entsoe VISION

A Power System for a Carbon Neutral Europe

10-12 October 2022

#VisionEvent22

A power system for a carbon neutral Europe

Welcome to ENTSO-E Vision Event

DAY 1, 10 OCTOBER, OPENING SESSION

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ASK YOUR QUESTIONS ONLINE WITH SLIDO

Day 1, 10 October, Opening Session

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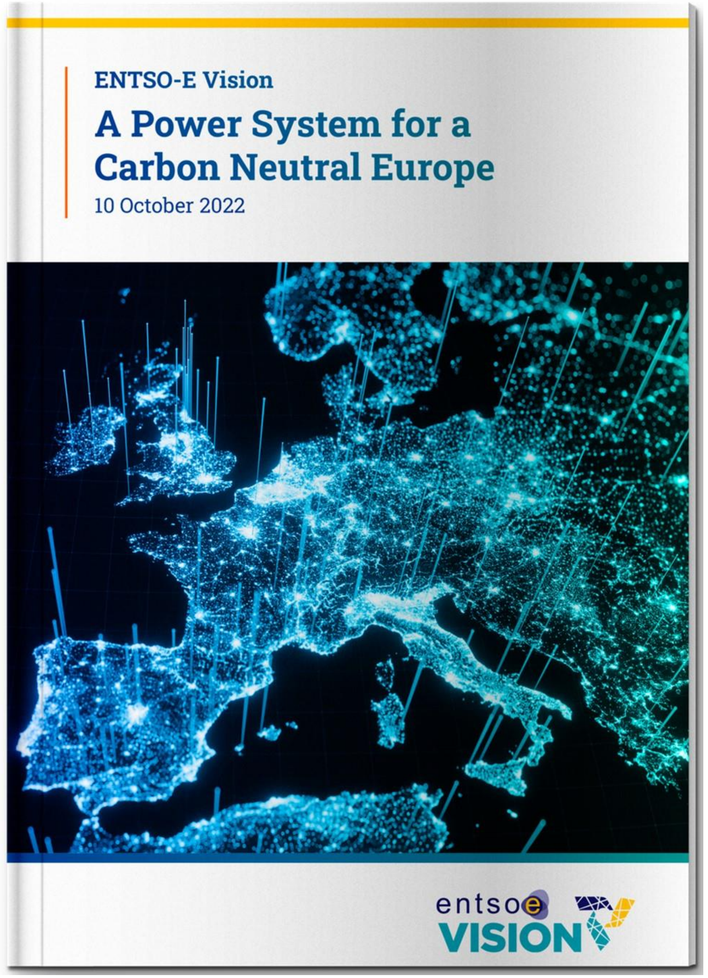
A power system for a carbon neutral Europe



ENTSO-E Vision

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A power system for a carbon neutral Europe

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Paving the way for a decarbonised, secure and sustainable power system

OPENING KEYNOTES

Hervé Laffaye

President, ENTSO-E

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Priorities of the EU Presidency

KEYNOTE SPEECH

Jozef Síkela

Minister of Industry and Trade of Czech Republic

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Session 1

ENTSO-E Vision for a Carbon Neutral Europe

DAY 1, 10 OCTOBER, SESSION 1

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A power system for a carbon neutral Europe

Introduction to the ENTSO-E Vision

Damian Cortinas

ENTSO-E Vision Project Manager, ENTSO-E

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ENTSO-E Vision for the future of the European Power System

Guiding principle

- A shared political goal for a fully **carbon-neutral European economy**

Our Vision

- A **comprehensive analysis** of what is necessary to achieve a power system fit for a carbon-neutral Europe
- As a contribution to the debate on the **European Energy Transition**
- Including **TSOs shared intelligence** on trends, scenarios, challenges, technology & innovation

