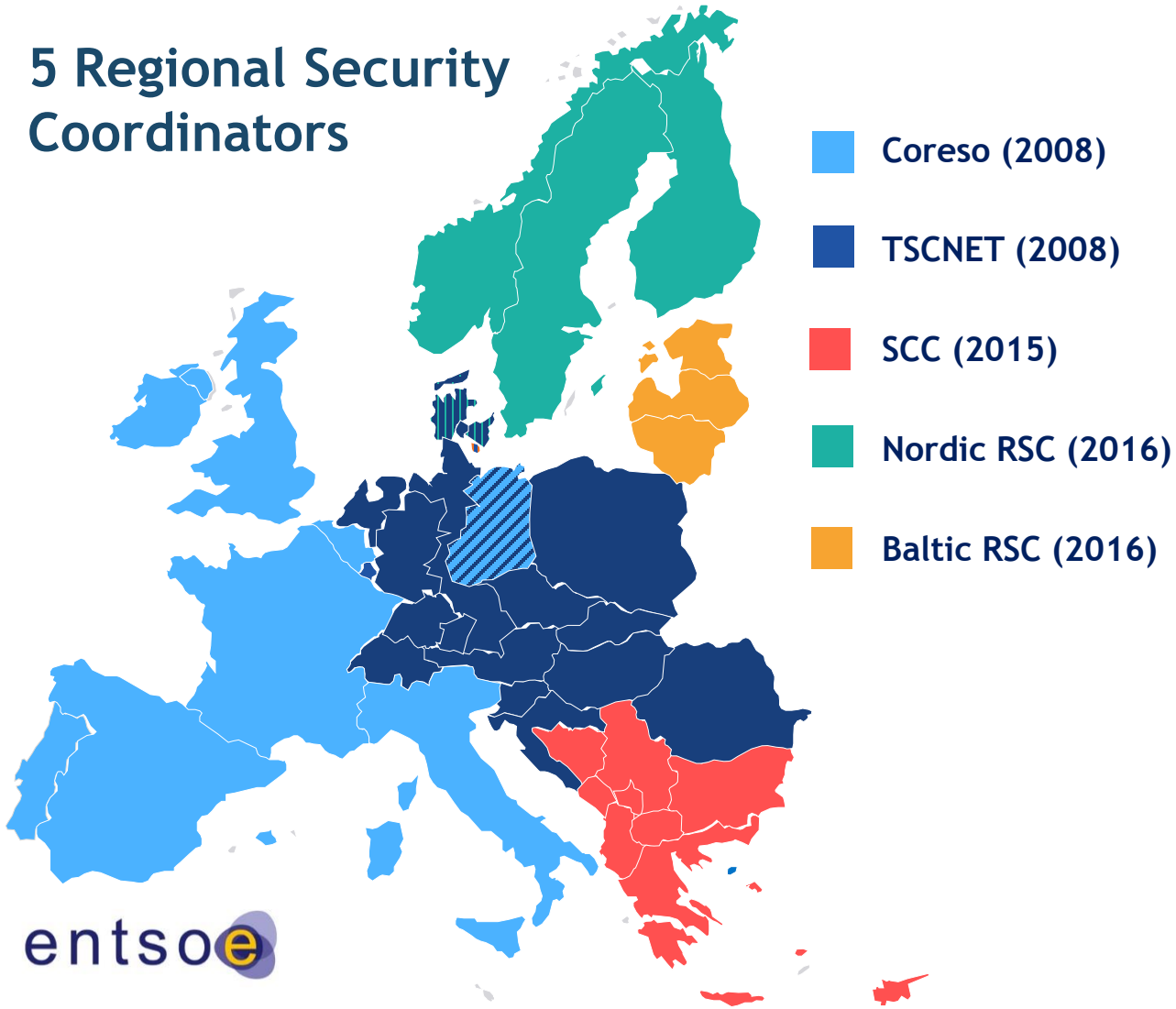
# TSOs' regional coordination in operations

## 5 Regional Security Coordinators




## 5 coordinated services

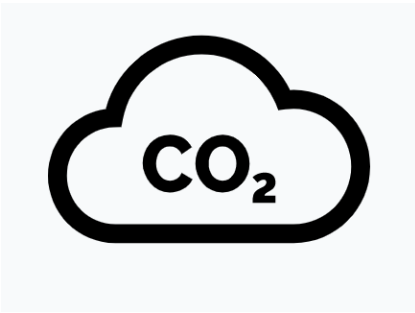
- Security analysis
- Capacity Calculation
- Common Grid Model
- Outage planning
- Adequacy forecast

# TSOs cooperate in grid planning for the benefit of society

## Cost of No Grid

Increase cost for Europeans by more than 40 billion euros per year as of 2040

Reduce security of supply




Waste more than 150 TWh of electricity produced from renewables each year

*Source: ENTSO-E Power System 2040*

# Evolution in mandated tasks

**2009**

- **Third Package:**
- ✓ Network codes
- ✓ TYNDP
- ✓ Generation adequacy
- ✓ RDI roadmaps

**2015**

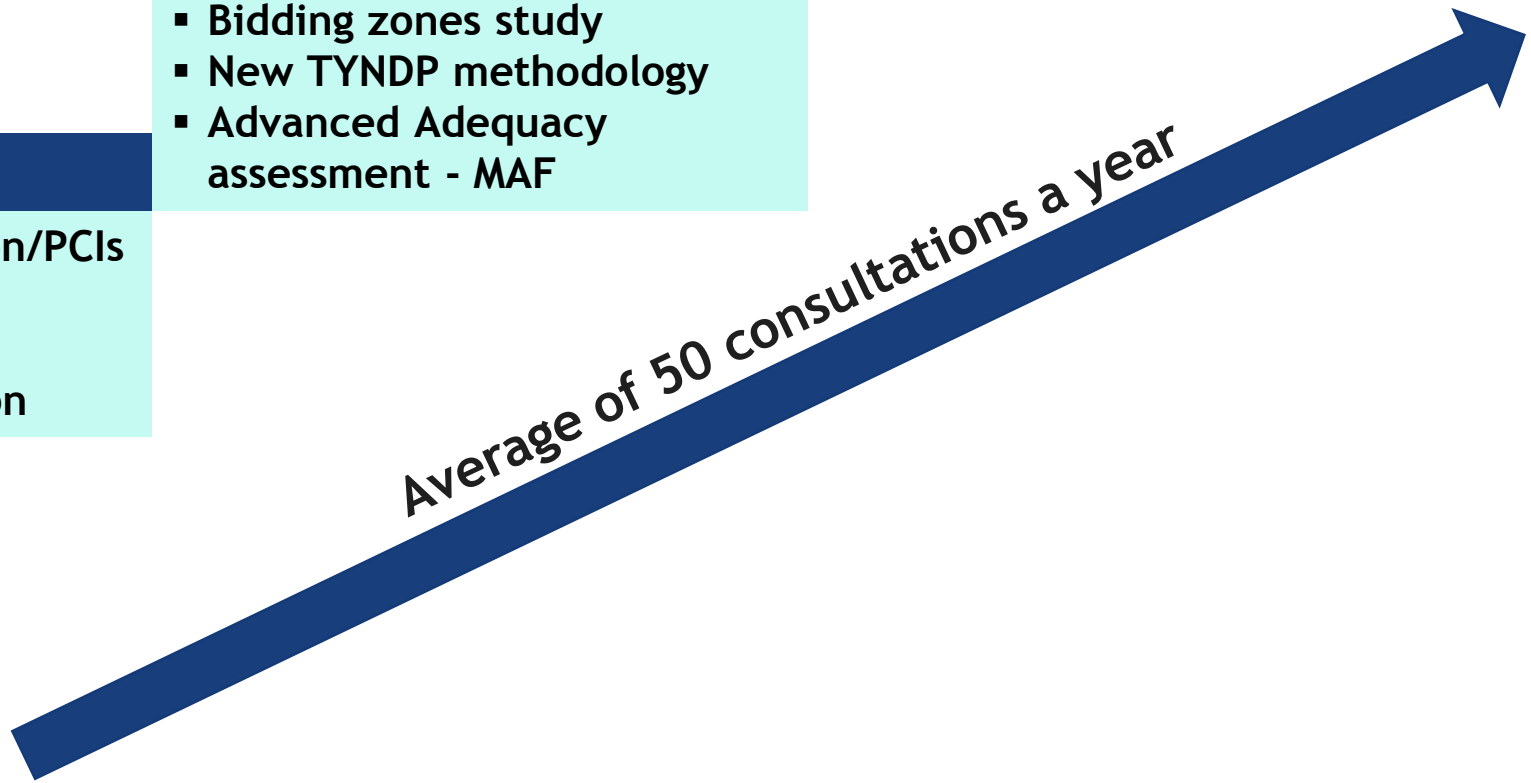
- **TEN-E Regulation/PCIs**
- **Transparency Regulation**
- **REMIT Regulation**

**2018**

- **Common Grid Model**
- **Bidding zones study**
- **New TYNDP methodology**
- **Advanced Adequacy assessment - MAF**

**2020**

- **Clean Energy Package:**
- ✓ Electricity Regulation & Risk preparedness
- ✓ Regional coordination centres
- ✓ Pan-European resource adequacy assessment
- ✓ New Network Codes

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# Session 1: Looking back for looking forward

Where do we want to land in 2030 and how do we get there?

**Joachim Vanzetta**

ENTSO-E Chair of the Board

# Where do we want to land in 2030?

**2030+**

- **2030 Vision: a ‘system of systems’**
- **Seamless integration of markets and operations**

2025+

- Sector coupling & sectorial integration
- Digital tools & platforms
- Research & Innovation
- Enhanced regional coordination

2020+

- Network Codes and Guidelines implementation
- Clean Energy Package
- TSO-DSO cooperation

# Bridging the gap from 2030 to 2050 and beyond

**Clean Energy Package: 2030 Targets & new ENTSO-E mandates**

- 32,5% improvement in energy efficiency
- 32% of energy from renewables
- 40% reduction of GHG emissions

**2050 EU Long-term strategy & climate neutrality**

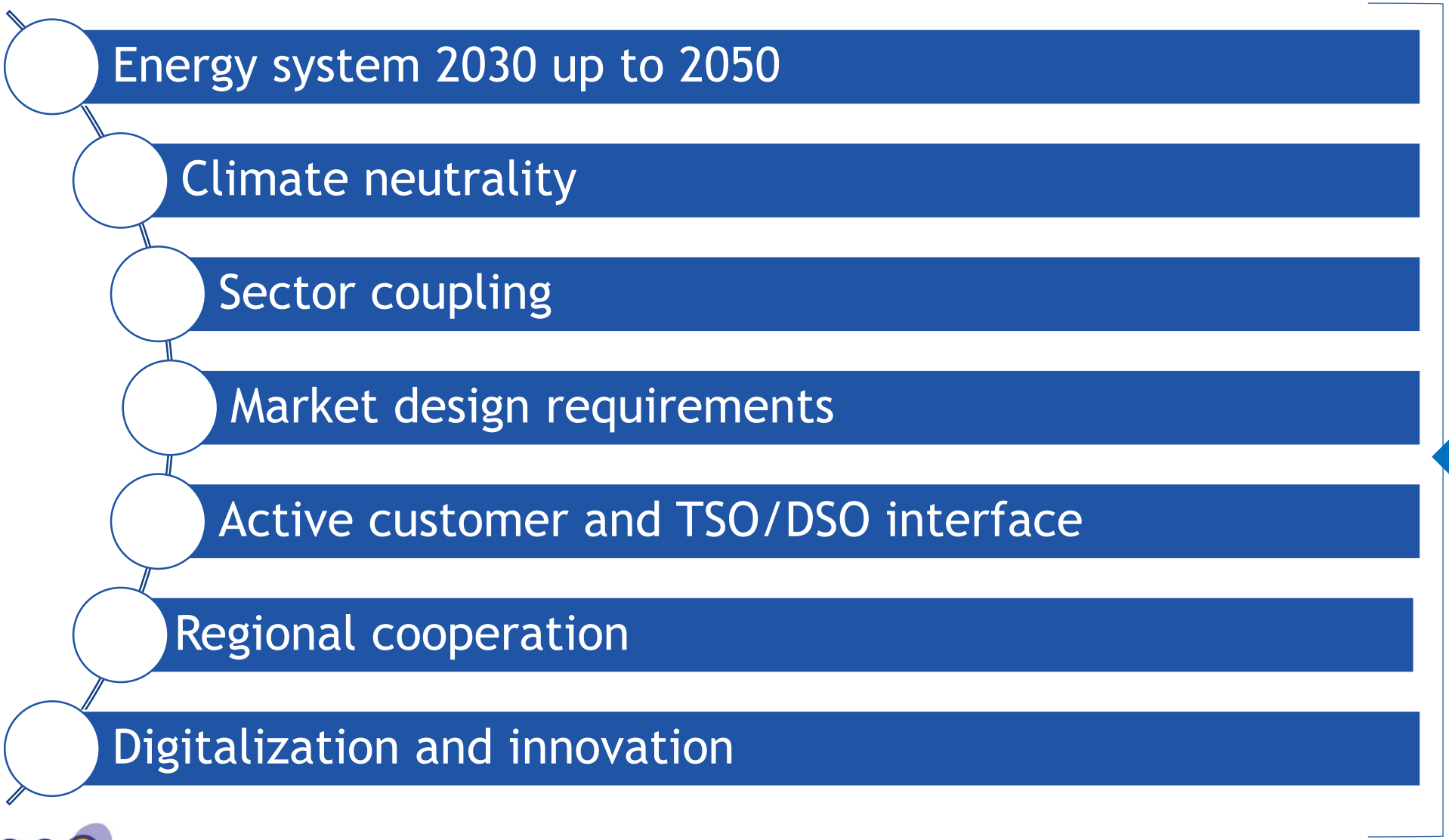
- Full decarbonisation of the energy system
- Reduction of emissions from other sectors

**2030** — **2050**

- **CEP implementation:** risk preparedness, pan-European resource adequacy assessment, Regional Coordination Centres, market design requirements
- **IT tools & platforms**

- **ENTSO-E Vision 2030**: a 'system of systems'
- **Ten-Year Network Developments Plans**, compliant with COP and NECPs
- **Long-term scenarios for 2030 and 2040** in cooperation with ENTSOG & system needs reports

# How do we get there?

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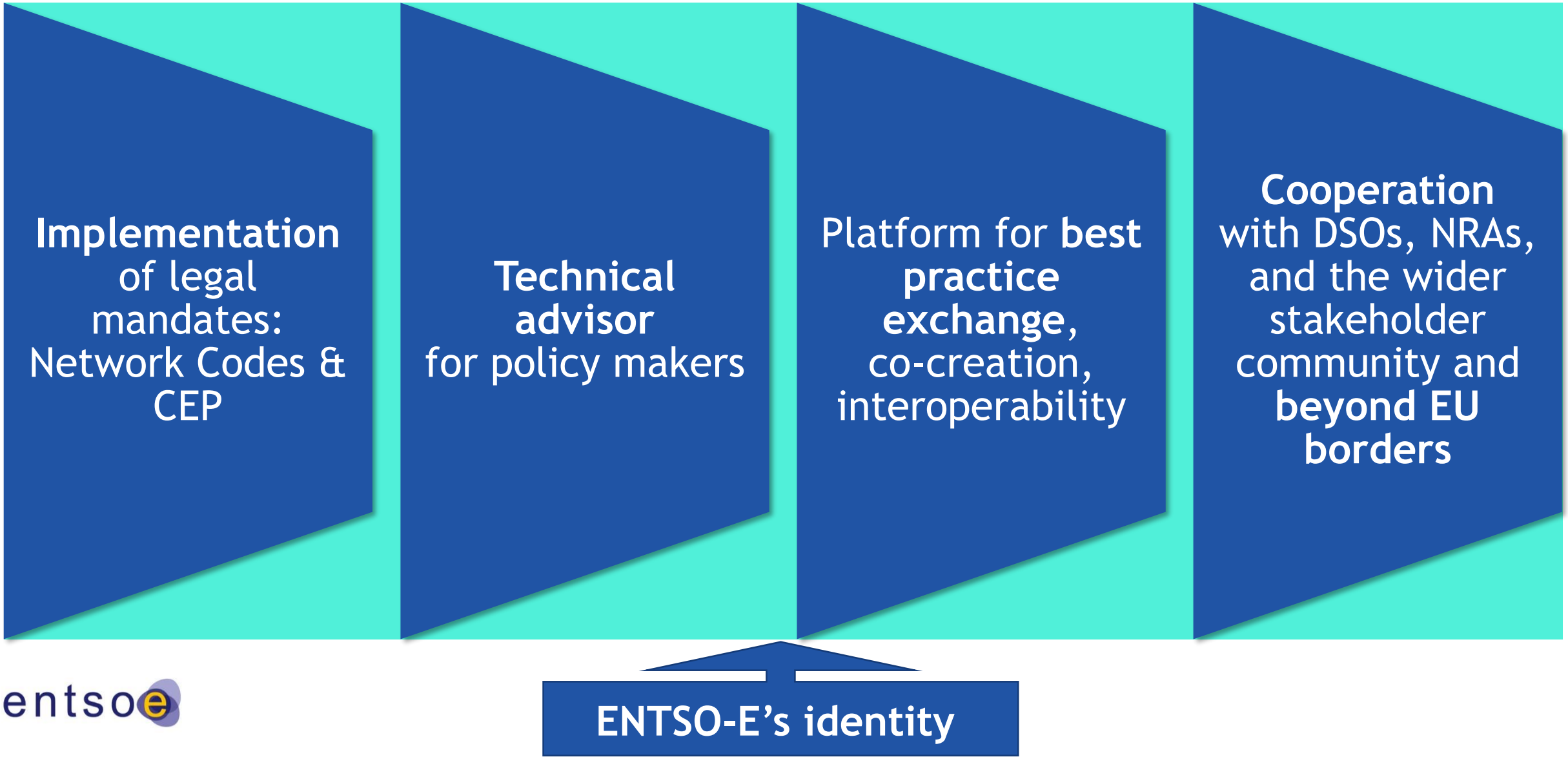
# How do we get there?

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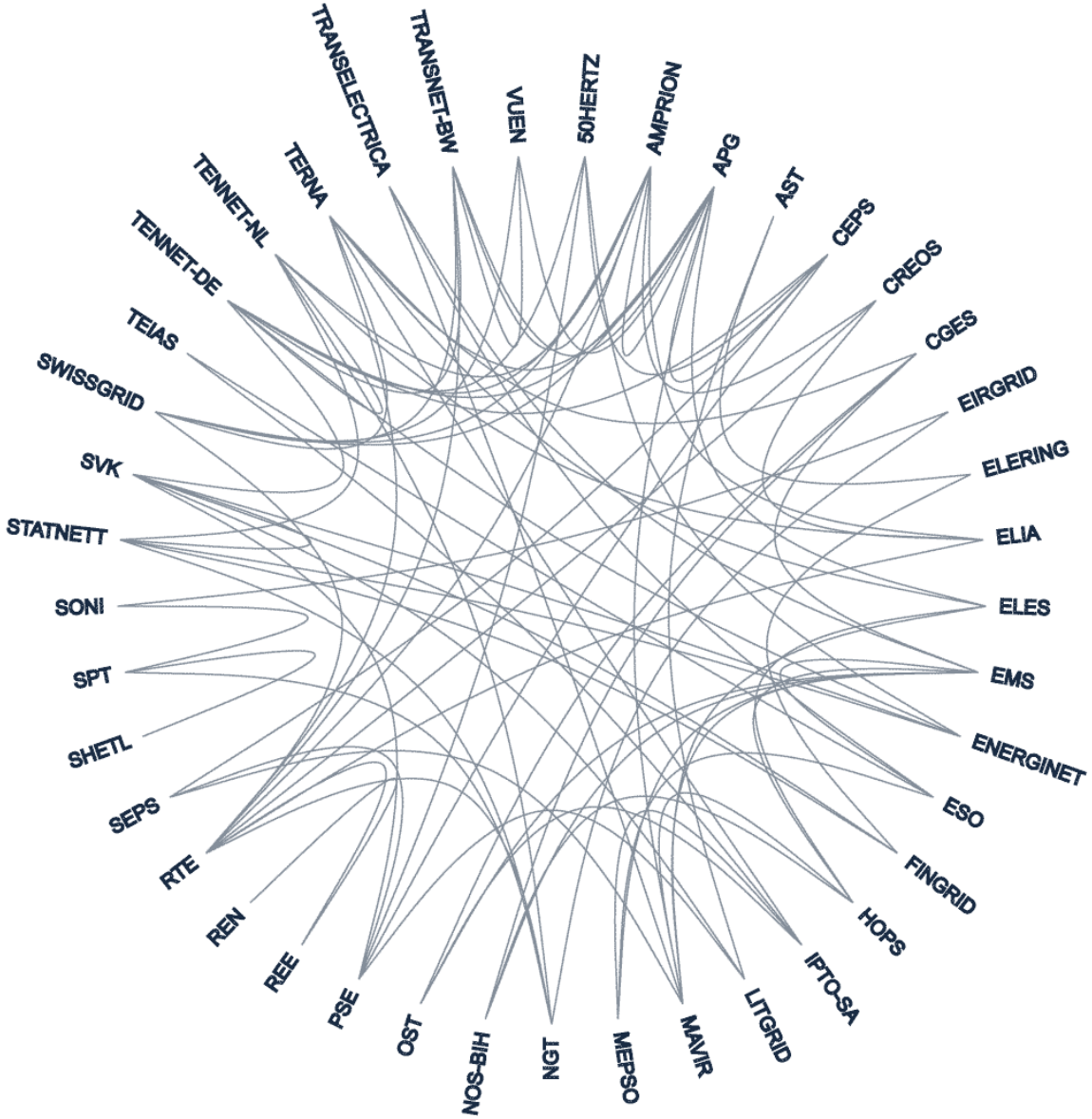
# Looking forward to a new decade of successful cooperation

Acting locally,
Coordinating regionally,
Thinking European.

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# E-voting on achievements last 10 years and expectations for the next decade

Scan the QR code on your phone to access the survey

https://www.surveymonkey.com/r/10yearconf

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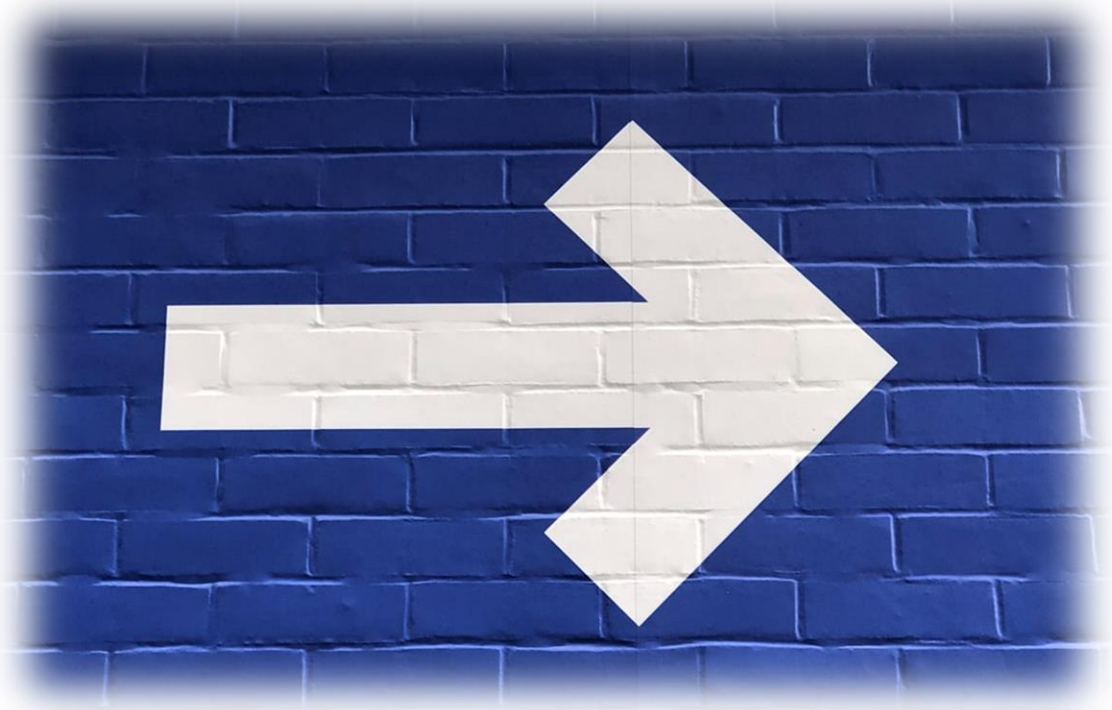
# E-voting on achievements last 10 years and expectations for the next decade



## Results

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# Coffee break

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# Session 2: ENTSO-E seen from outside: achievements & expectations

## An institutional perspective

**Claude Turmes**
Minister for Energy of the Government of Luxembourg

**Zbyněk Boldiš**
ENTSO-E Vice-President

**Atte Harjanne**
Member of the Finnish Parliament

**Christine Materazzi Wagner**
Acting Chair of ACER and CEER Electricity Working Groups

**Janez Kopač**
Director, Energy Community

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# Video by Claude Turmes

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# Session 2: ENTSO-E seen from outside: achievements & expectations

An institutional perspective

**Zbyněk Boldiš**

ENTSO-E Vice-President


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# Session 2: ENTSO-E seen from outside: achievements & expectations

An institutional perspective

**Atte Harjanne**

Member of the Finnish Parliament

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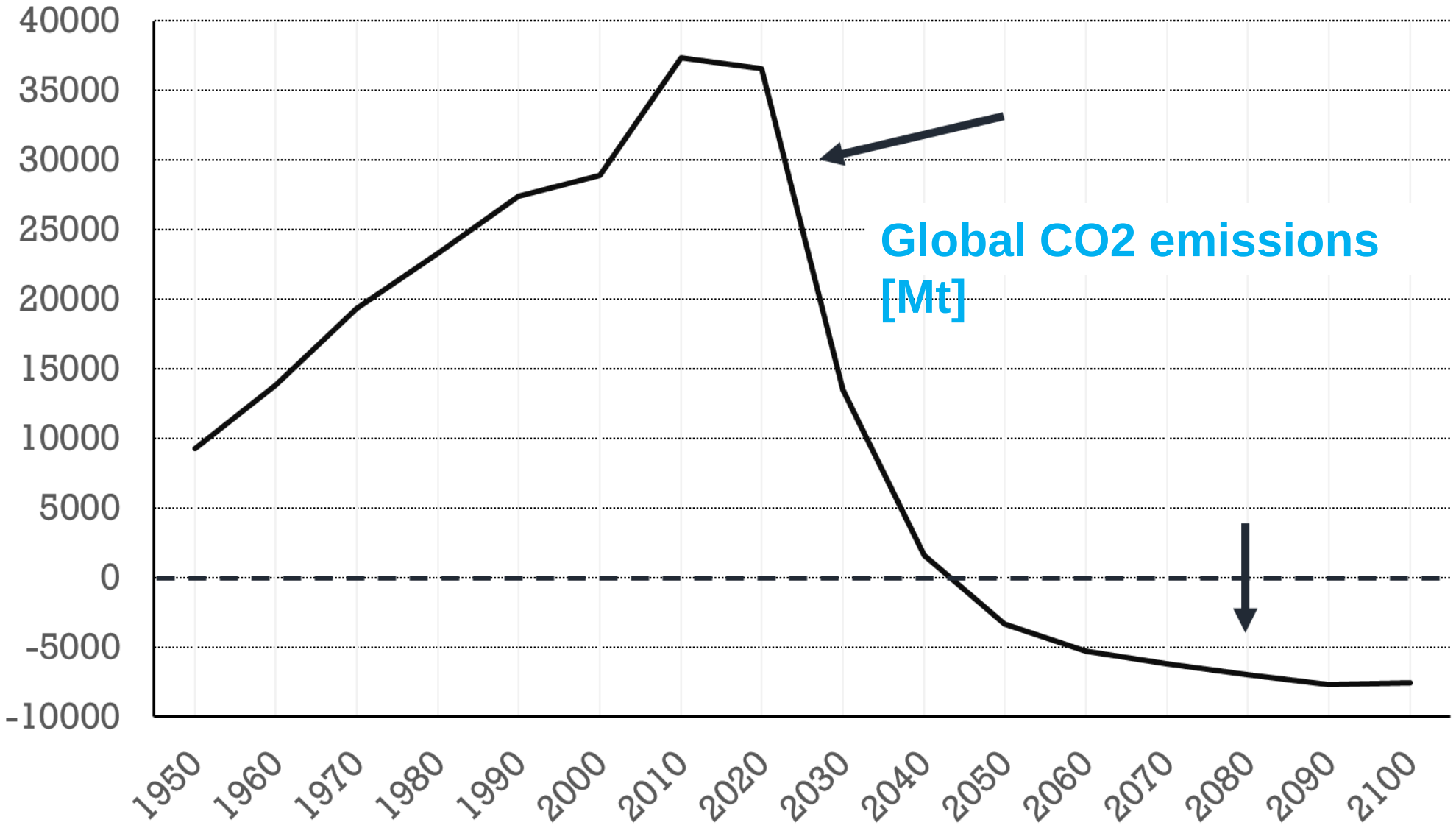



*Source: IIASA IAMC 1.5°C Scenario Explorer, IIASA RCP Database v. 2.0.5. Figure combines selected scenario and historical data and is supposed to illustrate the shape of the curve, not a detailed pathwasy*

**Our main problems are:**

- Emissions
- Loss of biodiversity
- (Energy) poverty

**They are not:**

- Lack of renewability
- Lack of smartness
- Lack of flexibility
- Lack of customer focus
- Etc.

**→ Let's not mix means and ends**

starting points

3rd package

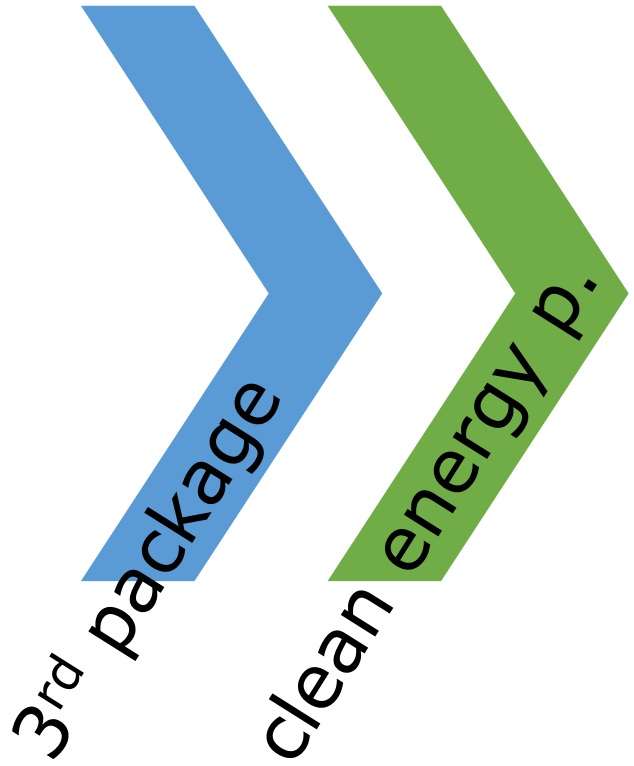
clean energy p.

common target

-10 years

today

+10 years




**ELECTRICITY** is crucial

**NETWORKS** are the backbone

**INSTRUMENTS** to shape the future

deliver **HIGH QUALITY, TIMELY**

ACER
Agency for the Cooperation of Energy Regulators

CEER
Council of European Energy Regulators

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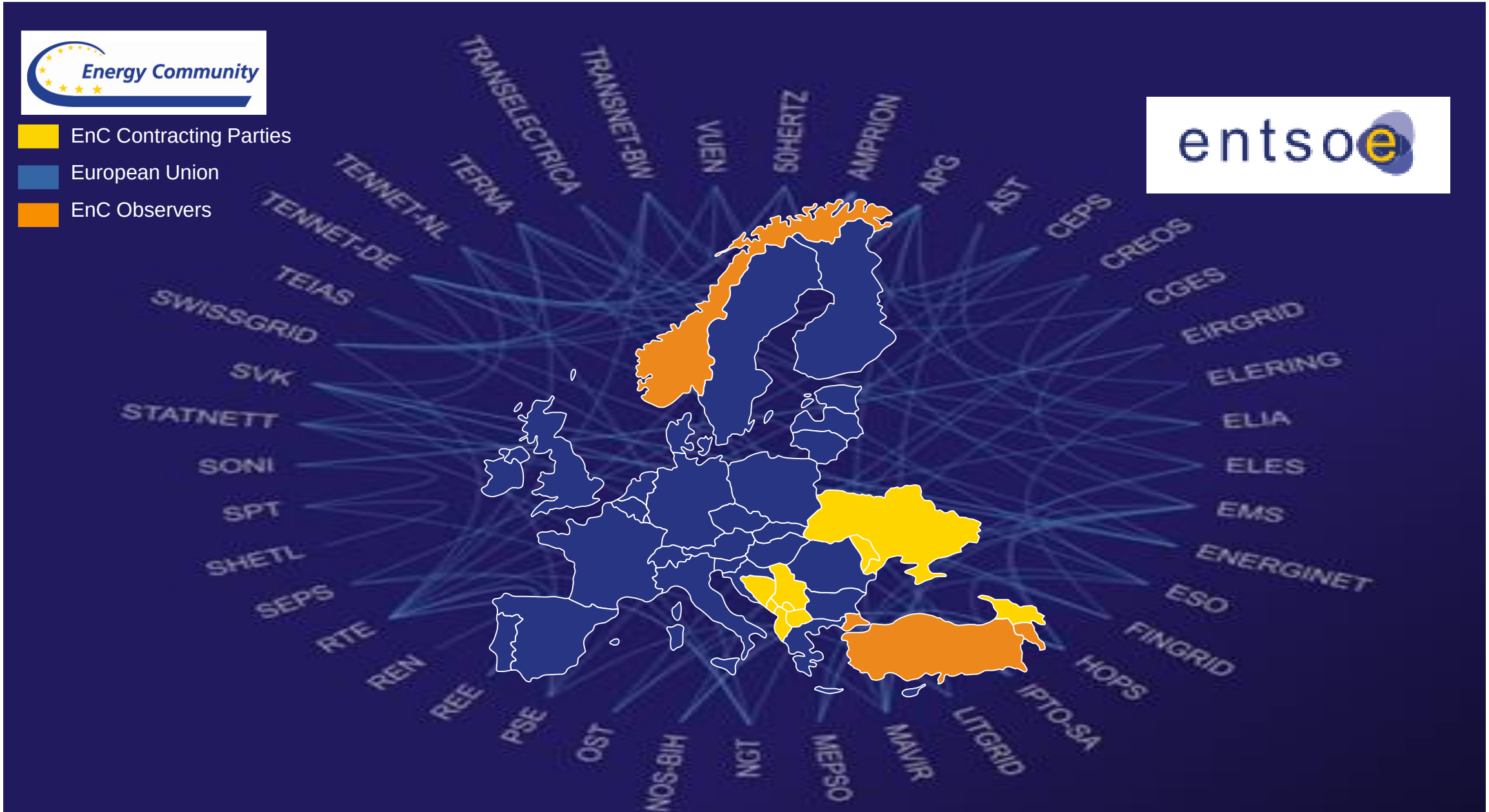
# ENTSO-E SEEN FROM OUTSIDE
# ACHIEVEMENTS AND EXPECTATIONS
# The Energy Community View

Janez Kopač, Director, Energy Community Secretariat

ENTSO-E 10 Years Conference, 13th November 2019

# The Energy Community and ENTSO-E – integrating electricity sector in *acquis* area



# ENTSO-E and Energy Community - Looking back

## ENTSO-E expanded:

- *Albania became a member of ENTSO-E on 30 March 2017 ⇒ 5 Western Balkan TSOs members of ENTSO-E*
- *ENTSO-E – KOSTT Connection agreement signed in 2015 (still to be implemented)*
- *Agreements on conditions for integration of power systems of Ukraine and Moldova with ENTSO-E were signed in 2017 (ongoing)*

## ECS and ENTSO-E cooperation on infrastructure planning and development:

- *Regulation 347/2013 TEN-E adopted for the EnC; ECS and ENTSO-E Secretariat aligned activities on PECI/PMI and ENTSO-E TYNDP*
- *TYNDP and RgIP – 5 EnC TSOs fully involved, Ukraine and Moldova still to be fully included*

## Network Codes and Guidelines in EnC:

- *Connection Codes adopted for the EnC; transposition and implementation by TSOs started with support of ENTSO-E*

## System operation:

- *Synchronous Area Framework Agreement (SAFA) for TSOs of Continental Europe entered into force in April 2019, signed also by 5 EnC TSOs*

## Regional TSO cooperation strengthened:

- *Regionally coordinated capacity allocation performed on 6 borders, including EnC CPs and EU MS, through SEE CAO*
- *Regional Security Coordination Center (SCC) provides services to 7 EnC and EU TSOs*

## EnC TSOs on board of ENTSO-E Data transparency:

- *Regulation (EU) 543/2013 on submission and publication of data in electricity markets adopted for the EnC;*
- *5 EnC TSOs submit the data to ENTSO-E Transparency Platform*

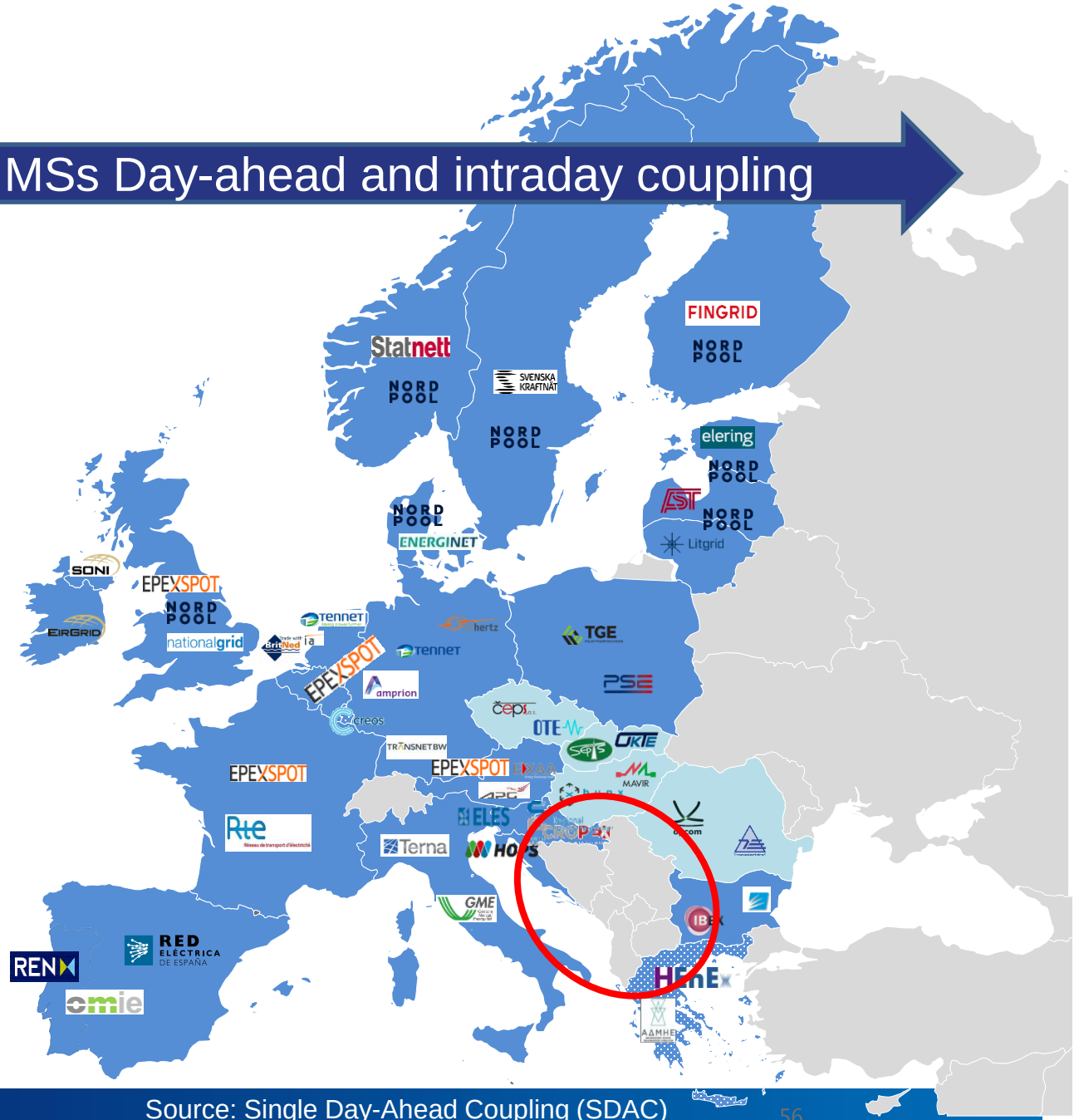
# Looking forward – EnC CPs-EU MSs Day-ahead and intraday coupling

***CACM not adopted in EnC***

***Stepping stone…***

***Early implementation of CACM:***

- ***Pilot projects in WB6 ongoing***
  - ✓ ***Bulgaria-North Macedonia***
  - ✓ ***Albania-Italy-Montenegro-Serbia***
  - ✓ ***Bulgaria-Croatia-Serbia***
- ***Designated EnC CPs' NEMOs to be allowed to join SDAC and SIDC before CACM is fully adopted***

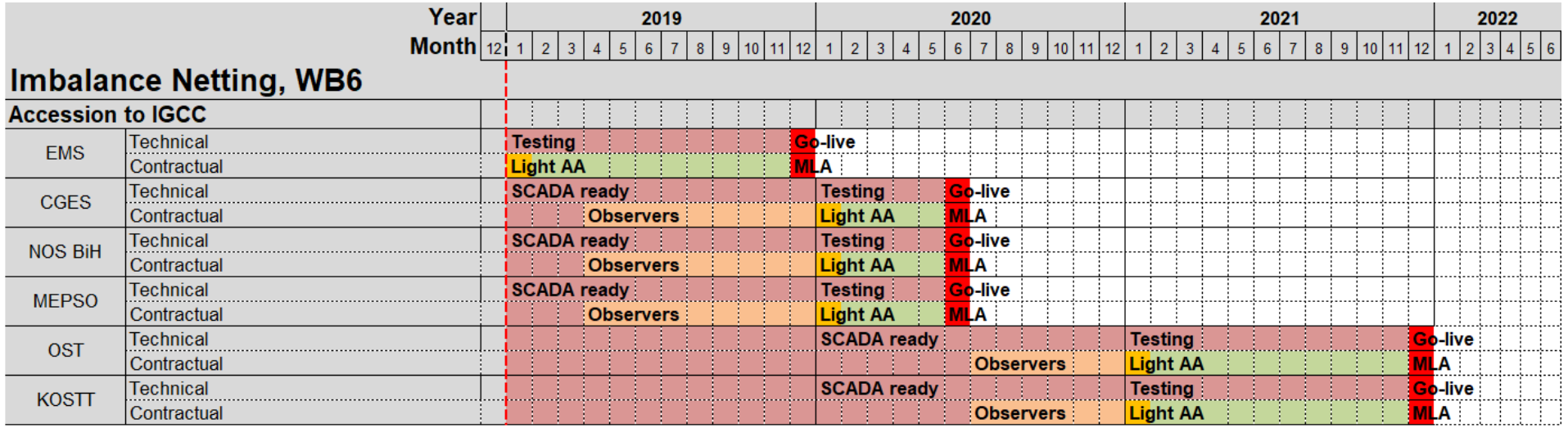


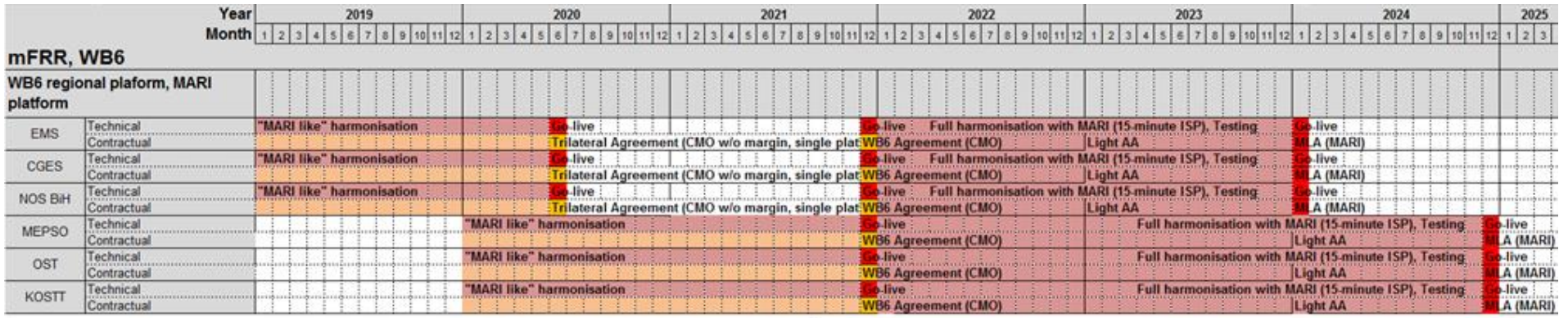

Source: Single Day-Ahead Coupling (SDAC) Presentation from the Athens forum 2019

# Integration of EnC TSOs in EU balancing platforms

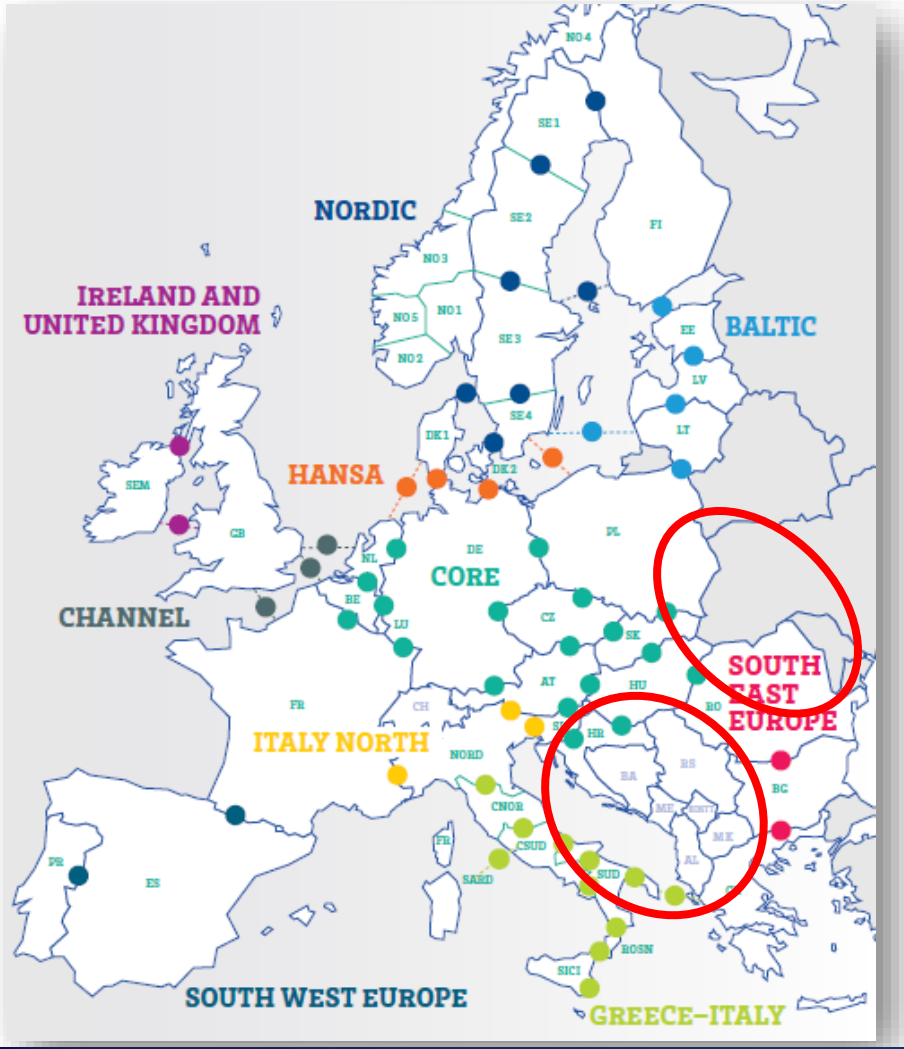
***Roadmaps for balancing integration of WB6 and into EU platforms developed….***

***Can EnC TSOs become operational members in EU Platforms before EB GL is adopted in EnC?***



# Coordinated capacity calculation in EnC




## *EU Capacity Calculation Regions (CCRs) are not covering EnC CPs*

*The explanatory document to TSOs proposal for CCRs (Annex 1) outlines the evolution of the CCRs including various non-EU bidding zone borders*

## *Is an early implementation possible?*

- ✓ *Coordinated NTC calculation methodology for Shadow SEE 10 region developed under WB6 initiative (neighbouring EU TSOs took part)*
- ✓ *Discussion on regulatory measures for early implementation of coordinated capacity calculation, including definition of CCRs in EnC, ongoing*

Source: ENTSO-E Report on Capacity Calculation and Allocation 2019

# Clean Energy Package (CEP) brings new challenges

***Maximizing capacity available for cross-zonal trade***

***Regulation (EU) 2019/943 on the internal market for electricity prescribes that Transmission System Operators ('TSOs') shall, as from 1 January 2020, make available for cross-zonal trade a minimum binding level of capacity (70%)***

***CEP not adopted in EnC…How will EnC CPs flows be considered?***

***ACER RECOMMENDATION 01/2019 as of 8 August 2019***

***According to the guidance of DG ENER, consideration of third (i.e. non EU member) country flows in capacity calculation and MACZT should be possible on the condition that an agreement has been concluded by all TSOs of a CCR with the TSO of the third country, approved by the respective regulatory authorities. The agreement should be fully in line with EU capacity calculation principles and rules, and should cover at least:***