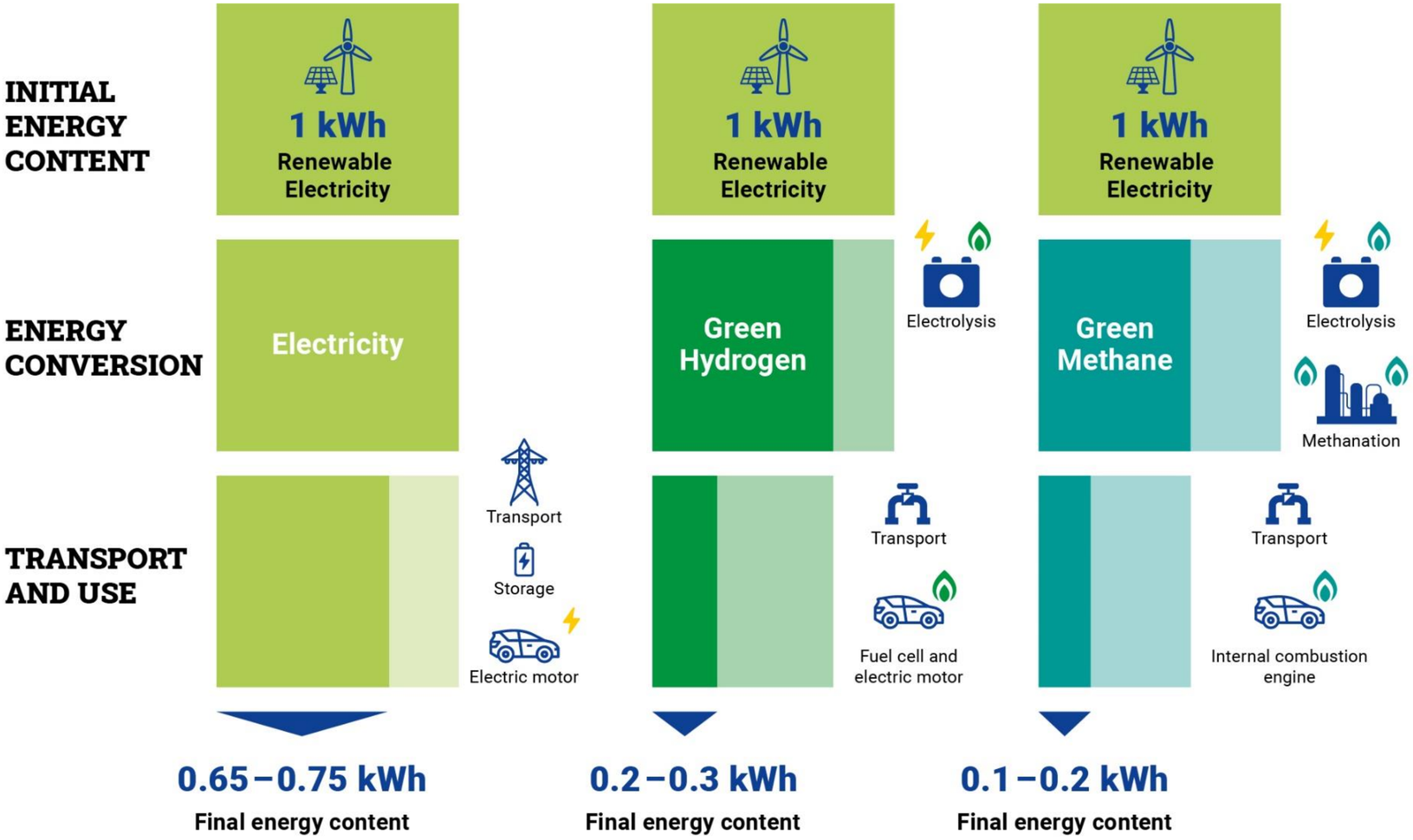
Developed by a strong project team

- 23 experts from 14 European TSOs and ENTSO-E secretariat

Results

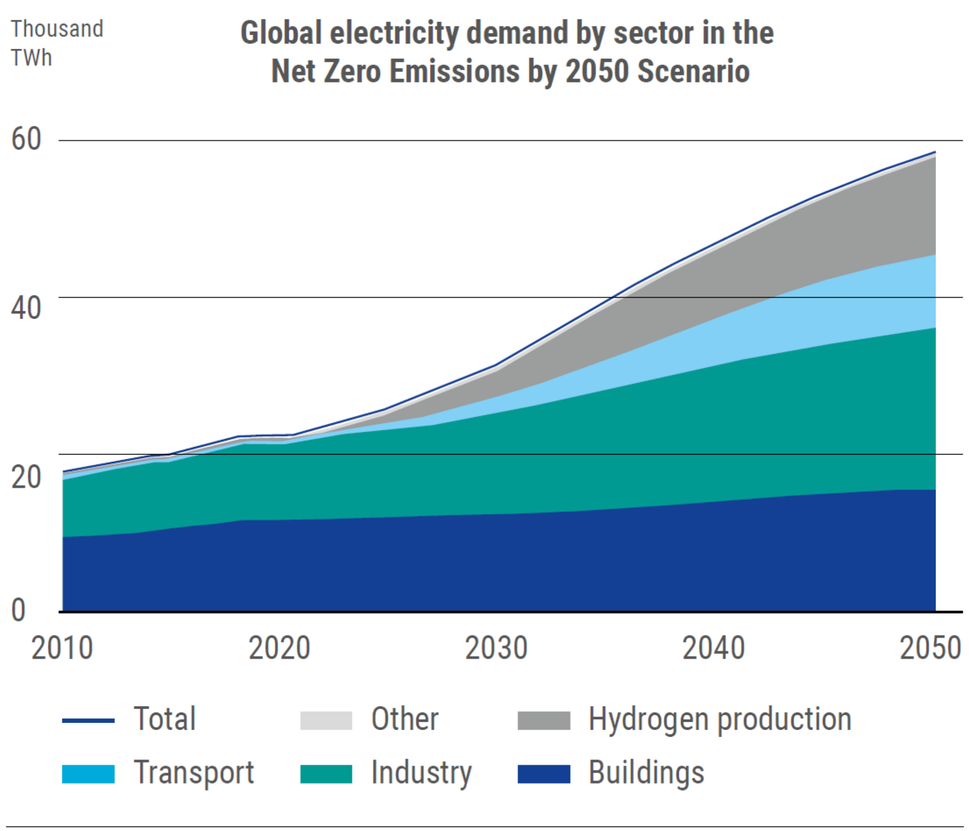
- High-level paper, backed by extensive analysis
- This 3-day conference: ENTSO-E main event this year

Electrification is the most efficient way to reach carbon neutrality
(for the majority of cases)

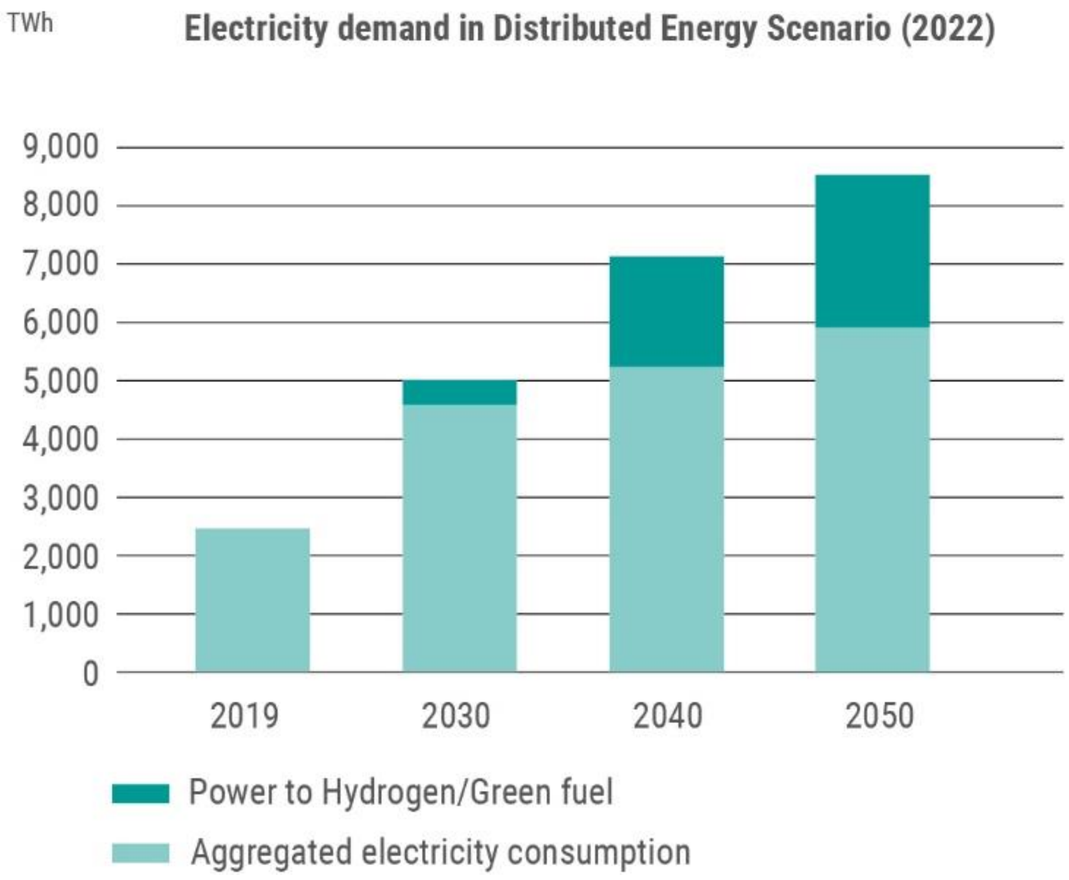


…but electricity alone will not be enough

A carbon neutral Europe needs a much more electrified economy

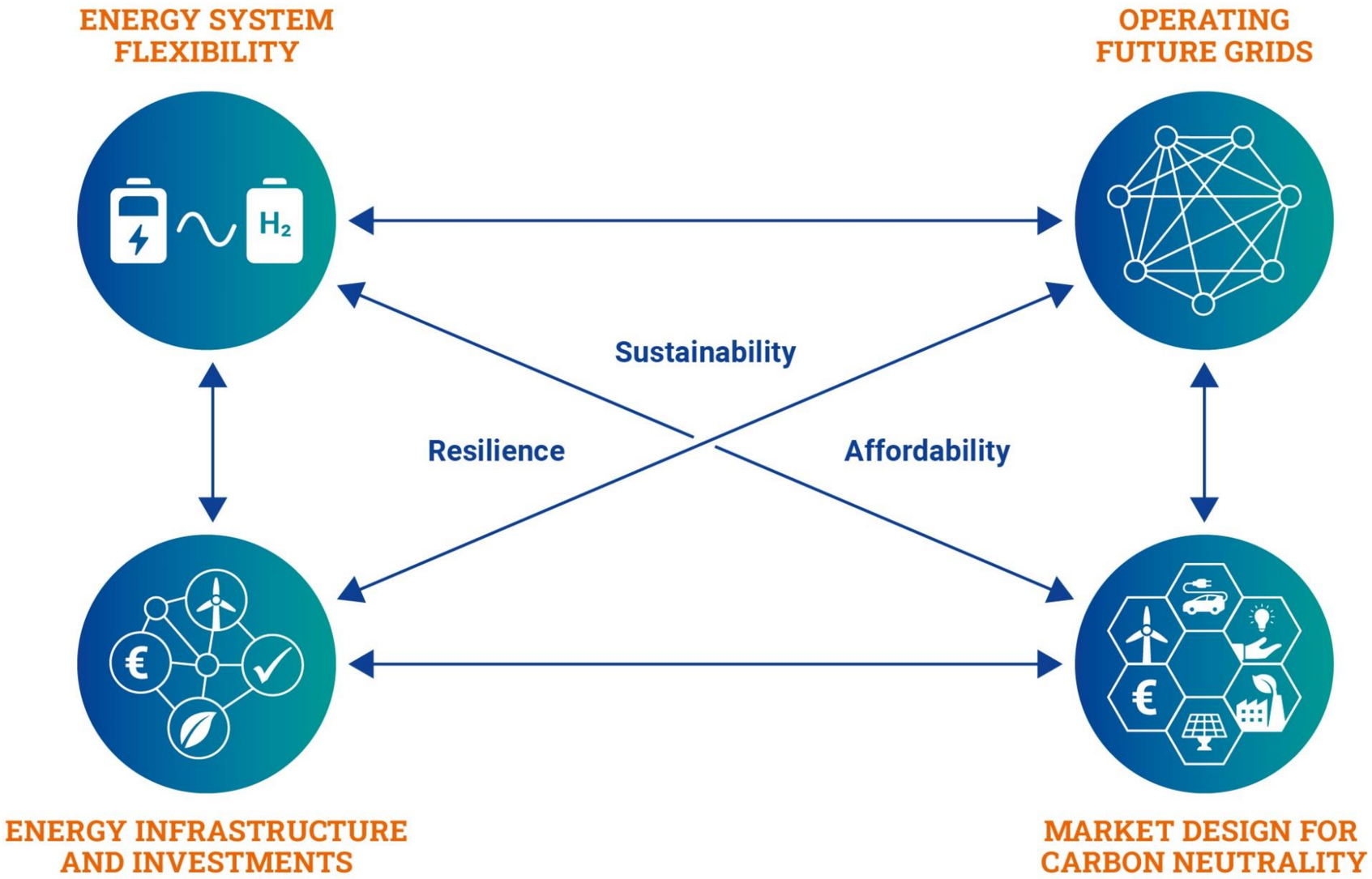