***(i) consideration of internal third country constraints for intra-EU capacity calculation,***
***(ii) consideration of EU internal constraints for capacity calculation on the border with third country, and***
***(iii) cost-sharing of remedial actions.***

# Decarbonisation as a common challenge

***Energy Community –***

***challenge of moving away from coal:***

- ***53% share of fossil-fuel in generation capacity mix***
- ***2.4 bill. EUR/a direct and indirect subsidies into fossil-fuel electricity production***
- ***~87 mill. tons/a CO2 emissions***
- ***almost no CO2 price in EnC CPs***
- ***~1 GW to be opted-out in WB6 by 2023***

# Carbon leakage challenge to XB exchange

***Carbon Leakage – a new challenge to cross-border exchange and a level playing field***

***Carbon pricing mechanism for the Energy Community?***

***Study on Carbon pricing design for the Energy Community to be launched by the end of 2019***

# System and market integration crucial for decarbonisation

## *ECS Study on Resource Adequacy (to be published in 2019):*

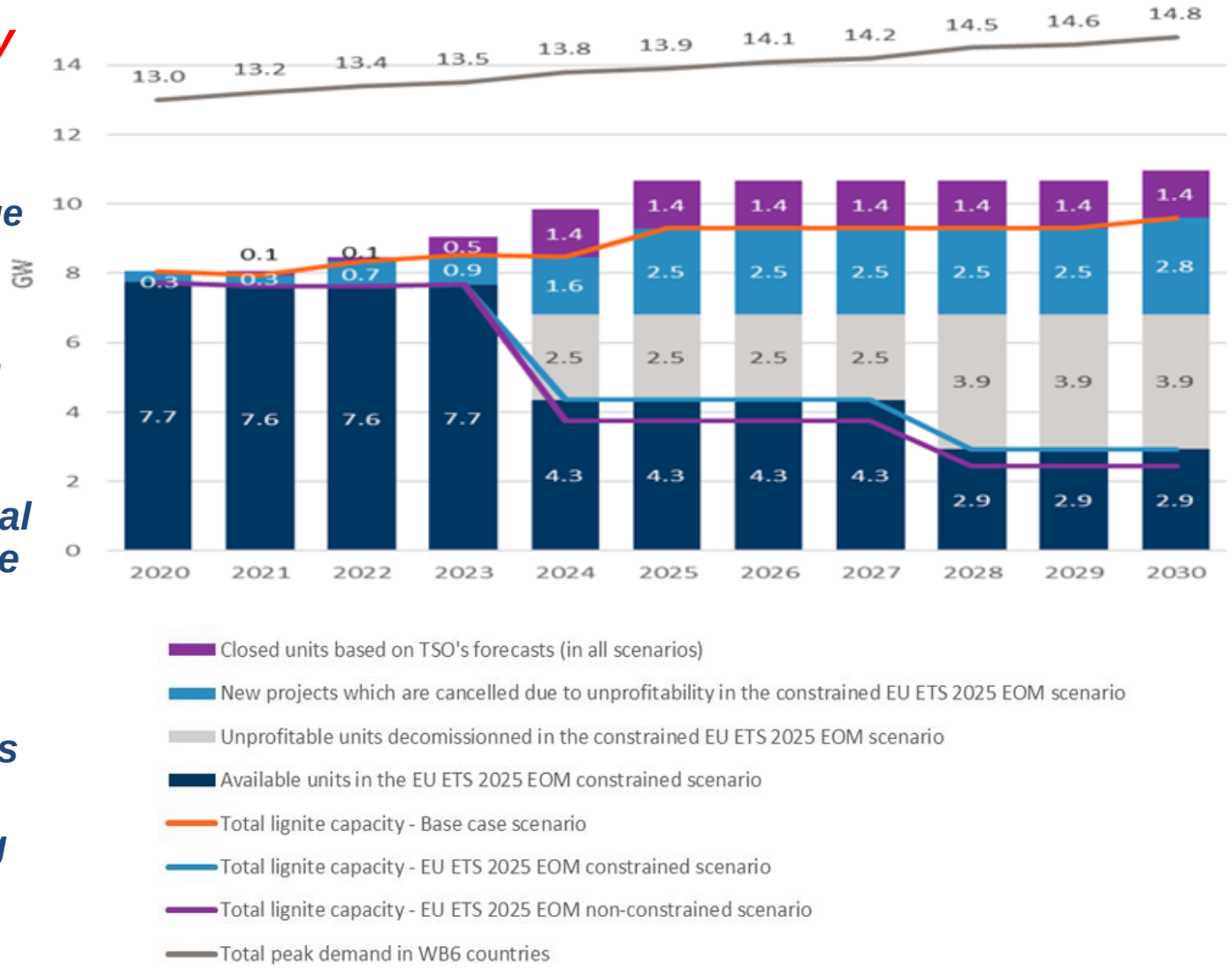
***Analyzed an impact of:***

- ***Cross-zonal capacity (CZC) usage***
- ***market integration***
- ***Introduction of CO2 price***

***on security of supply and generation mix in Western Balkans***

***Efficient usage of CZC become crucial in ensuring reserve margin, under the assumption that CO2 price is introduced in 2025***

- ***If cross-zonal capacity with neighbouring Member States is constrained – more lignite plants are needed for ensuring security of supply in WB6***



# PECI/PMI Electricity Projects in EnC up to 2030

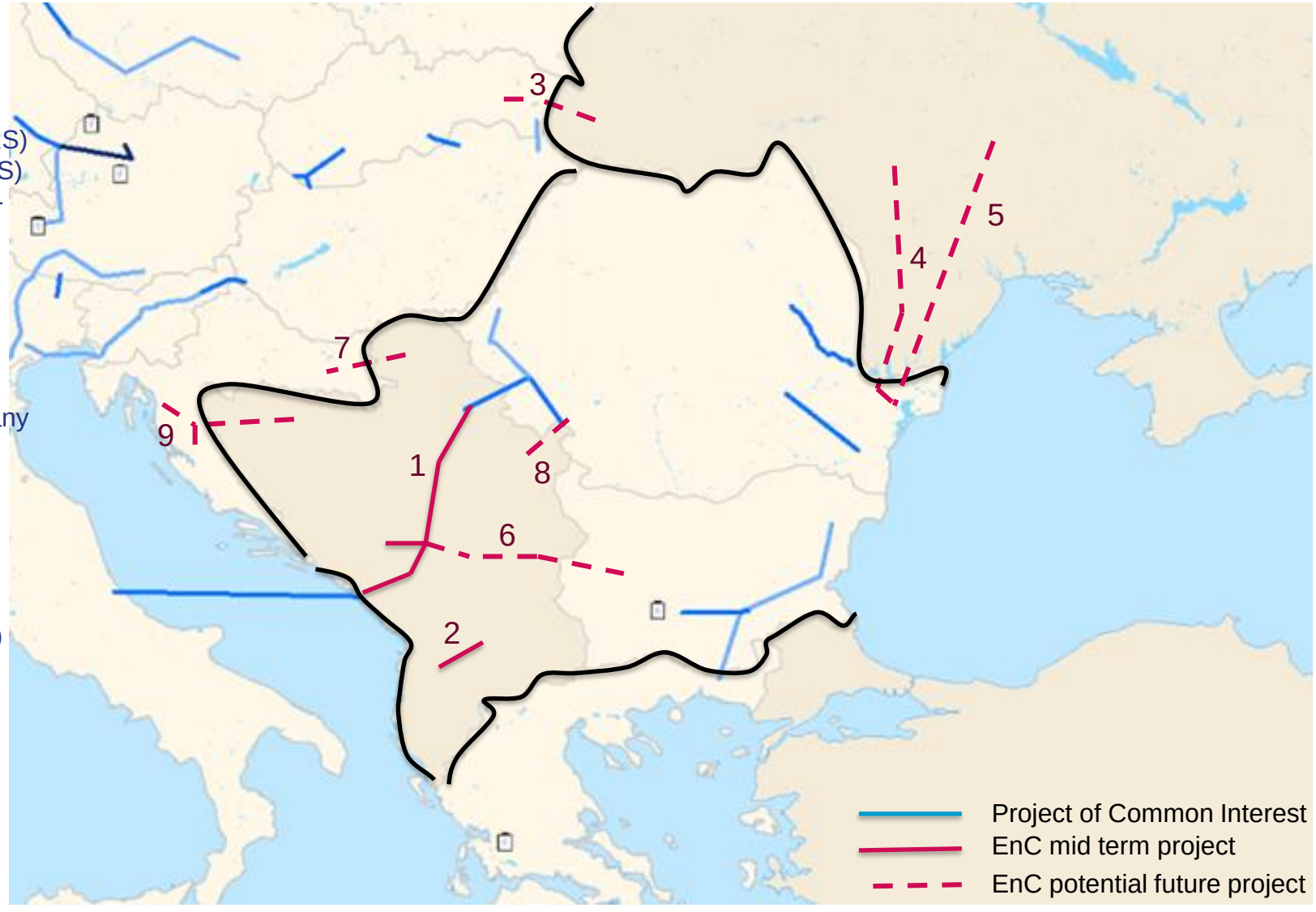
**Mid term projects (TYNDP) PECIs**

1. Transbalkan corridor – phase 1
- 400 kV OHL Resita (RO) – Pancevo (RS)
- 400 kV OHL Kragujevac (RS) – Kraljevo (RS)
- 400 kV OHL Obrenovac (RS) – B.Basta (RS)
- 400 kV OHL B.Basta (RS) – Pljevlja (ME) – Visegrad (BA)
- 400 kV OHL Pljevlja (ME) – Lastva (ME)

2. 400 kV OHL Bitola (MK) – Elbasan (AL)

**Mid to long term projects:**

3. 400 kV OHL Mukacheve (UA) – V.Kapusany (SK)
4. 400 kV OHL with B2B Substation, Isacea (RO) – Vulcanesti (MD) – Chisinau (MD)
5. 400 kV OHL Pivdennoukrainska NPP (Ukraine) – Isaccea (Romania)
6. Transbalkan corridor – phase 2
- 400 kV OHL B. Basta (RS) - Kraljevo (RS)
- 400 kV OHL Kraljevo (RS) – Nis (RS)
- New interconnection between Serbia and Bulgaria
7. New interconnection between Serbia – Croatia
8. New interconnection between Serbia – Romania (+ internal reinf.)
9. 400 kV OHL B. Luka (BA) – Lika (HR)

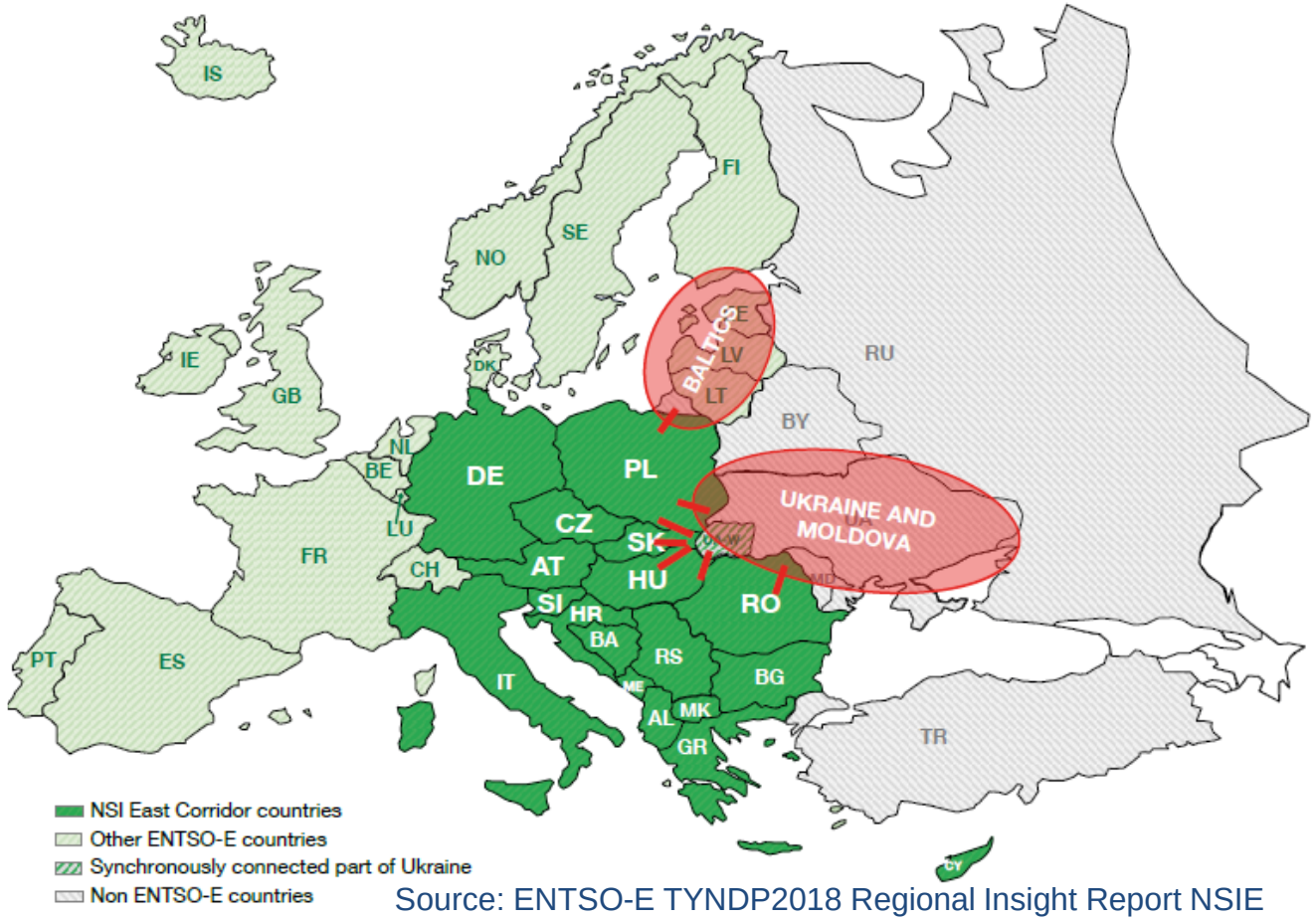


# Living up to expectations

***Ukraine/Moldova connection to ENTSO-E CE?***

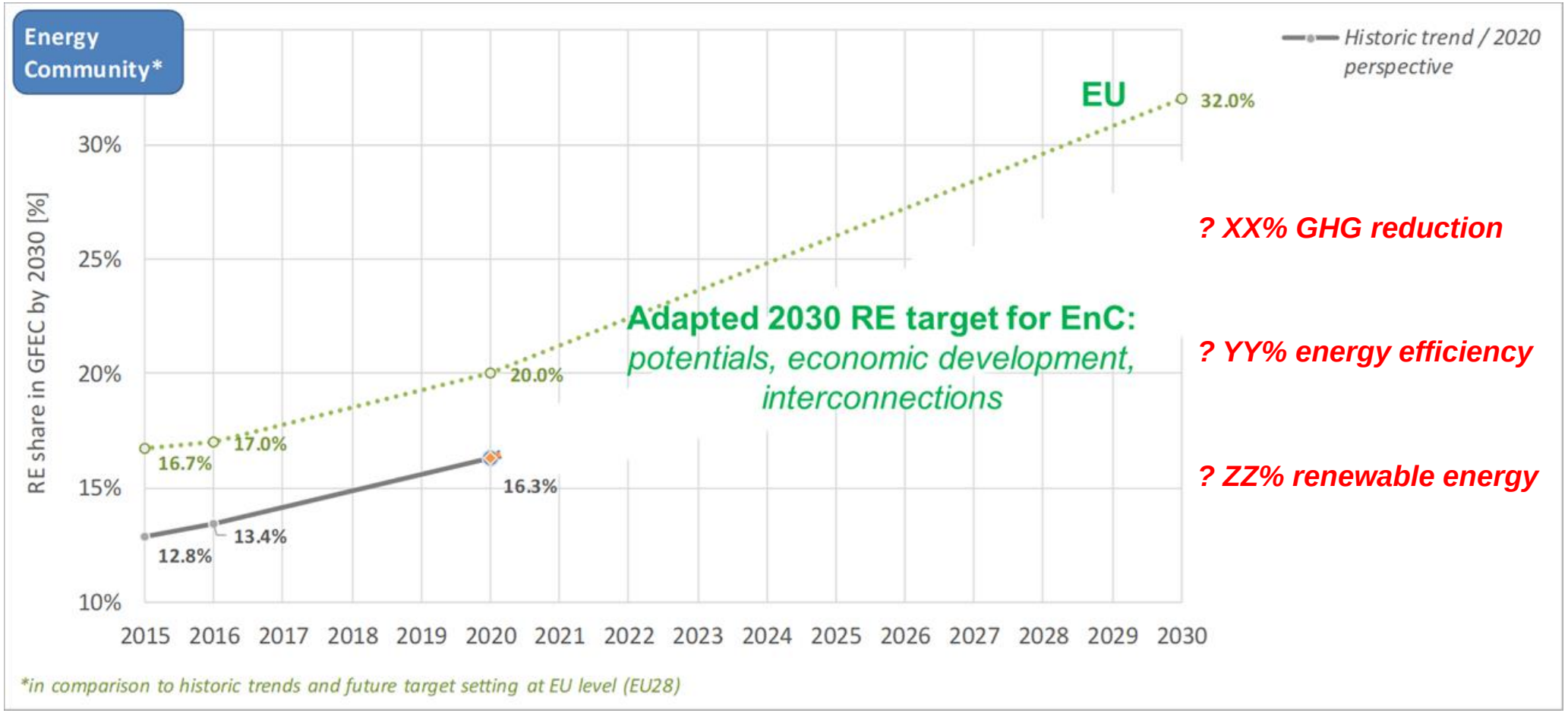
***Two different technology based options are considered for the physical connection of the power systems of Ukraine and Moldova to the Continental European power system:***

- ***Alternative Current (AC) connection - Joint Moldova-Ukraine synchronous interconnection with ENTSO-E – UA/MD synchronization project***
- ***Back-to-Back (B2B) High Voltage DC (HVDC) interconnection - asynchronous interconnection***
- ***Hybrid connection - Combination of AC and DC connection. Burstyn island connected synchronously and the rest of UA/MD system through B2B DC technology***




Source: ENTSO-E TYNDP2018 Regional Insight Report NSIE

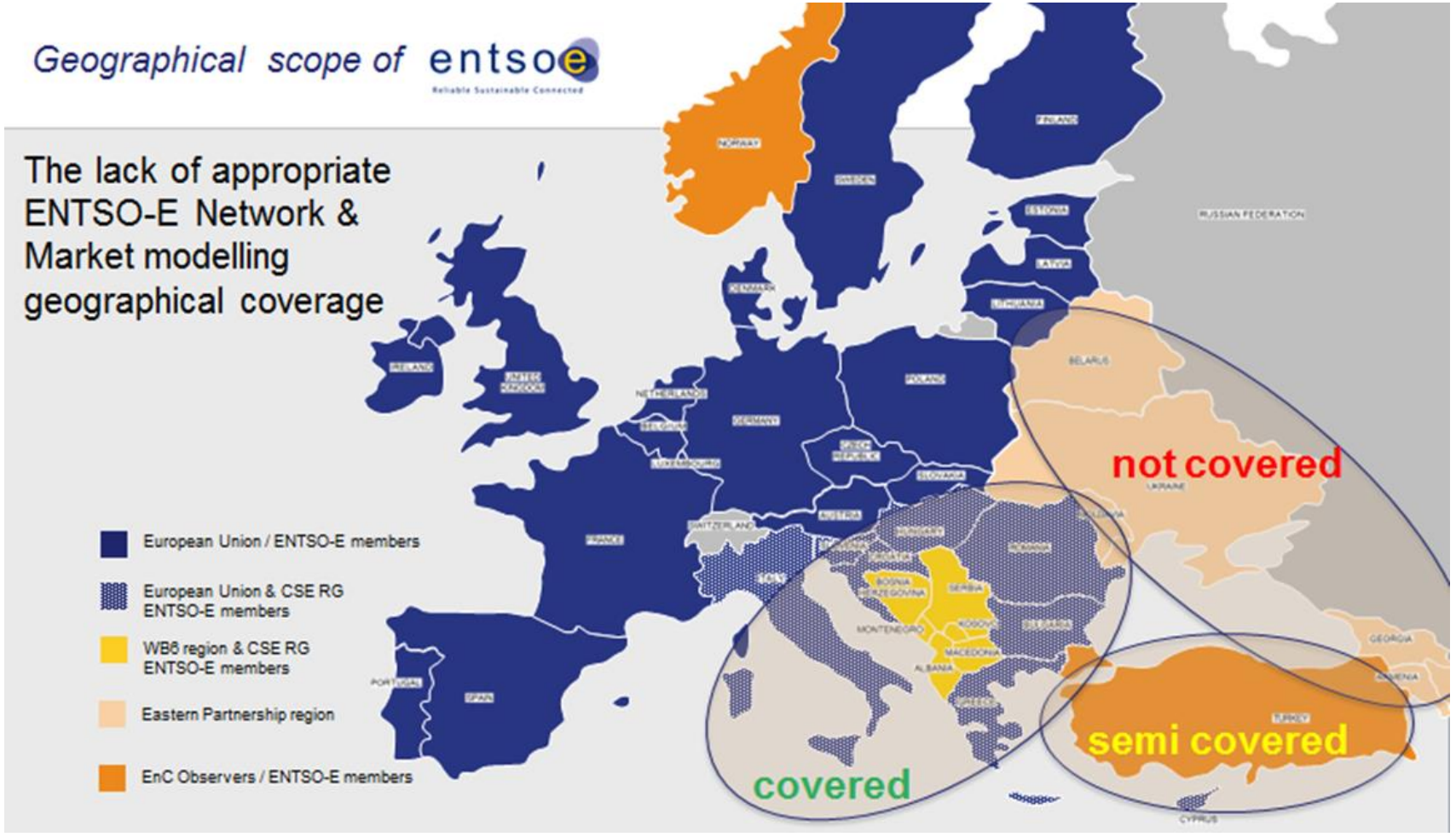
# Living up to expectations - 2030 targets for EnC



Energy Community

# Sector Coupling starts with long-term planning

***TYNDPs of ENTSO-E and ENTSOG to fully integrate EnC CPs***



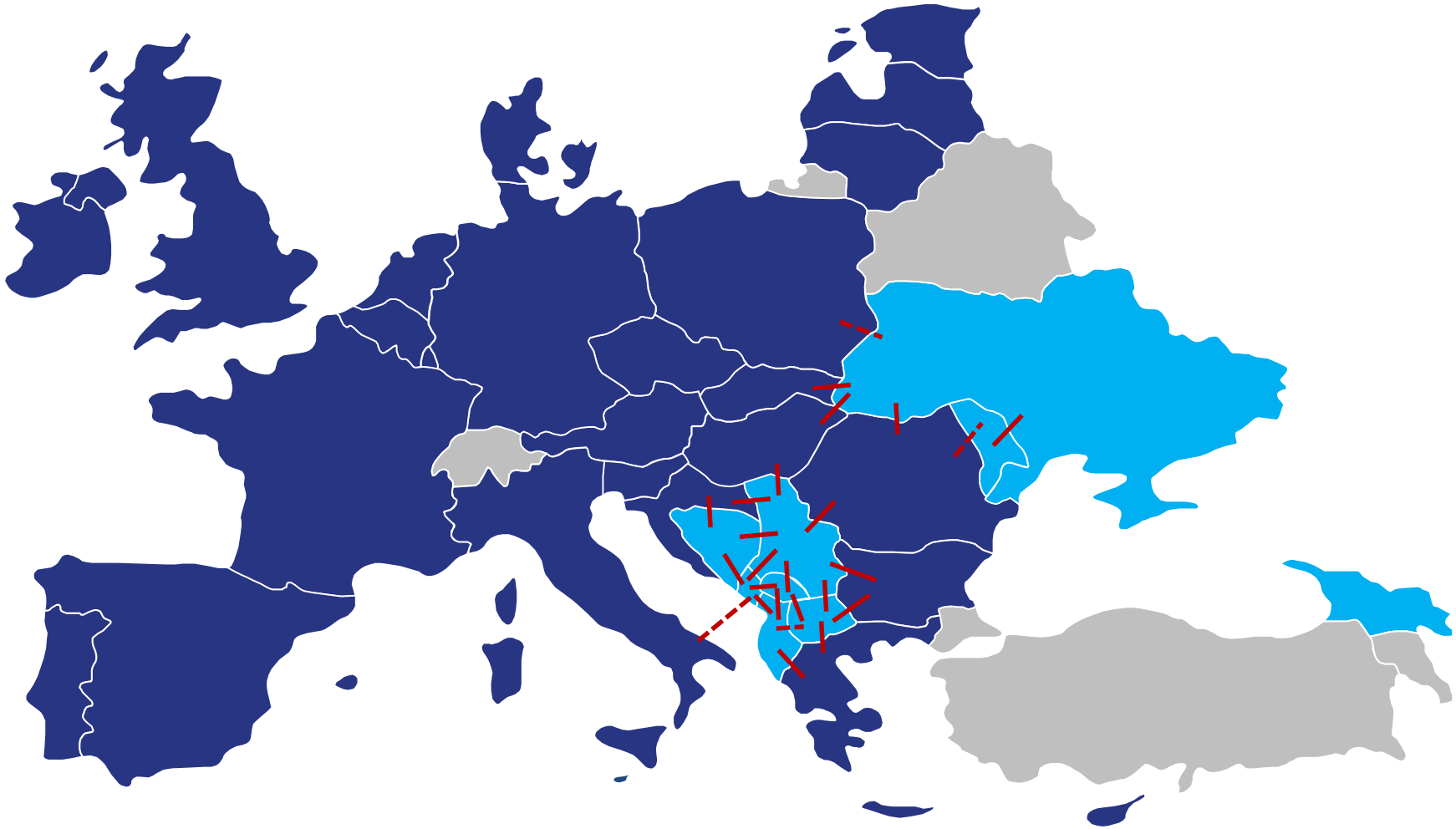
Energy Community

# Living up to expectations

## *Negotiations on EnC Treaty amendments ongoing*

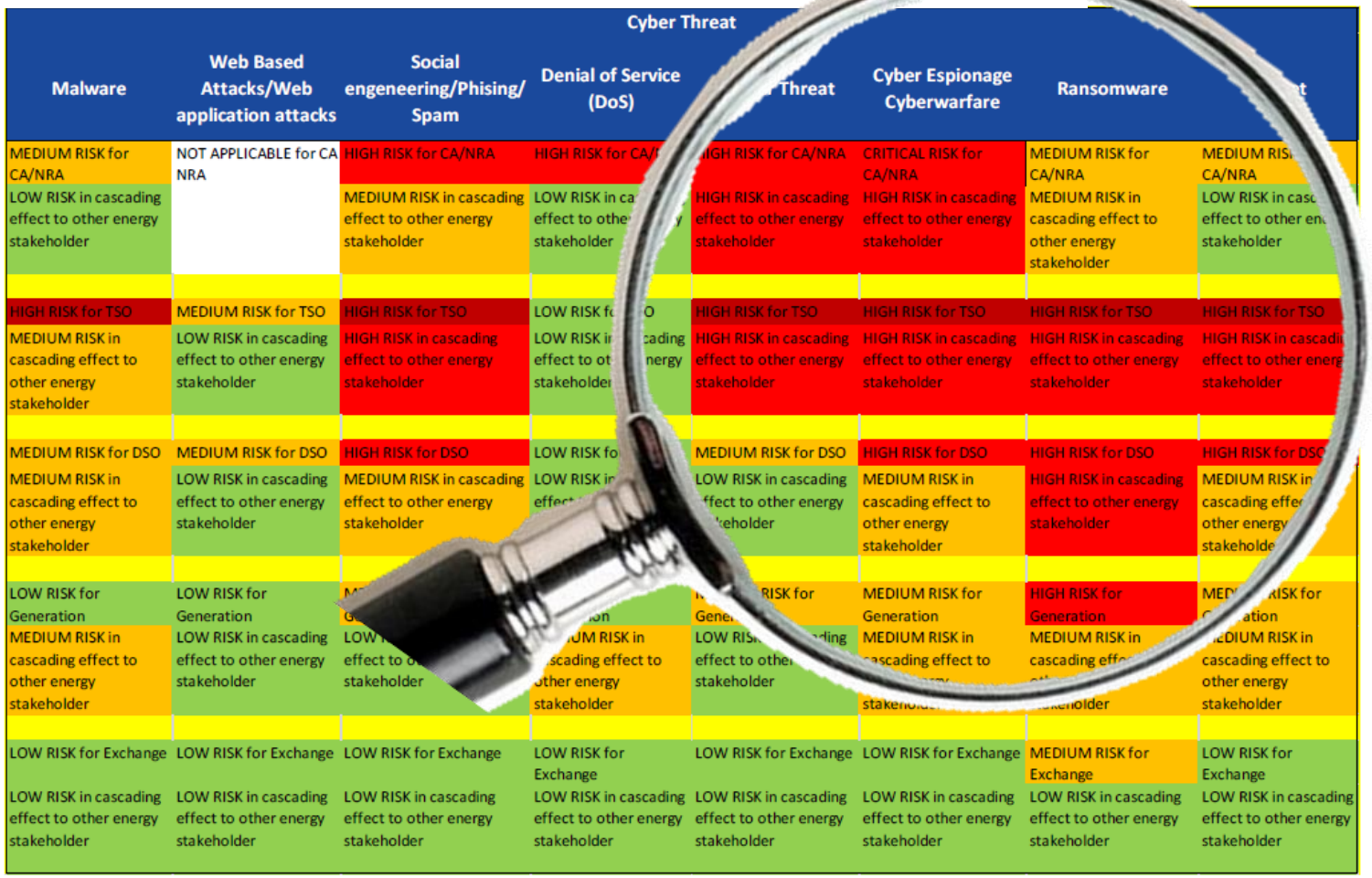
- ***particular focus on a reciprocity mechanism- legally binding solution for EU MS- EnC CP interconnections needed***
- ***adoption in 2020?***

EU MS-EnC CP interconnections



# Looking forward – Cyber Security challenge to XB exchange

## Study on Cybersecurity in the energy sector of the Energy Community



Cyber Threat

| Malware | Web Based Attacks/Web application attacks | Social engeneering/Phising/ Spam | Denial of Service (DoS) | Threat | Cyber Espionage Cyberwarfare | Ransomware | |
|---|---|---|---|---|---|---|---|
| MEDIUM RISK for CA/NRA | NOT APPLICABLE for CA NRA | HIGH RISK for CA/NRA | HIGH RISK for CA/ | IGH RISK for CA/NRA | CRITICAL RISK for CA/NRA | MEDIUM RISK for CA/NRA | MEDIUM RIS CA/NRA |
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| LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder | LOW RISK in cascading effect to other energy stakeholder |

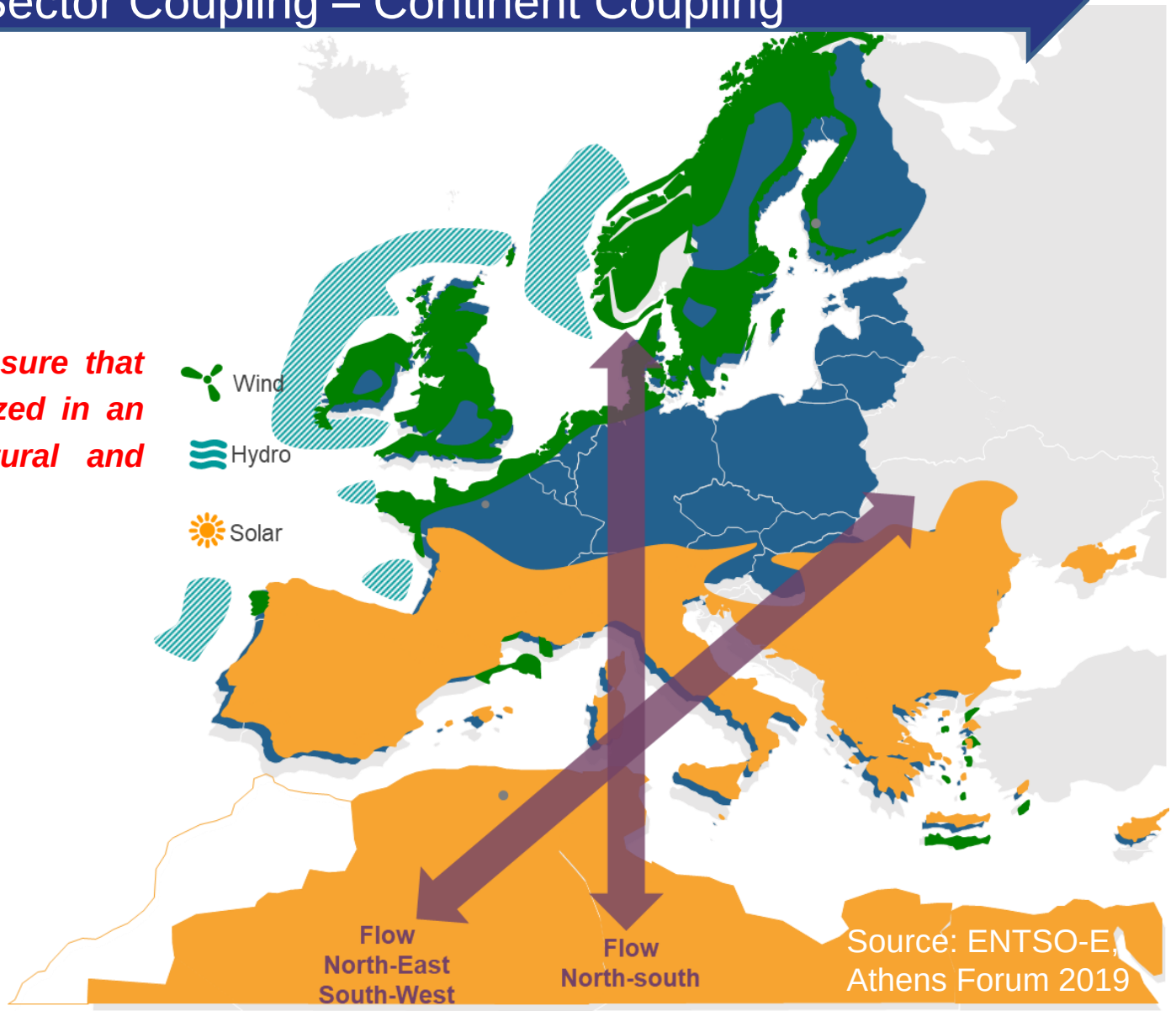
***Energy Community Cyber Security Coordination Group to enhance activities and cooperation on:***

- Information sharing
- EU Regulation / Network Code on cybersecurity
- Network resilience – Energy Community Energy CSIRT cooperation structure established
- Network security – technical standards (ISO 27000, others) / certified technologies applied

# Looking forward – Sector Coupling – Continent Coupling

***On the way to 2050 carbon-neutrality***

***ENTSO-E and the Energy Community to ensure that growing interconnection capacities are utilized in an optimal way, taking care that infrastructural and market development go hand in hand***




Source: ENTSO-E, Athens Forum 2019

# THANK YOU
# FOR YOUR ATTENTION

janez.kopac@energy.community.org

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/EnergyCommunityTV

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# Session 2: ENTSO-E seen from outside achievements & expectations

## A partner and stakeholder perspective

**Christian Baer**
Secretary General, Europex

**Peter Claes**
Vice President, IFIEC

**Gert De Block**
Secretary General, CEDEC

**Giles Dickson**
CEO, Wind Europe

**Monique Goyens**
Director General, BEUC

**Stefan Degener**
Vice President of Solar Power Europe

**Paul Giesbertz**
Head Advisor Market Policies and Regulatory Affairs, Statkraft

**Kristian Ruby**
Secretary General, EURELECTRIC

**Ines de la Barreda**
Chair of ENTSO-E Legal and Regulatory Group

**Paul Troughton**
Member of smartEn

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# Session 2: ENTSO-E seen from outside achievements & expectations

A partner and stakeholder perspective

**Ines de la Barreda**

Chair of ENTSO-E Legal and Regulatory Group

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# Video

## 10 Funny facts about Finland

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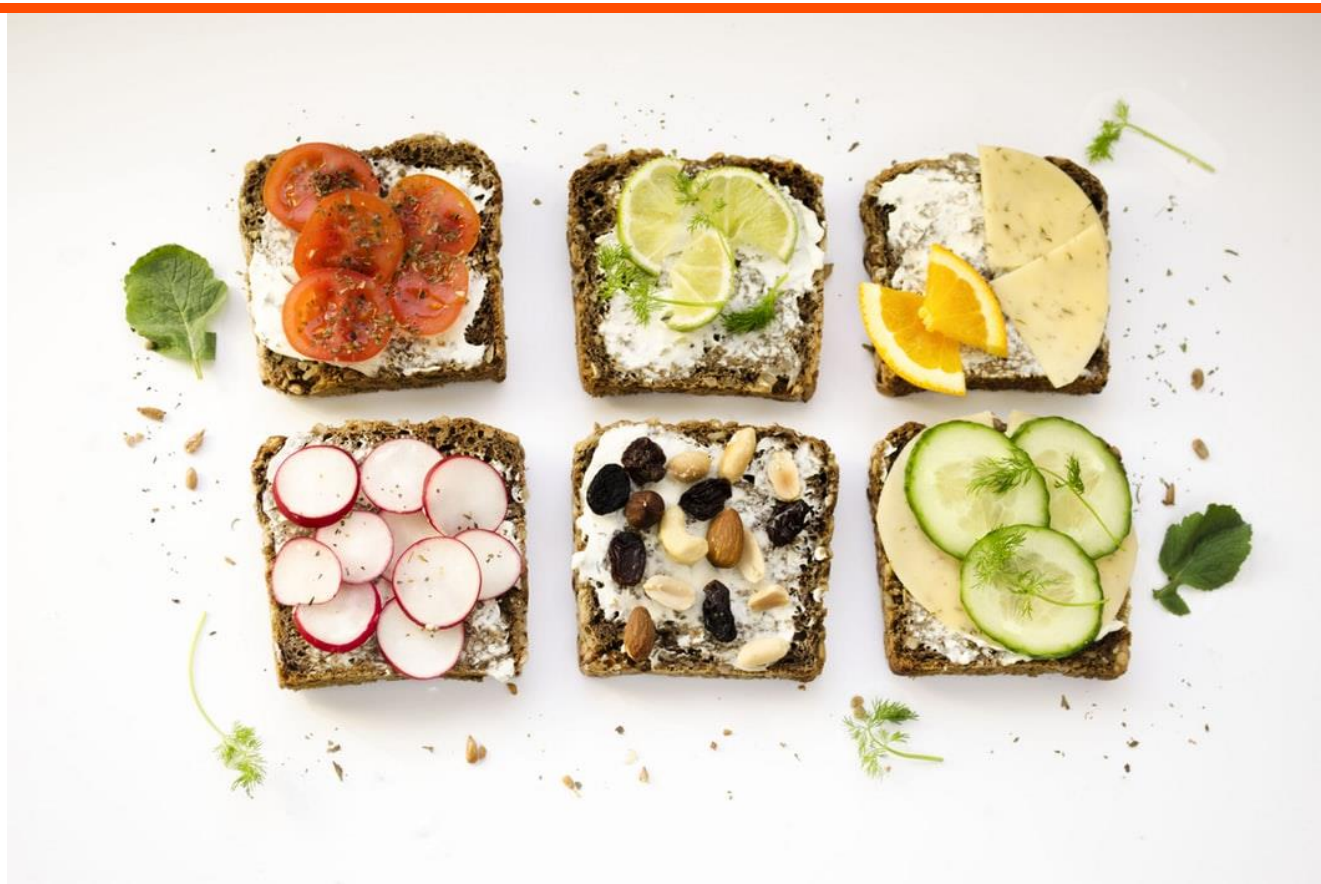
# Lunch



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# Session 3: The future energy system: a 2030 horizon

PowerFacts 2019

**Robert Schroeder**
ENTSO-E Managing Director System Development

**Fabien Roques**
Head of the European Energy practice, FTI-Compass Lexecon

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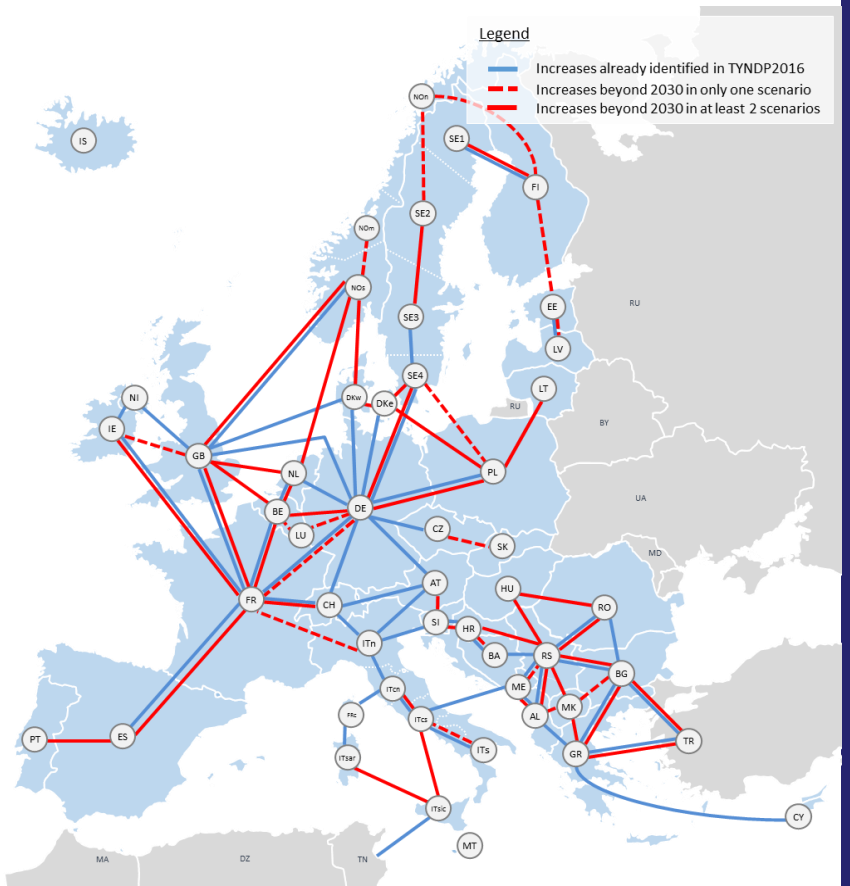
# POWER FACTS EUROPE

# *Optimal grid 2040 compared to "no-action" delivers…*




**3 to 14 €/MWh**
reduction in marginal costs of electricity generation

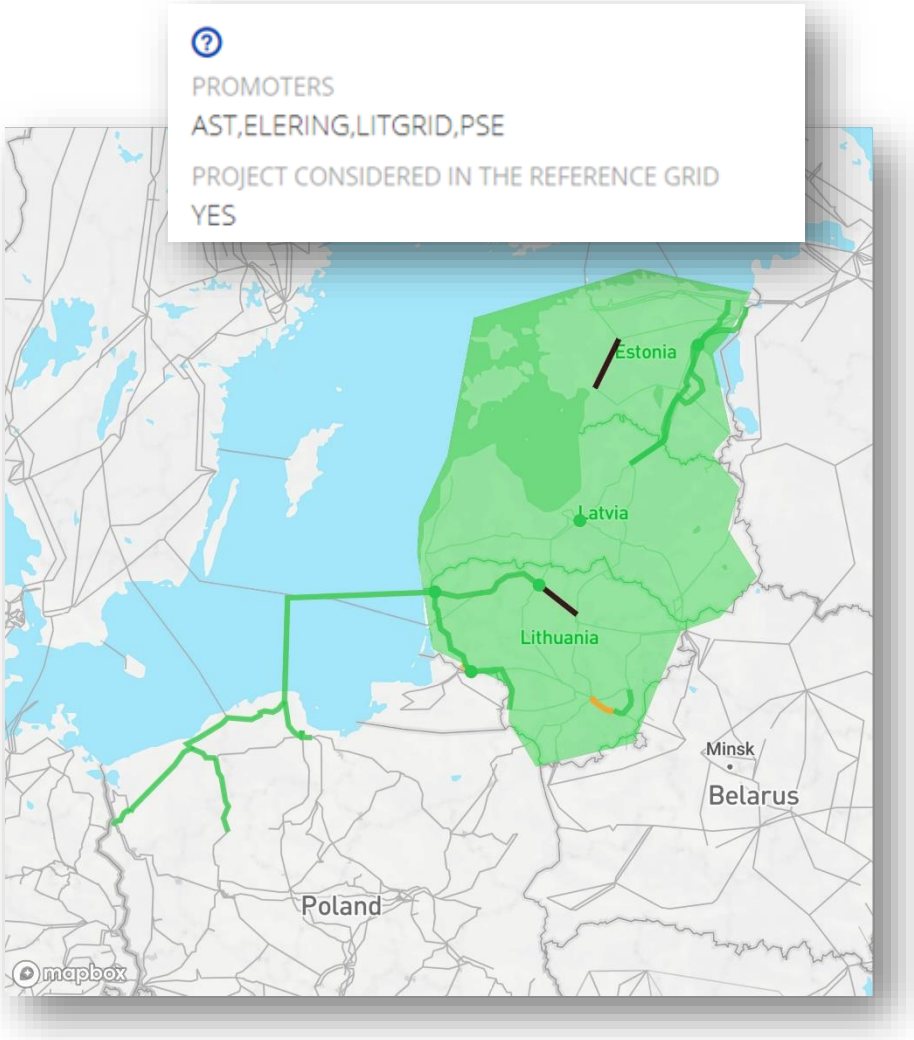
**58 to 156 TWh**
less curtailed renewable energy

**37 to 59 Mton**
reduction in $CO_2$

**24 to 471 GWh**
reduction in Energy Not Served

Source: ENTSO-E TYNDP 2018

# Grids for security of supply and markets
# Zoom on the Baltics




The three Baltic TSOs are preparing for desynchronization from IPS/UPS by 2025 and synchronization with the Continental European Network (CEN) through current DC interconnection between Lithuania and Poland.

Synchronization of Baltic countries with CEN will ensure energy security by connecting to grid, which is operated following the common European rules.

Baltic synchronization project covers many new projects for internal grid reinforcements required for synchronization and separation of 110kV Baltic grid from IPS/UPS system, DC convertor stations on borders with Russia, Belarus and Kaliningrad area, additional studies.