International Energy Agency model for Net Zero.



Electricity demand in ENTSO-E countries

A Vision based on 4 Key “Building Blocks”



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Energy System Flexibility

Mario Sisinni

ENTSO-E Vision Project Team Member

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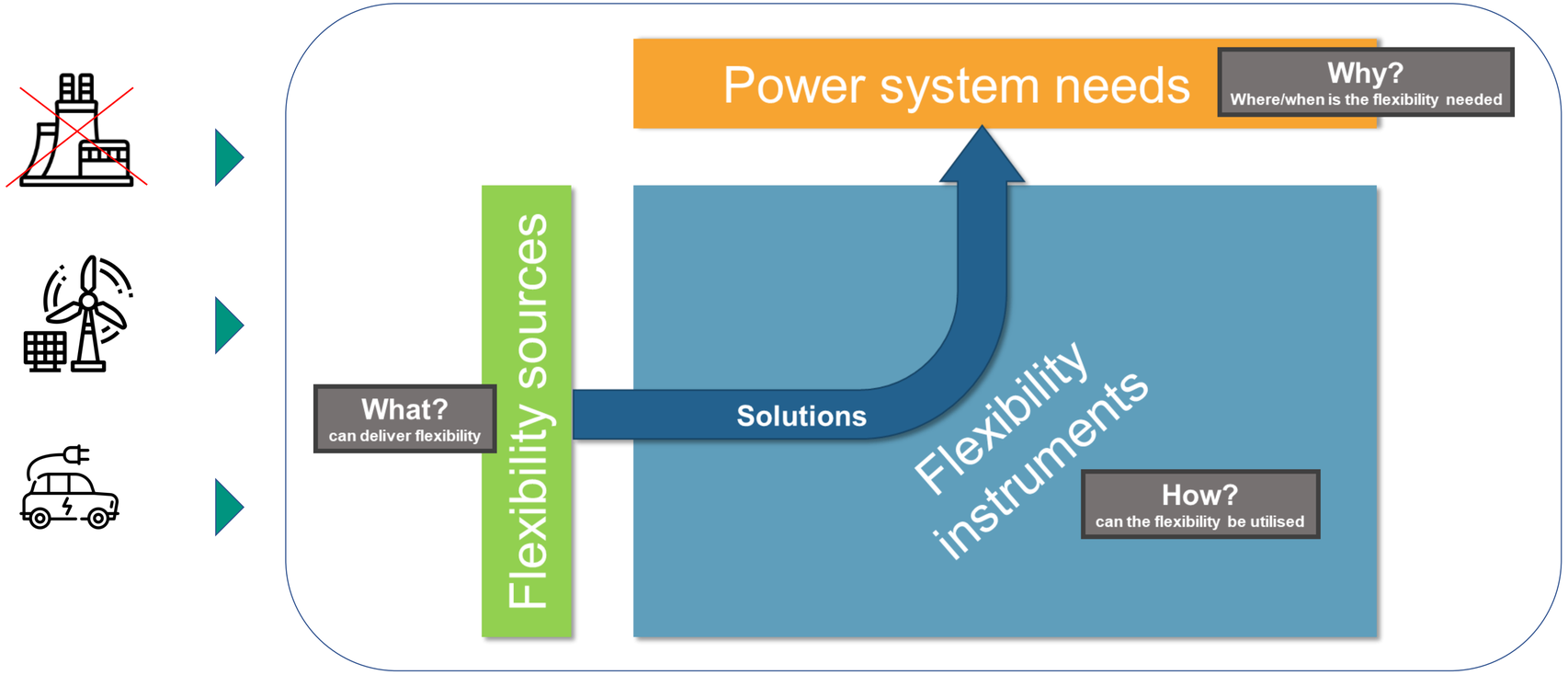
Energy System Flexibility – A definition

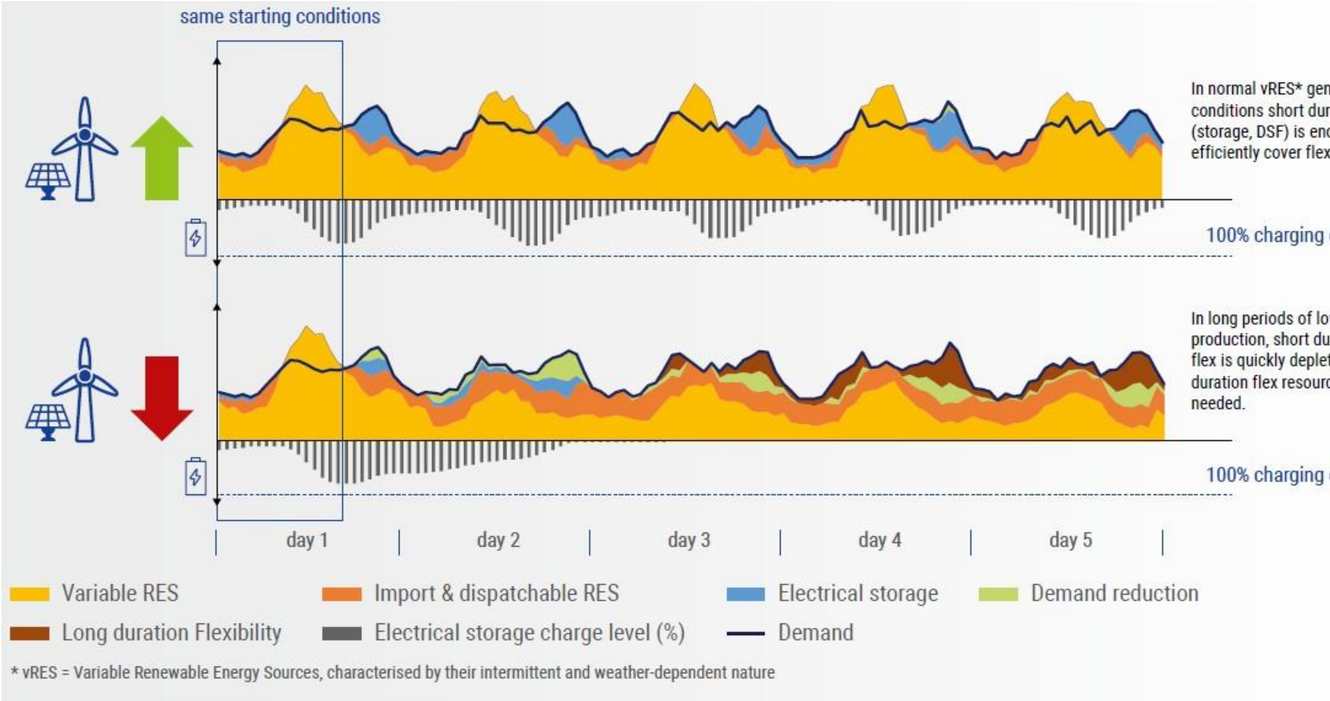
In a fully carbon neutral system, based on electrified consumption and variable renewable energy sources, flexibility will be essential to complement the variability of both generation and demand and to address the increase of system complexity