*Source: ENTSO-E TYNDP 2018*

# Grids for security of supply and markets
# Zoom on offshore grid

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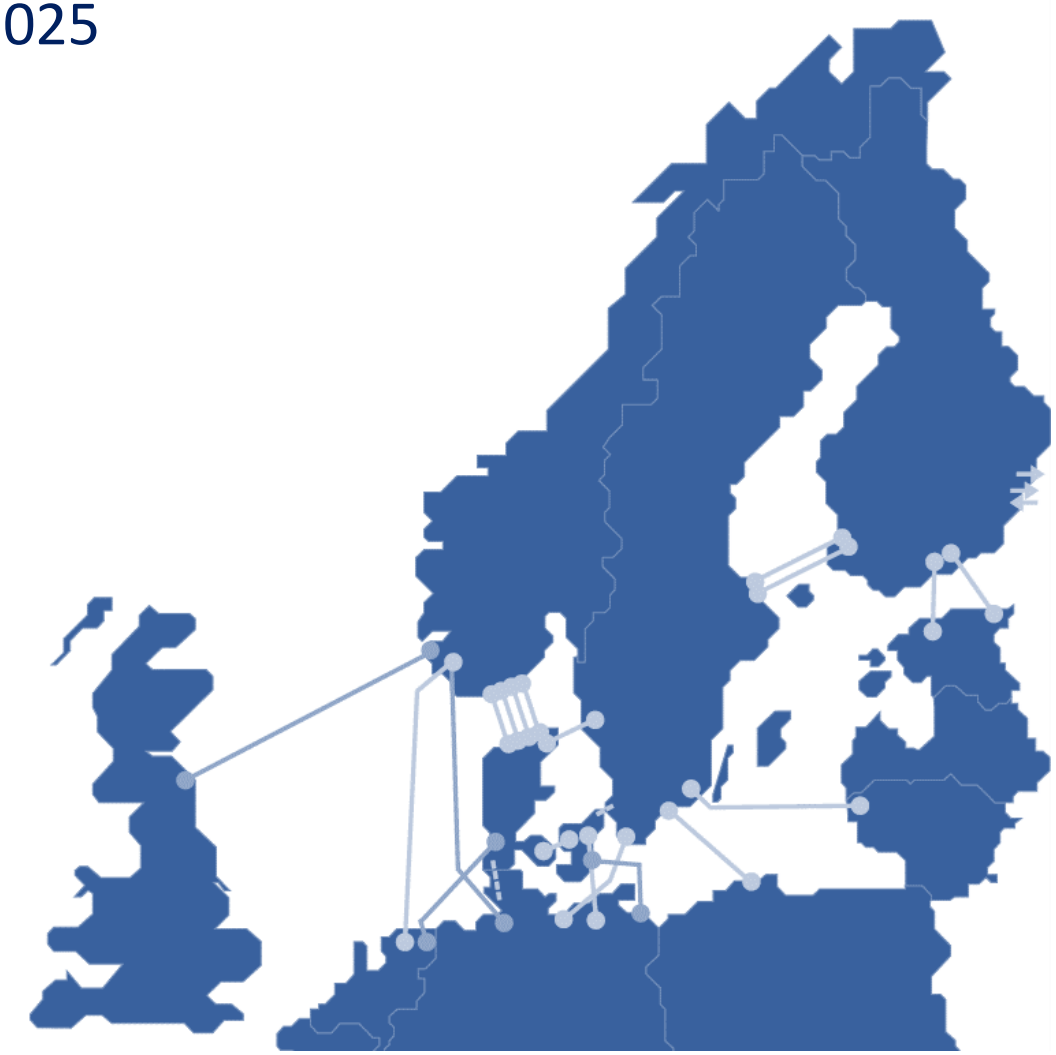
**60%** increase in interconnector capacity by 2025 between the continent and the Nordic

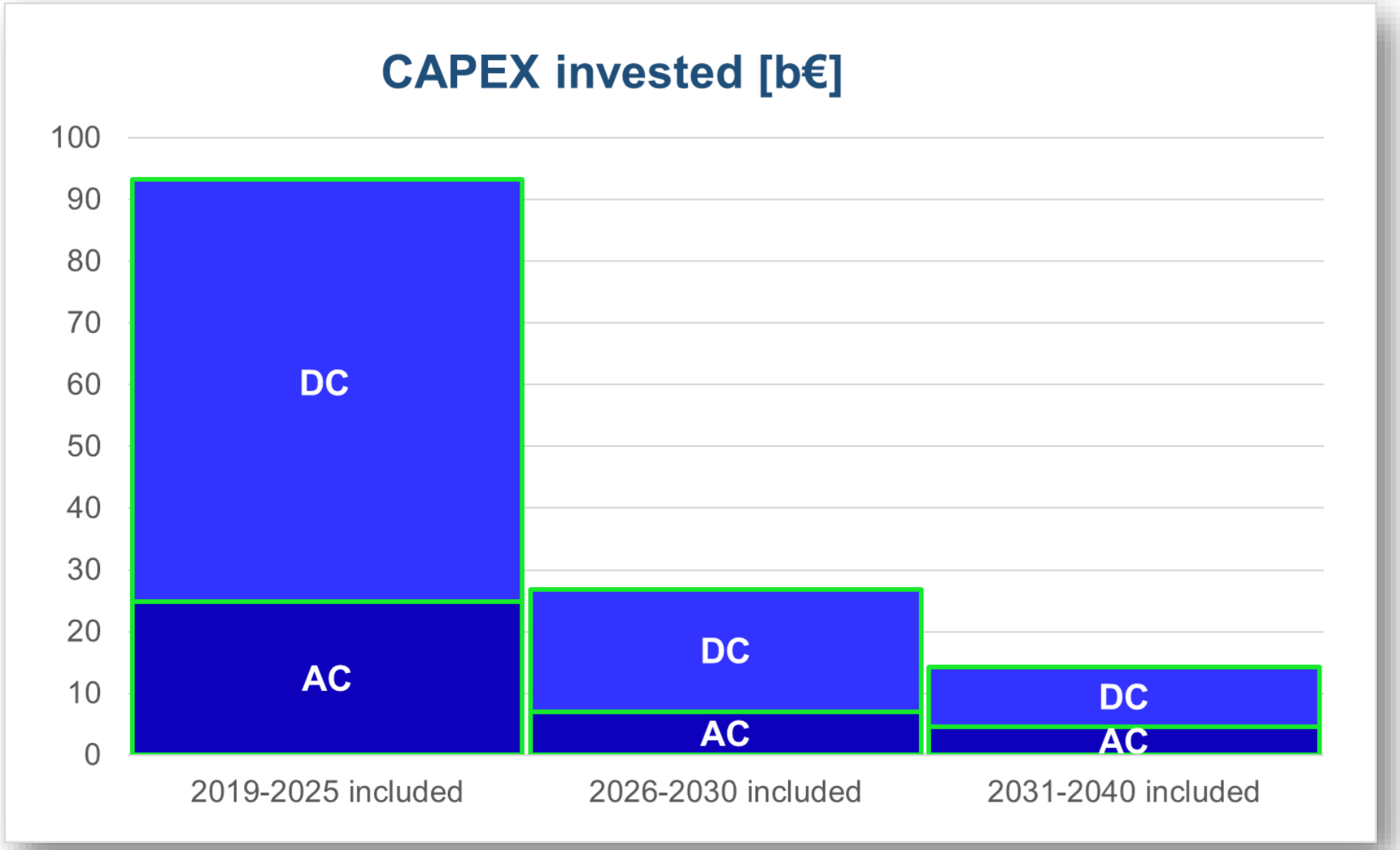
| | |
|---|---|
| Cobra | 700 MW |
| Kriegers Flak | 400 MW |
| Nord Link | 1400 MW |
| North Sea Link | 1400 MW |
| Viking Cable | 1400 MW |
| Hansa Power Bridge | 700 MW |
| Jutland-Germany | 1000 MW |
| **Total** | **7000 MW** |



*Source: ENTSO-E TYNDP 2018*

# Grids for security of supply and markets

## Future investments on AC/DC the lion share expected on DC until 2025

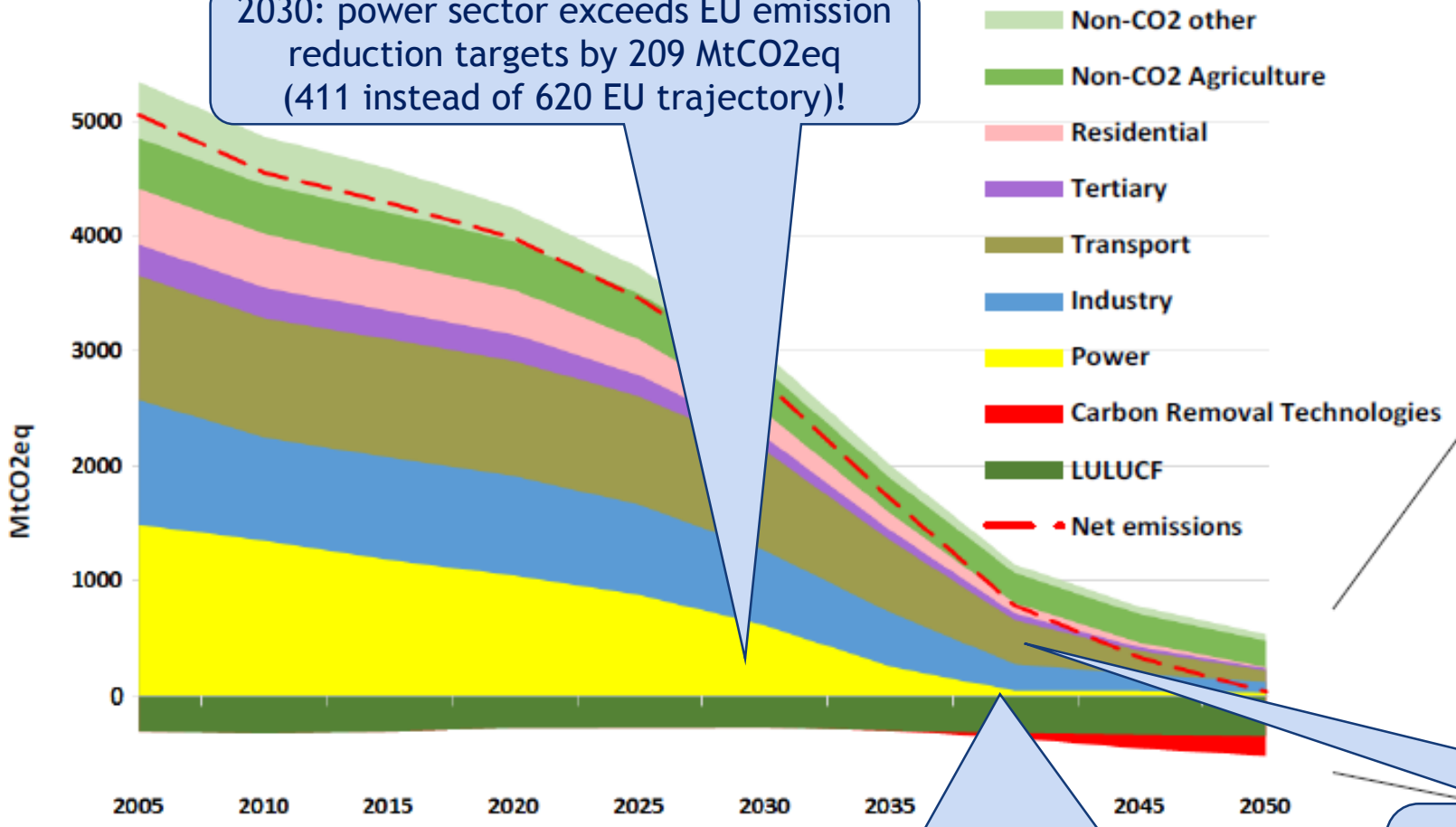


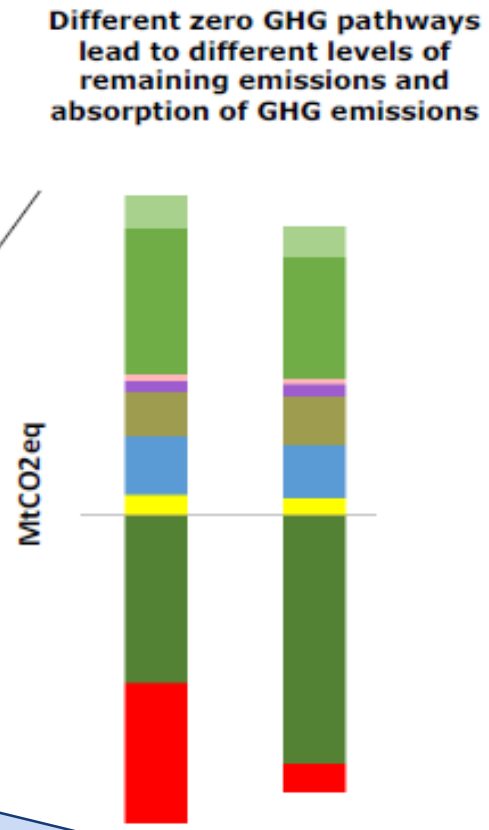

*Source: ENTSO-E TYNDP 2018*

# Setting the scene – What Green Deal?

## GHG emissions in a 1.5°C scenario

2030: power sector exceeds EU emission reduction targets by 209 MtCO2eq (411 instead of 620 EU trajectory)!



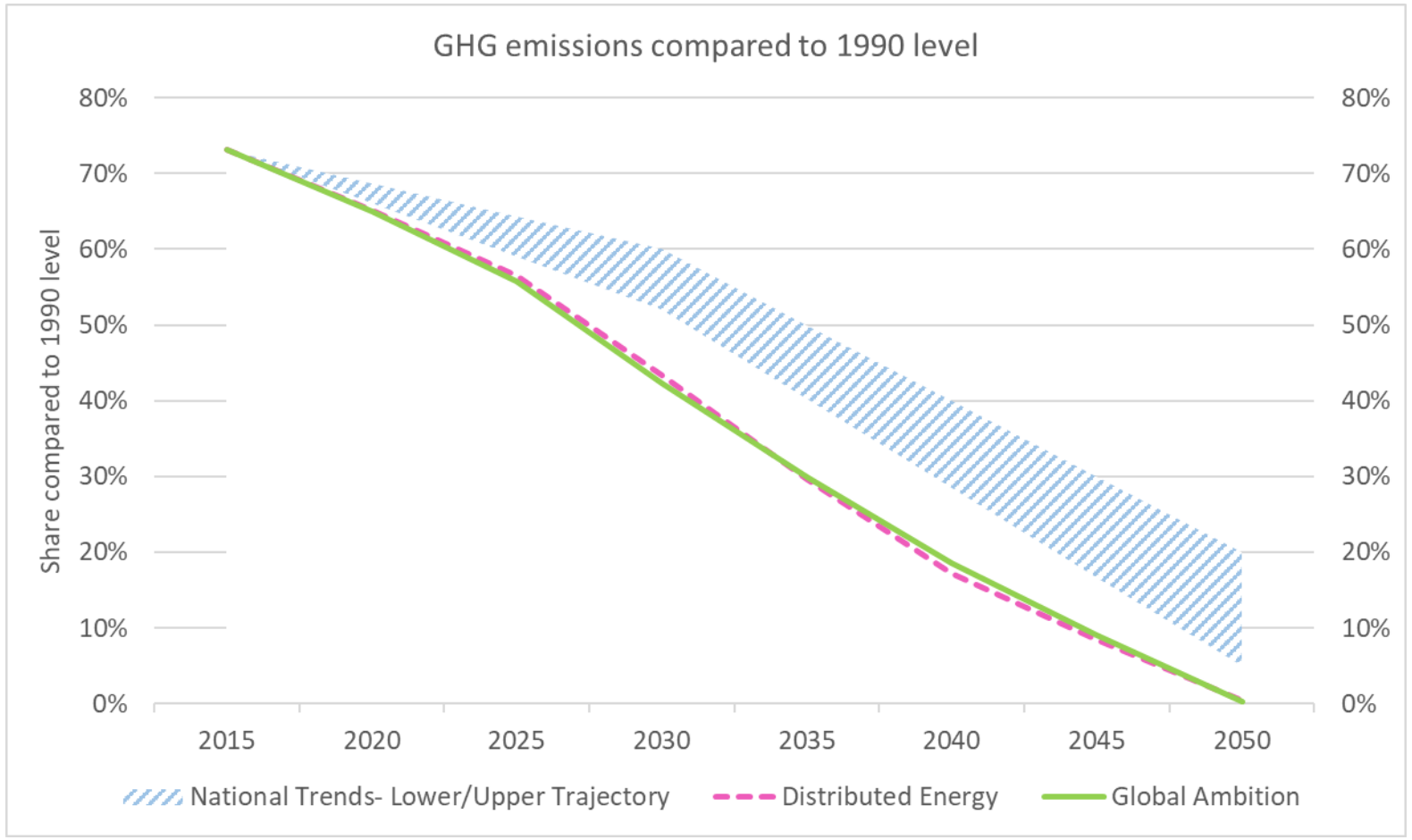




2040: Carbon neutral power sector

How to get other sectors clean?
- Transport/
- Heating/ Cooling
- Industry

Source: EU Long term Strategy November 2018

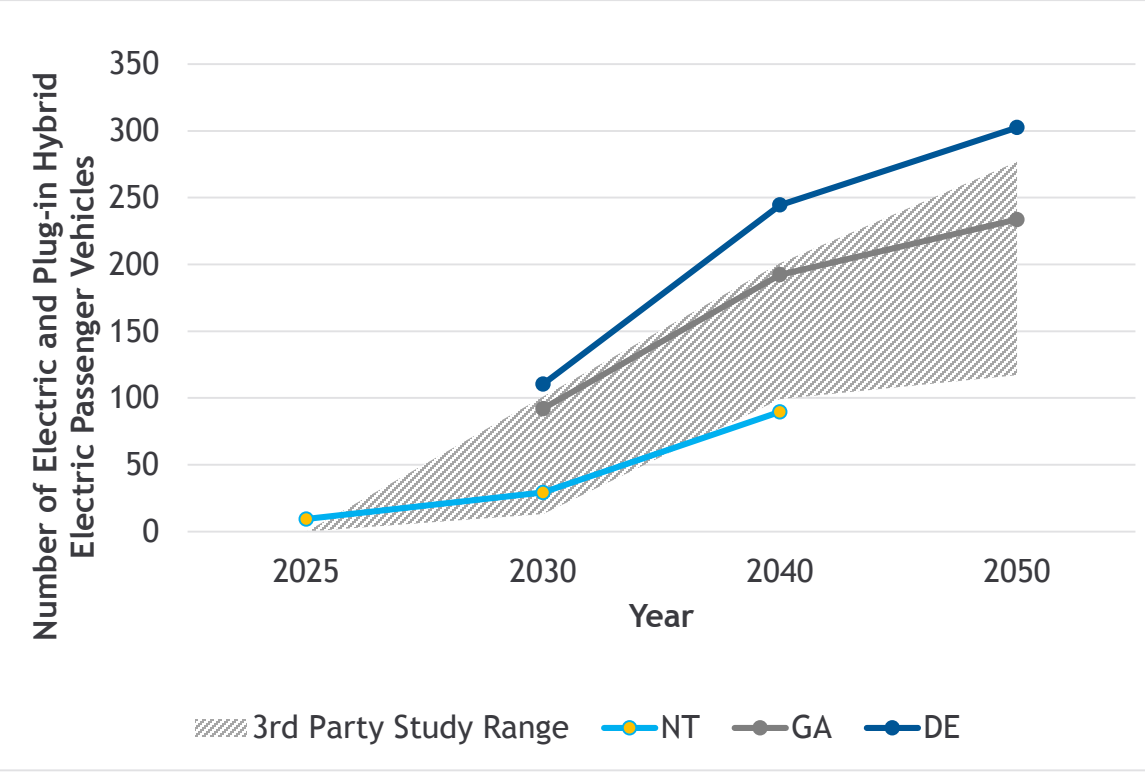
# Carbon neutrality can be reached by 2050 within a budget of 63.5 $GtCO_2$

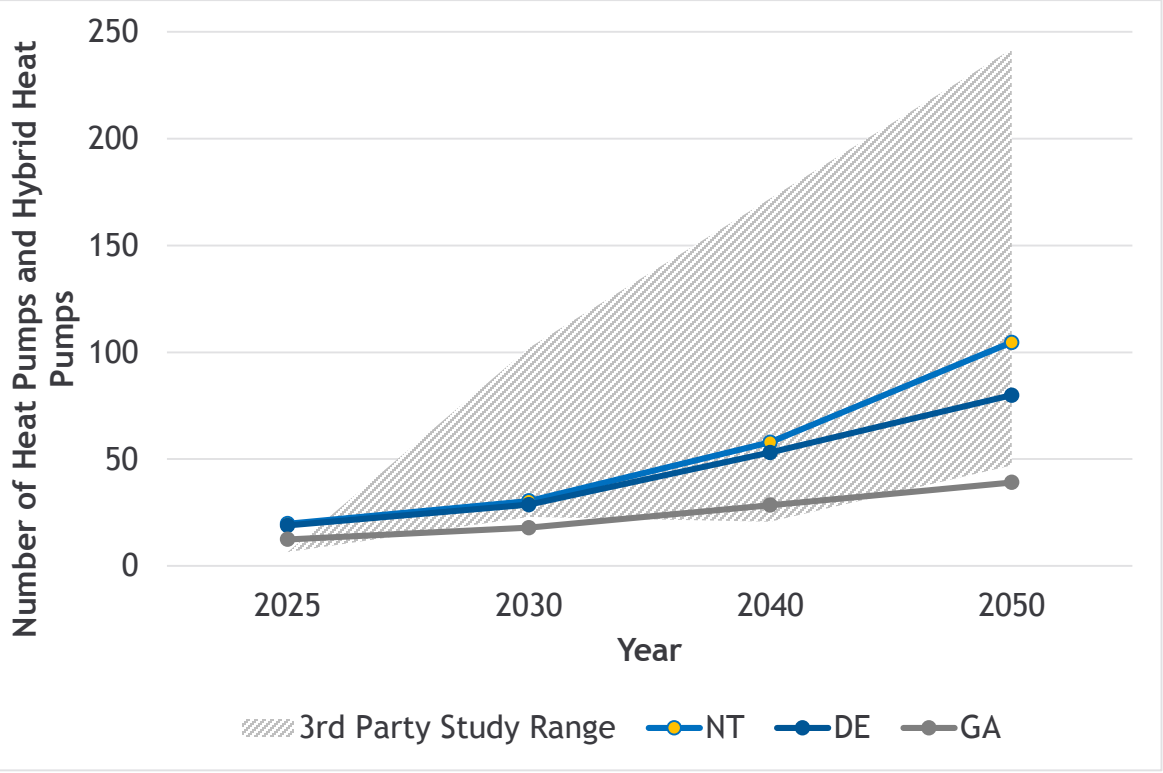



- TYNDP2020 Scenarios show that the energy system can achieve carbon neutrality by 2050.
- Considering different development of technologies, starting from 2018 onwards, the energy system can limit its emissions 63.5 $GtCO_2$ - 62.6 $GtCO_2$.

Source: TYNDP 2020 Scenario Report

# Electric Vehicles & heat pumps increase in all TYNDP 2020 scenarios

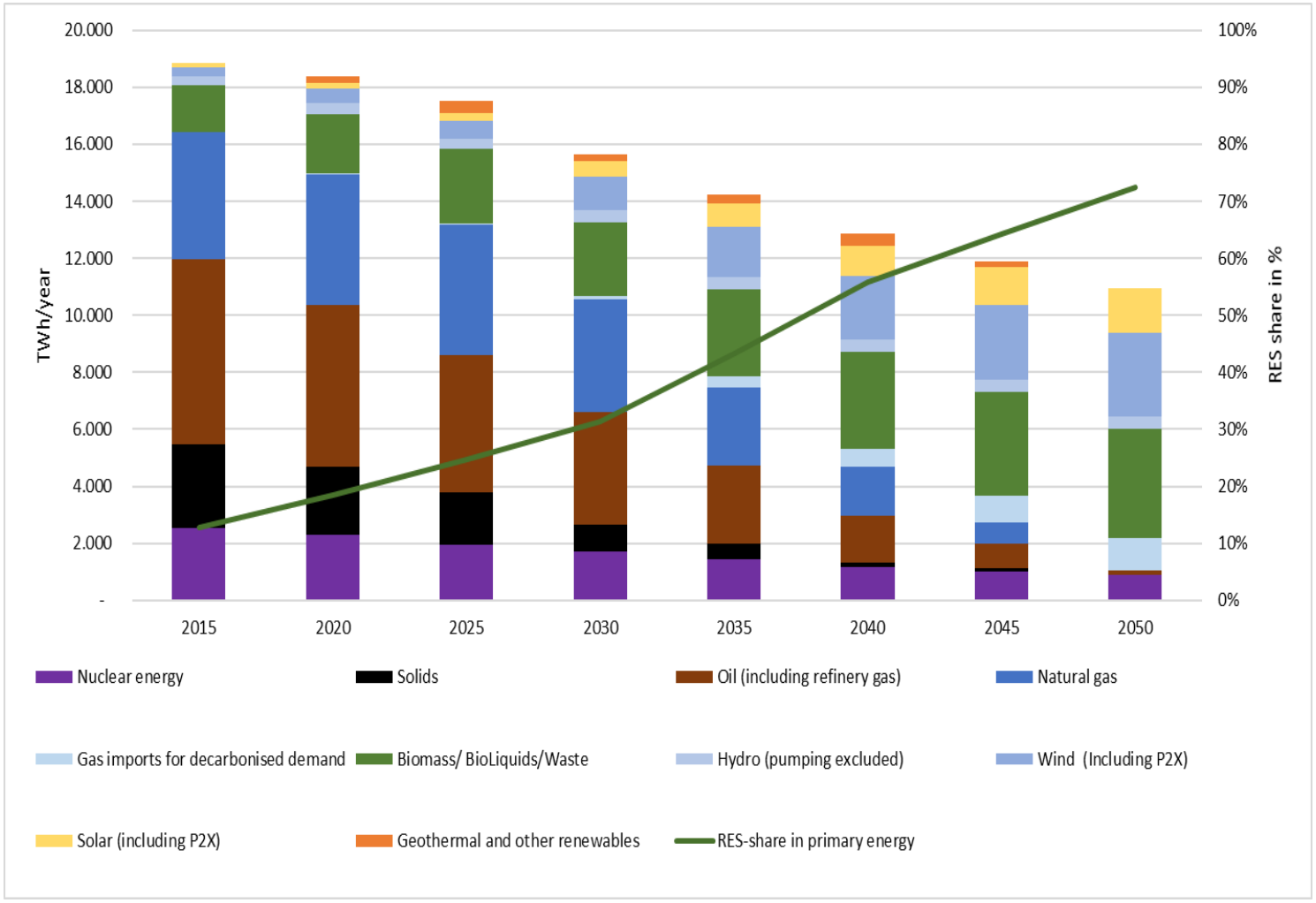



| 2040 | Electric vehicles (million) | Heat Pumps (million) |
|---|---|---|
| Distributed Energy (DE) | 240 | 50 |
| Global Ambition (GA) | 200 | 25 |
| National Trends (NT) (TSOs) | 100 | 60 |

Source: TYNDP 2020 Scenario Report

# RES increases to 64/80% in power mix by 2050 in GA and DE scenarios

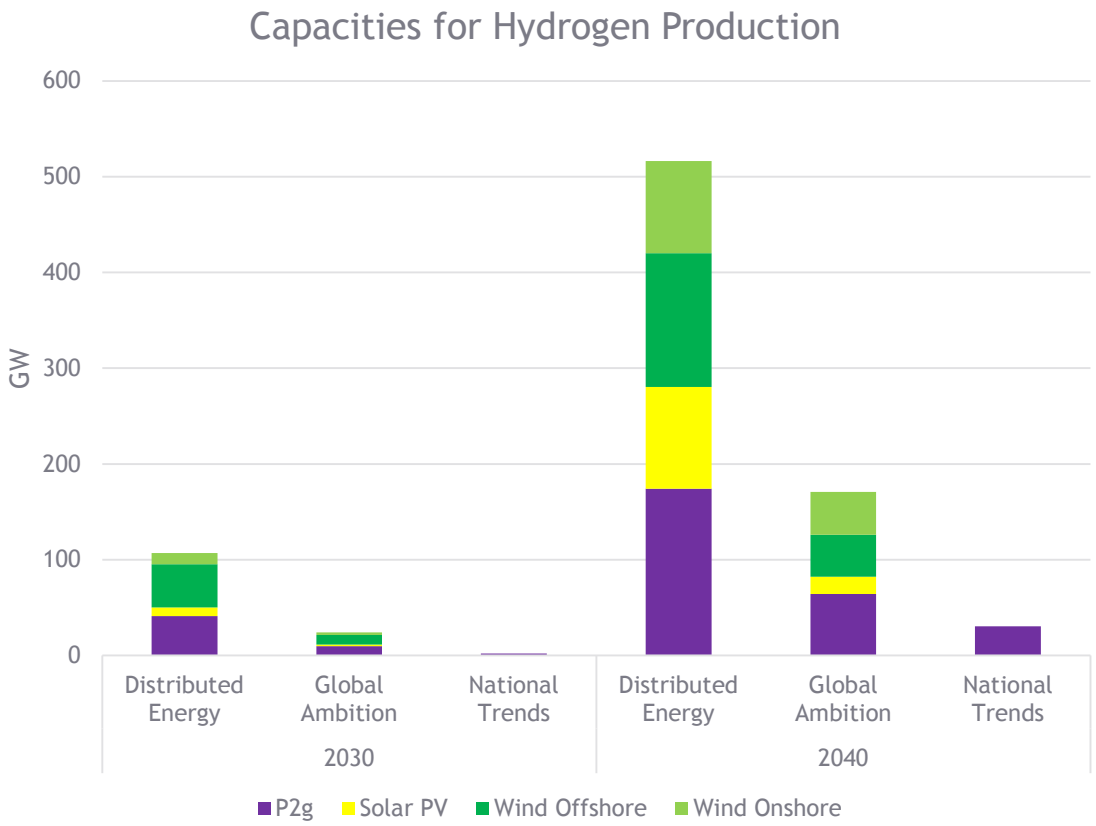


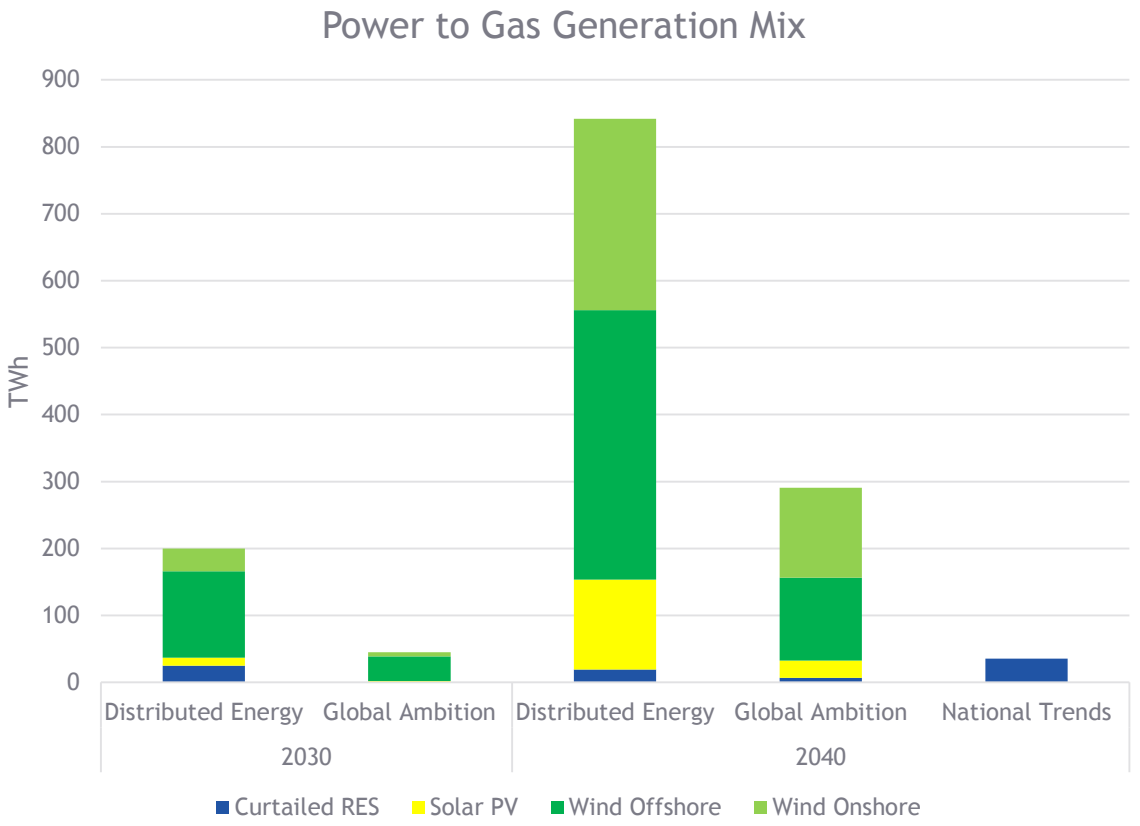

- Both COP21 scenarios are carbon-neutral by 2050.
- Both COP21 scenarios need significant increase in both renewables and further $CO_2$ removal technologies, while reducing primary energy demand

| 2050 | Demand decrease | RES share |
|---|---|---|
| Global Ambition | 42% | 64% |
| Distributed Energy | 43% | 80% |

Source: TYNDP 2020 Scenario Report

# Capacities for Hydrogen Production

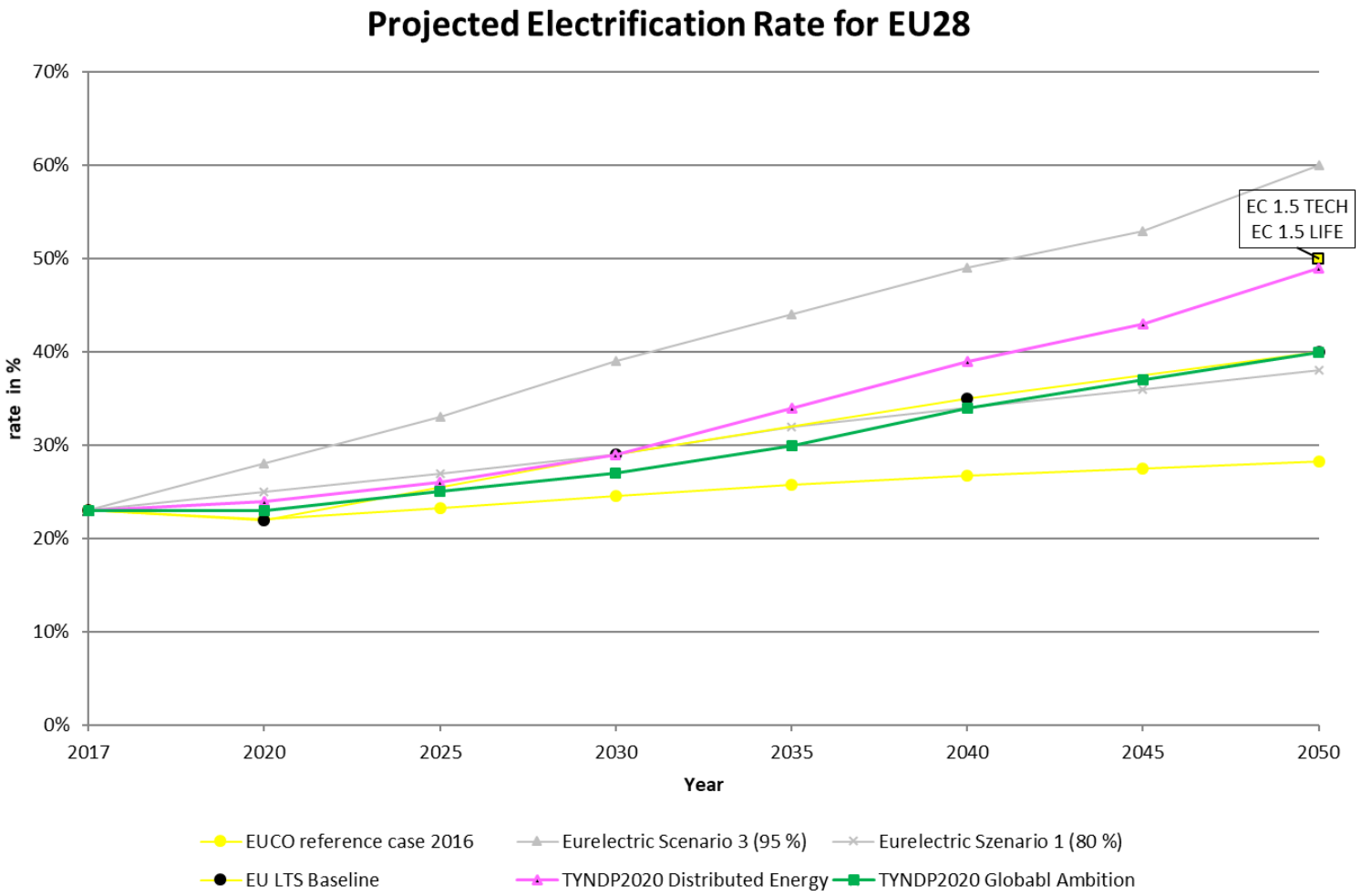



- Distributed Energy has a significantly higher demand for EU produced hydrogen and synthetic methane than Global Ambition in the 2030 and 2040, as the storyline assumes a reduction of 70% of gas imports by 2050 (from 4000 TWh in 2020 down to 1200 TWh in 2050) combined with the decarbonisation of the gas supply.
- In the COP21 scenarios, the main source used for electrolysis is offshore wind, but where regional constraints exist, onshore wind and solar PV will be the alternative.

Source: TYNDP 2020 Scenario Report

# Benchmarking: Electrification Rate for EU28




- In 2050, the Distributed Energy scenario achieves roughly the same electrification rate as the EC 1.5 TECH scenario, which is close to 50 %.
- The Global Ambition scenario follows approximately the same electrification path as the EU LTS Baseline scenario and additionally Eurelectric Scenario 1, which accomplishes the goal of 80 % emission reduction up to 2050.

Source: TYNDP 2020 Scenario Report

# Power system reliability

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# Limited number of incidents recorded on the grid

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**Number of incidents per scale in 2018 and the percentage distribution**

| Scale of incident | Number of incidents | Percentage (%) |
|---|---|---|
| Scale 0 | 2,762 | 91.2% |
| Scale 1 | 262 | 8.6% |
| Scale 2 | 6 | 0.2% |
| Scale 3 | 0 | 0.0% |
| Grand Total | 3,030 | 100.0% |

| Scale 0 | Scale 1 | Scale 2 | Scale 3 |
|---|---|---|---|
| Anomaly | Noteworthy incident | Extensive incidents | Wide area incident or major incident / 1 TSO |

Source: ENTSO-E Incident Classification Report 2019 on incidents reported by TSOs in 2018

# However, impact of energy transition on the system is a reality

## Zoom on 10 January 2019 significant frequency deviation

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### Graphical Representation of Continental Europe Control Block individual Area Control Error

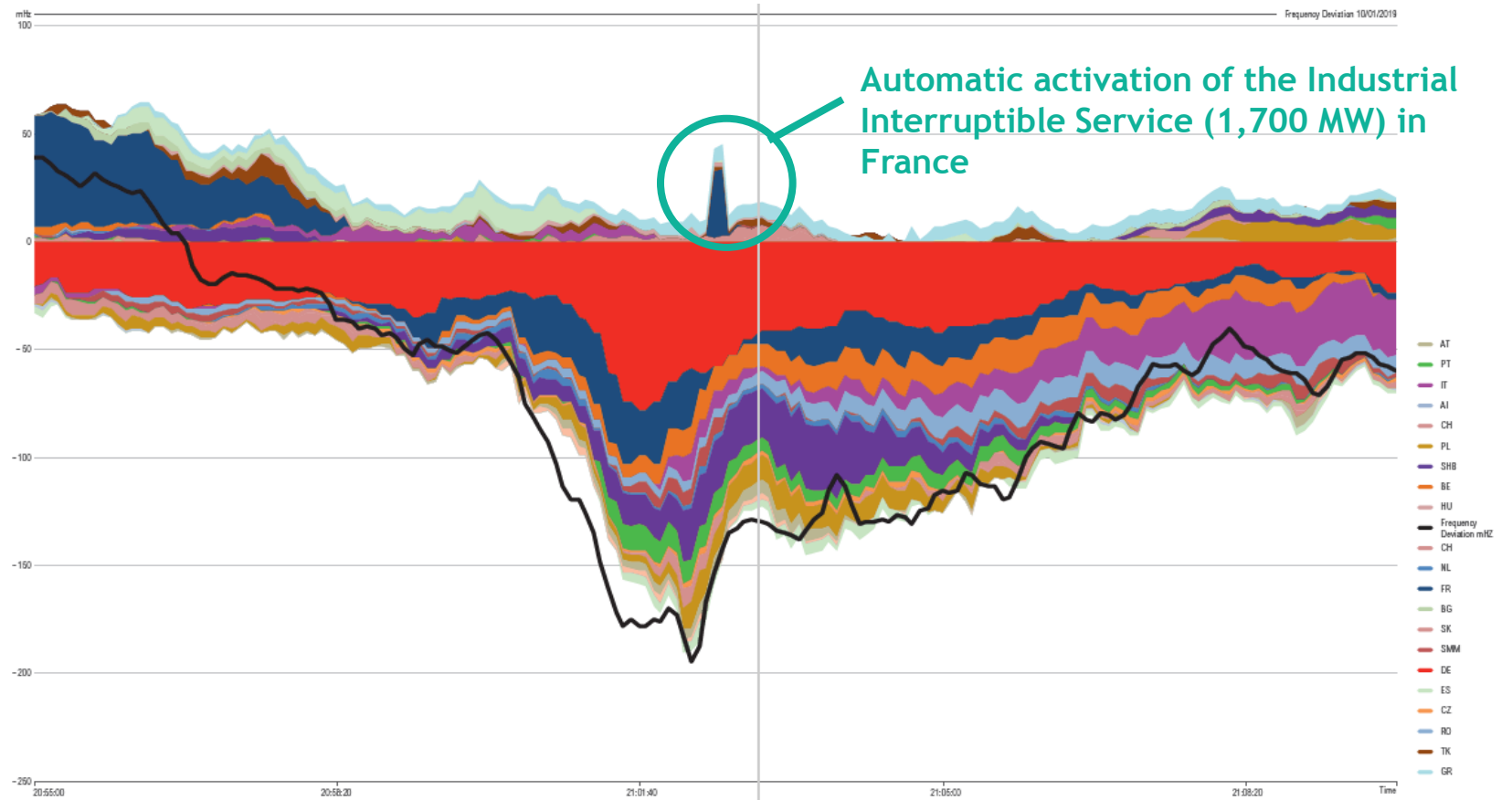



Fig. 3: Graphical Representation of CE Control Block individual ACE (source EAS; German ACE was ex post corrected by the mismatch/error within the TenneT DE controller) contribution from 20:55 to 21:10 on 10 January) contribution from 20:55 to 21:10 on 10 January

Due to their radial connection to the centre of the CE power system the interconnection of the Iberian TSOs, REN and REE, as well as Turkey experienced significance additional

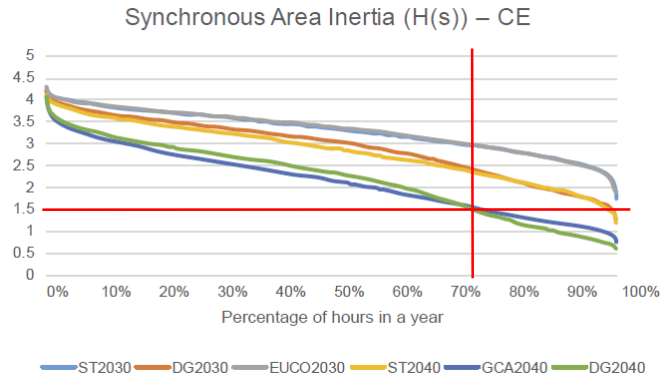
For the interconnection between REE and RTE there was convergence of approx. 4 GW of change in schedules wit an additional 400 MW of flow due to the activation of FC

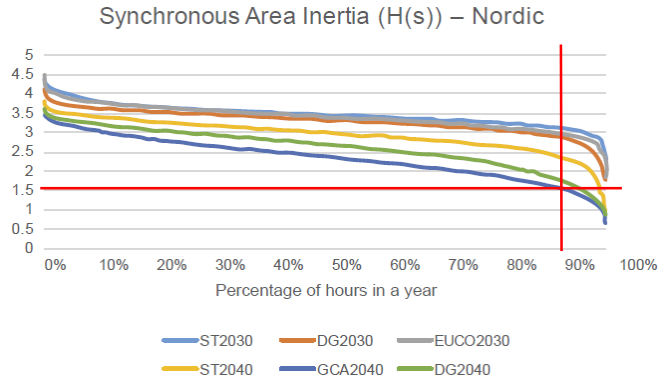
- European power system resilience and solidarity was tested in January 2019
- Fast and coordinated response from TSOs to avoid disconnection of non-interruptible load (violation only lasted 9 seconds)

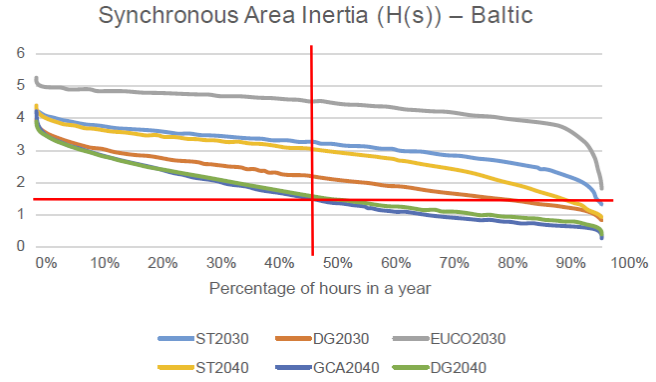
*Source: ENTSOE report on January 2019 frequency deviations*

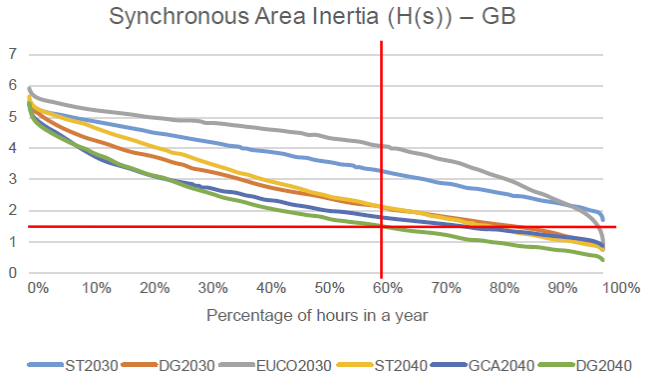
# System 2030/2040 - Inertia as a challenge…

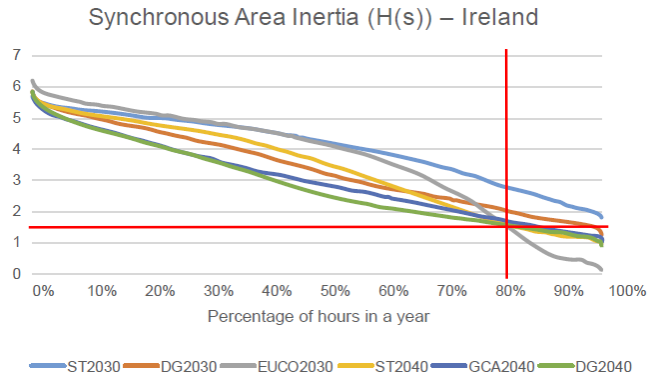
## All Synchronous Areas will become prone to a lack of inertia, which will cause large frequency excursions in cases of relatively low mismatches between generation and demand.




Source: ENTSO-E - TYNDP 2018 System Needs Report: European Power System 2040 – Completing the map

# Phasing out of conventional generation increases the Loss of Load expectation until 2025 in several countries

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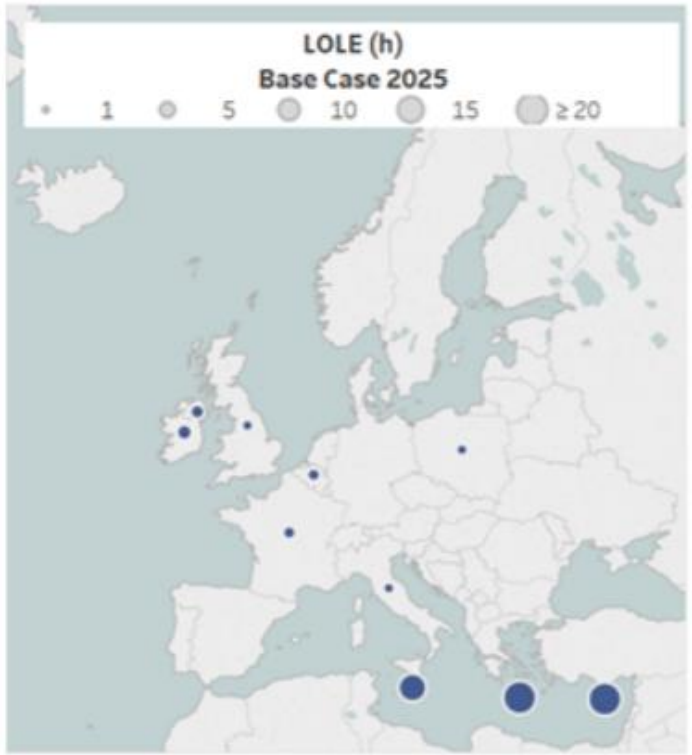
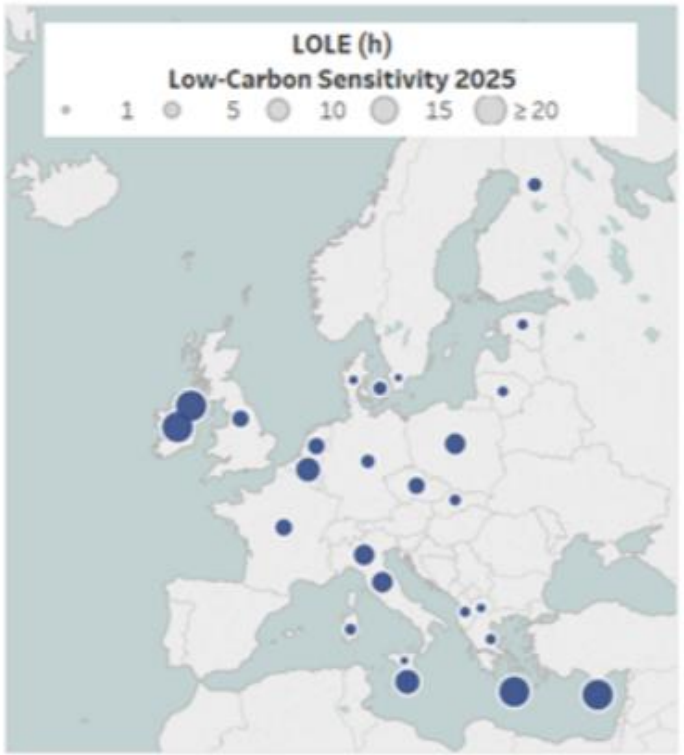
A stress-test scenario with further reduction of conventional thermal generation in 11 countries for 2025

Comparison of LOLE between the base case and the low-carbon sensitivity in 2025. The circles and the corresponding values used in the legends are only indicative and do not cover the whole range of circle radius and LOLE values that are presented in the maps – e.g., in the map circles exist that correspond to values between 1 and 5 h.




Source: ENTSO-E MAF 2018

# TSO deliver successfully five services and will do more in the near future through their Regional Centers

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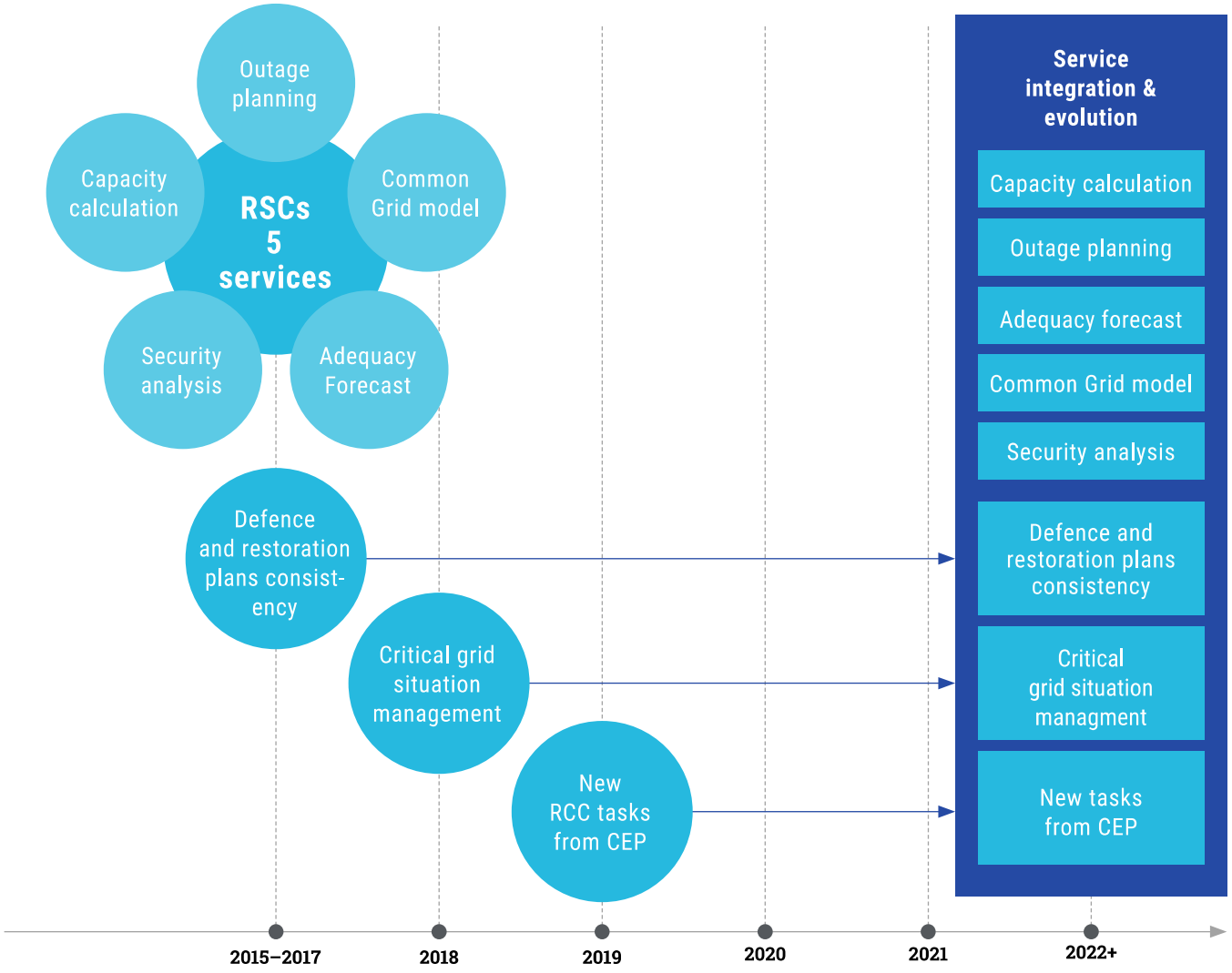
Timeline refers to entry into force and implementation of relevant network codes, all TSO decisions, and CEP regulation.




Source: ENTSOE report Enhanced TSO Regional Coordination for Europe

# Massive physical energy flows across Europe

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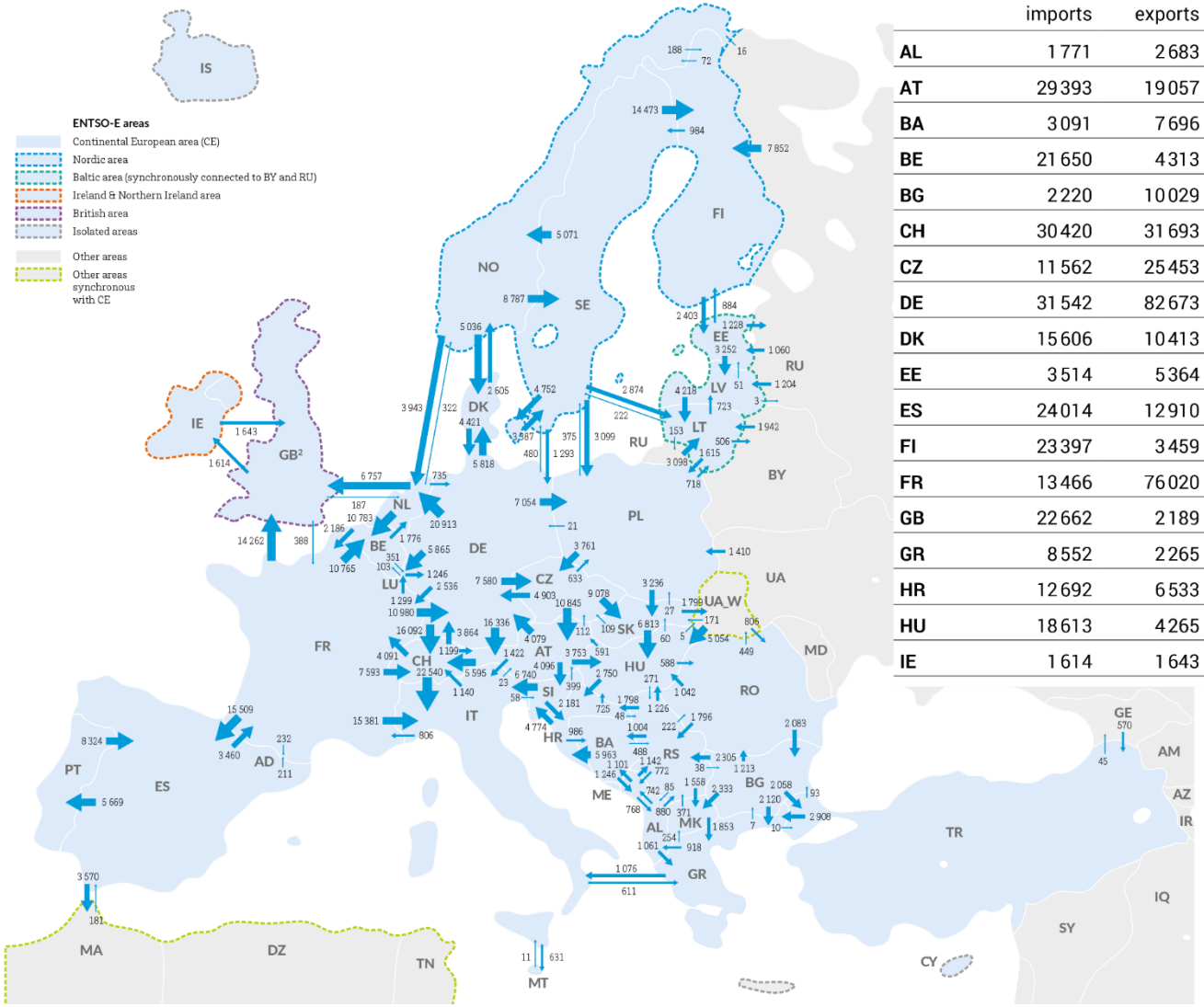
## GWh average over the year




| | Sum of imports | Sum of exports | Balance (imp – exp) |
|---|---|---|---|
| AL | 1 771 | 2 683 | −912 |
| AT | 29 393 | 19 057 | 10 336 |
| BA | 3 091 | 7 696 | −4 605 |
| BE | 21 650 | 4 313 | 17 338 |
| BG | 2 220 | 10 029 | −7 809 |
| CH | 30 420 | 31 693 | −1 274 |
| CZ | 11 562 | 25 453 | −13 891 |
| DE | 31 542 | 82 673 | −51 131 |
| DK | 15 606 | 10 413 | 5 193 |
| EE | 3 514 | 5 364 | −1 850 |
| ES | 24 014 | 12 910 | 11 104 |
| FI | 23 397 | 3 459 | 19 938 |
| FR | 13 466 | 76 020 | −62 554 |
| GB | 22 662 | 2 189 | 20 473 |
| GR | 8 552 | 2 265 | 6 288 |
| HR | 12 692 | 6 533 | 6 160 |
| HU | 18 613 | 4 265 | 14 348 |
| IE | 1 614 | 1 643 | − 29 |

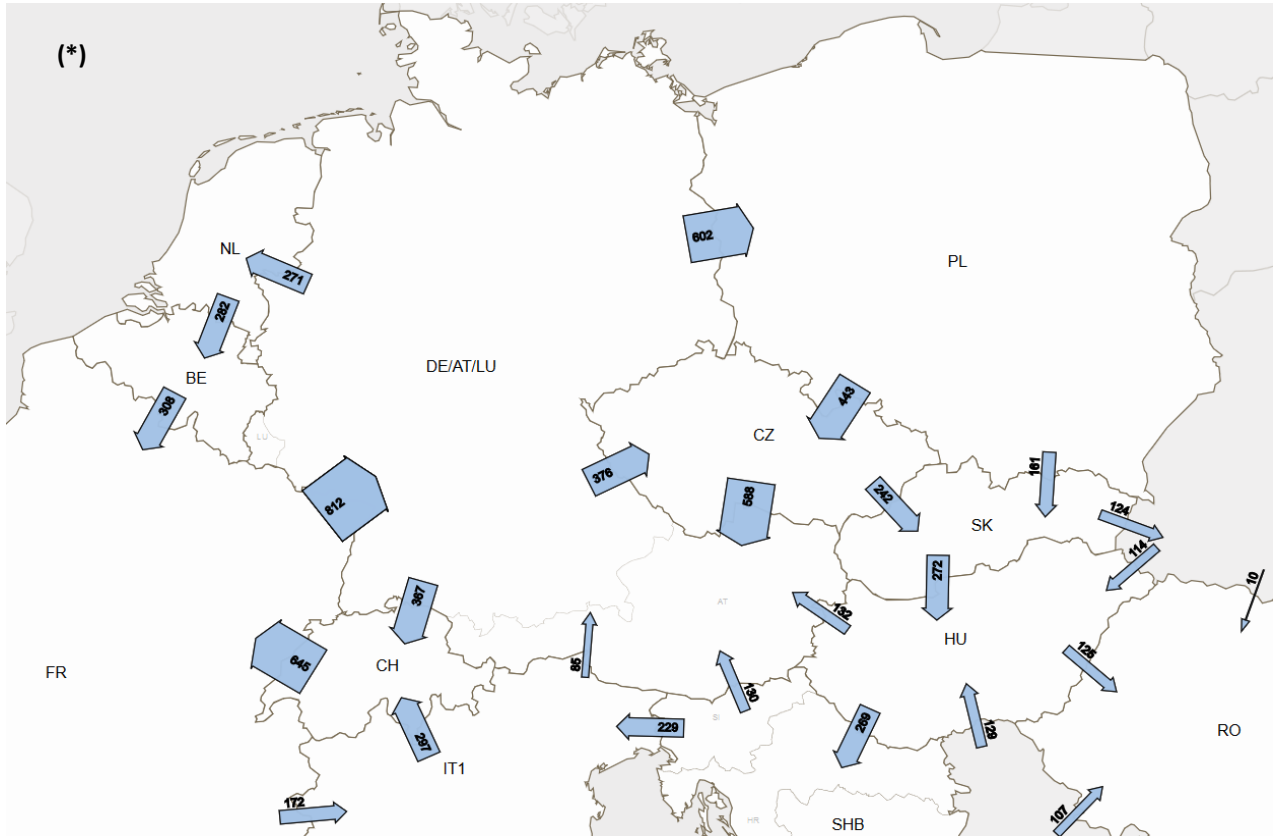
| | Sum of imports | Sum of exports | Balance (imp – exp) |
|---|---|---|---|
| IT | 47 169 | 3 268 | 43 902 |
| LT | 12 850 | 3 219 | 9 631 |
| LU | 7 514 | 1 349 | 6 166 |
| LV | 5 179 | 4 272 | 907 |
| ME | 2 760 | 3 011 | −251 |
| MK | 4 144 | 2 224 | 1 921 |
| NL | 26 818 | 18 596 | 8 223 |
| NO | 8 085 | 17 954 | −9 869 |
| PL | 13 839 | 8 121 | 5 718 |
| PT | 5 669 | 8 324 | −2 655 |
| RO | 2 829 | 5 370 | −2 541 |
| RS | 7 300 | 6 703 | 597 |
| SE | 14 234 | 31 561 | −17 328 |
| SI | 8 928 | 9 320 | −392 |
| SK | 12 544 | 8 747 | 3 797 |
| TR | 2 638 | 3 046 | −408 |
| **ENTSO-E** | **458 274** | **443 734** | **14 540** |

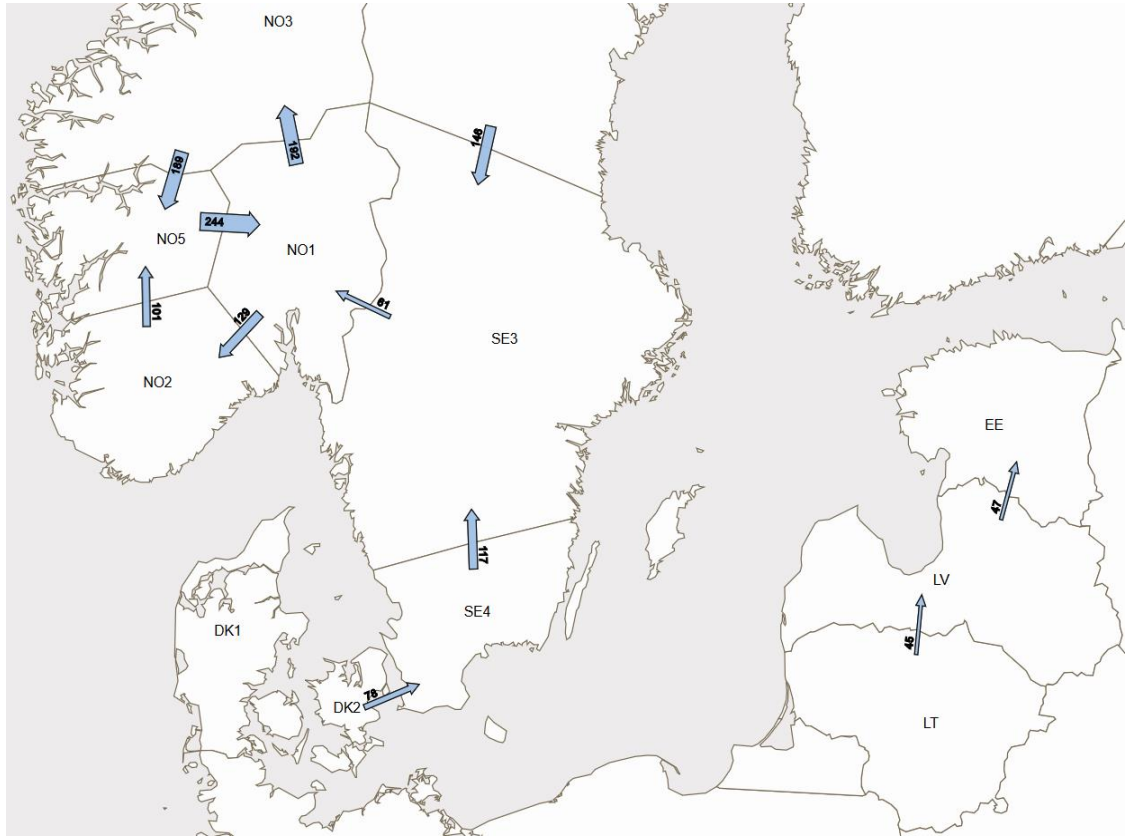
Physical flow values in GWh

Source: ENTSO-E Statistical Factsheet 2018

# Flows not resulting from the capacity allocation

## (loopflows and unscheduled flows)



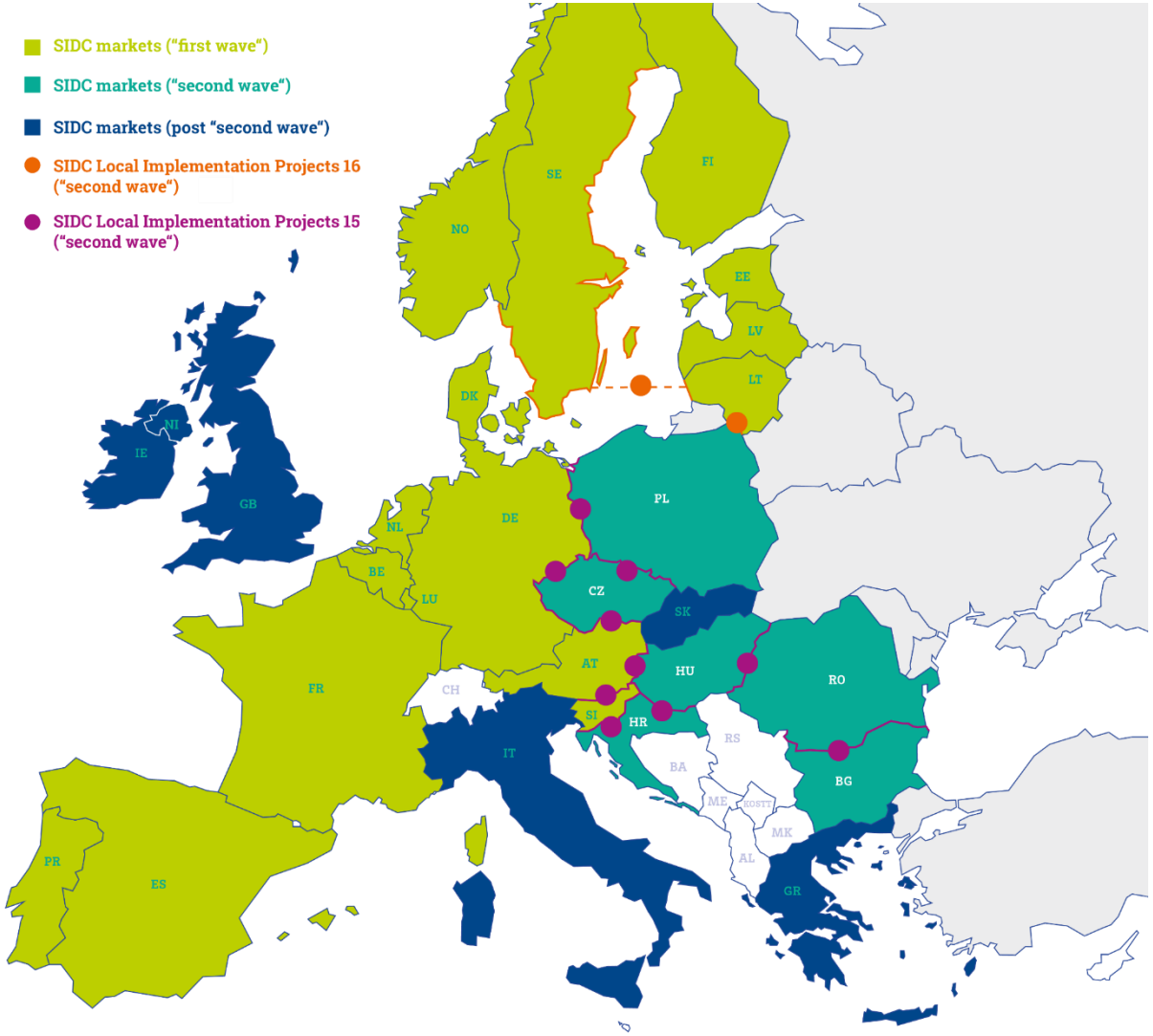




- Commercial transactions are physically realised by power flows distributed in the grid as per the law of physics
- Those power flows also include loopflows and unscheduled flows which cannot be ignored

*Average PTDF Flow Indicator for 2017 (in MW)

Source: ENTSO-E Bidding Zone Technical Report 2018

# Market integration: the Single Intraday Coupling




Current state-of-play of SIDC with the different waves depicted (as of July 2019)

XBID

The SIDC was implemented through the **XBID (Cross-Border Intraday) project.**

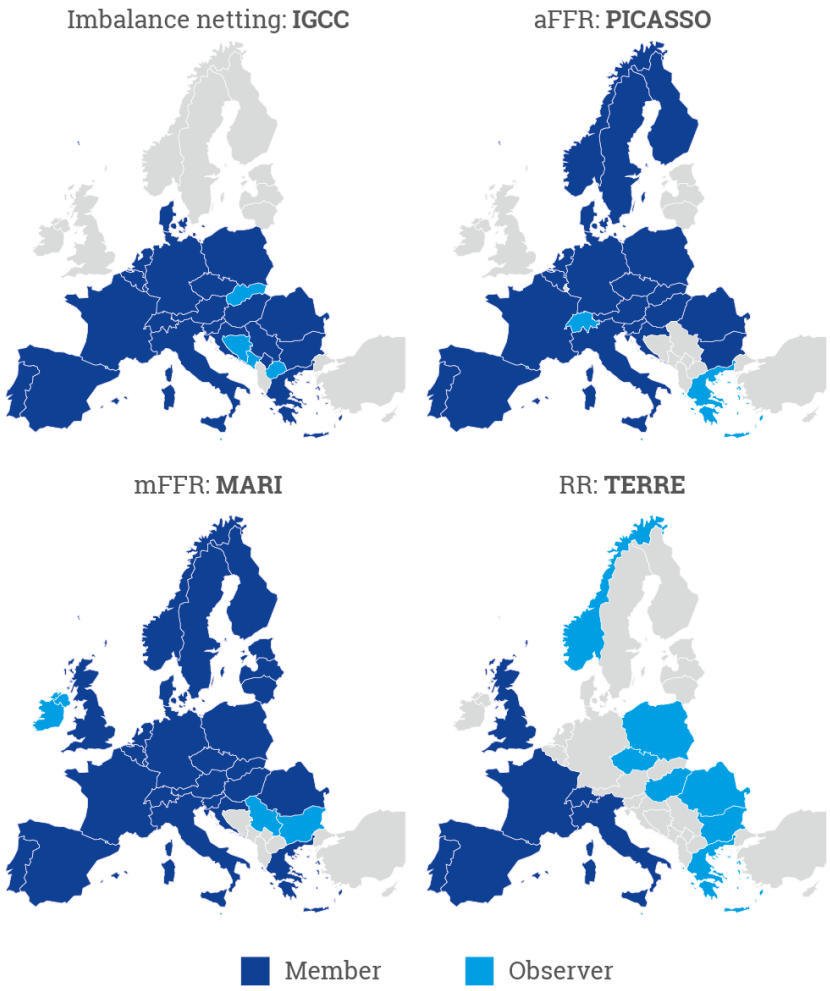
The **first go-live in June 2018** included 14 countries: Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, Norway, The Netherlands, Portugal, Spain and Sweden.

**Second go-live in November 2019** with 7 further countries – Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania and Slovenia.

*Source: ENTSO-E MARKET REPORT 2019*

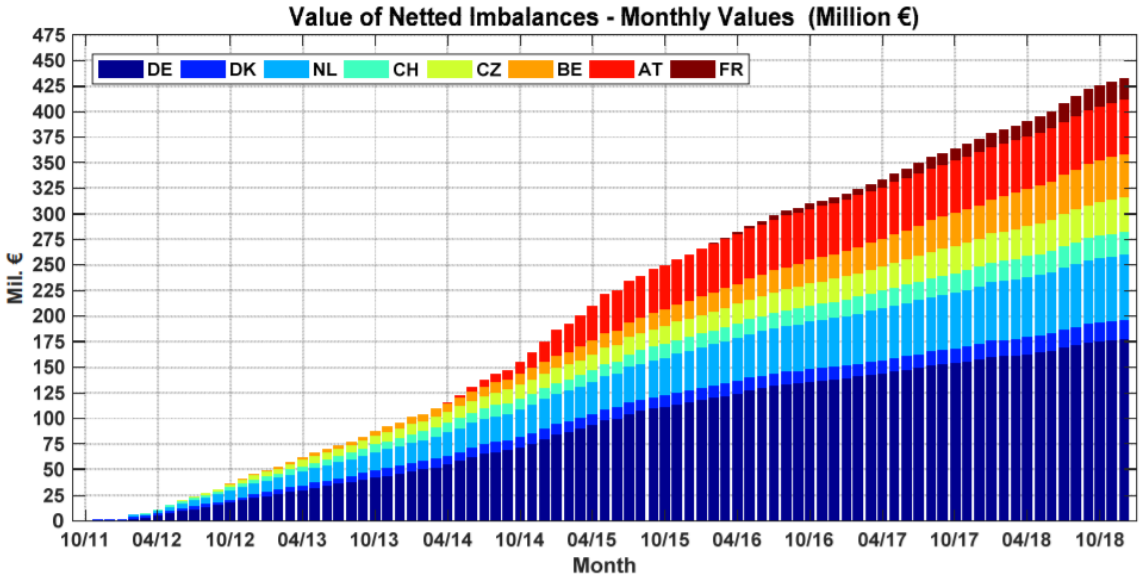
Source: ENTSO-E Market Report 2019

# Market integration: Balancing markets




**Major milestone** achieved in 2018 in integrating balancing markets: TSOs submitted **eight proposals** establishing the high-level design of European platforms for the exchange of balancing energy products and for the imbalance netting process.

**Substantial savings** for consumers: the cumulative value of netted imbalances for 2018 through IGCC amount to approx. EUR 60 million.



# TSO-DSO flexibility projects and integrated system management are a reality all across Europe and deal with markets, technical solutions, data management and aggregation

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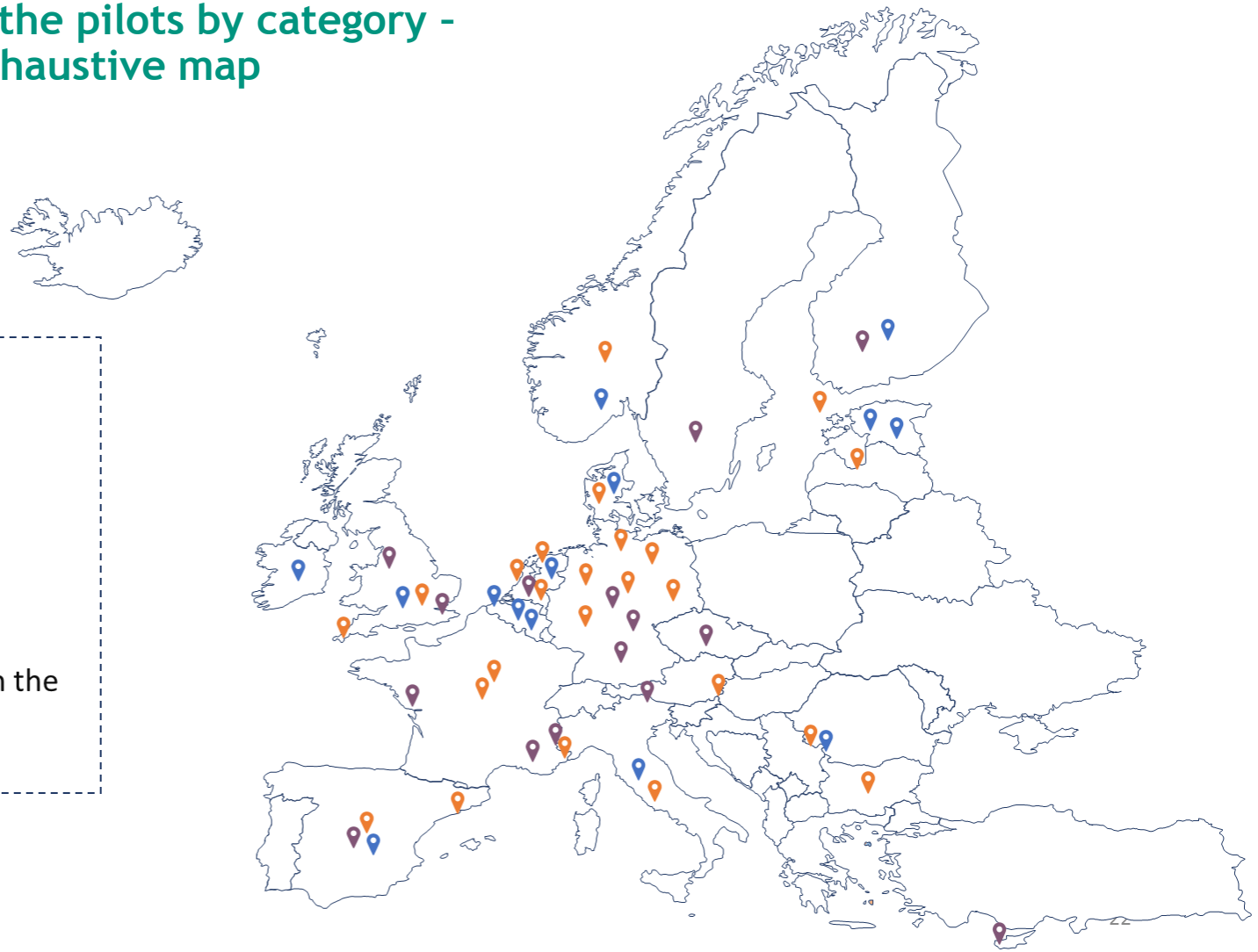
## Geographical scope of the pilots by category - illustrative and non-exhaustive map



Categories of the pilots:

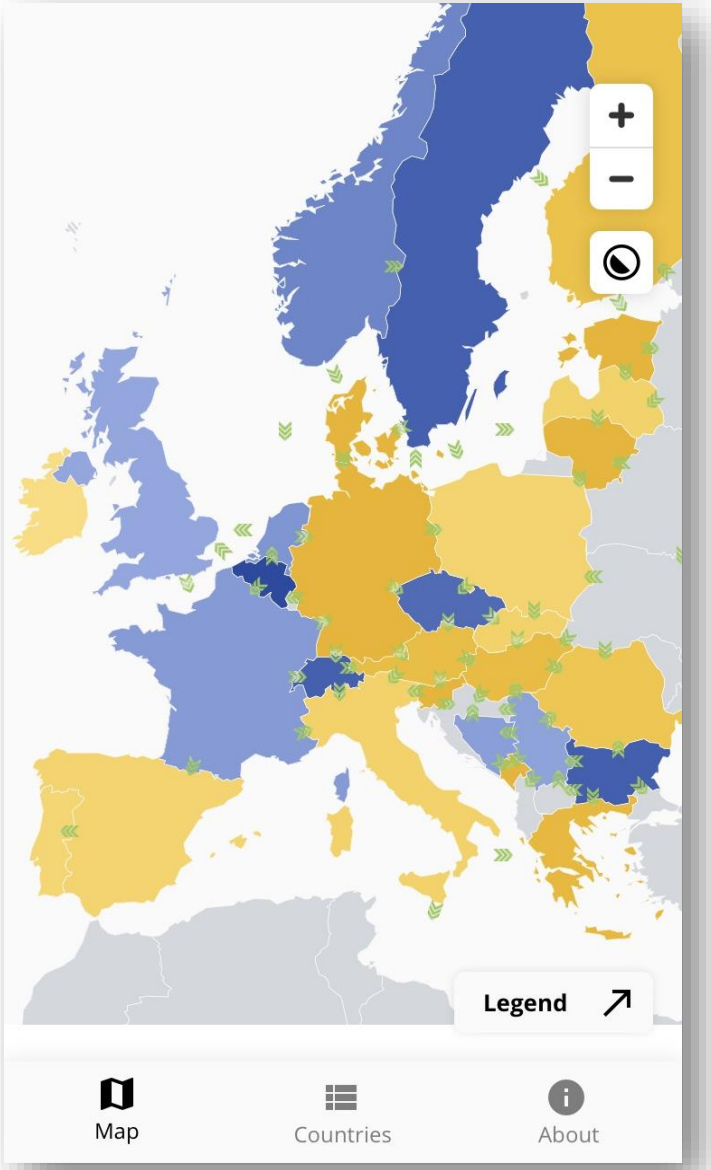
- Flexibility Market Places
- Data Exchange
- Technical Solutions
- Assets aggregation (not in the map as covering all European countries)

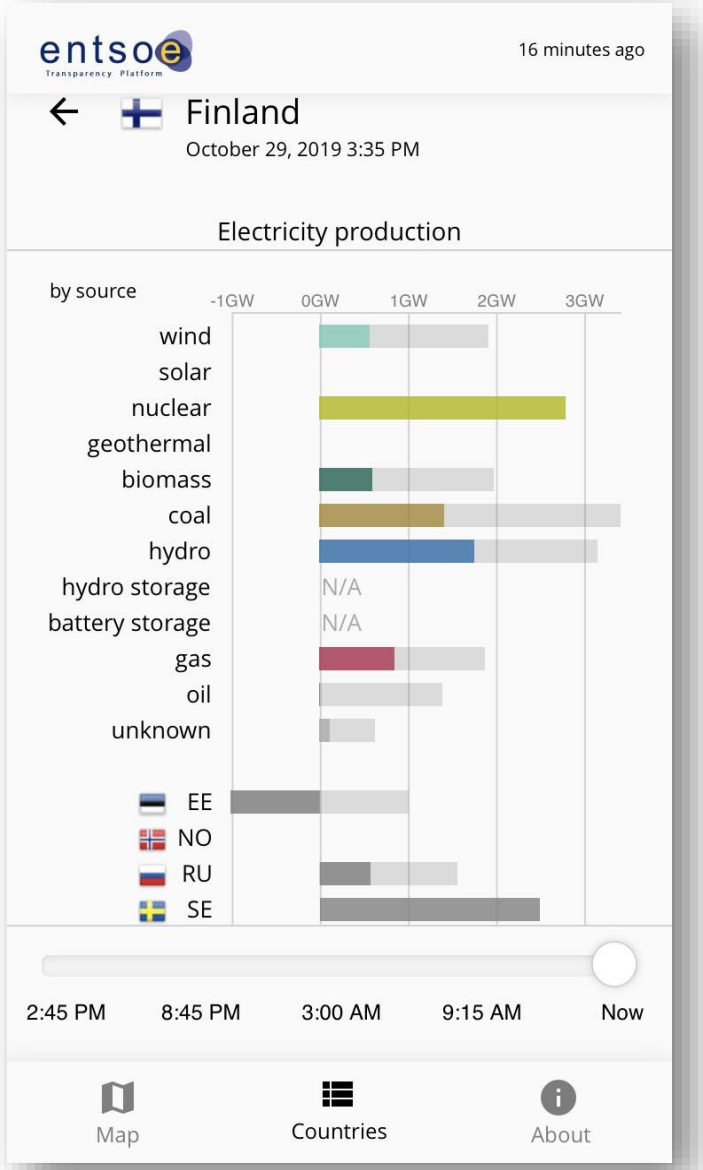
Source: ENTSO-E

# ENTSO-E Transparency Platform App

Live access to a summary of the data from the ENTSO-E Transparency Platform:

- Generation mix
- Cross-border physical flows
- Day-ahead prices



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# POWERFACTS EUROPE 2019

Download the full report on

www.entsoe.eu/data

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Presentation

# Toward smart regulation and governance for efficient infrastructure development

ENTSO-E 10 Years Anniversary Conference

*Fabien Roques, Executive Vice President and Head of Energy Practice, Compass Lexecon*

**Helsinki, 13 November 2019**

# CONTENTS

# 1. Introduction to Compass Lexecon

# FTI – COMPASS LEXECON AT A GLANCE

FTI Consulting is a global advisory firm that provides multidisciplinary solutions to complex challenges and opportunities faced by international companies.

## GLOBAL REACH

With over 4,700 employees in 29 countries on six continents, our breadth and depth extends across every major social, political and economic hub across the globe.

## EXPERIENCED PROFESSIONALS

FTI Consulting are trusted advisors with diverse expertise and exceptional credentials serving clients globally including accountants, economists, engineers, former CFOs and strategists.

The Compass Lexecon trademark brings together world-renowned competition and antitrust experts.

## DEEP INDUSTRY EXPERTISE

FTI combines unparalleled expertise and industry knowledge to address critical challenges for clients. Our largest industry groups are:

- **Energy, Power & Products**
- Financial Institutions & Insurance
- Healthcare & Life Sciences
- Real Estate
- Retail & Consumer
- Telecom, Media & Technology

## FACTS AND FIGURES

| | | |
|---|---|---|
| 1,300+ Clients served | 3 Nobel laureates | AMCF Association of Management Consulting Firms<br>2012 award for corporate strategy<br>FTI Consulting was rewarded for its support in the redesign of The E.W. Scripps Company's newspaper business model |
| 700+ Industry experts | 1982 Year founded | |
| $2 BLN Market capitalisation | | FCN Publicly traded – NYSE |

# FTI – COMPASS LEXECON IS A LEADING ADVISORY FIRM FOR ECONOMIC AND POLICY ANALYSES IN EUROPE

## Services provided by FTI-CL Energy

- FTI-CL Energy is the cooperation of energy experts from FTI Consulting and its wholly-owned subsidiary Compass Lexecon, bringing together highly experienced economists, accountants and industry practitioners.

FTI CONSULTING + COMPASS LEXECON → FTI CONSULTING COMPASS LEXECON ENERGY

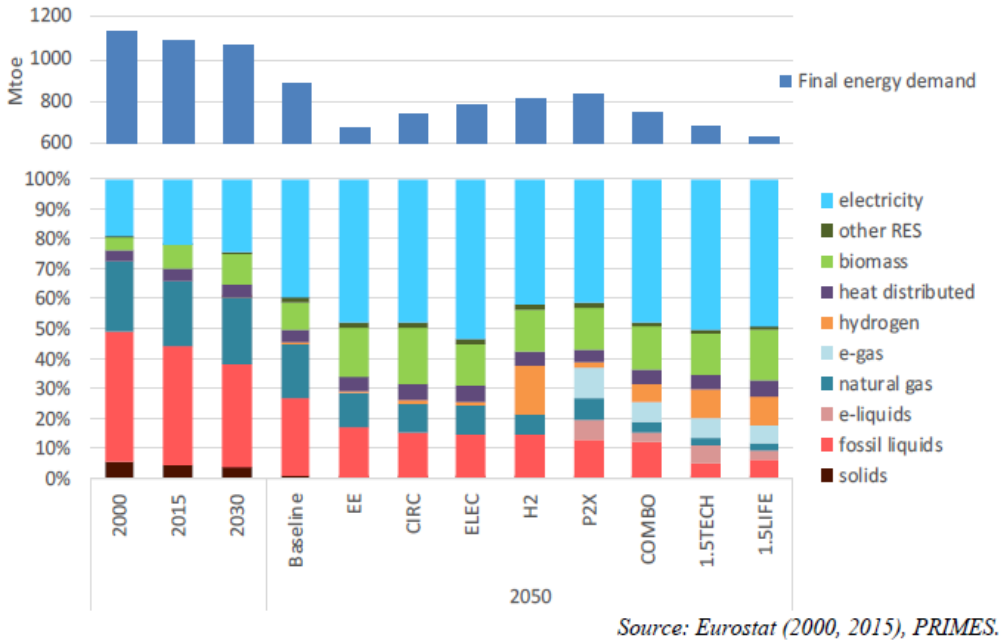
- FTI-CL Energy's experts support their clients on a wide range of assignments.
  - **Policy and market design**
  - Investment decision support
  - **Energy markets modelling**
  - Financial valuation of assets
  - Business model development
  - **Corporate strategy design**
  - Economic expertise in commercial litigations

## Selection of FTI-CL Energy's clients in the energy sector

# 2. Key regulatory and governance challenges

# INTRODUCTION: DEEP UNCERTAINTY ON ENERGY VECTORS AND ASSOCIATED INFRASTRUCTURE NEEDS FOR DECARBONISATION

**Share of energy carriers in final energy consumption in European Commission 2050 scenarios**




*Source: European Commission (2018). A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy. European Commission, November 2018.*

**Several possible pathways** depending on technology developments and choice of energy vectors:

- **Electrification to different degrees**, with debate on role of other possible energy vectors: Green gas, Hydrogen, etc.
- **Use of existing infrastructures and need for new infrastructures** different depending on scenario
- Deep **uncertainty for infrastructure planning** and risk of stranded assets

# AVOIDING STRANDED ASSETS IN THE ENERGY TRANSITION: POTENTIAL MITIGATION STRATEGIES

Energy market operators can take a number of steps to limit the risks of stranded assets:

- Work with regulators and policy makers to **design efficient energy transition policies** and **anticipate the impact of regulatory interventions** on assets revenues, for instance mechanisms that decouple / insulate asset revenues and utilization and/or risk sharing mechanisms with regard to policy / regulatory changes

- **Cut operating costs** and **accelerate depreciation schedule** for existing assets, renegotiate or buy out expensive long term contacts

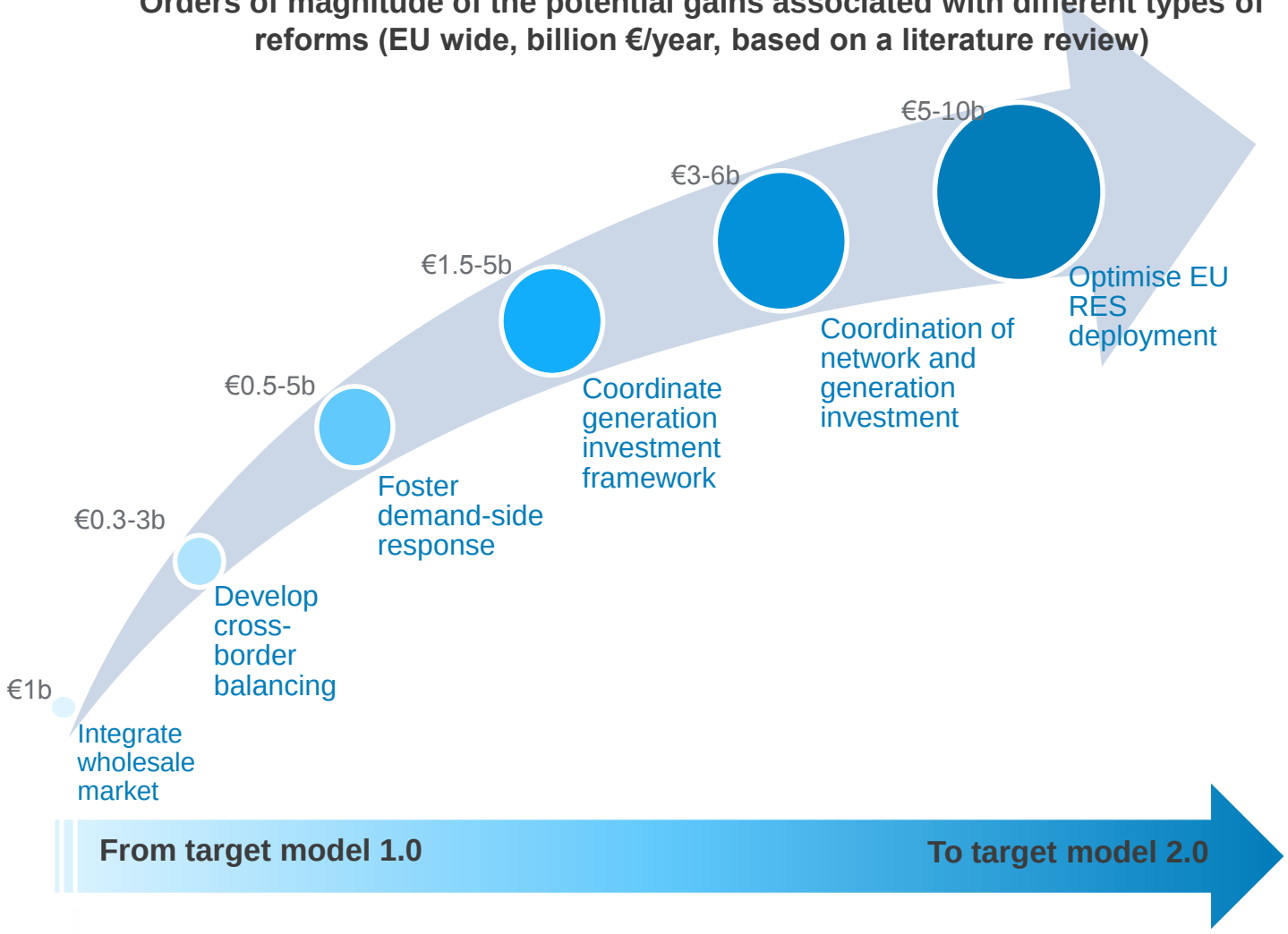
- Strategy for new investment should factor in risk of regulatory / policy change, eg. **favor investments with fast payback** and with **flexibility / optionality providing resilience** across different possible future regulatory pathways (c.f. recent investment in small and scalable technologies)

# PLANNING INFRASTRUCTURE DEVELOPMENT: IDENTIFY ‘LOW REGRET OPTIONS’

| Traditional approach to planning | | Desirable characteristics of new approach |
|---|---|---|
| • Indicative planning on a sector basis (electricity, gas, transport, etc.) | → | • Integrated / cross sector planning with holistic approach |
| • Mix of uncoordinated planning processes at the national and European levels | → | • Coordination of planning at different geographic levels (local, regional, European) |
| • Limited account of uncertainty given know technology paradigms – central scenario and alternatives / sensitivities | → | • Approach factoring in uncertainty and path dependency |
| • Authorization / public support largely decided based on CBA | → | • Identify ‘low regret options’ and minimize potential stranded costs |

# FURTHER MARKET INTEGRATION REQUIRES COORDINATION OF POLICIES ON KEY ISSUES

**Orders of magnitude of the potential gains associated with different types of reforms (EU wide, billion €/year, based on a literature review)**





114

# SMART INFRASTRUCTURES NEED SMART REGULATION: APPROACHES TO SUPPORT INNOVATION AND COORDINATION

### Lack of vertical and horizontal coupling of policies and regulations

- Lack of coordination between electricity and gas regulations
- Insufficient coordination of ‘downstream policies’ for e.g. buildings and transport sectors with upstream energy policies
- Lack of coordination between energy regulator and buildings / transport regulatory agencies

→

- Reinforce governance framework for regional cross sector policy coordination (policy regions)
- Revisit mandate and foster coordination of regulatory agencies on regional basis

### Incentives for TSOs / DSOs

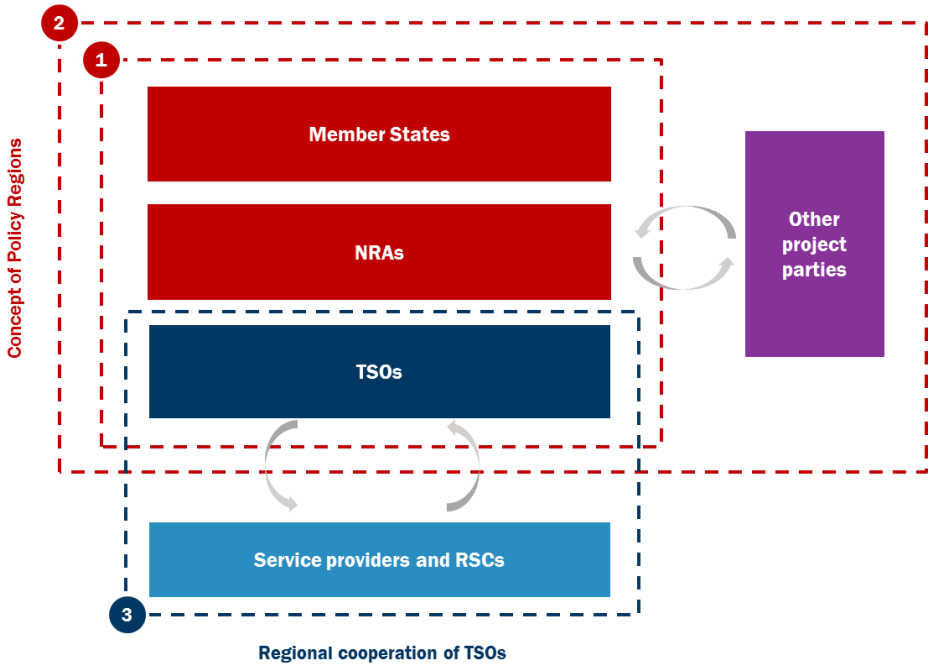
- Traditional regulatory approaches do not foster innovation and cross sector cooperation
- Electricity / gas system operators incentivised based on their own sector KPIs

→

- Implement regulatory approaches supporting innovation (e.g. incentive / output based regulation)
- Definition of sector coupling KPIs and related incentives for regulated companies
- “Sandbagging” where relevant to unleash regulatory innovation

# GREATER COORDINATION OF POLICIES AND REGULATION IS NEEDED BOTH AT REGIONAL AND LOCAL LEVELS

**Multi stakeholder "policy regions"**



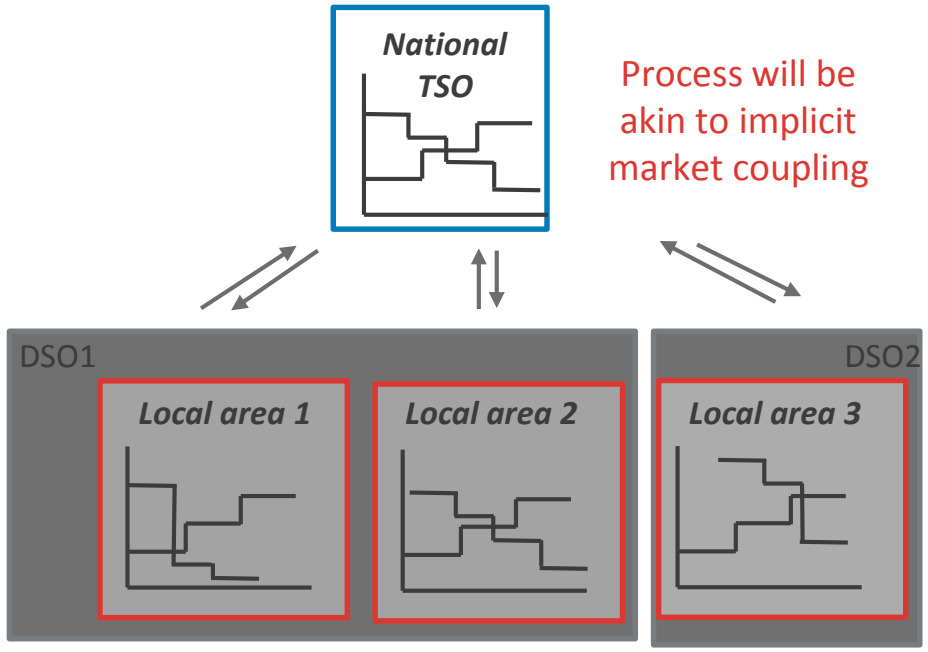

*Source: Fabien Roques and Charles Verhaeghe (2016). Options for the future of power system regional coordination, FTI-CL Energy report for ENTSOE*