Flexibility refers to the ability of the power system to cope with variability and uncertainty in generation, demand and grid availability

Energy System Flexibility – Evolving needs and cost-efficient resources

Flexibility needs will evolve both in nature and volume, as the system evolves towards carbon neutrality



Flexibility needs can be classified in:

- ***Short duration flexibility***

(From milliseconds to a few hours, to balance the system within the day and ensure system stability)

- ***Long duration flexibility***

(Up to several weeks, to compensate for long events with shortage of wind/solar and hydro generation)

Each type of flexibility need shall be covered by the most suitable and cost-efficient set of flexibility resources

Going forward, the possibility of quantify all types of flexibility needs across time and space will become essential to guide a cost-efficient deployment of flexibility resources

Energy System Flexibility – A key to the future

- The portfolio of flexibility resources will extend across voltage levels, national borders and sectors:
  - The set of carbon-neutral **short-duration flexibility** resources is wide, with **Demand Response** and **electrical storage** being the most promising for larger diffusion, for instance through active consumers and vehicle-to-grid solutions
  - There are very few potential sources of carbon-neutral **long duration flexibilities.** The most promising are **carbon-free dispatchable generation** (mainly hydroelectric) and **high energy density storage** (hydrogen, other new technologies)
- The **deployment** of both types of flexibility resources shall be **coordinated** with the integration of weather-dependent renewables and the phase-out of fossil-fuel generation
- **Grid development and interconnections** will be key to mitigate overall flexibility needs, as national and regional variations should partly offset each other
- To access and coordinate the portfolios of flexibility sources across voltage levels, national borders and sector integration, the future will clearly be a **system of systems**. Cooperation between TSOs, between TSOs and DSOs and with operators of other sectors will be fundamental
- A number of European countries foresee also **nuclear power generation** as a non-renewable but carbon-free source of energy, and its inclusion in the mix should partially decrease some flexibility needs

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Operating Future Grids

Danny Klaar

ENTSO-E Vision Project Team Member

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Key Challenges of Operating Future Grids

Growth in grid complexity

- Millions of active devices
- Hybrid AC/DC grids
- Operation across energy sectors

Change of system characteristics

- Weather dependency
- Dynamic stability issues

Maximizing use of the grid

- Operating close to full utilization
- Resilient operation after incidents

Key Enablers for Operating Future Grids

Power electronics with grid forming capabilities

- Providing services inherently provided by synchronous machines
- Inertia, short-circuit current contribution, oscillation damping

Enhanced forecasting capabilities and controllability

- Visibility of real-time and forecasted system states
- Availability and controllability of flexibility resources
- Ensuring control of the system in emergency situations