**Governance needs to foster closer coordination of policies and regulations at different levels**

- **At the European and regional level:**
  - Regional bodies in key 'policy regions' to coordinate across neighboring countries key policy decisions affecting the common energy market and deployment of critical infrastructures and be articulated with role of the pan European existing bodies ACER and ENTSO-E/G
- **At the local level:**
  - Local consultation and coordination processes to be implemented both in urban as well as in rural areas at the relevant scale, with a view to engage the relevant stakeholders into a set of indicative coordination and planning processes for the deployment of key infrastructures

# LOCAL FLEXIBILITY MARKETS ARE A PROMISING WAY FORWARD, BUT RAISE CHALLENGES FOR TSO / DSO COORDINATION

**Example of a potential model of "co-optimised" local flexibility markets with national markets**




Process will be akin to implicit market coupling

**Issues to be addressed around coordination of TSOs / DSOs and approach for coupling of markets at different levels.**

**Current flexibility platform experiments show different approaches:**

NODES

UK Power Networks

enera

GOPACS

# 4. Conclusions

# SUMMARY: NEED FOR INNOVATIONS IN THE GOVERNANCE AND REGULATORY FRAMEWORK FOR AN EFFICIENT TRANSITION

- The **timely development of infrastructure and flexibility** is a prerequisite for an efficient decarbonisation of the power sector…
- … But uncertainty on pathways for decarbonisation makes system planning challenging and could delay some of these necessary **infrastructure investments**
- Further market integration requires **coordination of policies and regulatory frameworks** on key issues at regional and local levels
- Smart grids need smart regulation to foster innovation in **infrastructure planning and regulatory frameworks** for an efficient decarbonisation
  - New planning and investment evaluation methods taking into uncertainty (‘low regret options’) to minimise risk of stranded costs
  - Regulatory framework creating incentives for cross sector planning and sector coupling (vertical and horizontal)
  - Regulatory approaches supporting innovation (e.g. incentive / output based regulation)

# FINAL THOUGHTS: A WINDOW OF OPPORTUNITY TO FAST-TRACK INFRASTRUCTURE DEVELOPMENT IN EUROPE?

*"At present there is a global and structural need for infrastructure investment of nearly 7 trillion dollars per year, taking into account the energy transition in addition to traditional investment requirements.*

*Paradoxically, the investment gap is growing at a time when governments can obtain long-term financing at very low, even negative, rates."*

*Laurence Boone, OECD Chief Economist (weblink)*

Growing recognition among economists that **monetary policy is reaching its limits in stimulating economic growth… and that investment in infrastructure can be an efficient way to support the economy at times of low / negative interest rates.**

⇒ **Opportunity to scale up investments in infrastructure and deliver on Europe's climate ambitions**

# THANK YOU FOR YOUR ATTENTION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# Session 3: The future energy system: a 2030 horizon

An evolving grid: A Technology Perspective

**Claudio Facchin**

President, Power Grids business, ABB

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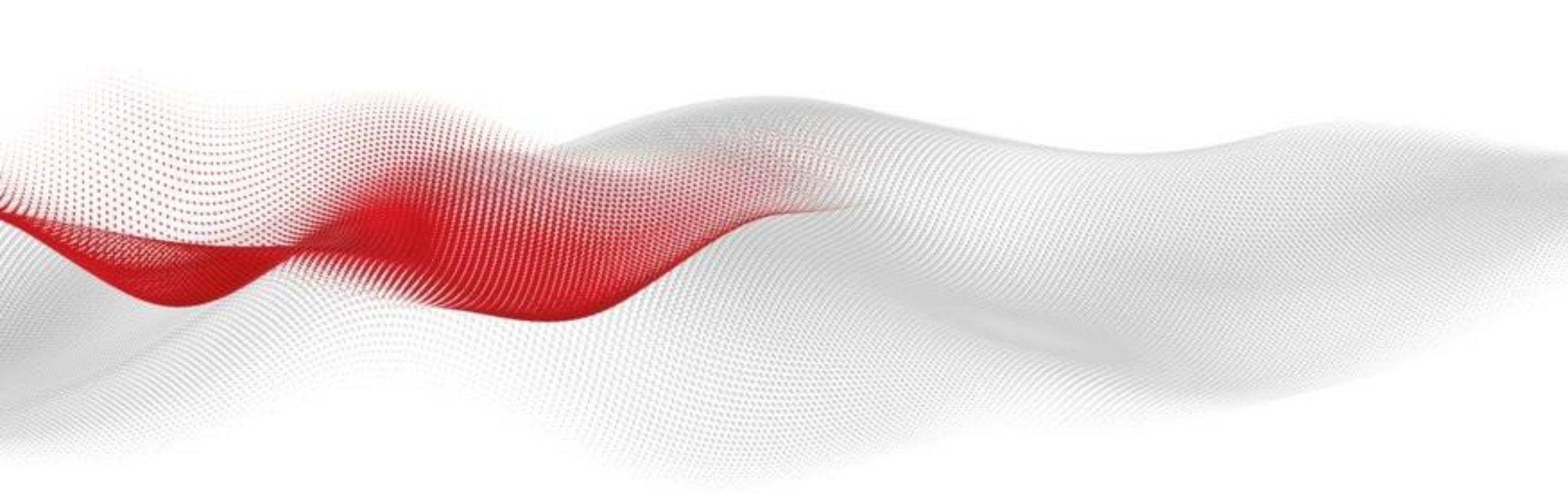


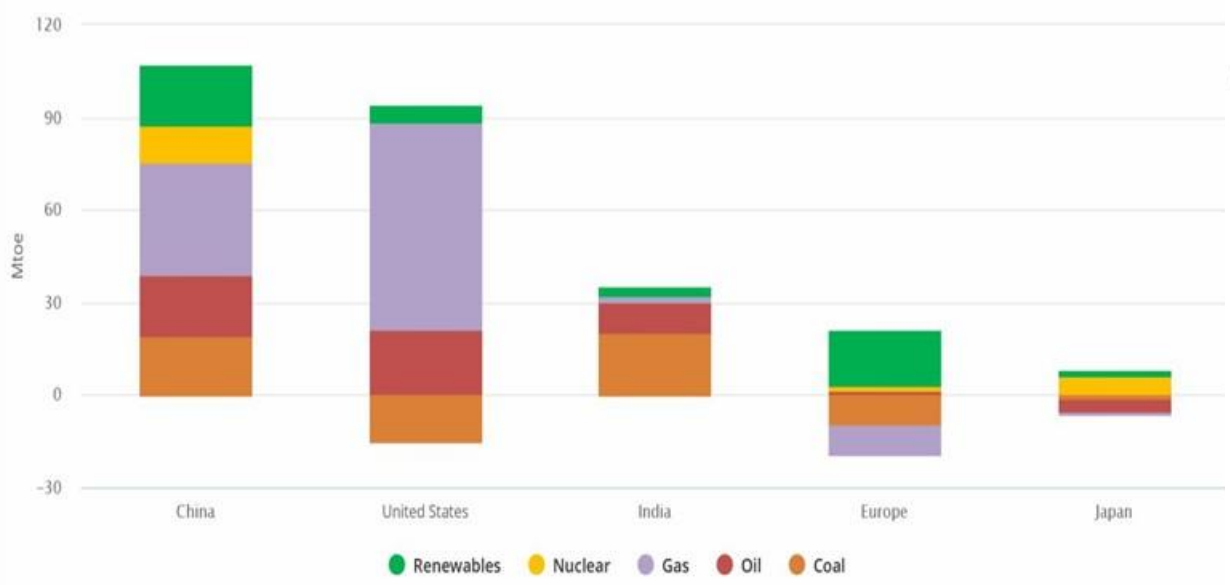
ENTSO-E, HELSINKI, FINLAND, NOVEMBER 13, 2019

# Enabling a stronger, smarter and greener grid

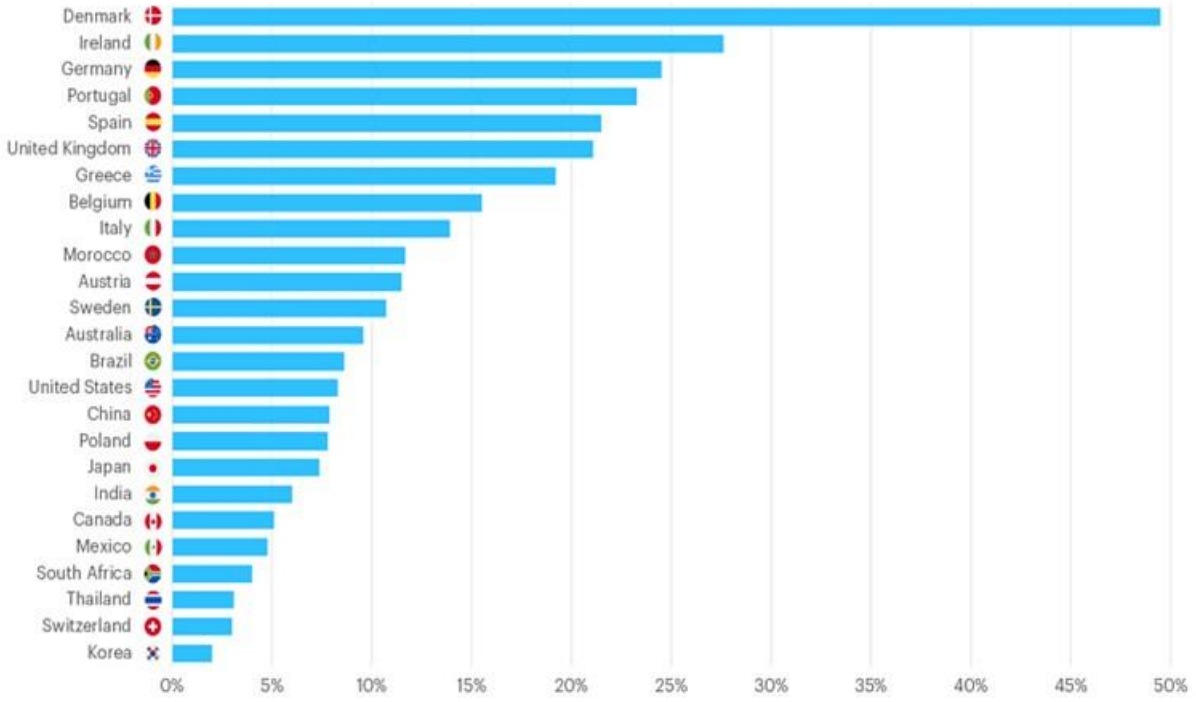
Claudio Facchin, President, ABB Power Grids

# The global energy mix is changing rapidly and renewables are on the rise

**Primary energy demand growth by fuel in major energy markets 2017-18**




**Variable renewable energy share in total electricity generation, 2018**




**Renewable energy was the only energy source to grow globally in every major region**

**9 of the top 10 countries with the highest share of renewables in their energy mix were in Europe**

Source: IEA

# A resurgent ‘Green Wave’ is transforming Europe’s energy system

2050 Climate Neutrality and the Green European Deal

93 percent of Europeans see climate change as a serious issue[1]

The majority of EU countries (plus NO and CH) already endorse the target of climate neutrality by 2050.

The new European Commission will propose a Green Deal in 2020

- Increasing 2030 Green House Gases (GHG) reduction target from 40 to 55 percent
- Pushing for sustainable electrification of transport, buildings
- Guiding European investments towards zero-emission technology

To reach its carbon-neutrality aims, current EU offshore wind capacity of ~20 gigawatts (GW) could rise to ~180 GW becoming the region’s largest single source of electricity.[2]

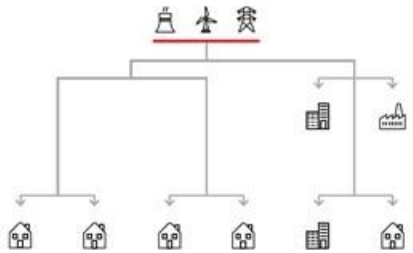
**Climate change mitigation and maximization of renewable penetration calls for a well interconnected European power system**




[1] Eurobarometer Survey 2019
[2] IEA Offshore Wind Energy Outlook Oct 2019

# Global trends and technology are driving the evolution of the grid

## Yesterday

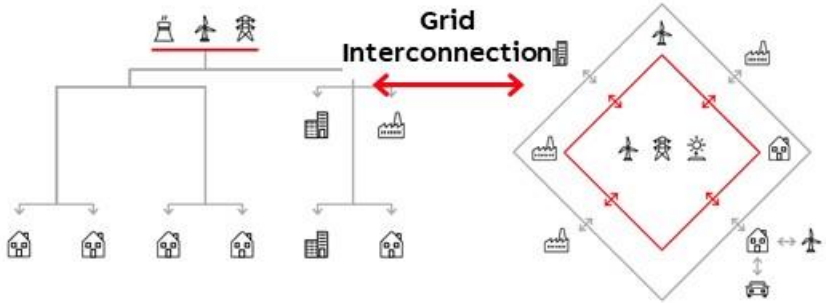


2000

Humans fully in charge

Established principles and processes

## Today

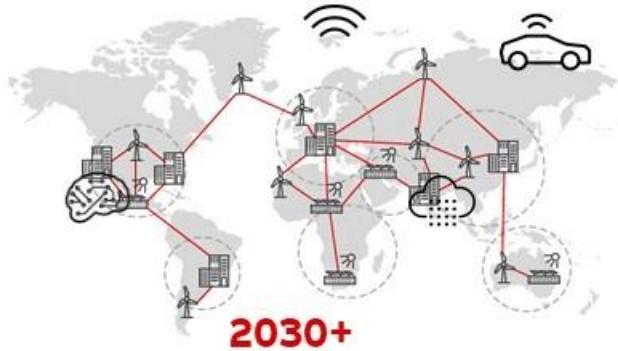



2019

Lack of full control over generation and load

Emergence of autonomous systems

## Tomorrow



2030+

More functionality given to “machines”

Emergence of AI[1] and its influence

**From a few well controlled generating units to a myriad of distributed, autonomous generators and loads**

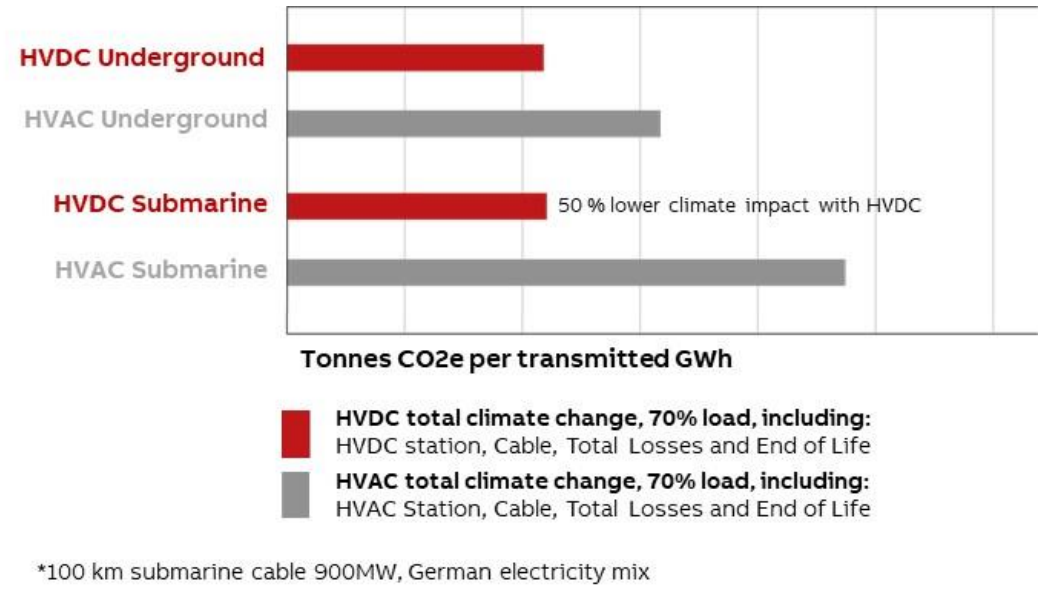


Source: ABB

# The grid is becoming increasingly interconnected

HVDC enables long distance transmission and interconnections with minimum losses

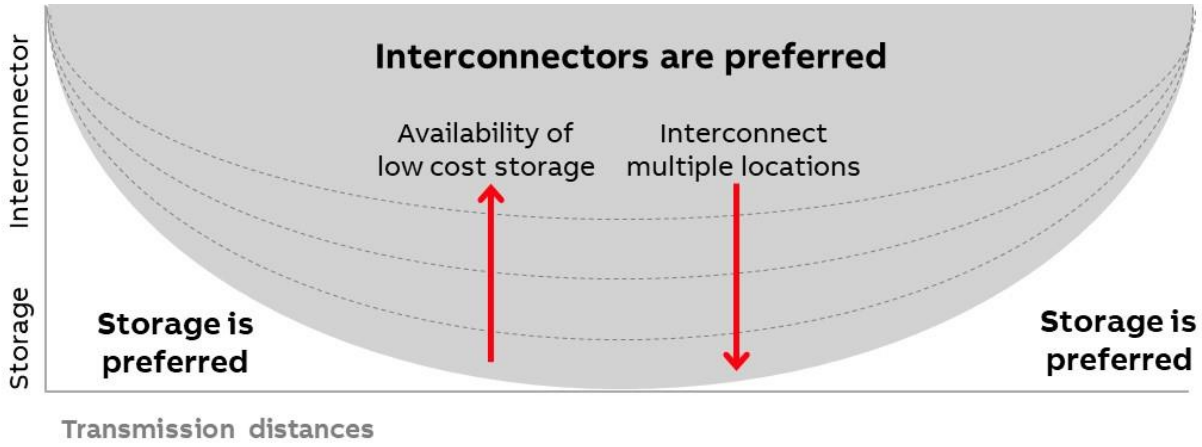
## HVDC brings many environmental benefits




*100 km submarine cable 900MW, German electricity mix

**An HVDC link can reduce climate impact by half* in terms of carbon footprint compared to an AC transmission link, thanks to lower transmission losses**

## Interconnections and Storage are complimentary

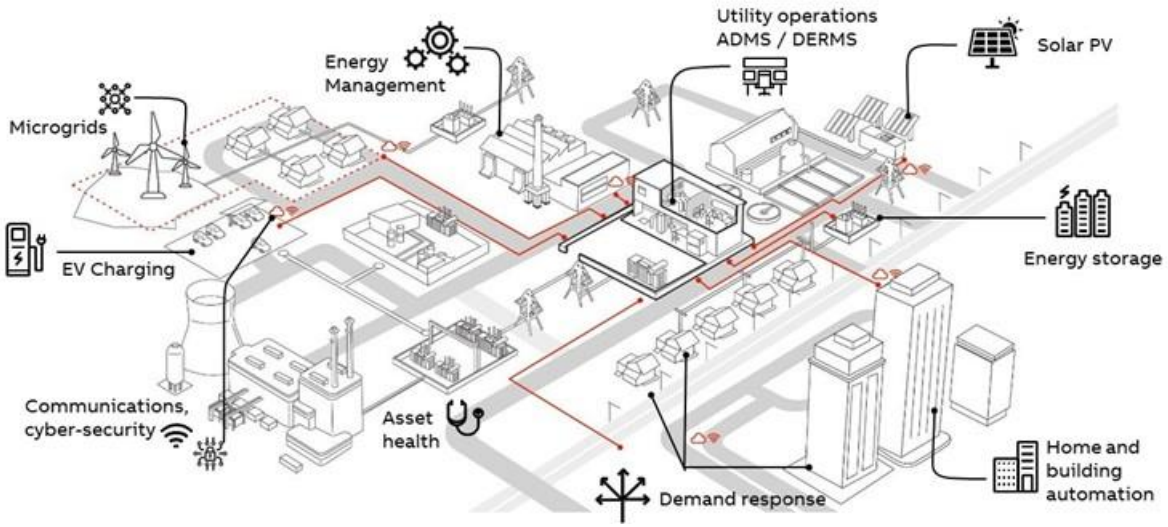




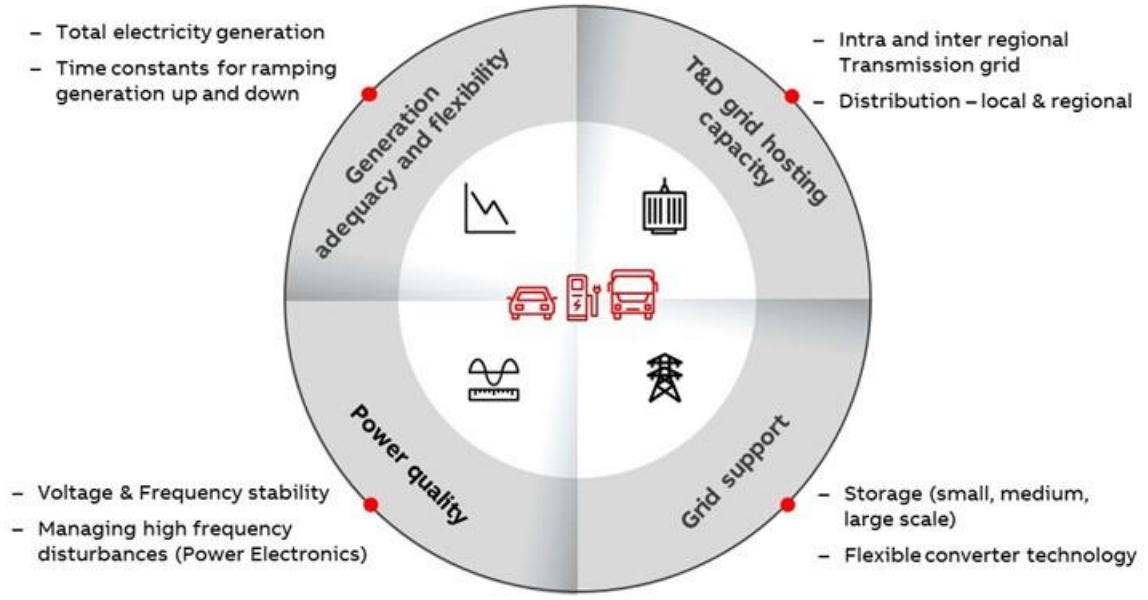

*VSC: Voltage Sourced Converter
kV: Kilovolt ; MW: Megawatt ; km: Kilometer

# Grid Edge Technologies integrate distributed energy and address new loads

## Managing new complexities




## E-mobility impact on the grid



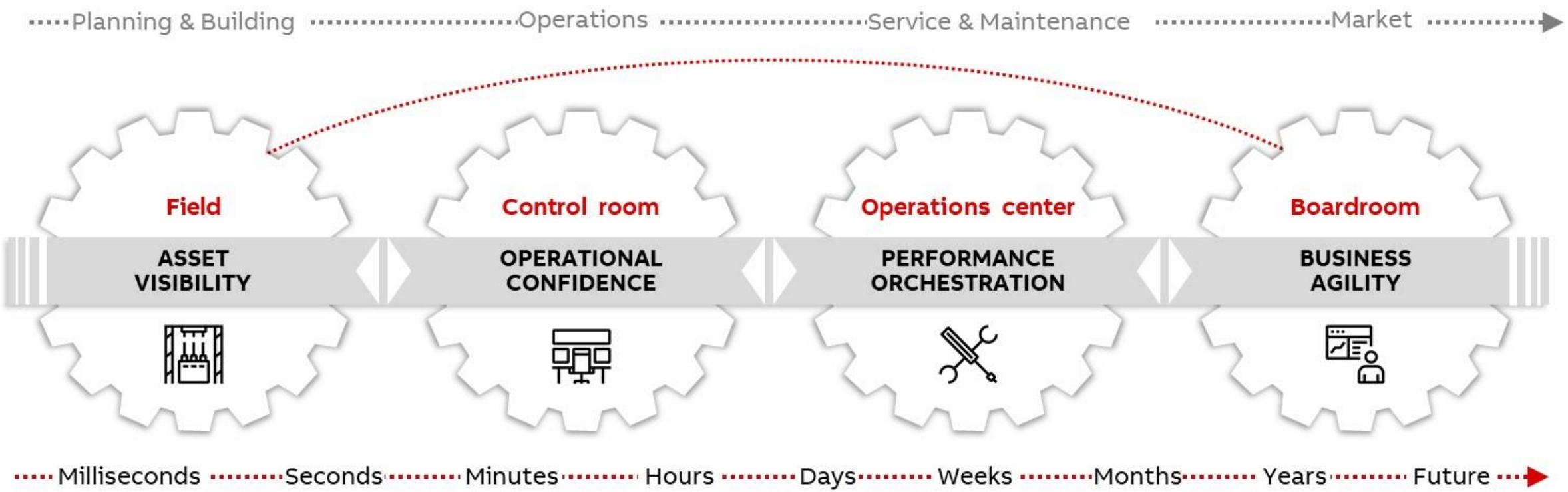




ADMS: Advanced Distribution Management System
DERMS: Distributed Energy Resource Management System
EV: Electric Vehicle

# The fast-changing digital world requires dynamic business operations

Faster decisions and real-time action requires visibility of assets across the business




**Digitalization helps manage new supply and demand dynamics across the value chain in real time**

# Powering the world without consuming the earth

**Electricity sector transformation** is playing a central role in the **Energy Revolution**

This can be achieved through **innovative technologies, digitalization and new business models to enable a more flexible, reliable and efficient T&D[1] grid**

**Collaboration** across stakeholders[2] will be a key success factor to address the growing demand for electricity with minimum environmental impact




[1]Transmission and Distribution
[2]e.g. Governments & policy makers, regulators, utilities, consumers and technology providers

# ABB Power Grids

“Shaping the future of sustainable energy, with pioneering technologies, as the partner of choice for enabling a stronger, smarter and greener grid.”


ABB

Follow the discussion on Twitter @ENTSO_E #10YearAnniversary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# Session 3: The future energy system: a 2030 horizon

## ENTSO-E Vision 2030: Setting the Scene

**Pascale Fonck**

ENTSO-E Vice-Chair of the Board

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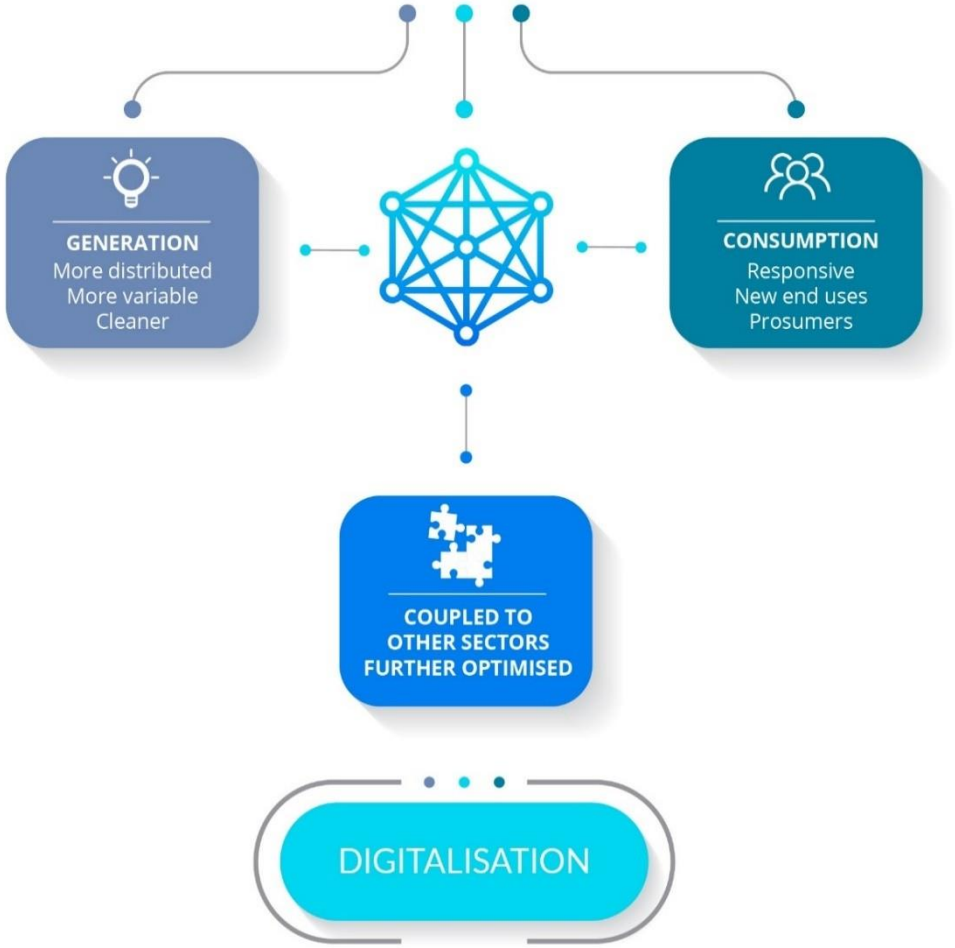
# Major trends in the power sector and new political framework




The European electricity system undergoes significant changes driven by a **strong climate action agenda** and related development of renewable energies.

These changes take place at unprecedented speed and add **further complexity** to system operation and electricity markets, while also offering **new opportunities**.

The Clean Energy Package is an important milestone for this transition. Its timely **implementation is the priority** for TSOs.

ENTSO-E's Vision aims to contribute to the shift of Europe's energy sector from a fossil fuel dominated and supply-centric model to a **clean, digitalised and electrified consumer centric system with many distributed resources**.

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# Session 3: The future energy system: a 2030 horizon

## ENTSO-E Vision 2030: A perspective from Markets, Operations and TSO-DSO

**Damian Cortinas**
System Operation Lead of the ENTSO-E 2030 Vision Project

**Gerard Doorman**
Market Lead of the ENTSO-E 2030 Vision Project

**Tahir Kapetanovic**
ENTSO-E System Operations Committee Chair

**Konrad Purchała**
ENTSO-E Market Committee Chair

**Robert Paprocki**
ENTSO-E Vice Chair, Steering Group, TSO-DSO Interface

**Laurent Schmitt**
ENTSO-E Secretary General

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# How the Vision 2030 was constructed


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# One System 2030 drivers

- **Distributed flexibilities** in future distribution networks with close TSO & DSO alignment
- **Power Electronics** towards hybrid AC / DC systems
- **Markets and Physics** seamlessly integrated within One System
- **Sector Coupling** where operators have pivotal role for “system of systems”, beyond power
- **Mastering future challenges** with resilience, forecast (RES), automation, Artificial Intelligence

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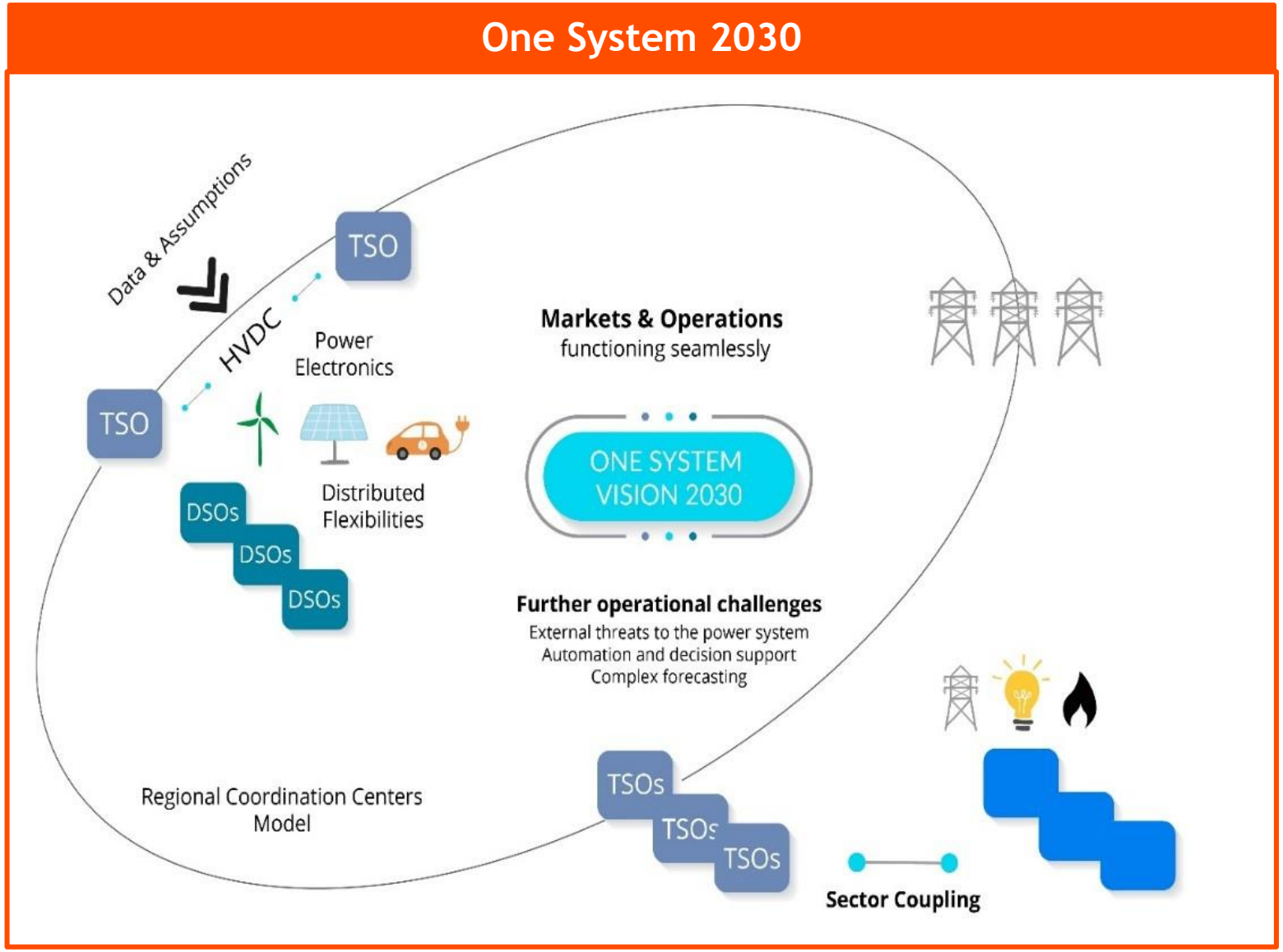
# One System 2030 key elements

- Seamlessly integrated
- Decentralized resources
- New technologies
- Aligned with all connected assets
- Enabling cross-sector coupling

A true System of Systems

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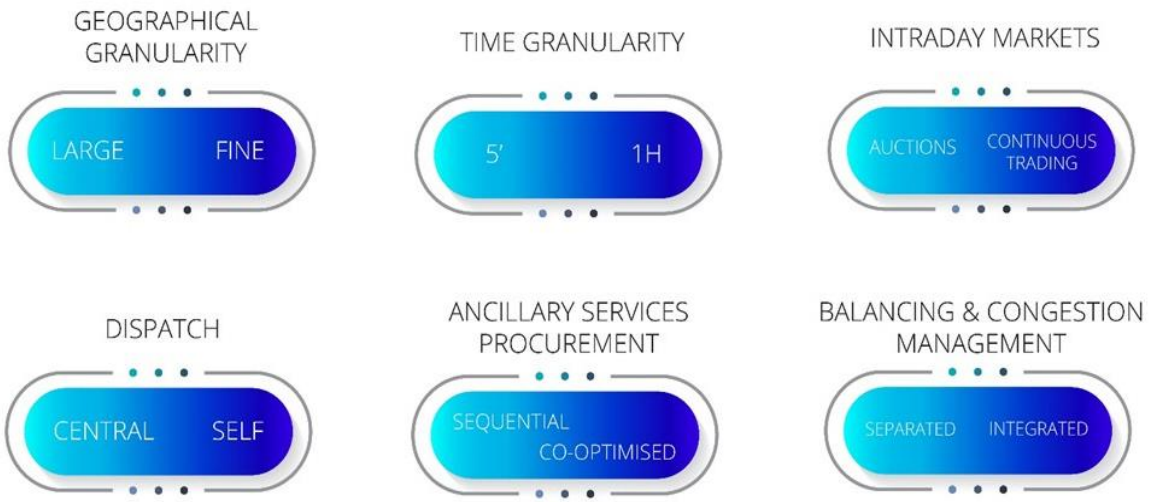
# Market Design 2030 options & recommendations

## no one-size-fits-all: Options*




** Examples of market design options for short term markets and congestion management*

## Recommendations

- No radical market design change
- Focus on CEP implementation: no need to introduce new EU legislation
- Foster efficient Internal European Market
- Solutions depend on national specifics
- Different fit-for-purpose solutions needed to avoid constraining innovation, but ensure preserving the IEM benefits

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# Market Design 2030 common principles

Fit-for-purpose solutions, reducing the gap between market outcomes and physics, enabling whole Europe to meet the 2030 challenges, and preserving the benefits of the IEM:

- Include **stronger locational signals**
- Increase the **locational visibility of resources**
- Enhance **short-term markets** to allow market participants to **trade closer to real-time**
- Facilitate provision of **new (including non-frequency) ancillary services**, in line with the CEP
- Ensure **efficient use of the grid capabilities** and of flexible resources
- Ensure **close TSOs' - DSOs' coordination**

*Solutions for short-term market and congestion management should be part of a holistic market design addressing all 2030 challenges, such as investment price signals and system adequacy*

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# TSO – DSO cooperation: the new chapter

Always in place, nowadays to be significantly adapted in order to cope with new challenges:

- more and more resources necessary for proper operation of power systems, i.e. distributed generation, active load and storages, **connected to distribution networks**
- one way power flow on T&D interface **being replaced by two way traffic**
- volatility of power flows experienced so far on transmission level **moves towards distribution grid**
- congestion management **becomes the issue also at distribution level**
- under deregulated conditions **relevant market design solutions shall cover also distribution level**
- DSOs set up varies among Member States **so will do future solutions for T&D interface, also**
- some guidance at European level recommended **to ensure interoperability, e.g. for data exchange**
- CEP requires **to set up EU DSO entity by 2021**

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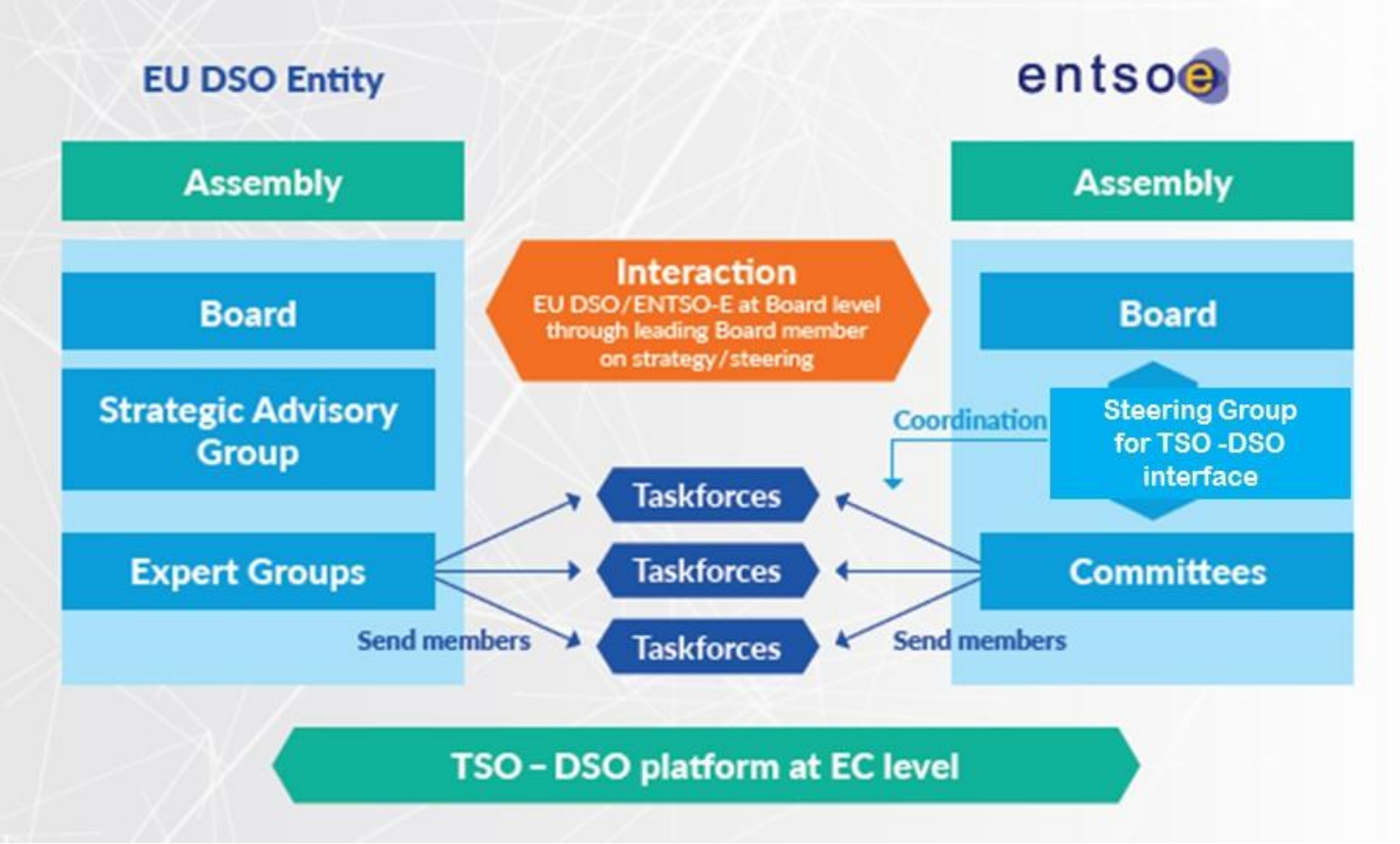
# A new Steering Group for a sustainable TSO-DSO interface




Set up in 2019 in order to:

- ✓ provide strategic overview of the interface from TSOs side
- ✓ ensure coordination of the relevant work done within Business Committees
- ✓ prioritise topics for cooperation with DSOs
- ✓ be a single point of contact for DSOs and stakeholders

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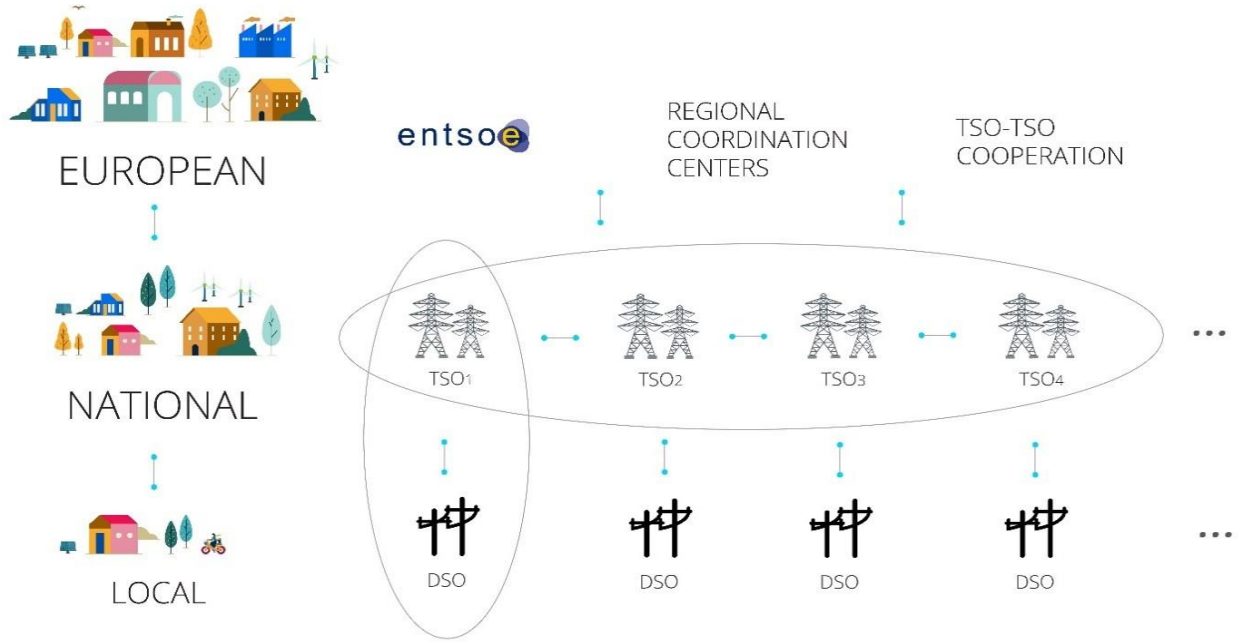
# Our Vision: One System & Market 2030




- Multilevel architecture
- Different geographical scales
- Functional layers
- Multilateral interfaces
- Interoperability
- System operators = key facilitators
- Governance involving stakeholders

**Let‘s build it together!**

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# Session 3: The future energy system: a 2030 horizon

Building the grid for 2030: What power grid for 2030?

**Dimitrios Chaniotis**

ENTSO-E System Development Committee Chair

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# 10 years of achievements

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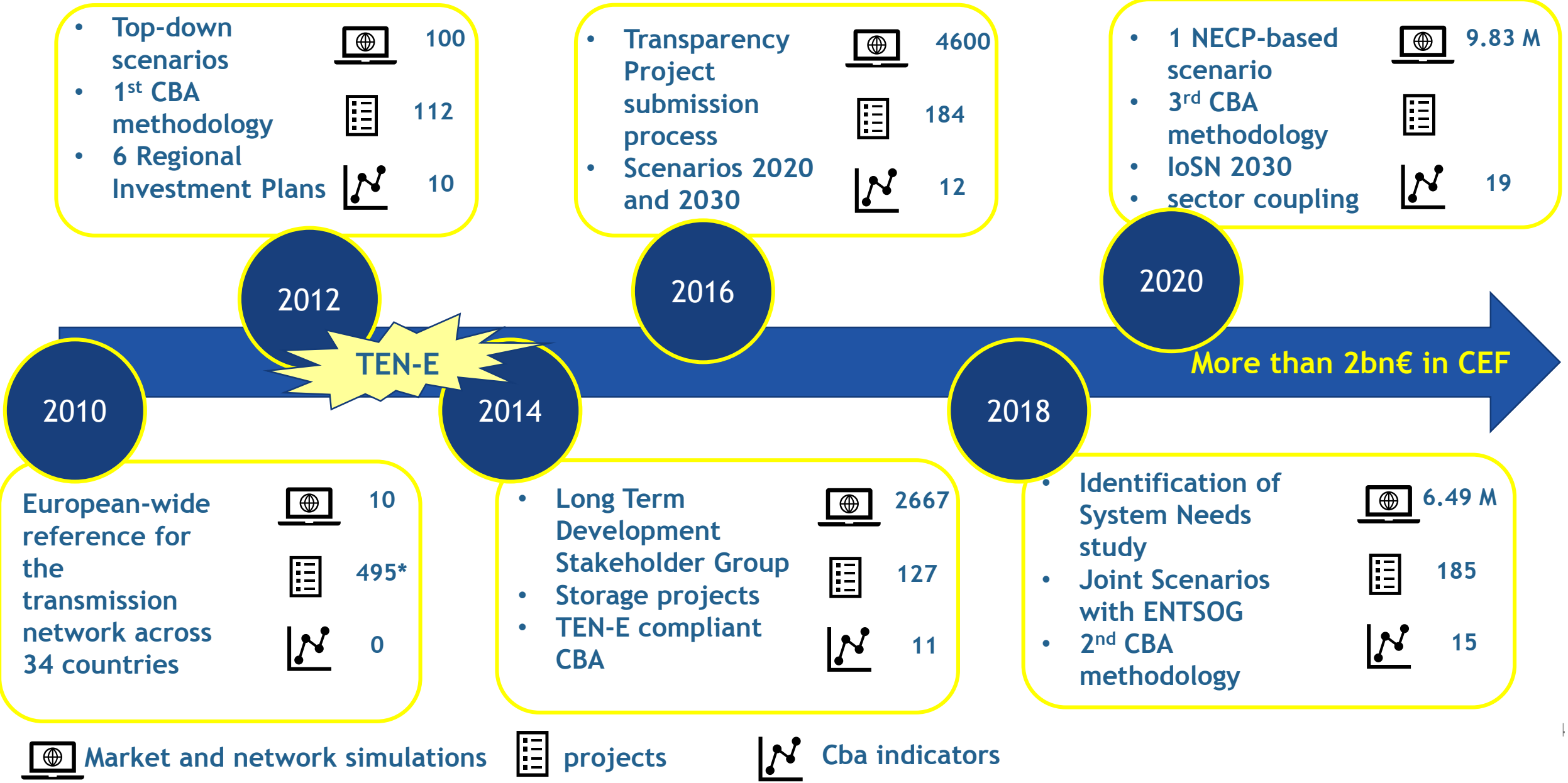
# TYDNP: 10 years of improvement



# MAF: 5 years of probabilistic assessments

**2015**
Deterministic
Flexibility and ramping needs

**2016**
Probabilistic approach
11 climate years
New metrics: LOLE and EENS

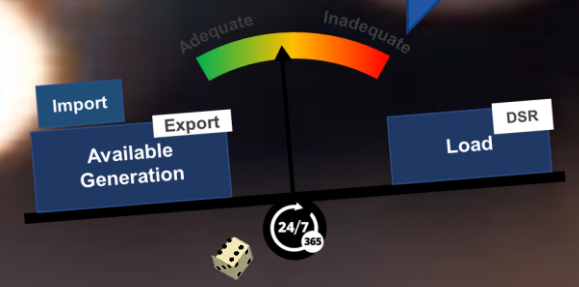
**2017**
34 climate years
Demand side response
Impact of cold waves
Mothballing sensitivity

**2018**
Consolidated Generation database and tools
Low-carbon sensitivity

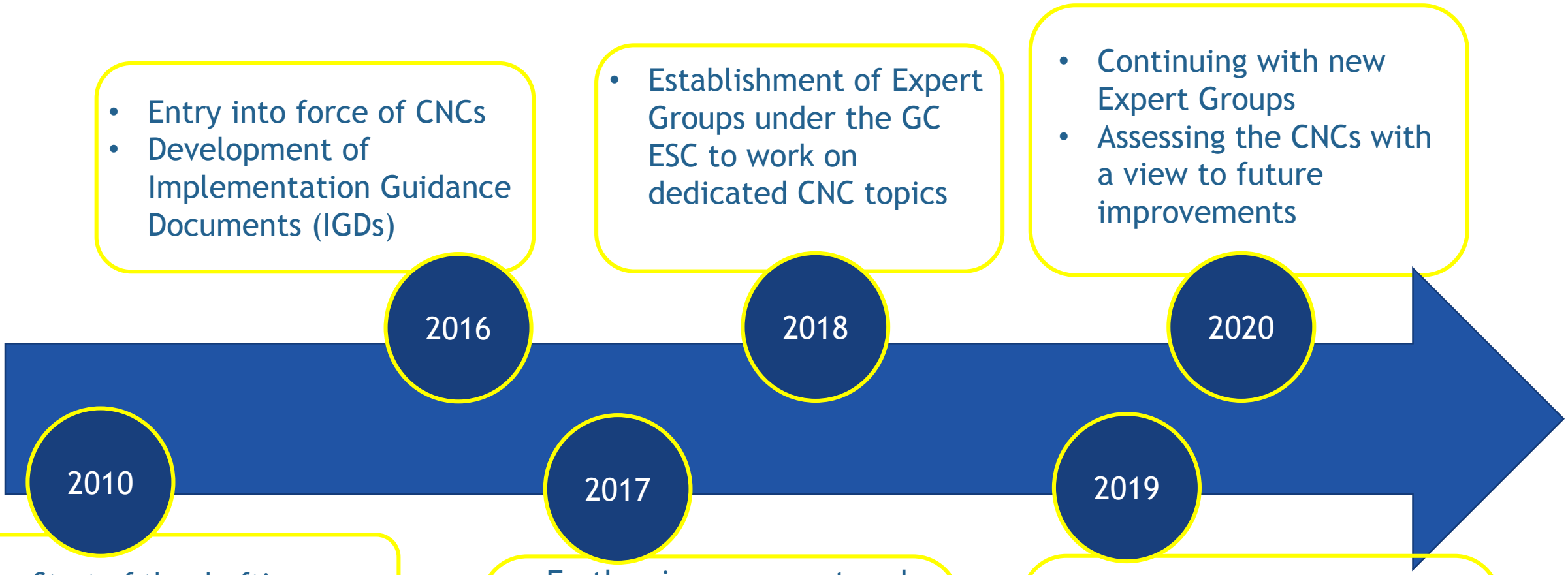
**2019**
Common demand tool
Hydro database
Unit thermal generation
Flow-based in CWE

**2020**
Stepwise CEP implementation
NECP 2030

**Methodology and insights**



# Connection Network Codes: what we have achieved

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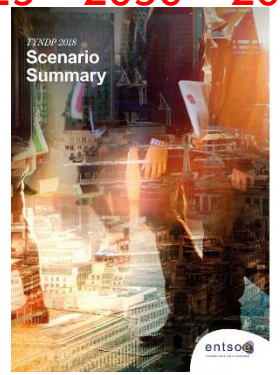
# What’s going on now?

# Transmission Planning in Europe – TYNDP 2018

Scenario building

2025 – 2030 - 2040




- 48%-58% RES in demand (2030)
- 65%-81% RES in demand (2040)
- Consumers in the center - evolution in behavior, regulation, technology
- Demand will increase despite energy efficiency measures
- High volatility in country-level balance (import-export)
- Smart decarbonisation is also renewable gases, smart grid technologies, electricity storage, power-to-gas or CCS/CCU

Screening

2040


TSO
3PP
TSO
3PP
TSO
3PP

Projects

CBA

2025 - 2030


- 166 transmission projects proposed
  - Close to 20% subsea cables
  - 20 Storage projects
- **114bn€ investment**
- System needs or transmission needs?
- Traditional sources of ancillary services phased out
- 17% of projects delayed due to low acceptability – need for Regulation to endorse “better project” approach

- 65%-75% $CO^2$ reduction in 2030
- 80%-90% $CO^2$ reduction in 2040
- 2-4bn€ annual generation cost savings
- 3 to 14€/MWh electricity marginal cost reduction in 2040
- 58 to 156 TWh avoid RES curtailment
- 100bn€/y cost of no action !

# Scenarios 2020

| | 2020 | 2025 | | | 2030 | | | 2040 | | | 2050 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NT | DE | GA | NT | DE | GA | NT | DE | GA | NT |
| Res-E (wind/solar/hydro) | n/a | 20 %<br>8 %<br>11 % | 28 %<br>13 %<br>13 % | 30 %<br>10 %<br>13 % | 29 %<br>12 %<br>12 % | 41 %<br>17 %<br>13 % | 44 %<br>12 %<br>12 % | 41 %<br>14 %<br>11 % | n/a | n/a | n/a |
| Direct Electrification | 22 % | 24 % | 29 % | 27 % | n/a | 39 % | 34 % | n/a | 49 % | 40 % | n/a |
| Res-G (biomethane/P2G) | 1 % | 1 % | 7 %<br>3 % | 5 %<br>1 % | 3 %<br>0 % | 20 %<br>17 % | 13 %<br>5 % | 12 %<br>tbc | 30 %<br>35 % | 19 %<br>11 % | n/a |
| Decarbonisation of gas supply | 1 % | 1 % | 12 % | 12 % | 3 % | 49 % | 41 % | tbc | 87 % | 80 % | n/a |
| Gas import share | 78 % | 84 % | 76 % | 81 % | 86 % | 53 % | 72 % | 84 % | 35 % | 70 % | n/a |

NEW

- NECP compliant scenario
- COP21 scenarios – a carbon budget approach
- Increased share of Sector Coupling
- Soon Current Trends Scenario

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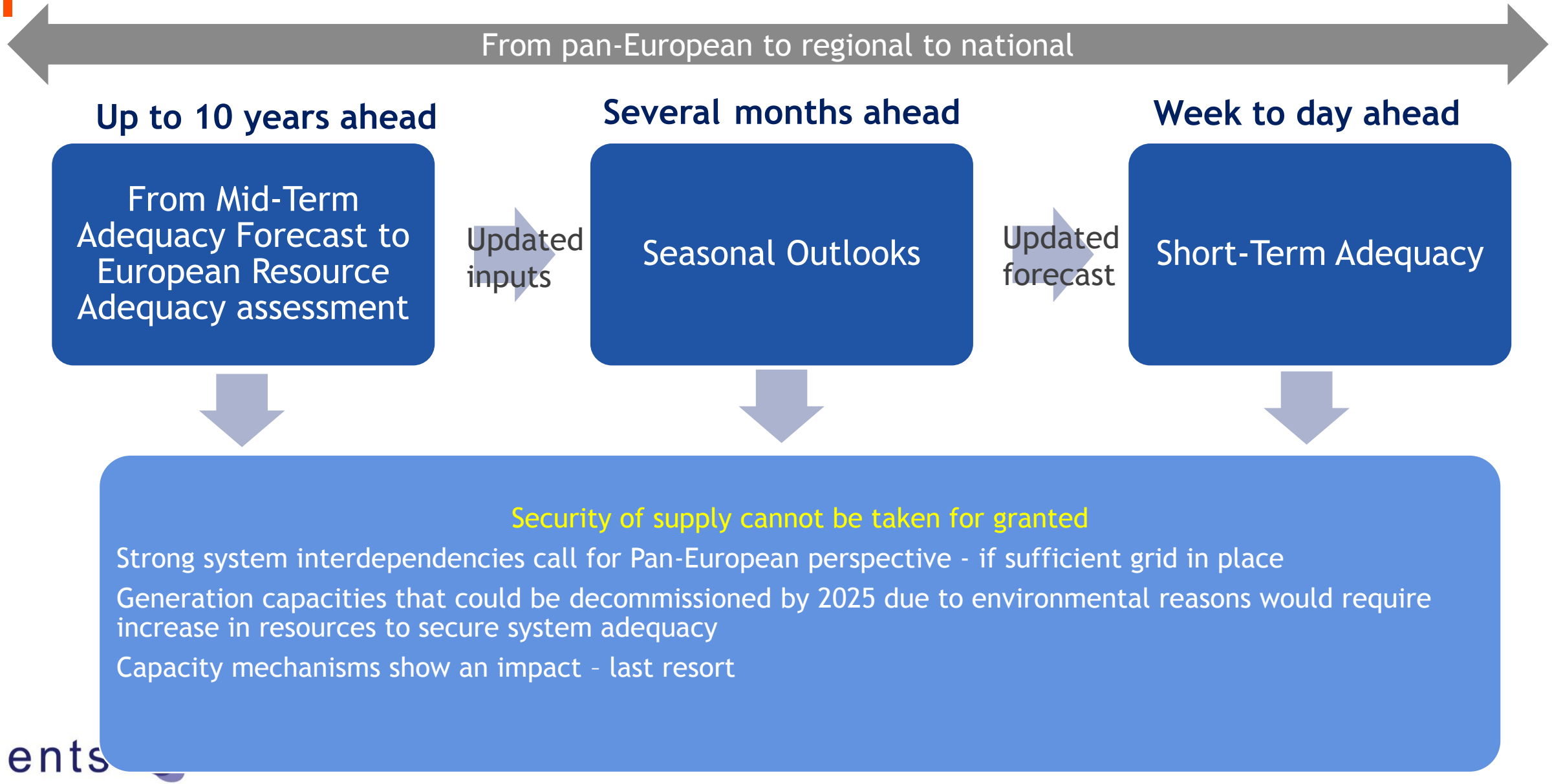
# Ensuring resource adequacy in all time horizons & regional scopes



# Toward 2030 … and beyond!

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# Next milestones and improvements

## Connection Codes

- **Transparency enhancements:** European Stakeholder Committees & Active Library
- **Improvements of regulation:** Review of Implementation guidance documents & CEP implementation
- **Monitoring activities**

## Pan-European resource adequacy assessments

- Gradual implementation with proof of concept tests
- Yearly granularity & 10 year horizon
- Economic viability analysis
- Scenarios with and without capacity mechanisms
- Flow-based where applicable
- Sectorial Integration & flexibility

## TYNDPs

- NECPs compliance beyond 2020
- Top-down scenarios: testing system resilience
- CBA improvements: a reference at the EU level
- Sector Coupling

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# Conclusions

## A challenging and uncertain future

- TSOs operate a system to its limits
- Higher penetration of intermittent resources – scarcity of system services and flexibility
- Consumer: a new player
- High-voltage transmission infrastructure remains the go-to solution, but not only

## Up to the task?

- Acceptance of infrastructure – value « better projects »
- Efficient markets and Regulation are key for system adequacy and resilience
- Enable implementation of new technologies
- The TSO Community is set to enable the transition also through ENTSO-E deliverables

## New opportunities

- Transmission and Distribution: work in tandem "one system view"
- Sector Coupling: new technologies enabling strong synergies between sectors for a cost efficient transition
- Electricity grid is central - TSOs are key for the coupling of sector specific infrastructures *

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* Link to sector coupling paper

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# Session 3: The future energy system: a 2030 horizon

Cables as key enabler for building the grid of 2030

**Raul Gil**

Chairman, Europacable Energy Infrastructure Team

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# Cables as key enabler for building the grid of 2030

**Raul Gil, Chairman, Europacable Energy Infrastructure Team**

**Presentation to ENTSO-E 10 Years Conference, Helsinki, Finland, 13 November 2019**

Europacable, 58 Rue Marie de Bourgogne, 1000 Brussels
www.europacable.eu

# European Cable Industry: We are ready to deliver


## Europacable EHV Member Companies

BRUGG CABLES Well connected.

CABLEL HELLENIC CABLES S.A.

Nexans BRINGS ENERGY TO LIFE

NKT

Prysmian Group

## Associated Europacable Partners

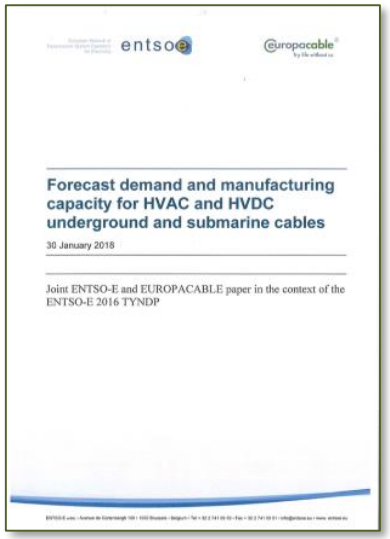
BOREALIS Keep Discovering

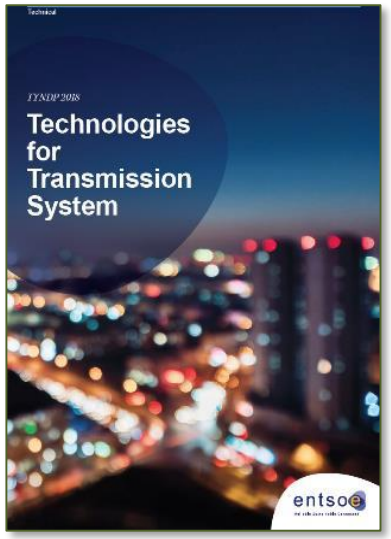
DOW

Cu European Copper Institute Copper Alliance

# Europacable & ENTSO-E cooperation since 2010…


Joint paper:
Feasibility and technical aspects of partial undergrounding of extra high voltage power transmission lines


Forecast demand and manufacturing capacity for HVAC and HVDC underground and submarine cables
30 January 2018
Joint ENTSO-E and EUROPACABLE paper in the context of the ENTSO-E 2016 TYNDP

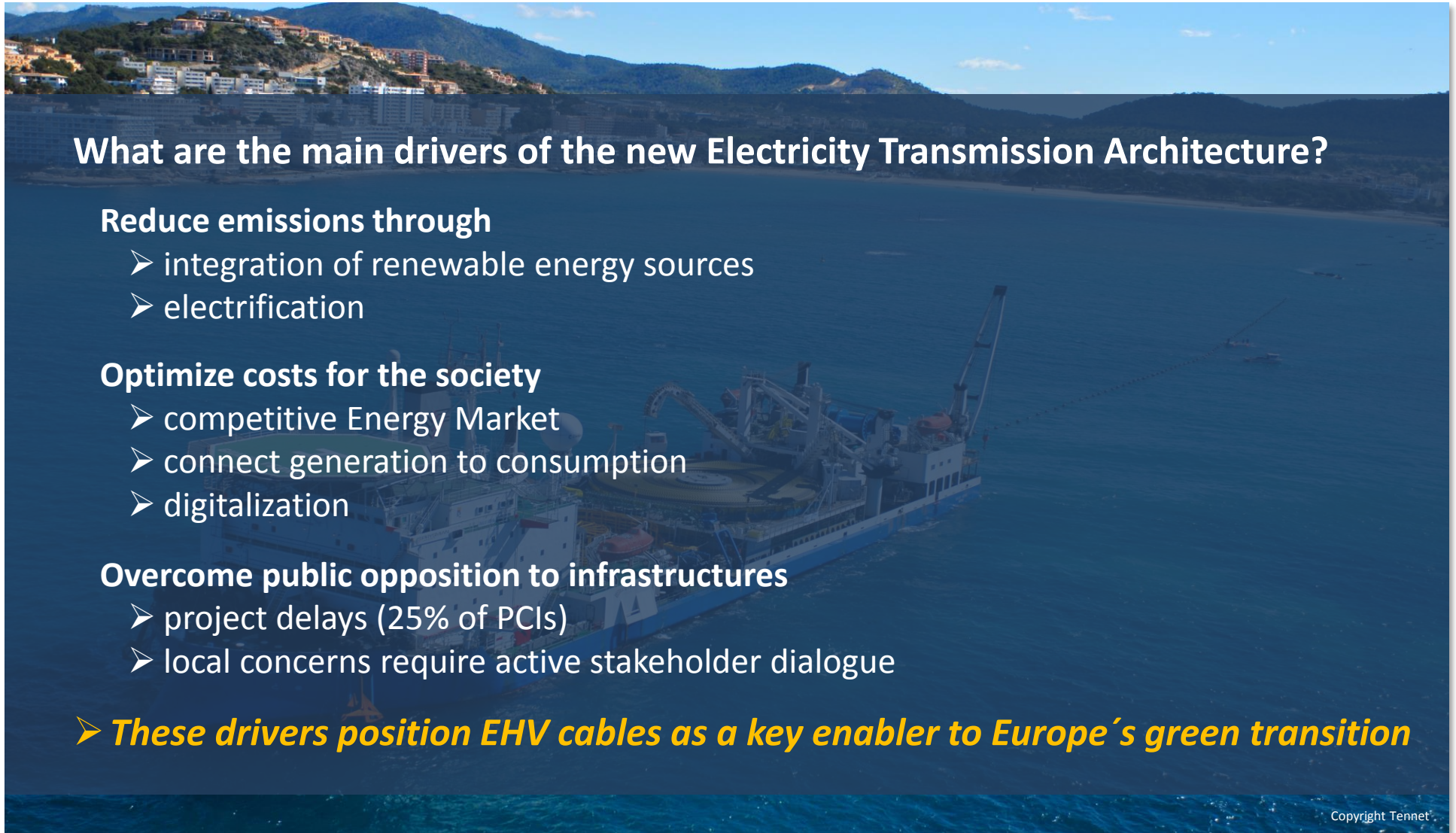

TYNDP 2018
Technologies for Transmission System


Recommendations to improve HVDC cable systems reliability
13 June 2019
Joint ENTSO-E[1] and EUROPACABLE[2] paper

**Cooperation & active dialogue is key to:**

- *deliver TYNDP projects now in the pipeline*
- *drive technology innovation forward*
- *create best available grid for Europe*

# Our mission: Enable the zero emission world



## What are the main drivers of the new Electricity Transmission Architecture?

**Reduce emissions through**
- integration of renewable energy sources
- electrification

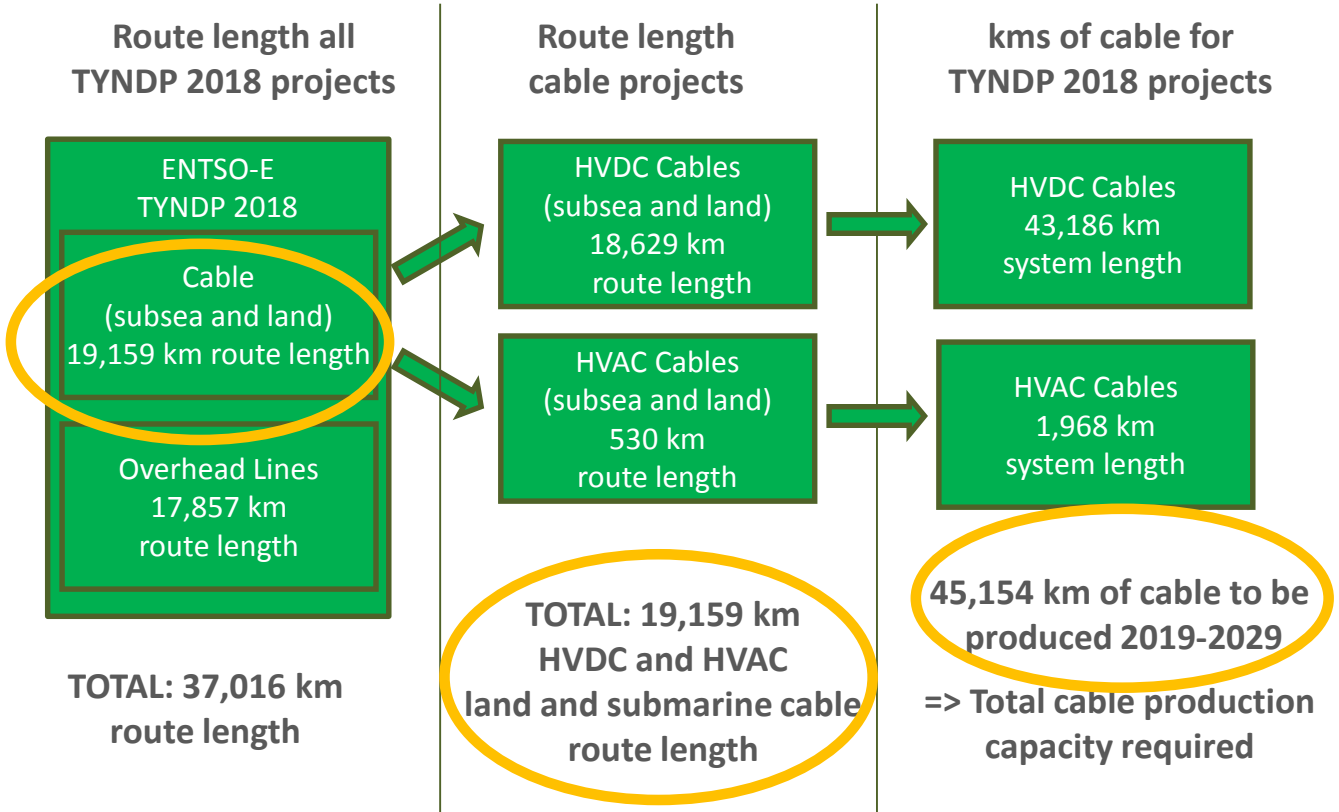
**Optimize costs for the society**
- competitive Energy Market
- connect generation to consumption
- digitalization

**Overcome public opposition to infrastructures**
- project delays (25% of PCIs)
- local concerns require active stakeholder dialogue

➢ ***These drivers position EHV cables as a key enabler to Europe´s green transition***

# EHV Cables: Core technology to connect Europe

## ENTSO-E 2018 Ten Year Network Development Plan (TYNDP)




➢ *30% of 2018 TYNDP projects & 52% of the distance planned as EHV land or subsea cables*

# EHV cable technology: Mature & fully available

**On Land: Available alternative**

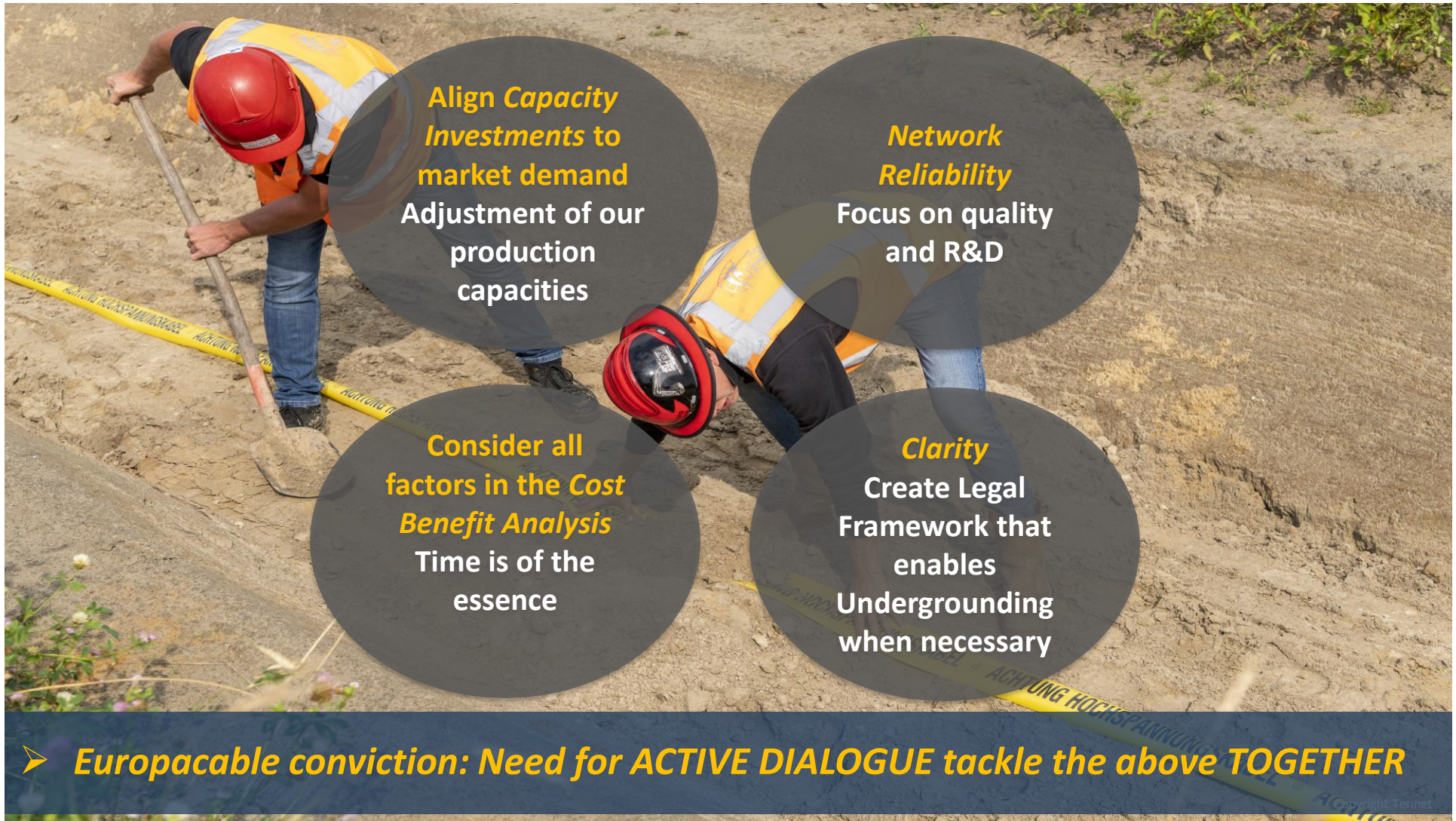
- HVDC undergrounding: Long distances to carry RES supply to demand areas
- HVAC partial undergrounding: Complementing OHL in sensitive areas

**At sea: Only solution**

- interconnect countries or islands & connect offshore renewable to main grids
- HVDC & HVAC solutions widely available

- ***European cable manufacturers have the technology and the capacity to supply ENTSO-E projects by 2030***

# The Challenge: Project Implementation



# Cooperation is key to

- *deliver ENTSO-E´s TYNDP projects now in the pipeline*
- *build a sustainable, cost competitive grid for a decarbonized future*
- *take local communities affected by new grids along*
- *drive Europe´s technology innovation forward*

- ***Let´s deepen Europe´s Electricity Ecosystem to create the best available grid for Europe!***

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# Try life without us … .. .

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# Session 3: The future energy system: a 2030 horizon

What does greenhouse gas reduction
and renewable target compliant mean for the grid?

**Antina Sander**

Deputy CEO, RGI

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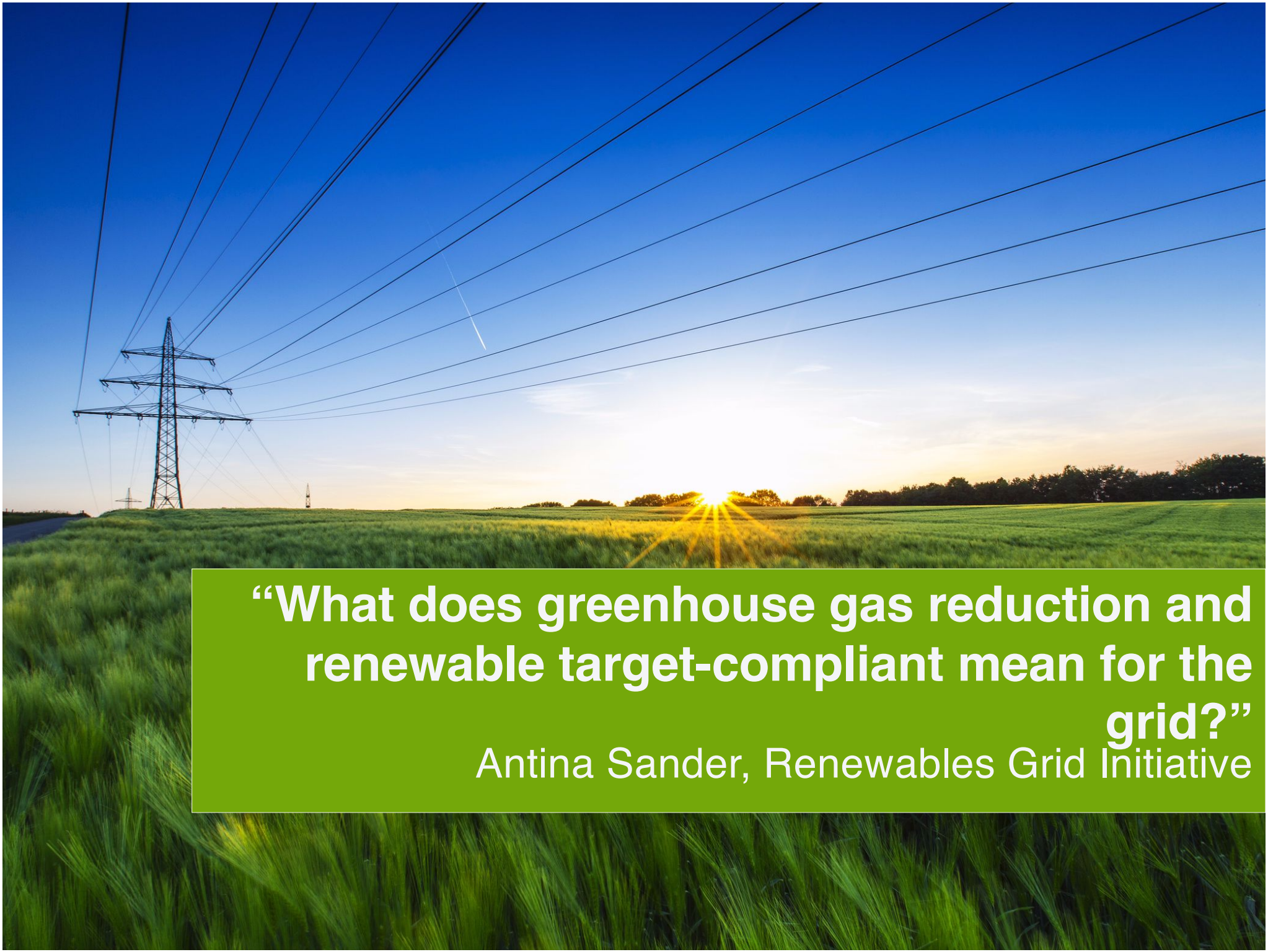


**“What does greenhouse gas reduction and renewable target-compliant mean for the grid?”**

Antina Sander, Renewables Grid Initiative

# Who is talking

**Focus of TSOs:**
"We need to build up the power system without delay while minimising impacts on nature and people."

**Focus of NGOs:**
"We need to grow renewable energy much faster to reach our climate targets while ensuring an environmentally sensitive development of the power system."


"We want a grid built in time that supports the further steady growth of renewables while respecting environmental objectives and people's concerns."

# Not a lot of carbon budget left for EU-28

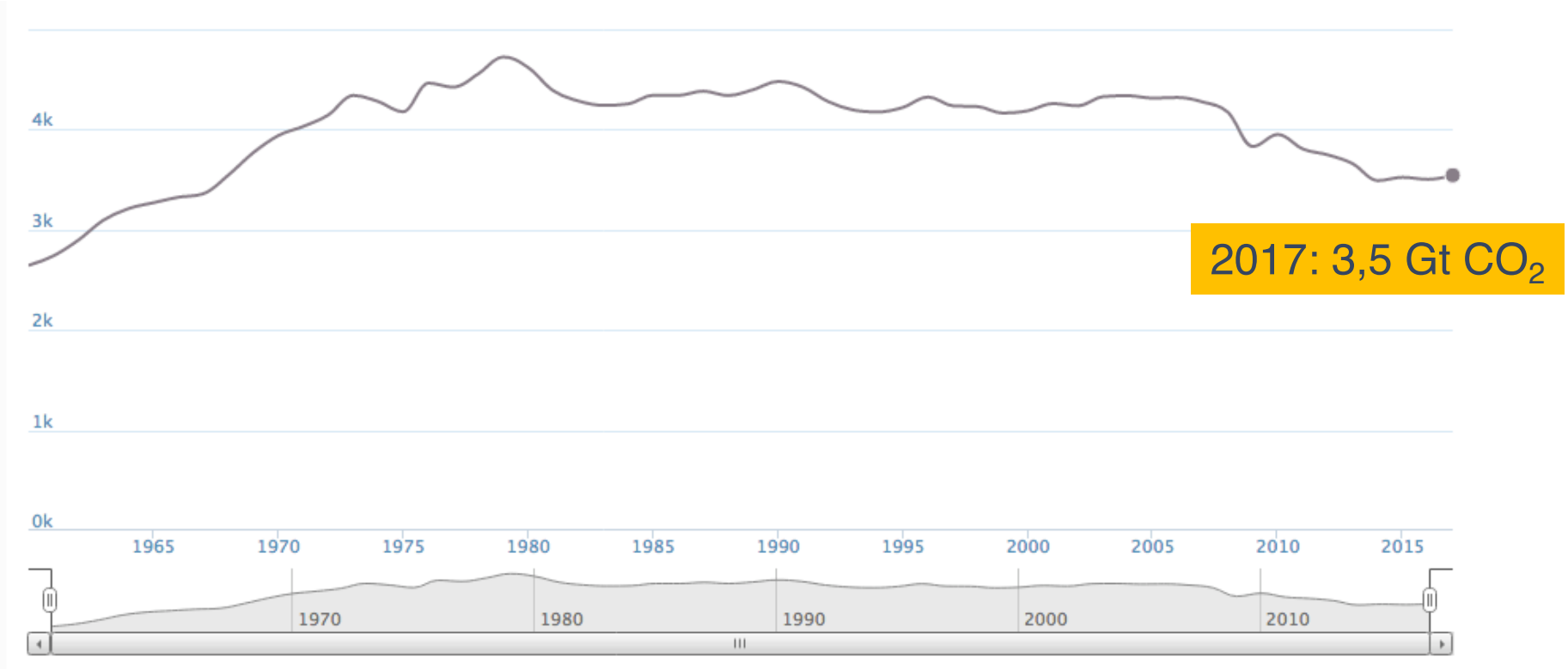
- Global budget for 2018 – 2100: **570 $GtCO_2$**
- EU-28 share* based on
  - population: **38,78 $GtCO_2$**
  - Equity: **29,39 $GtCO_2$**

- Global Carbon Budget based on
  - IPCC Special Report
  - Global Mean Surface Temperature: 1,5 Degree Celsius
  - 66% Probability



* EU-28 shares: Climate Action Network Europe

# EU-28 still adds about 3,5 Gt $CO_2$ per year




**At this pace 10 years of budget left!**

Renewables Grid Initiative

Source: http://www.globalcarbonatlas.org/en/CO2-emissions

# We have to move a lot faster

**CAN Europe**

- 80-95% GHG emissions reduction target is outdated
- Net zero by 2040

**European Green Deal (excerp)**

- EU NDC* from 40% to 50%-55% GHG emissions reductions by 2030

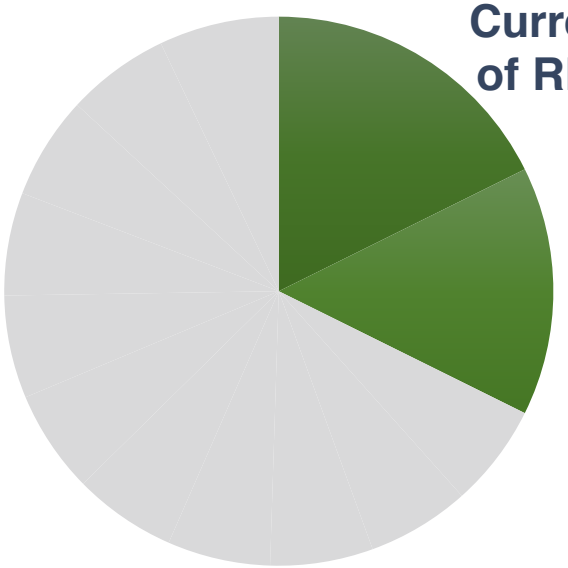
- Energy market: integrated, interconnected and with consumer focus
- Energy system „largely based on renewables“, increased connectivity and energy storage
- Facilitate the smart integration of electricity, heating, transport and industry sectors
- Scale up investments in clean energy (Sustainable Energy Investment Plan)



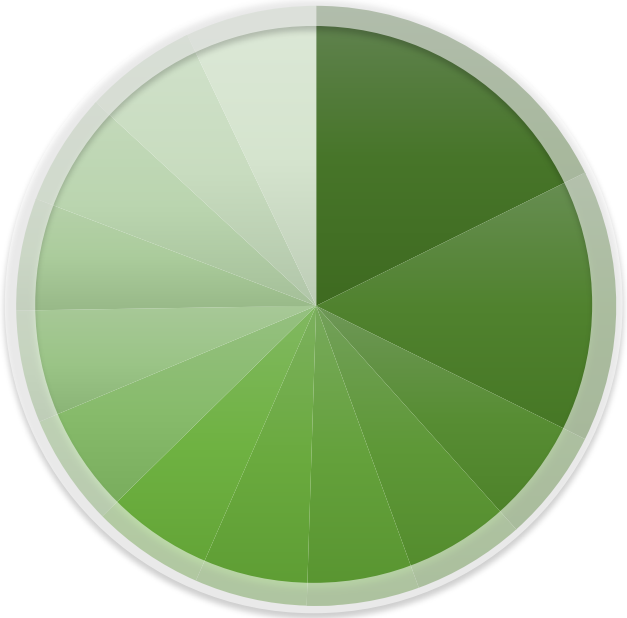
*NDC = Nationally Determined Contribution

# RES targets have to increase – there is a long way to go

**Current final energy consumption and RES**



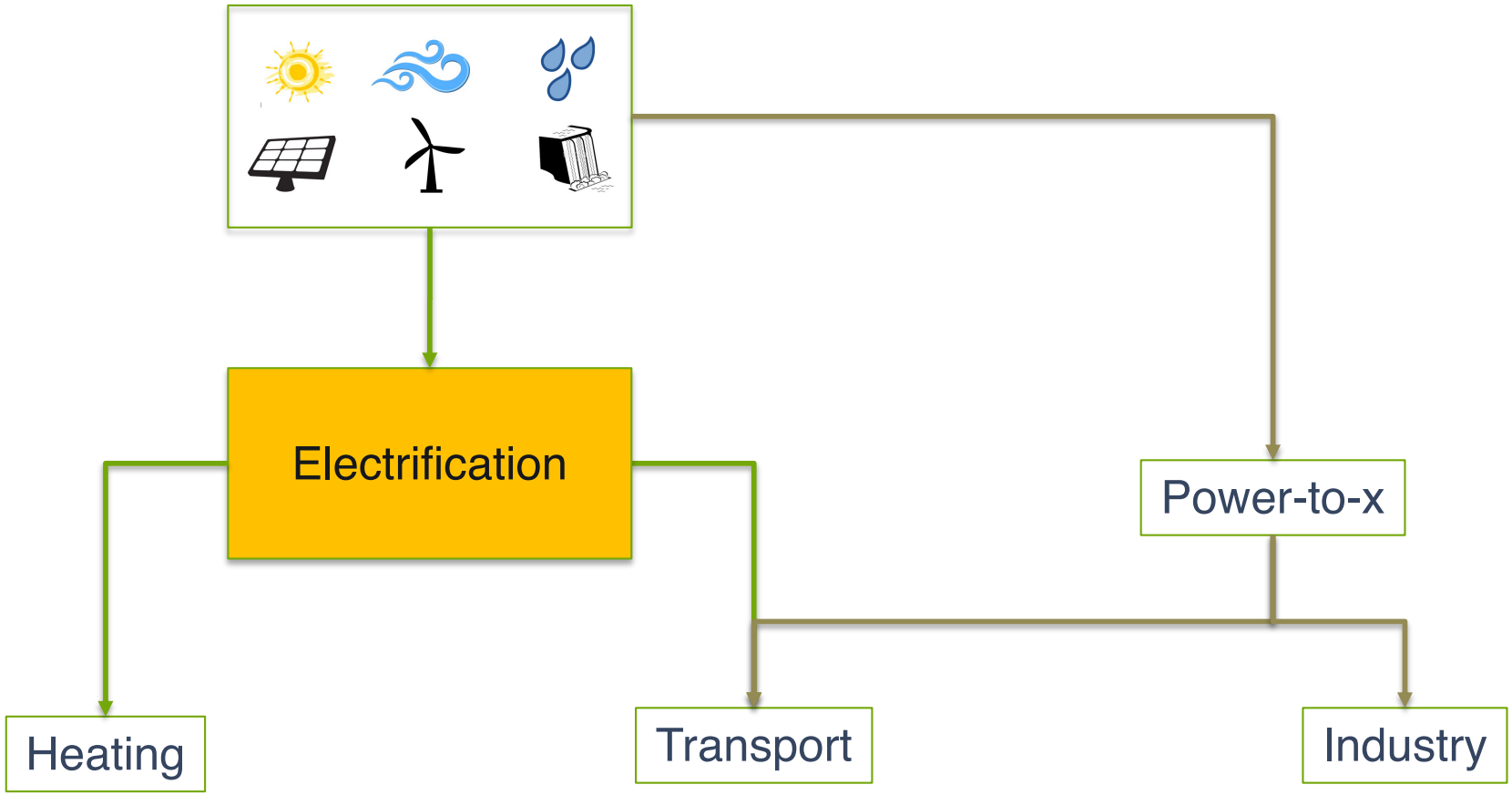

**Future final energy consumption and RES?**



Increasing shares of RES

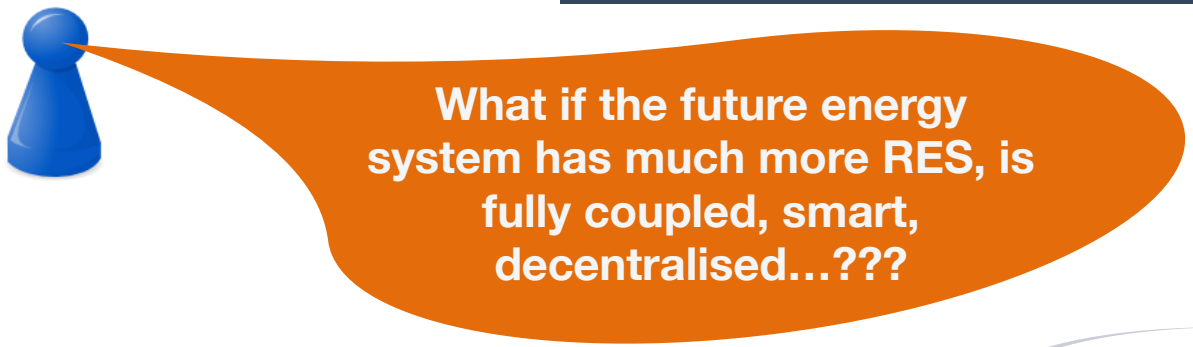
→ We need to be faster in reducing greenhouse gases and increasing RES

# Larger shares of RES via electrification and sector coupling/integration



→ We need to fully embrace electrification

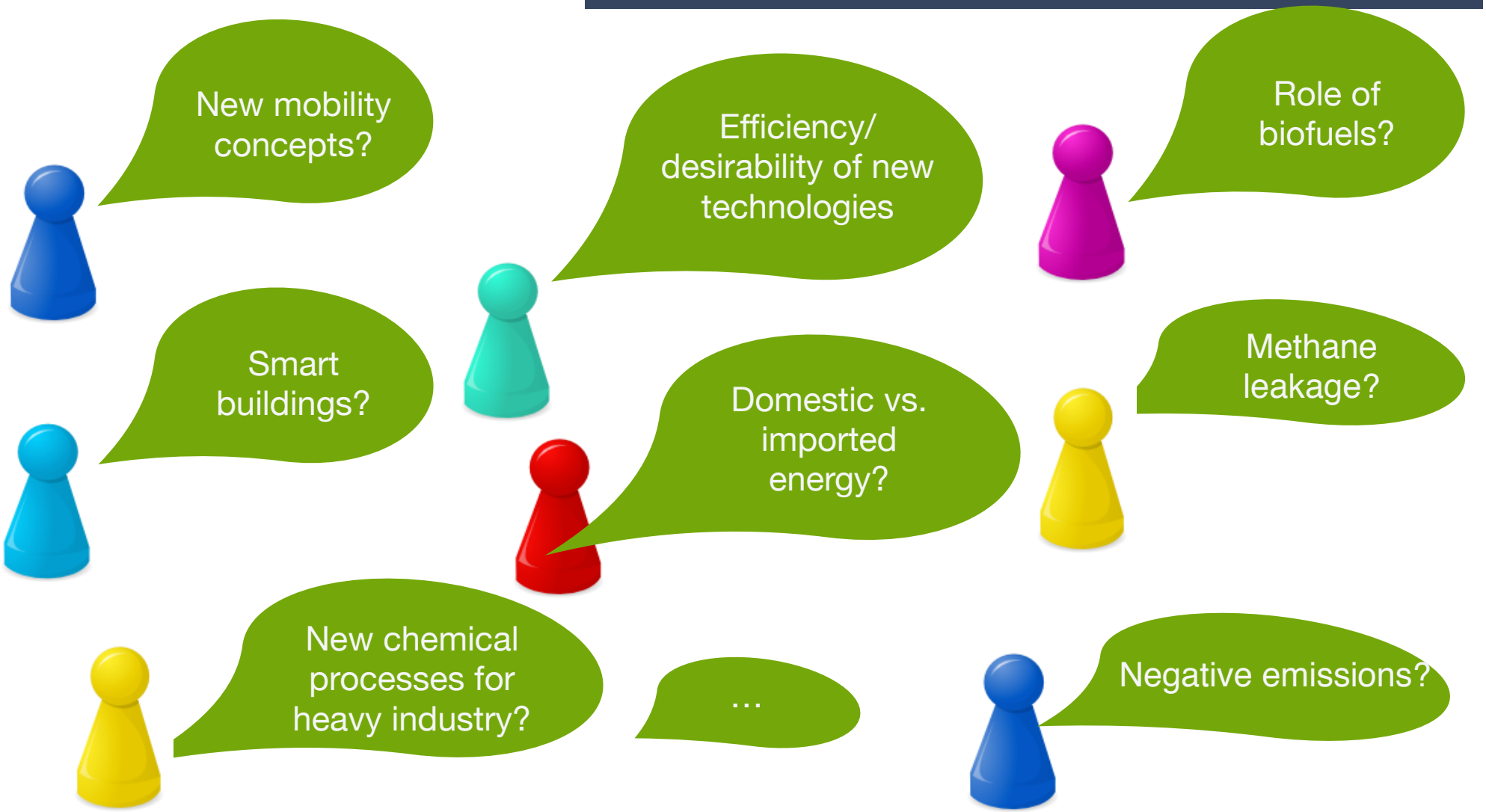
# We need to understand what this means for the grid





**If we don't get this right……. people will not respect results here**

# Building a solid scenario requires many types of proficiencies



# PAC project for solid input and a legitimate scenario

PAC: Paris Agreement compatible scenarios for energy infrastructure

**Project partners**

150/140 European NGO members

80 members covering industry, intergovernmental orgs, NGOs, academia, and governments.

22 European TSOs and NGOs

… and their respective stakeholder networks

**Special stakeholders**

**ENTSO-E** **ENTSOG**

**Core tasks**

- Scrutinize/advising TYNDP scenarios for Paris compatibility
- Provide feedback on likely and desirable 'futures' that should be reflected by TYNDP scenarios
- Develop a own scenario supported by broad civil society base
- Learn how to collaborate as a multi-stakeholder network on scenario development

→ We need to collaborate ACROSS SECTORS AND ACROSS SOCIETY in a different way to get it done

# What does greenhouse gas reduction and renewable target-compliant mean for the grid

→ We need to be faster in reducing greenhouse gases and increasing RES

→ We need to fully embrace electrification

→ We need to collaborate ACROSS SECTORS AND ACROSS SOCIETY in a different way to get it done

# Thank you!

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# Session 3: The future energy system: a 2030 horizon

## Comments on the Vision 2030

**Jan Ingwersen**

General Manager, ENTSOG

**Jean-Michel Glachant**

Director, Florence School of Regulation

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# Session 4: Innovative and digital solutions

Digital & Innovative Solutions for the Power System

**Chris Peeters**

CEO of Elia Group

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# Innovating to better serve society

Chris Peeters
Elia Group CEO

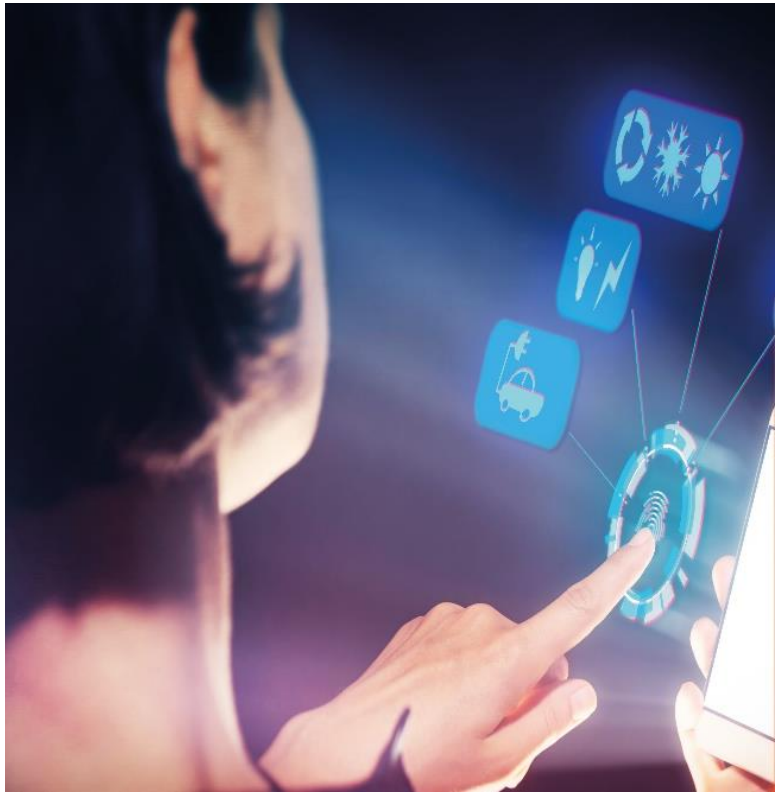

ENTSO-E 10 Year Conference
Helsinki
November 13, 2019

# The energy transition meets the digital revolution

# Triggering new demands from society

Speeding-up decarbonisation of energy mix

Decarbonising energy-intensive sectors

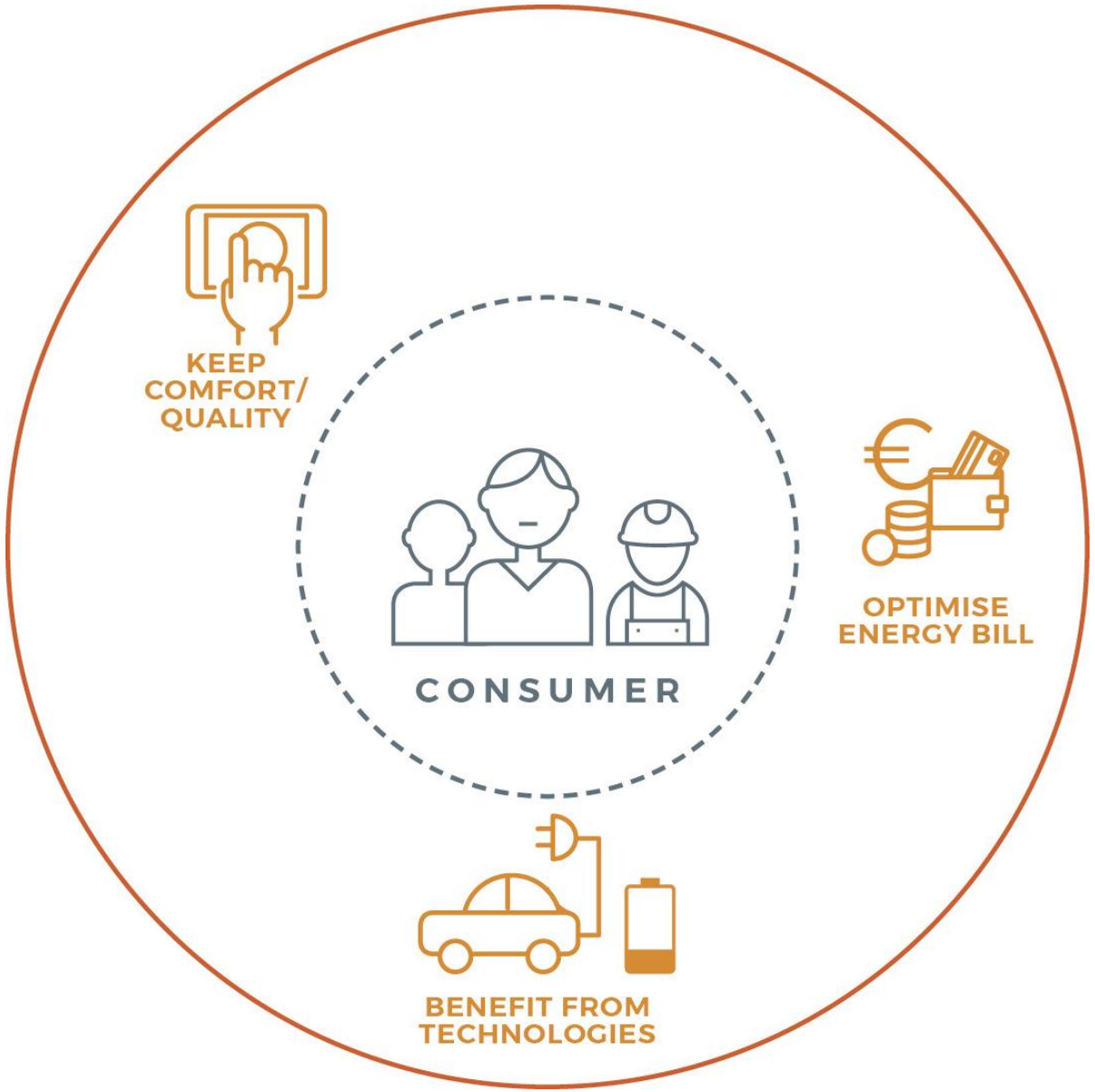


Putting the consumer at the centre

# Fading away boundaries among sectors

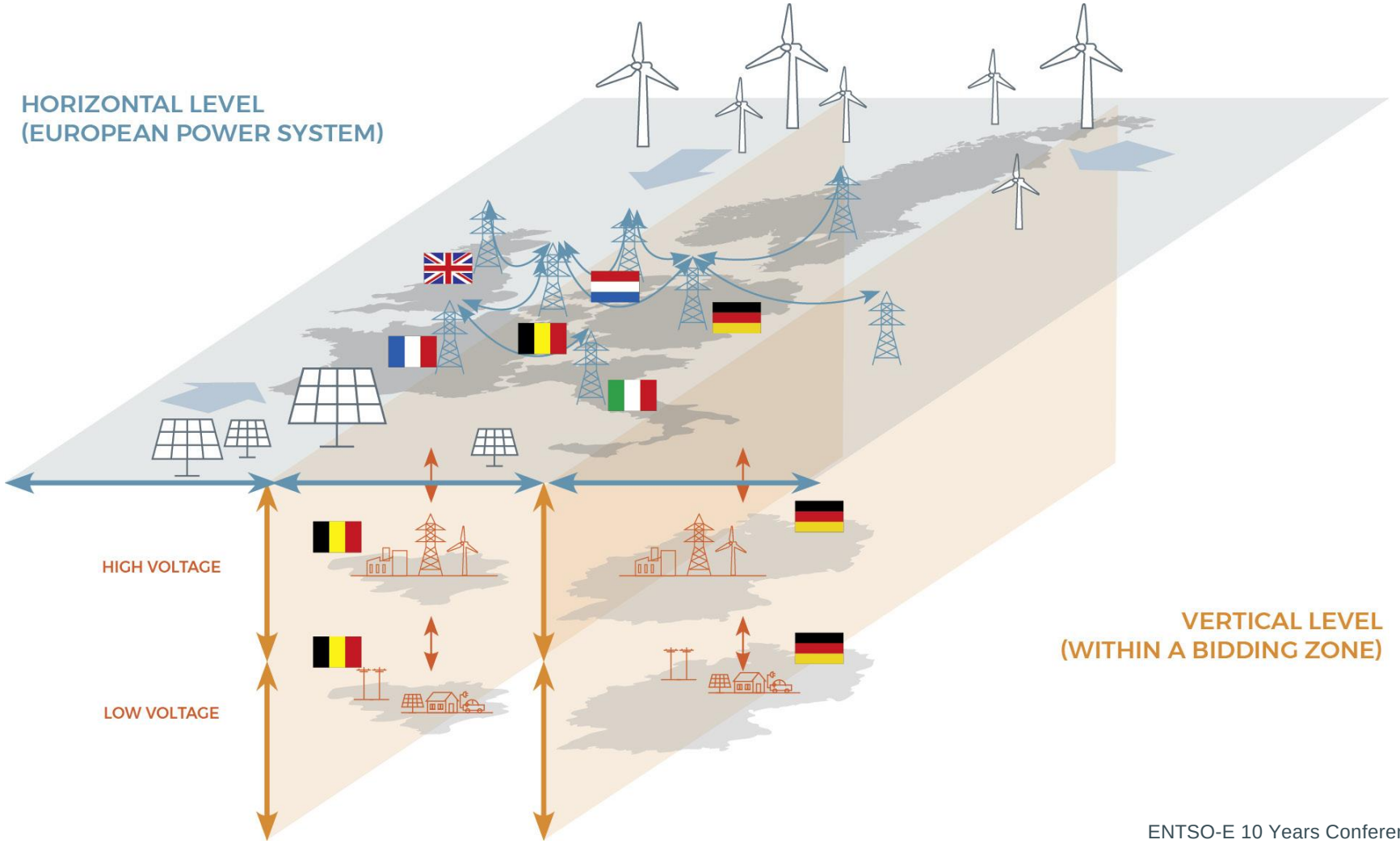
01/08/19 | Wolfsburg/Berlin | Volkswagen Group News

## Volkswagen to become a power supplier



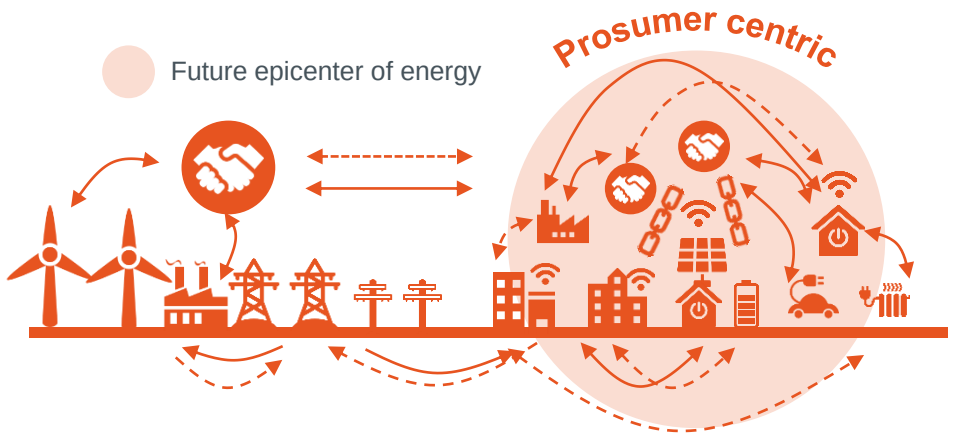

# Pushing a move from commodity to services

# We need to operate in an even more complex environment



# Requiring a change of paradigm to better serve society


**Generation follows consumption**




**Demand will follow generation**

Money flow
Electricity flow

# By innovating in what we currently do

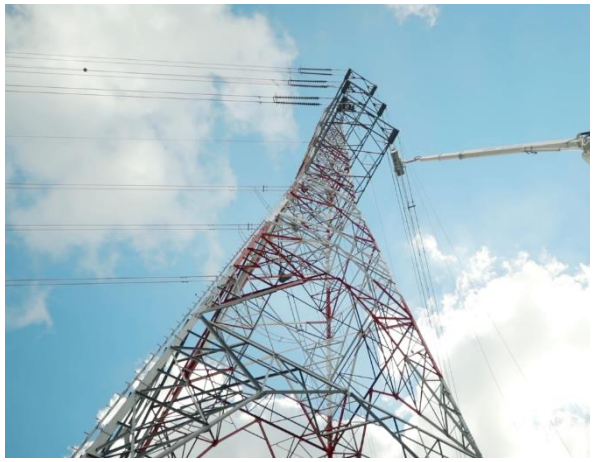

## Belgian Modular Offshore Grid

## Combined Grid Solution
## Offshore Interconnector DE-DK

# And maximising the use of infrastructure for society's benefit

**DLR**

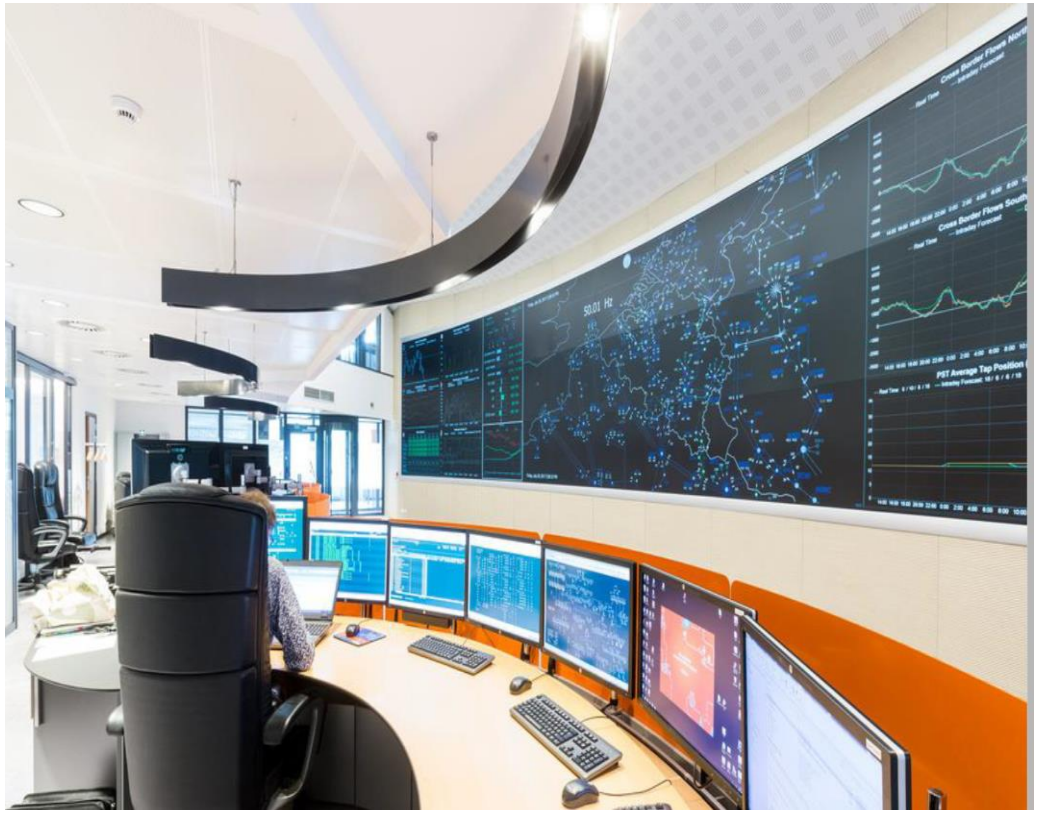
**HTLS**



**PST**

**HVDC**

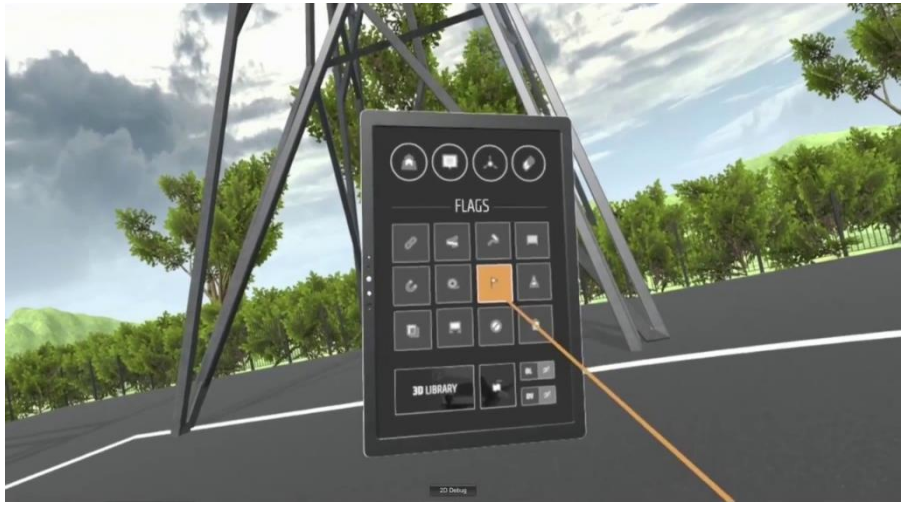
+



**Enhanced operational practices & tools**

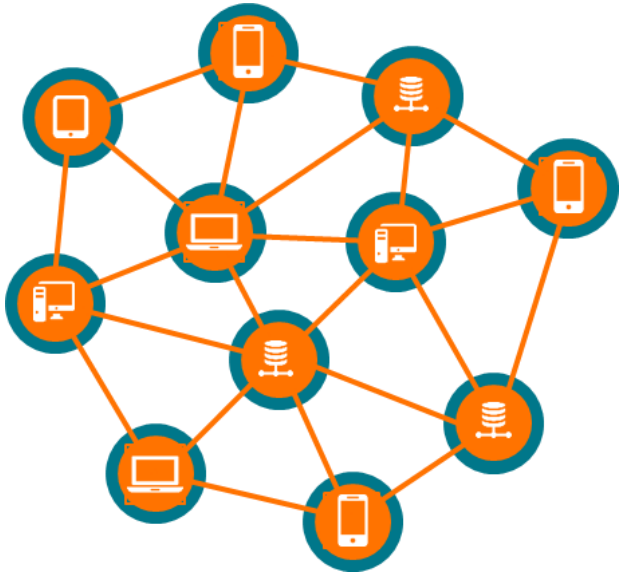
# By embracing fully digitalisation in core activities

**Drones & AI**
for automated inspection




**VR/AR**
for training and increased safety

**Blockchain**
to unlock D-flexibility



**Machine Learning**
for decision-support in control rooms

# And collaborating to explore new frontiers

## IO.Energy Ecosystem: started in February ’19

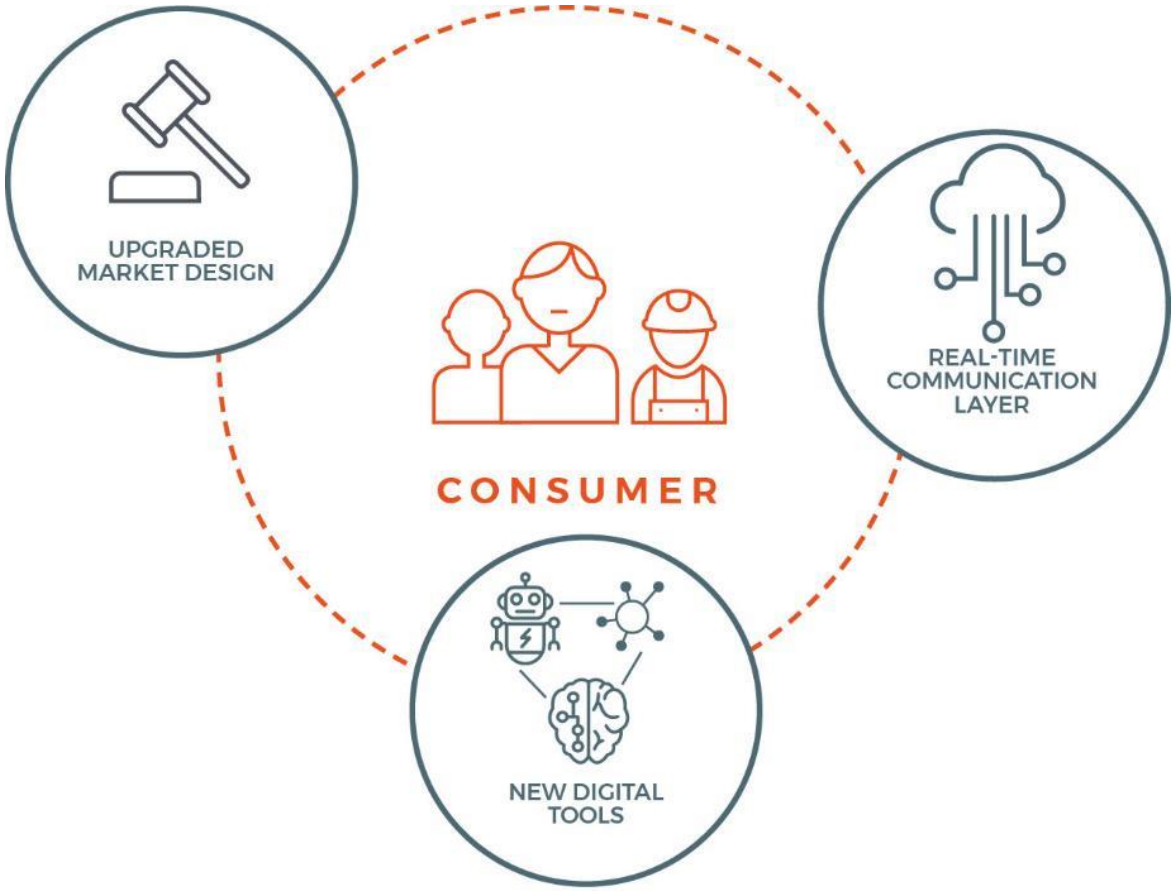

60+ active partners from multiple sectors
30+ supporting partners
**Facilitated by Belgian DSOs & TSO**

## 8 use cases selected for sandboxing by end of June ’19

Flexity
Community Forecaster
MAKA Strava for energy
CheckMyFlex REWARD FOR FLEXIBILITY
SoTeria
CLEF Clean Energy Forecaster
SUNSHARE
Enleash Energy from buildings

## Sandboxing phase: from October ’19 to April ’20 to deliver first results

# To enable that tomorrow's system is centred around consumers

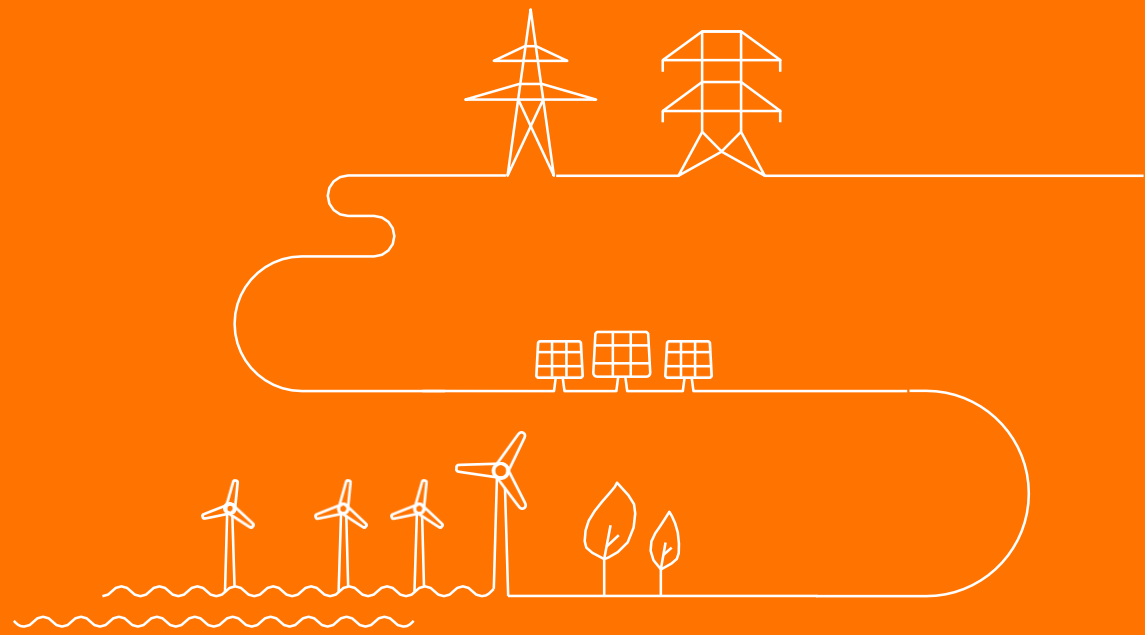



EXCITING
TIMES

# Thanks for your attention


## Chris Peeters

**Chris.Peeters@elia.be**

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# Coffee break

Follow the discussion on Twitter @ENTSO_E #10YearAnniversary


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# Session 4: Innovative and digital solutions

European TSOs research & innovation projects

**Hakon Borgen**

ENTSO-E Research, Development & Innovation Committee Chair

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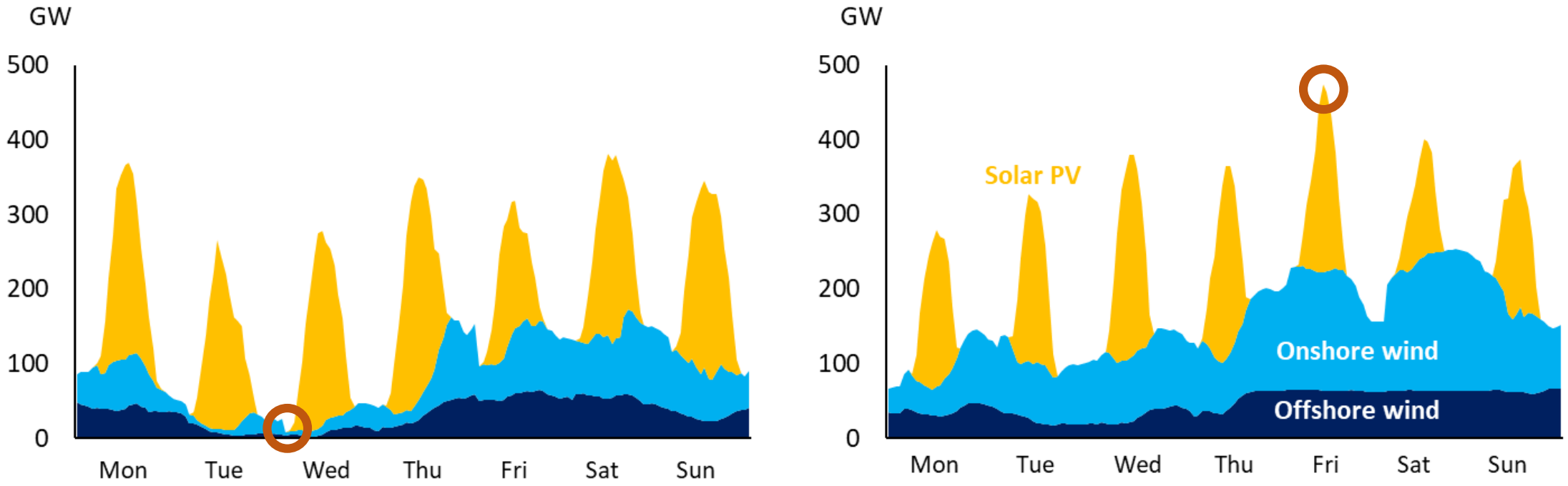
**2050 EU Goal**
(Energy Roadmap 2050)

# European power system 2040
# Variations in RES generation calls for rapid innovation




*Data from Statnett analyses (LMA 2018)*

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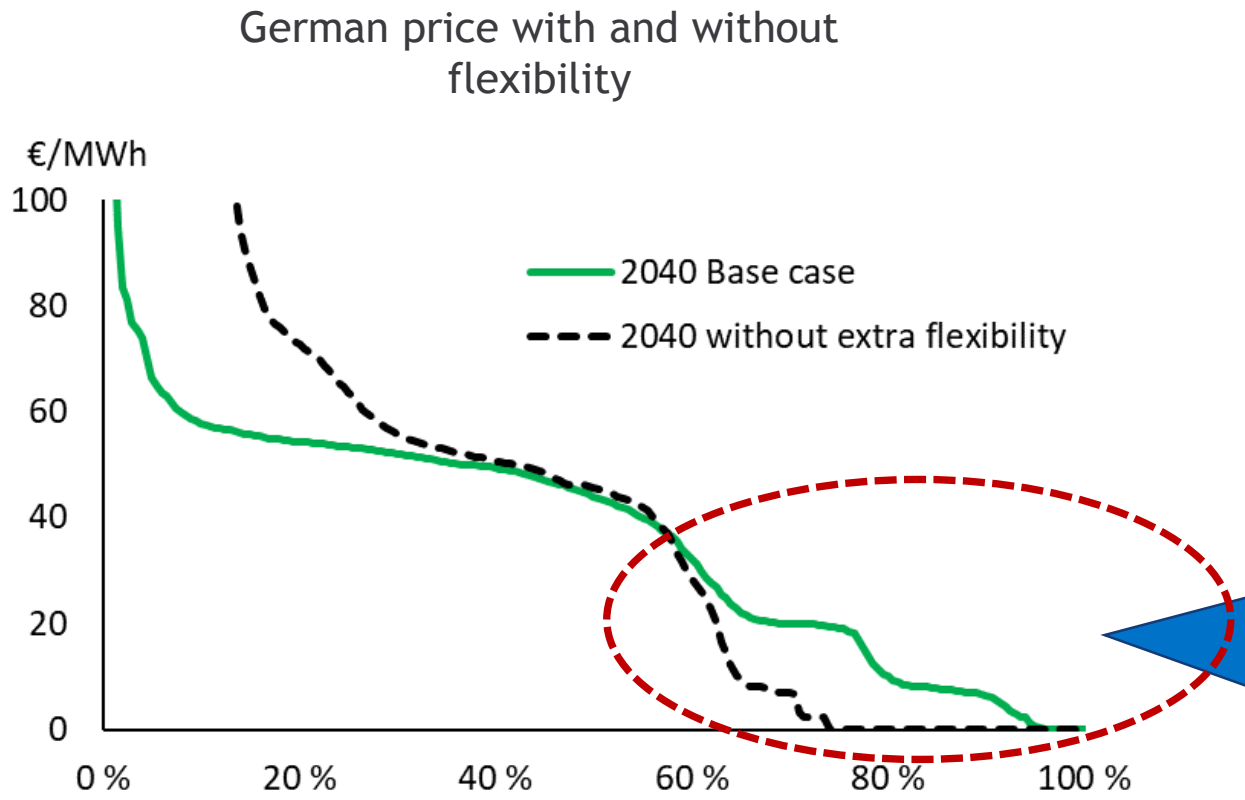
# Need: new solutions for surplus of wind and solar




Needs

Sources

Services & instruments

All types of flexibilities
- Sector coupling (Power to gas, smart charging of EVs , power to heat etc)
- Demand response , prosumers

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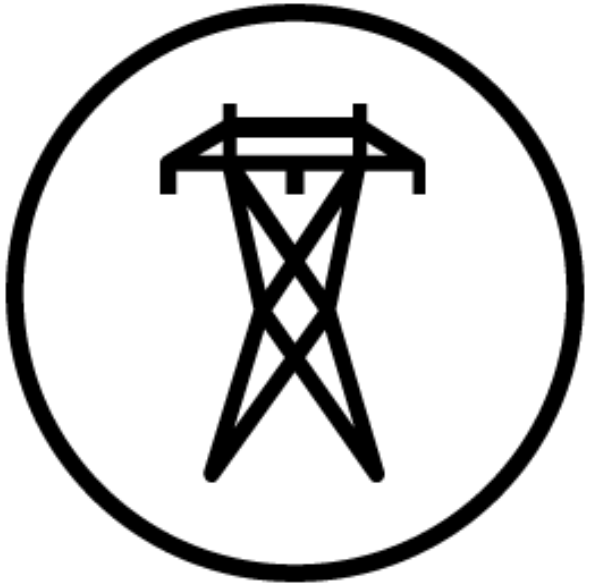
# WE HAVE TO PRIORITIZE the innovations with focus

Digitalisation



Technology development


Cost efficiency

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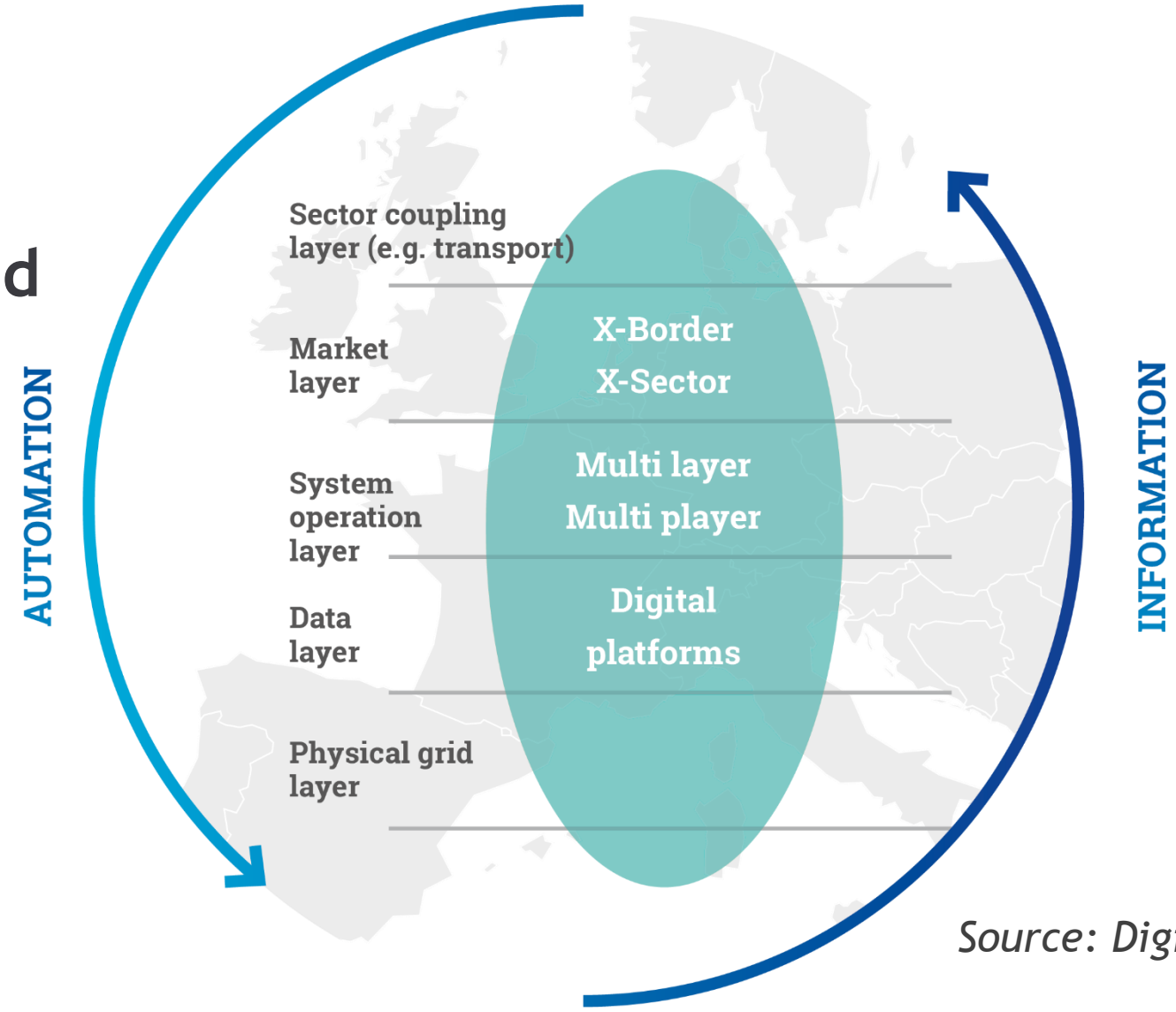
# RDIC: New DIGITAL REPORT >> 100 European Digital projects

## VISION 2030

### The Cyber Physical Grid




*Source: Digital Report*

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# Roadmap towards HVDC interoperability

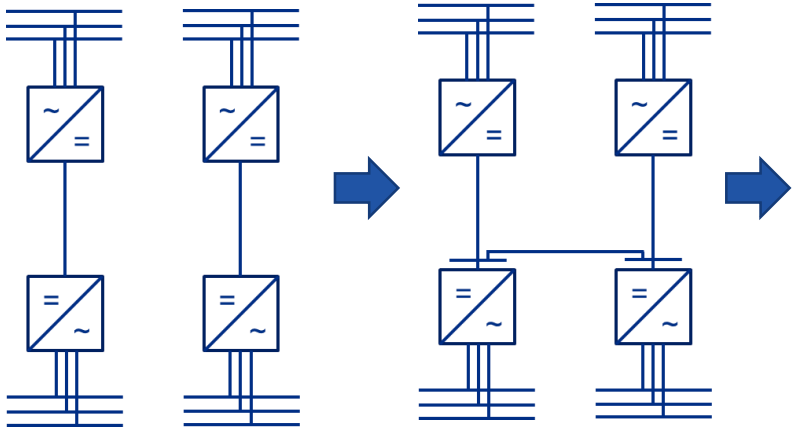
*"Make DC as easy as AC!"*

**Enhancement of Flexibilisation**

HVDC systems offer required flexibility for large scale integration of PEIG and grid forming control

HVDC systems can improve the overall AC/DC grid operation

HVDC systems can contribute to grid stabilization.
Especially in areas with low SCR



Today: Single Point-to-point connections

Multiterminal Systems

Source:
PEI, European grid vision

DC grids as a backbone system for AC?

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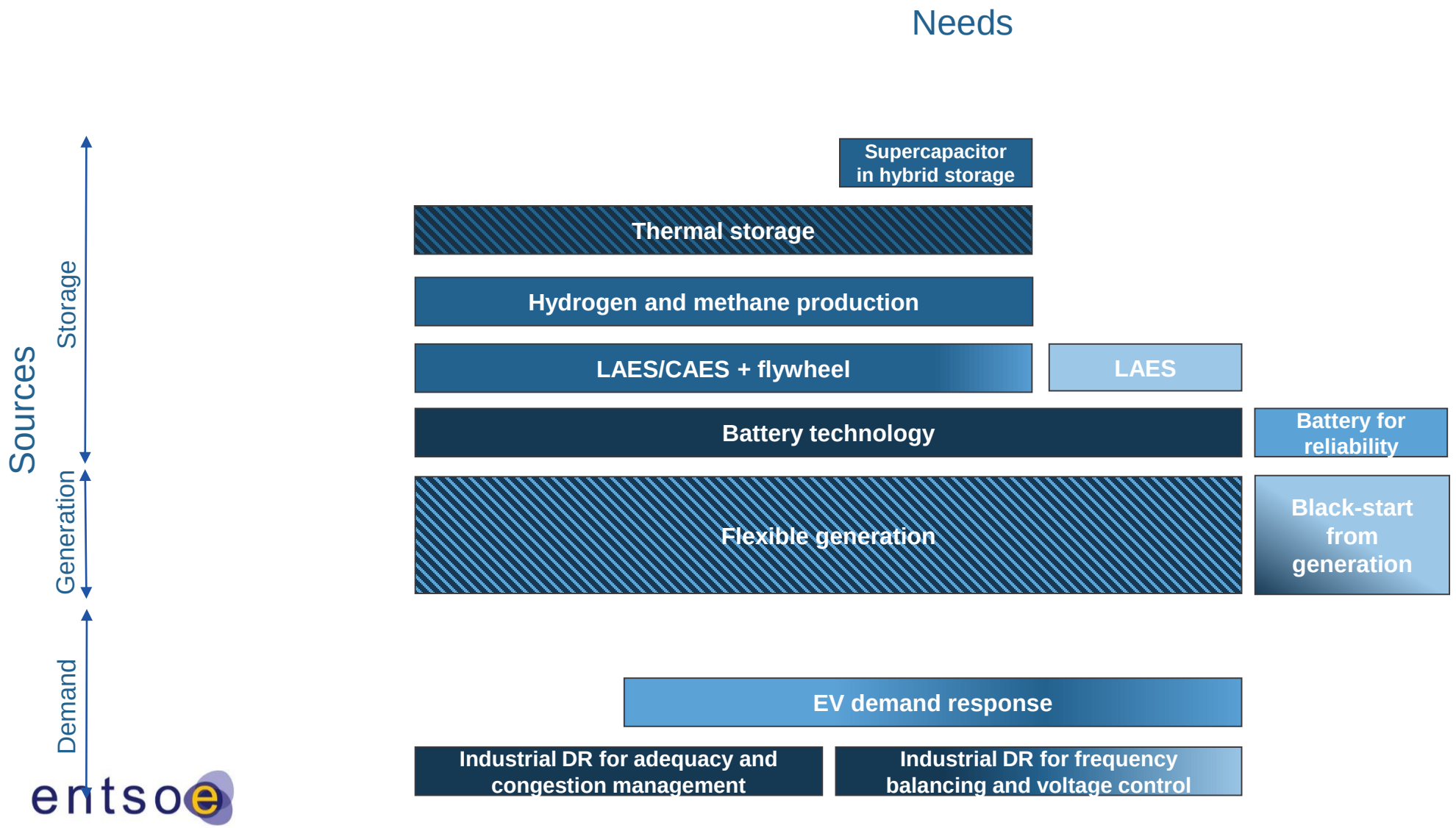
# RDIC: Current status>>60 Flexibility projects




## Scale

(number of demonstrations)

Max

- Battery technology (12)
- LAES/CAES + flywheel (7)
- Flexible generation (7)
- EV demand response (4)
- Battery for reliability (4)
- Industrial DR for frequency balancing and voltage control (4
- Hydrogen and methane (4)
- Industrial DR for adequacy and congestion management (3)
- Thermal storage (3)
- LAES (2)
- Black-start from generation (2)
- Supercapacitor in hybrid storage (2)

Min

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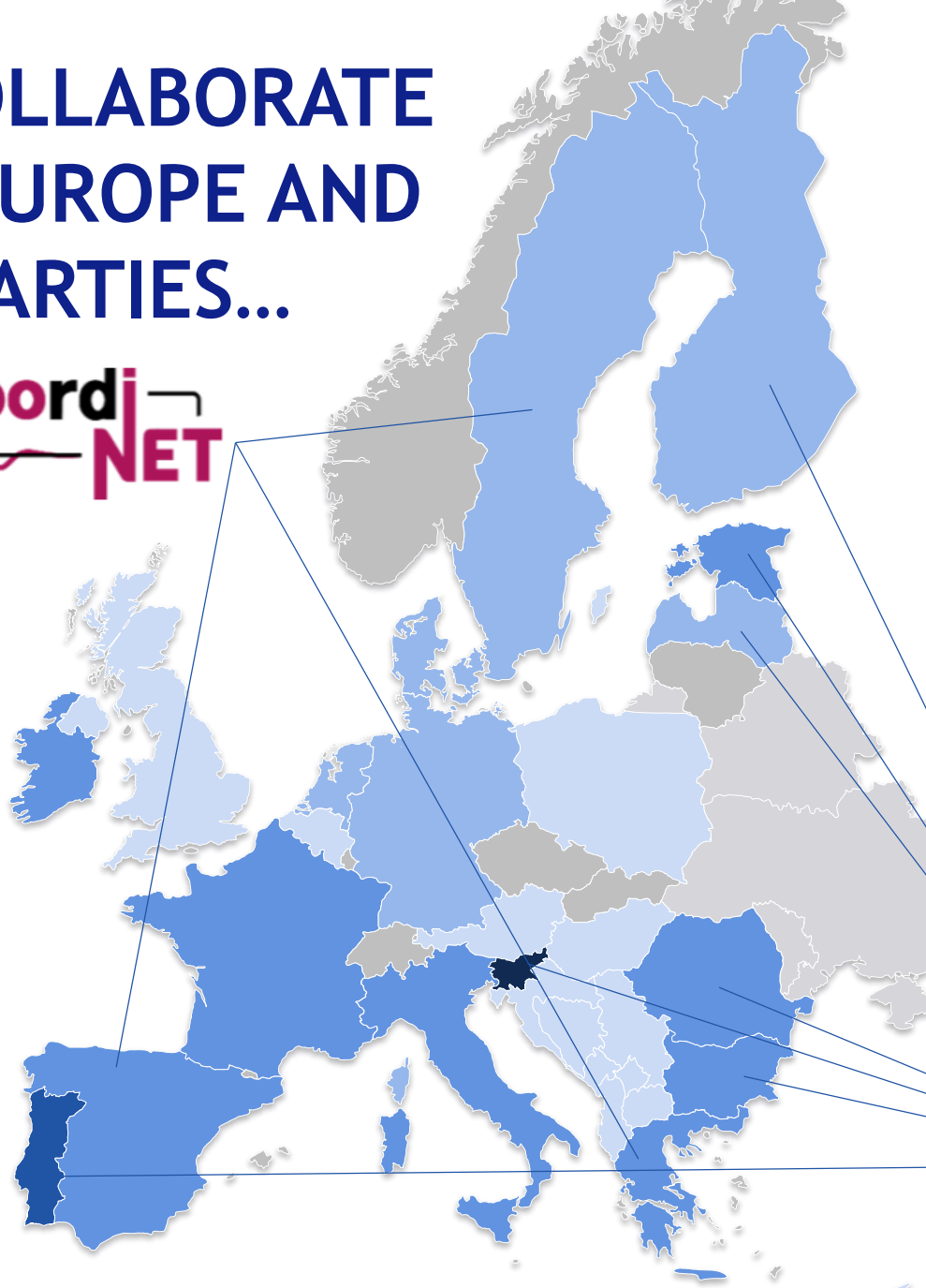
TRL 1 (building competence) TRL 2-3 (research) TRL 4-5 (development) TRL 6-7 (demonstration) TRL 8-9 (implementation)

# …today WE COLLABORATE ALL ACROSS EUROPE AND WITH MANY PARTIES…




**Source:** The BRIDGE initiative and project fact sheets, 2019 March. Link

# 2020 : New more prioritized ENTSO R&D&I Roadmap to the needs for a 100% renewable and secure energy system in 2050

**Cluster 1:** Assets and technologies

**Cluster 2:** Security & operation of tomorrow

**Cluster 3:** Flexibility and economics

**Cluster 4:** Future of energy system

**Cluster 5:** Digital and communication

2020 2030 2040 2050

**Research and Innovation space/needs for TSOs Top-Down**

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# Co-operation is essential for R&D
# prioritize, share scarce resources, inspire and harmonize

## National level

smartgrid The Norwegian Smartgrid Centre

energi 21

Forskningsrådet

## Nordic level

Nordic R&D Group

ENERGINET FINGRID

LANDSNET

SVENSKA KRAFTNÄT Statnett

Nordic Energy Research

## European level

ETIP SNET

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## International

ENERGY TRANSITIONS COMMISSION

ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

iea International Energy Agency

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# Session 4: Innovative and digital solutions

How to facilitate the deployment of innovative technologies

**Michael Walsh**

Managing Director - Europe, SmartWires

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SMART WIRES

REIMAGINE THE GRID

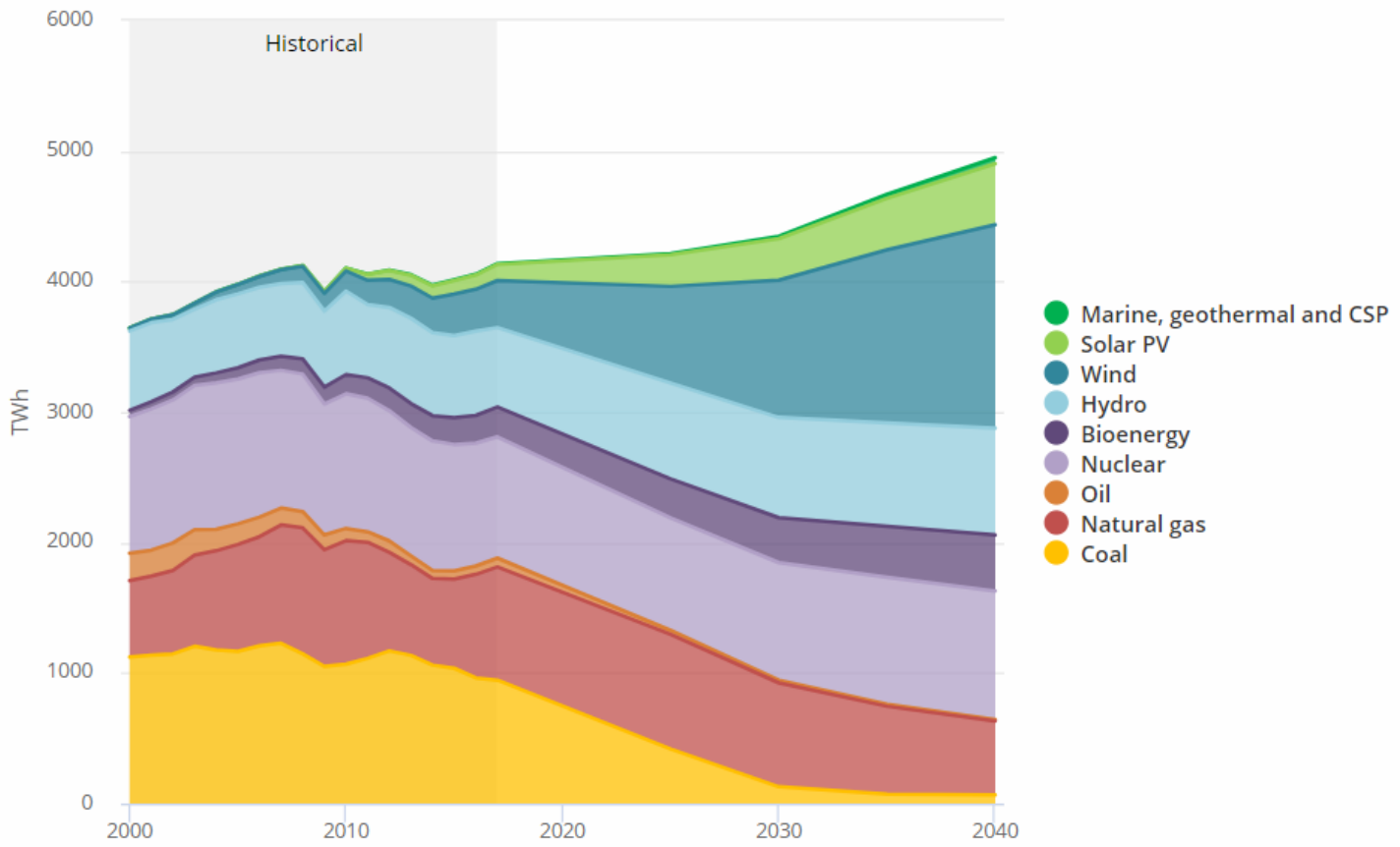
# Mind the gap !

# From Proven Innovation to Application

**Michael Walsh**

# The European Path to Decarbonisation

## Generation by Technology World Energy Outlook 2018 New Policies Scenario




IEA/World Energy Outlook 2018

### To do List

- ✓ Build RES Generation
- ✓ Balance Supply and Demand
- ✓ Keep system stable
- ✓ Transport electricity to customers





SMART WIRES
REIMAGINE THE GRID

# European Investment Needs

**GENERATION**

Today

EUR 50-60 B

**Required**

**EUR 54-80 B**

**TRANSMISSION & DISTRIBUTION**

Today

EUR 35 B

**Required**

**EUR 40-62 B**

**25%** of TYNDP projects are delayed, mainly due to lack of public acceptance.

ENTSOE 2040 “No Grid” scenario foresees extra system costs €43 bn per year by 2040.

**Costs of “No grid”**

**EUR 43 B**

http://www.europarl.europa.eu/RegData/etudes/STUD/2017/595356/IPOL_STU(2017)595356_EN.pdf

https://docstore.entsoe.eu/Documents/Publications/ENTSO-E%20general%20publications/ENTSO-E_PowerFacts_2019.pdf

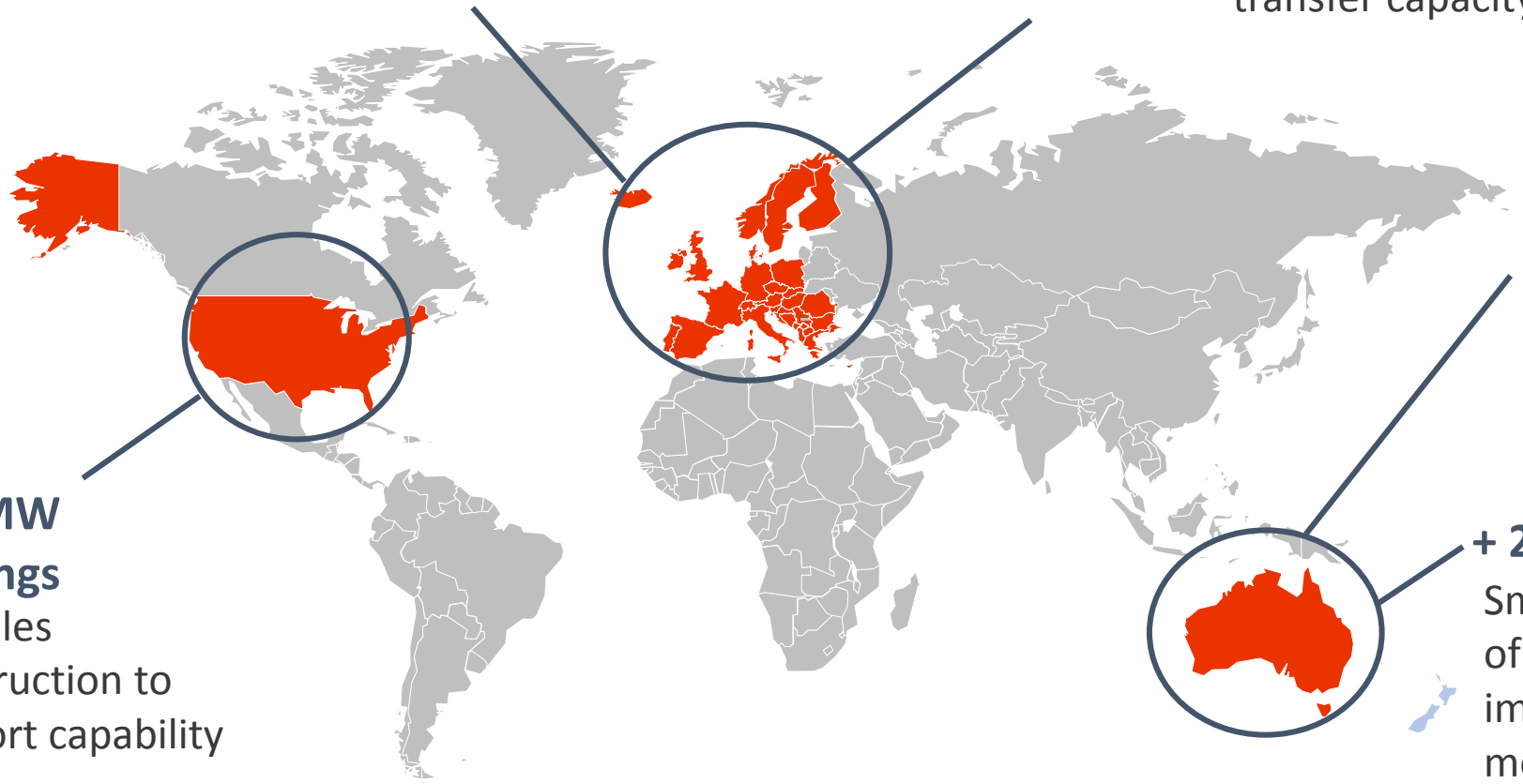




SMART WIRES
REIMAGINE THE GRID

**Dynamic Line Rating** project saved 500k EUR in one day

**+1.5 GW** Smart Wires enable 1.5 GW of incremental transfer capacity within 2 years.



**Demand response**

Part of Ausgrid's planning toolkit

**+ 450 MW**

**+ $10M savings**

Smart Wires enables challenging construction to increase city import capability by 450 MW

**+ 220 MW**

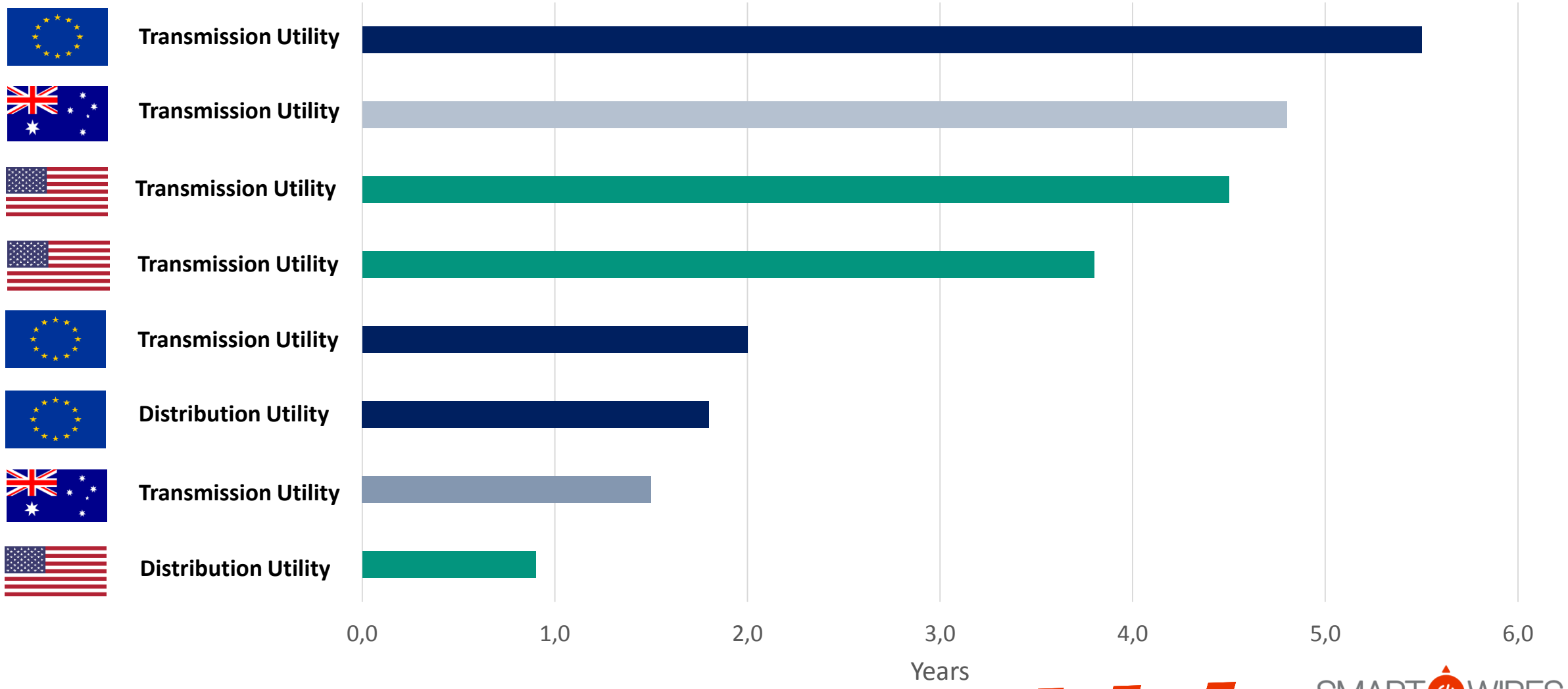
Smart Wires deliver 220 MW of regional transfer capacity improvement within 12 months

## New technology can deliver significant Impact
## Is the Time to Market slowing energy transition?

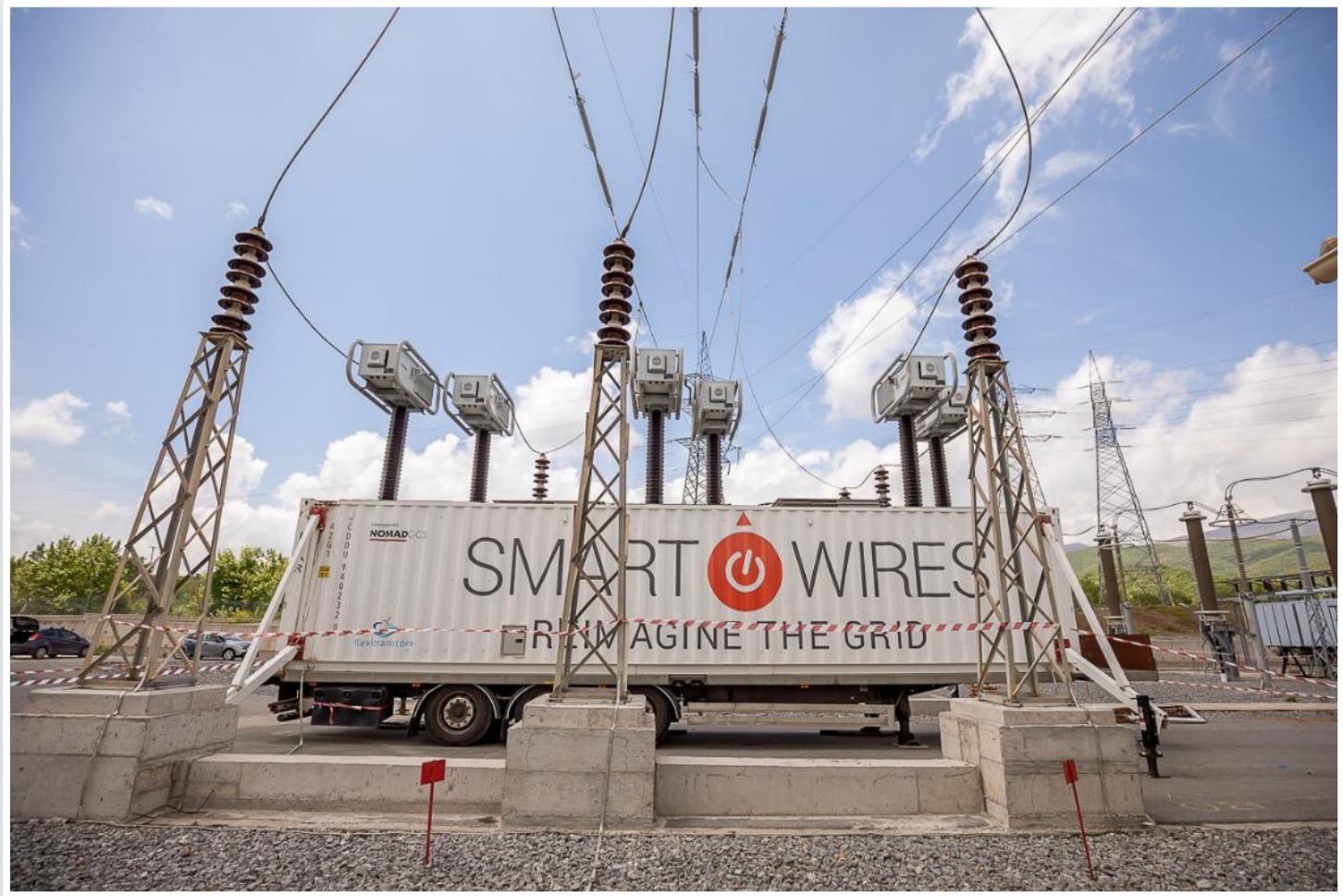
SMART WIRES
REIMAGINE THE GRID

# Global Snapshot of Timelines from Capital Approval to Installation

(All examples are similar Substation Based Projects)




SMART WIRES
REIMAGINE THE GRID




ΑΔΜΗΕ
ΑΝΕΞΑΡΤΗΤΟΣ ΔΙΑΧΕΙΡΙΣΤΗΣ
ΜΕΤΑΦΟΡΑΣ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ

- IPTO is leveraging Mobile power flow control to enhance and accelerate the integration of renewables into the Greek grid
- Installation was completed in 5 days and required outage time of less than 24 hours
- Installed at 150 kV and can easily be moved to other lines of different voltages

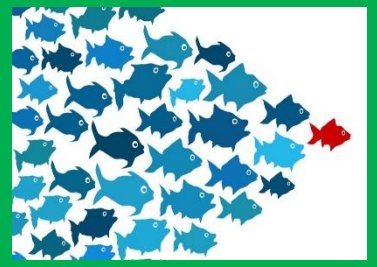




SMART WIRES
REIMAGINE THE GRID

# What works well, what causes delays?

## Smart Wires experience across ~ 100 Network Companies



Leadership

Incentives

Targets


Research


Prioritisation

Co-operation

Time to act


Transparency





SMART WIRES
REIMAGINE THE GRID

# Recommendations

1. Introduce regulation that incentivises results and impact
   - Rate base regulation encourages high capital cost projects
2. Publish system needs and allow third parties to propose solutions
   - Transparency and competition drive efficiency
3. Executive focus on implementation of innovation
   - Stop small tasks holding up innovative projects for years
4. Share knowledge
   - No need for everyone to pilot same solution before roll out
5. Implement targets (in policy and internal in companies)
   - It's a busy world – what gets measured gets done !

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# Session 4: Innovative and digital solutions

## Panel debate on innovative and digital solutions

**Haitze Siemers**
Head of New energy technologies, innovation and clean coal Unit, DG ENER

**Tooraj Jamasb**
Director, Copenhagen Energy Infrastructure School

**Jukka Ruusunen**
CEO of Fingrid

**Laurent Schmitt**
ENTSO-E Secretary General

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# Session 4: Innovative and digital solutions

Panel debate on innovative and digital solutions

**Jukka Ruusunen**

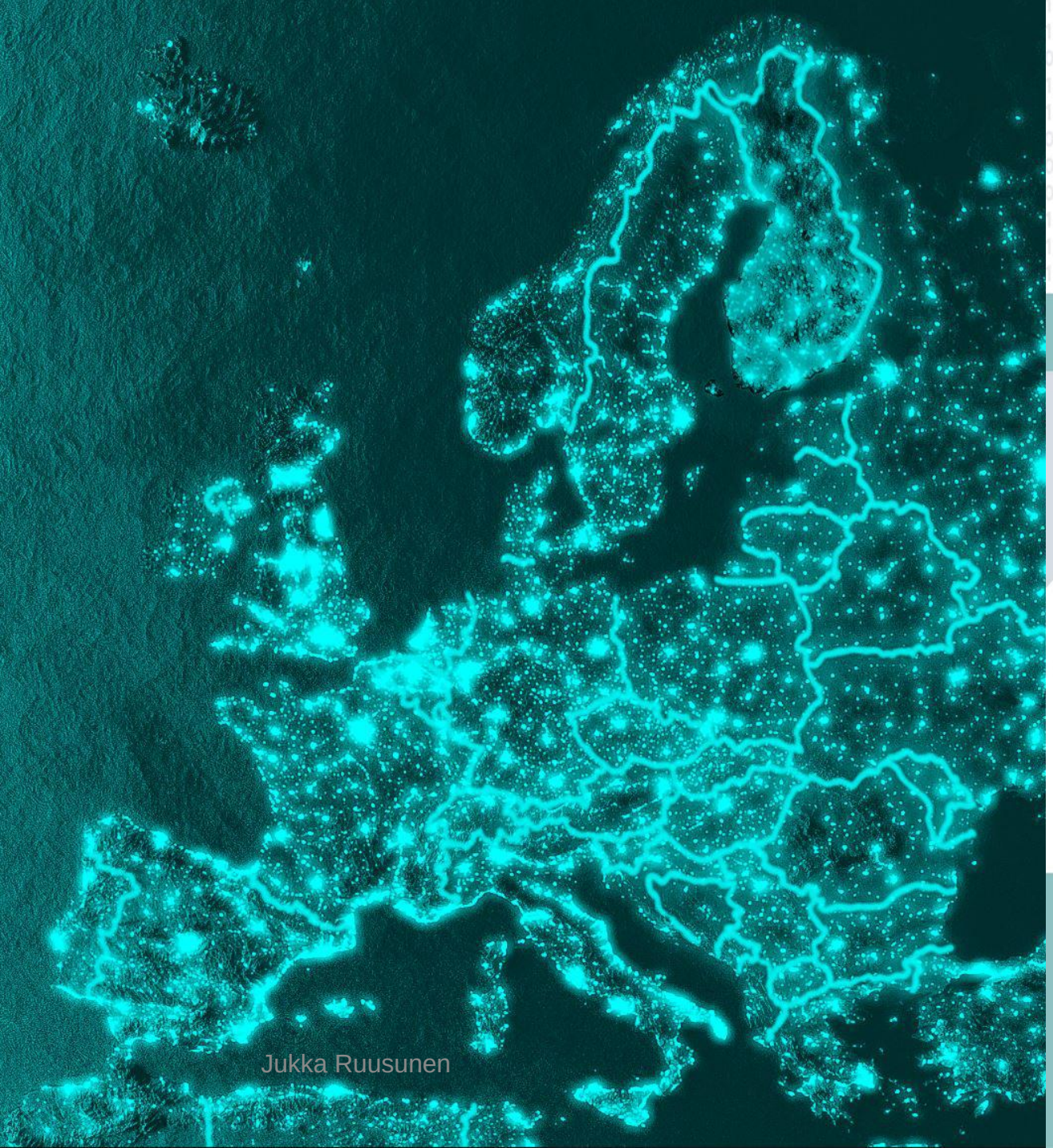
CEO of Fingrid

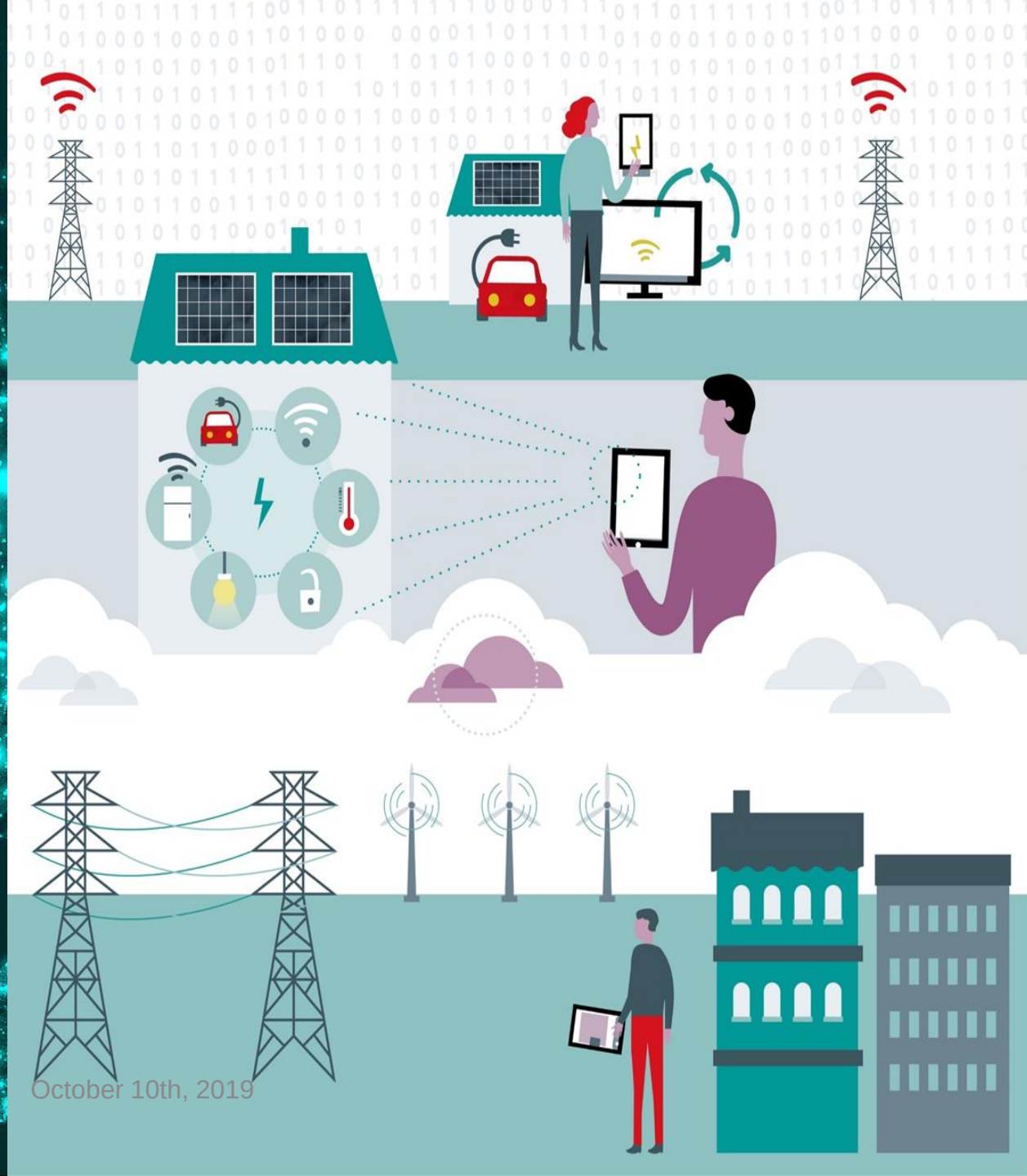
Jukka Ruusunen
President and CEO, Fingrid Oyj
@RuusunenJukka

# Innovative and digital solutions

ENTSO-E 10 Years Conference, 13th November, Ooppera Baletti, Helsinki

FINGRID





Jukka Ruusunen

October 10th, 2019

**Fingrid Oyj**
Läkkisepäntie 21
00620 Helsinki
PL 530, 00101 Helsinki
Puh. 030 395 5000
Fax. 030 395 5196

See Fingrid market video at
https://www.youtube.com/watch?v=dNU8p71p020

FINGRID

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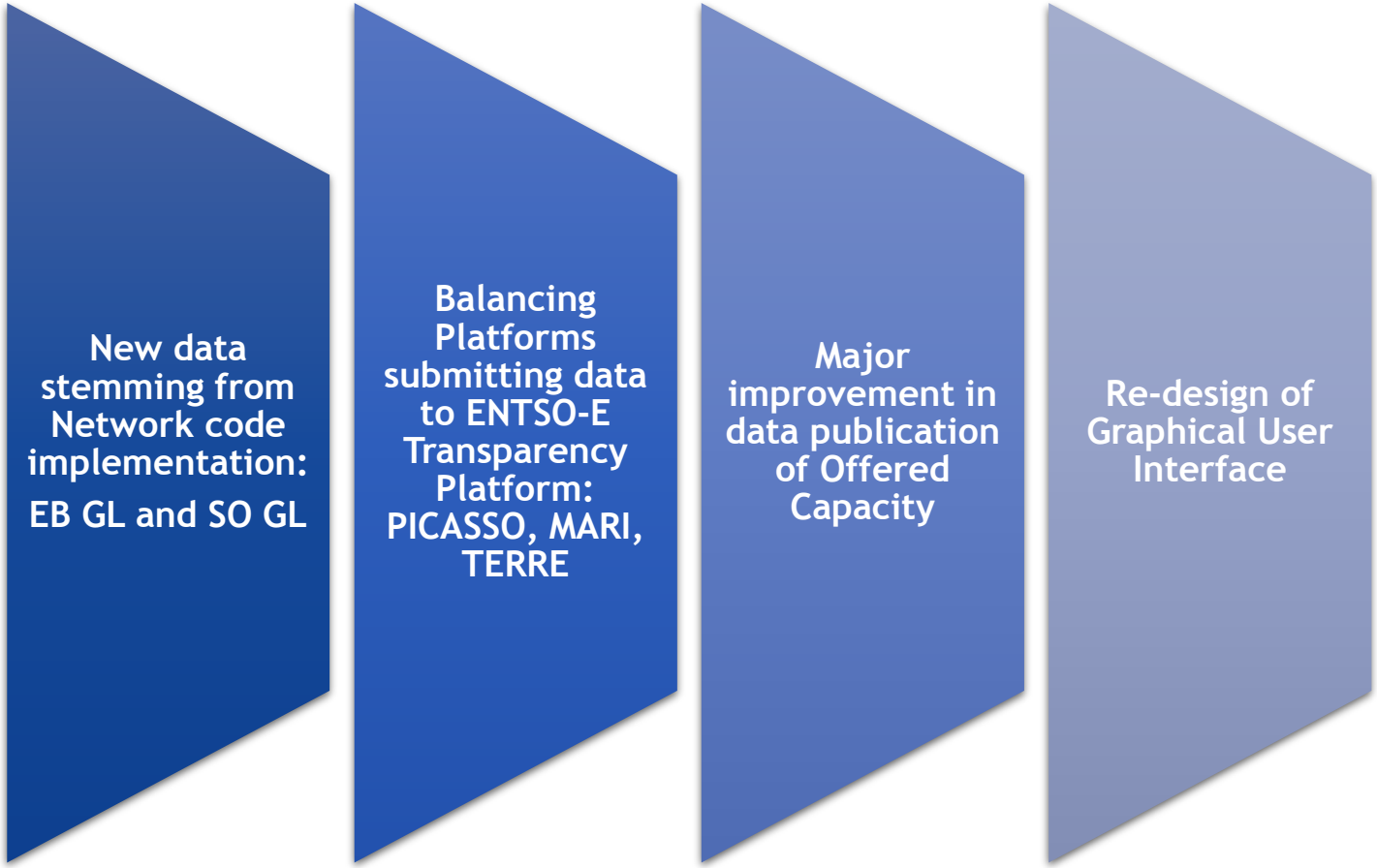
# Session 4: Innovative and digital solutions

Panel debate on innovative and digital solutions

**Laurent Schmitt**

ENTSO-E Secretary General

# Major milestones on TP

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Transparency Platform

# New data stemming from EU Regulation: EB GL and SO GL

## EB GL Article 12

**EB GL requires ENTSO-E to publish following information: Go-live is expected in Q4 2019**

- Current system balance
- Balancing energy bids
- Aggregated balancing energy bids
- Procured balancing capacity
- Initial terms & conditions (rules)
- Allocation of cross-zonal balancing capacity
- Use of cross-zonal balancing capacity

## SO GL Articles 183-190

**SO GL requires ENTSO-E to publish the following information:**

**Go-live is expected in Q4 2019**

- Frequency, reserves and operational agreements.
- Since Q2 2019, the ENTSO-E Transparency Platform is already receiving Synchronous area and LFC block agreements under data domain “System Operations”.

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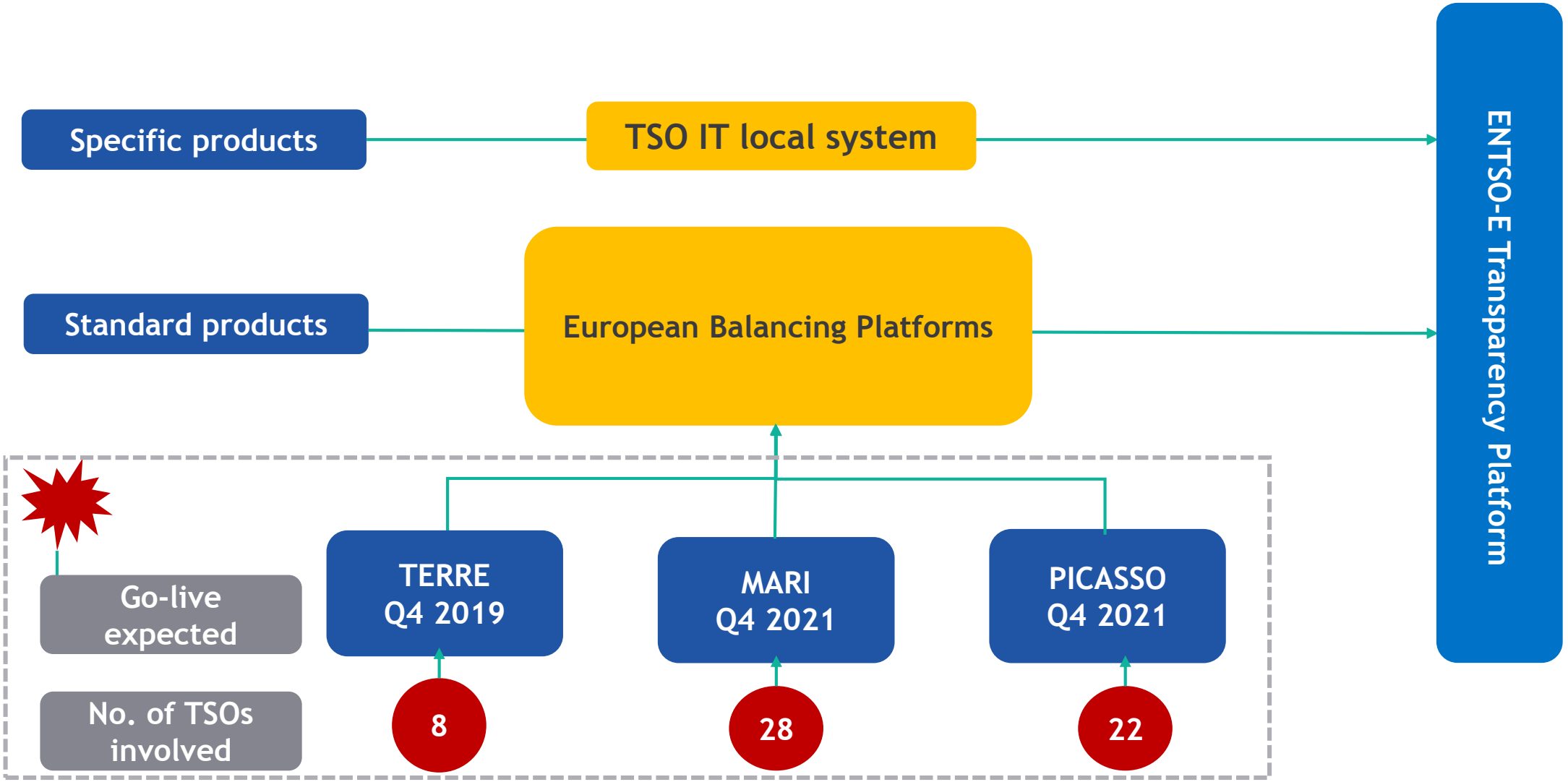
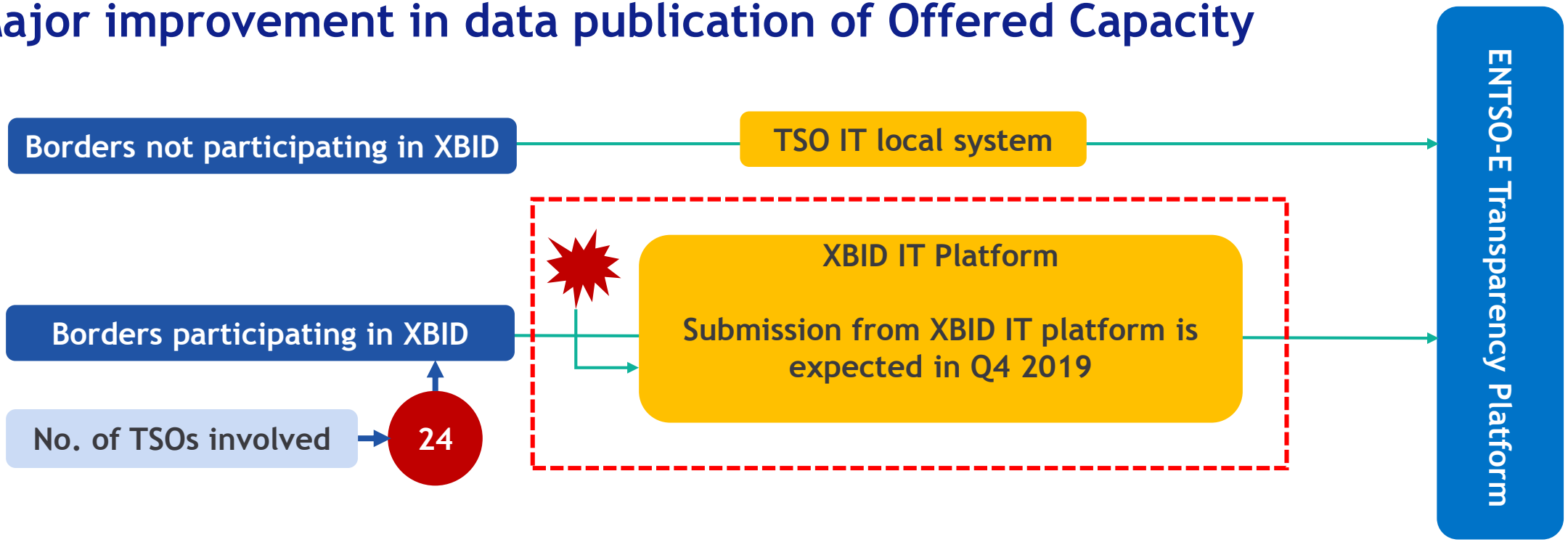
# Balancing Platforms submitting data to TP: PICASSO, MARI, TERRE



# Major improvement in data publication of Offered Capacity




It is worthwhile highlighting that the snapshot of the most recent values of the offered capacity (TR art. 11.2) for explicit and implicit allocations will be published, every 15 mins on the platform. The full evolution of the offered capacity will be made available for download.

The full evolution of the offered capacity will be made available for download.

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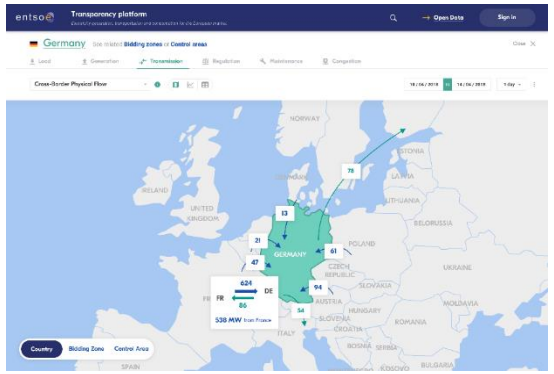
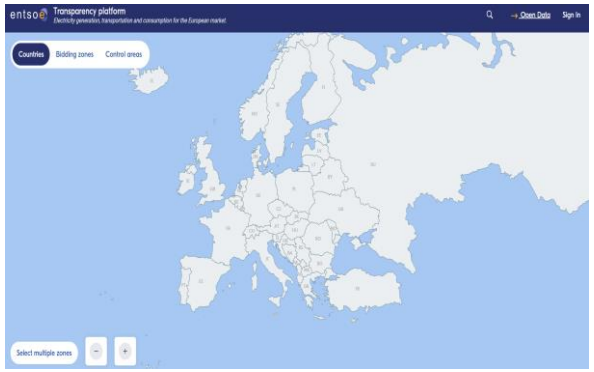
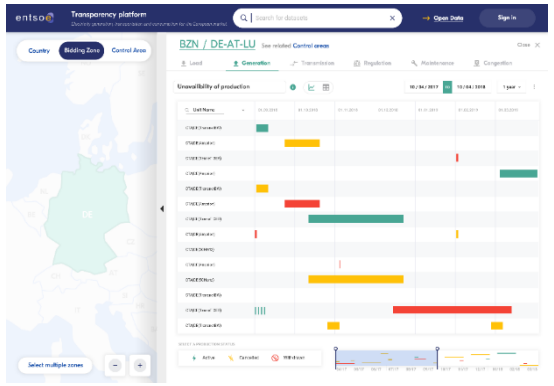
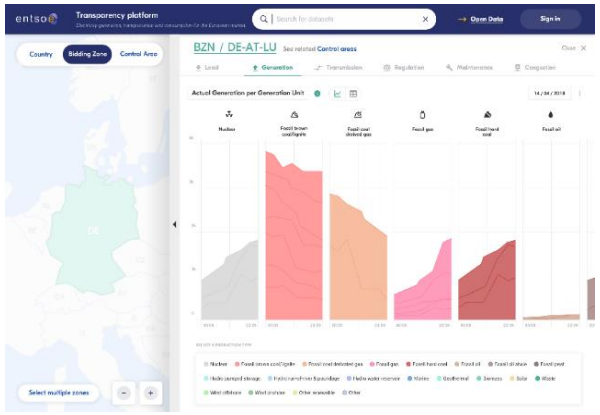
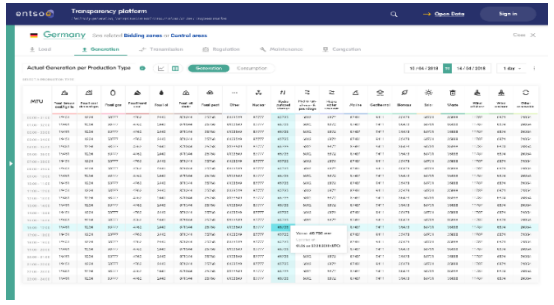
# Re-design of TP Graphical User Interface

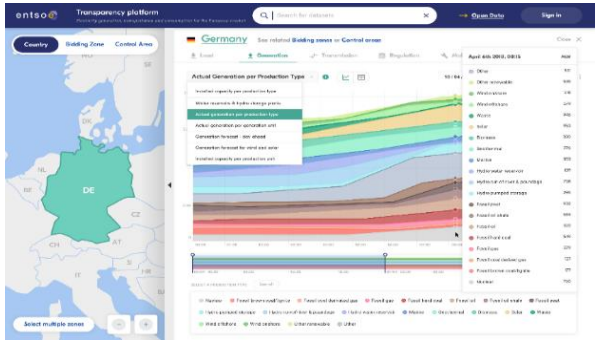



Proof of Concept (PoC) for the new Graphical User Interface (GUI), named New Transparency is open for user feedback.

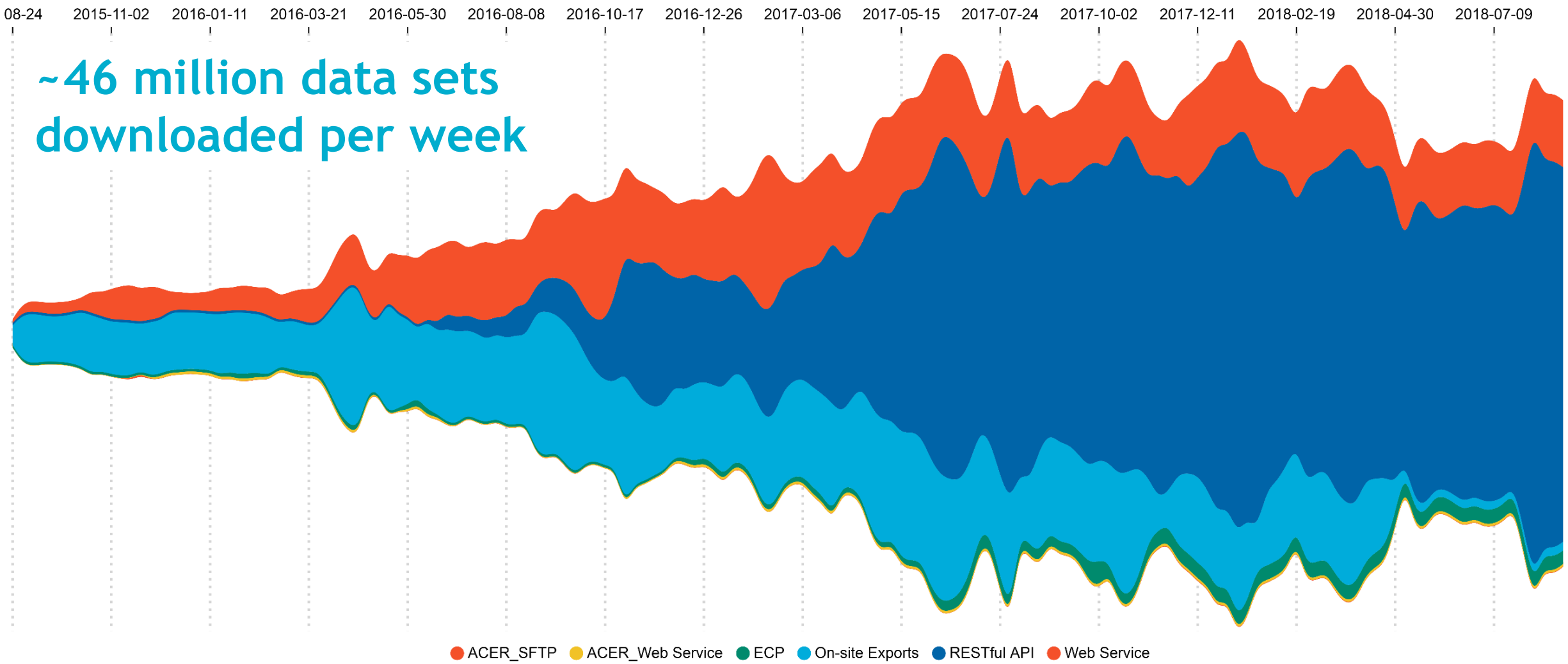
PoC is currently limited in terms of functionalities, in any case, there will more additions to it in future.

Following screens are accessible, under PoC:

- Actual generation per production type
- Unavailability of production and generation units
- Cross-border physical flows
- Actual generation per generation unit

Landing page and Load domain will be deployed by December 2019, and rest of the other domains by 2020.

# Increase of Transparency Platform usage in the last 3 years

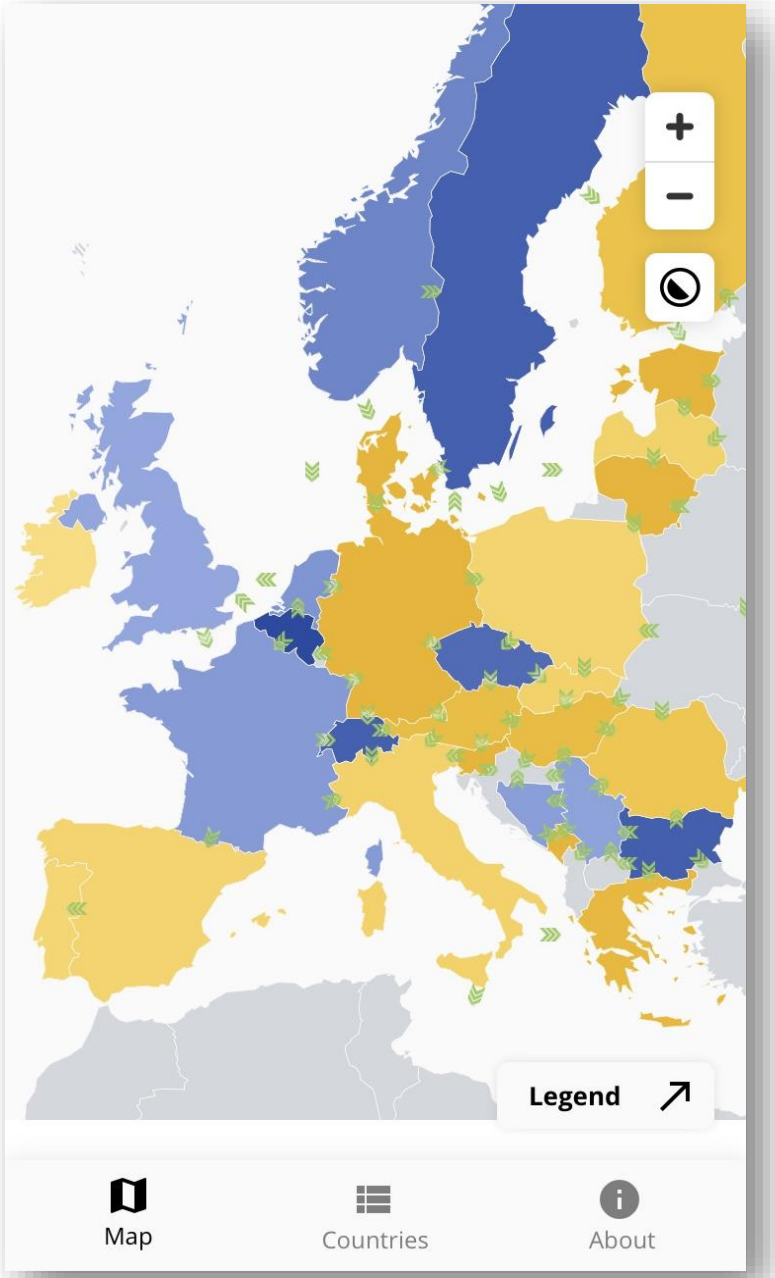


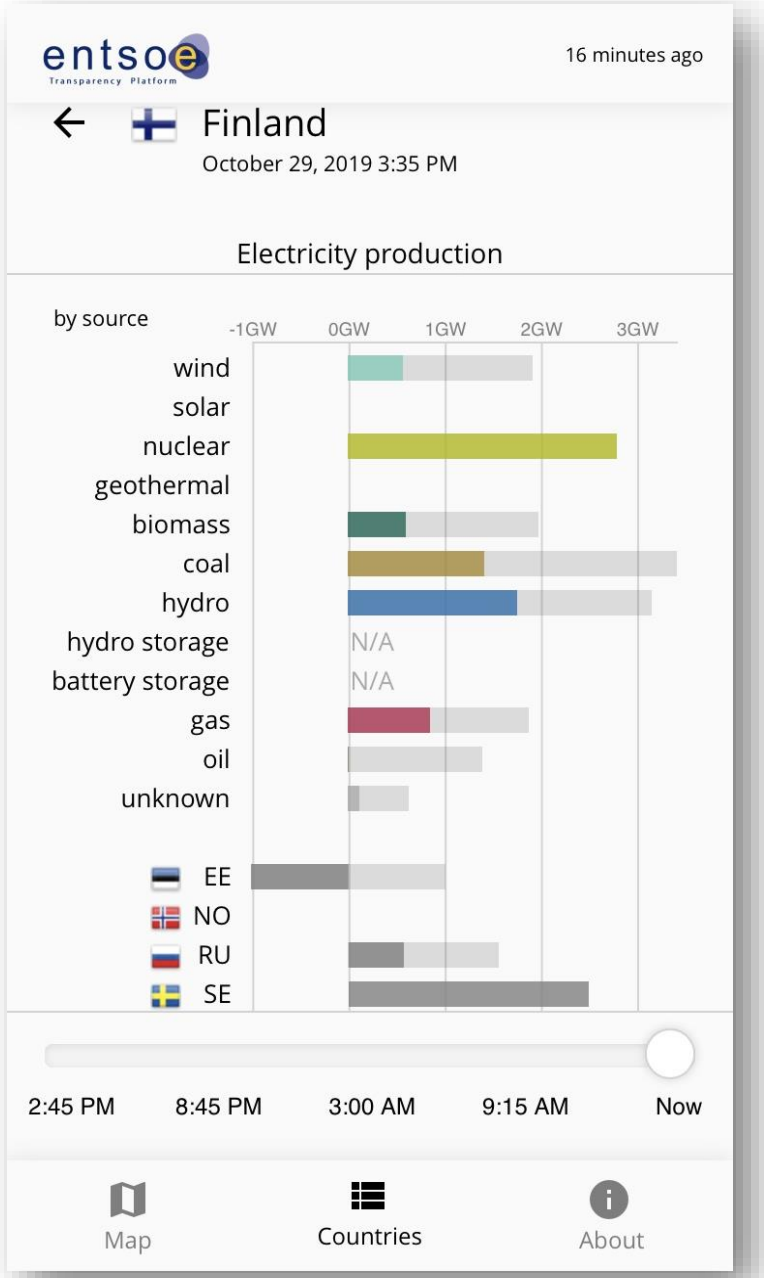

*(source: ENTSO-E)*

# ENTSO-E Transparency Platform App

Live access to a summary of the data from the ENTSO-E Transparency Platform:

- Generation mix
- Cross-border physical flows
- Day-ahead prices



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# Session 5: A regional perspective

## The Nordic & Baltic experience of TSO cooperation

**Jens Møller Birkebæk**
Manager, Nordic RSC

**Thomas Egebo**
CEO, Energinet

**Hakon Borgen**
ENTSO-E Research, Development & Innovation Committee Chair

**Jukka Leskelä**
Managing Director, Finnish Energy

**Taavi Veskimagi**
CEO, Elering

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# The next decade ahead - Concluding remarks

**Keynote** - What priorities for the European Commission on energy?

**Joachim Vanzetta**

ENTSO-E Chair of the Board

**Ditte Juul-Jørgensen**

Director General, DG ENER, European Commission

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# New app, tools & publications - Download from Resources page on our Annual Conference website

TYNDP Scenarios Consultation

Sector Coupling Position Paper

Power Facts Europe 2019

Enhanced TSO Regional Coordination for Europe

Annual Work Programme Consultation

Transparency Platform New Graphical User Interface

Transparency Platform App (ANDROID)

Transparency Platform App (iOS)

Power Flow Tool

Digital Report

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# Thank you for your attention

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