Automation and artificial intelligence

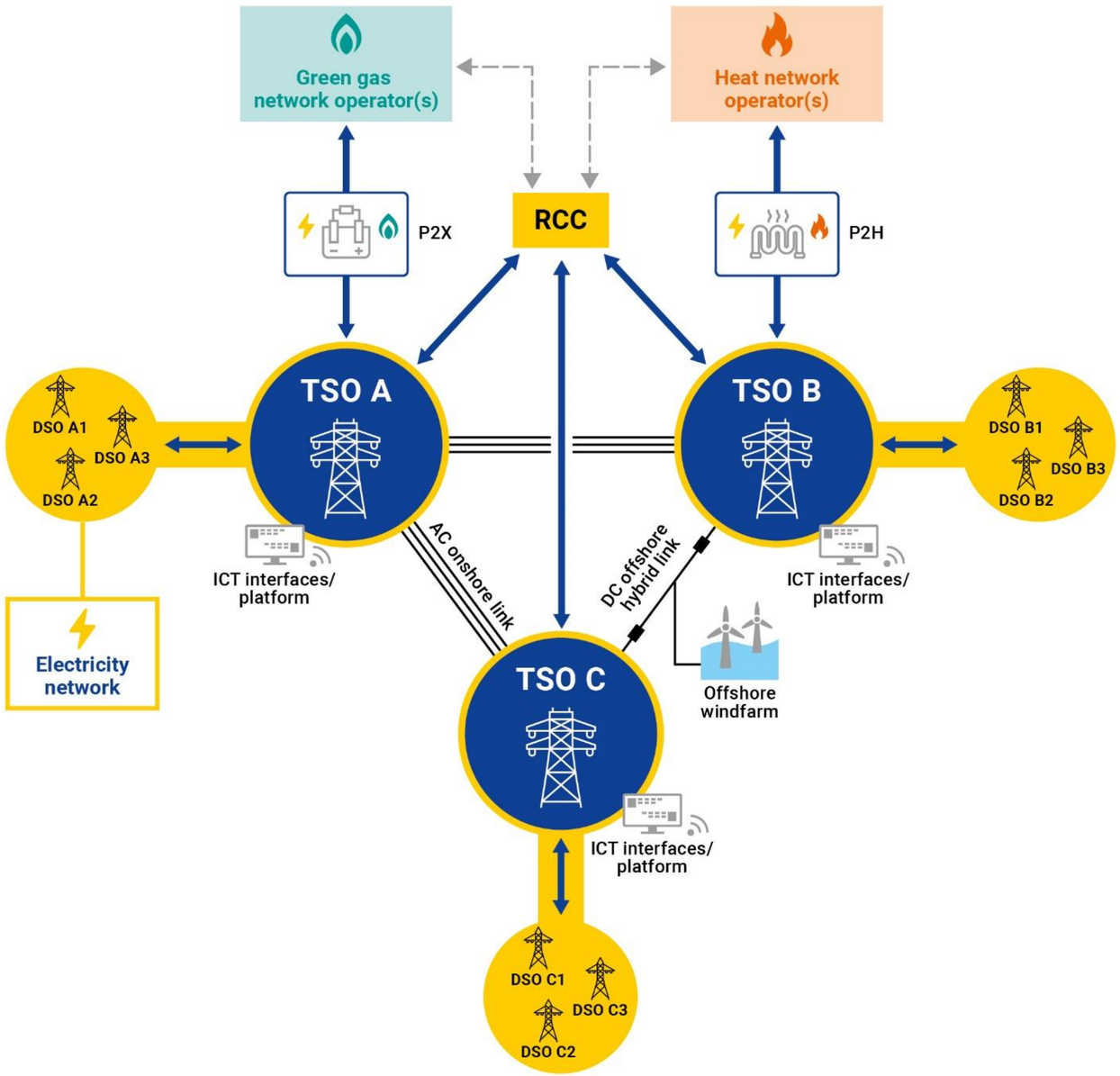
- Extending initial response of the system
- Aiding decision-making of human operators

Operation in a System of Systems

The future power system will be much more **complex** than today, with growing weather dependency, sector integration and large-scale flexibilities. It will need new approaches to **operate it safely and efficiently**.

In particular, the **operation of the transmission grid** will be done in close cooperation

- amongst **TSOs** at European and Regional level, assisted by RCCs
- with **DSOs** inside each control zone
- with other **energy sectors** integrated with the power system



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Energy Infrastructure and Investments

Miguel de la Torre

ENTSO-E Vision Project Team Member

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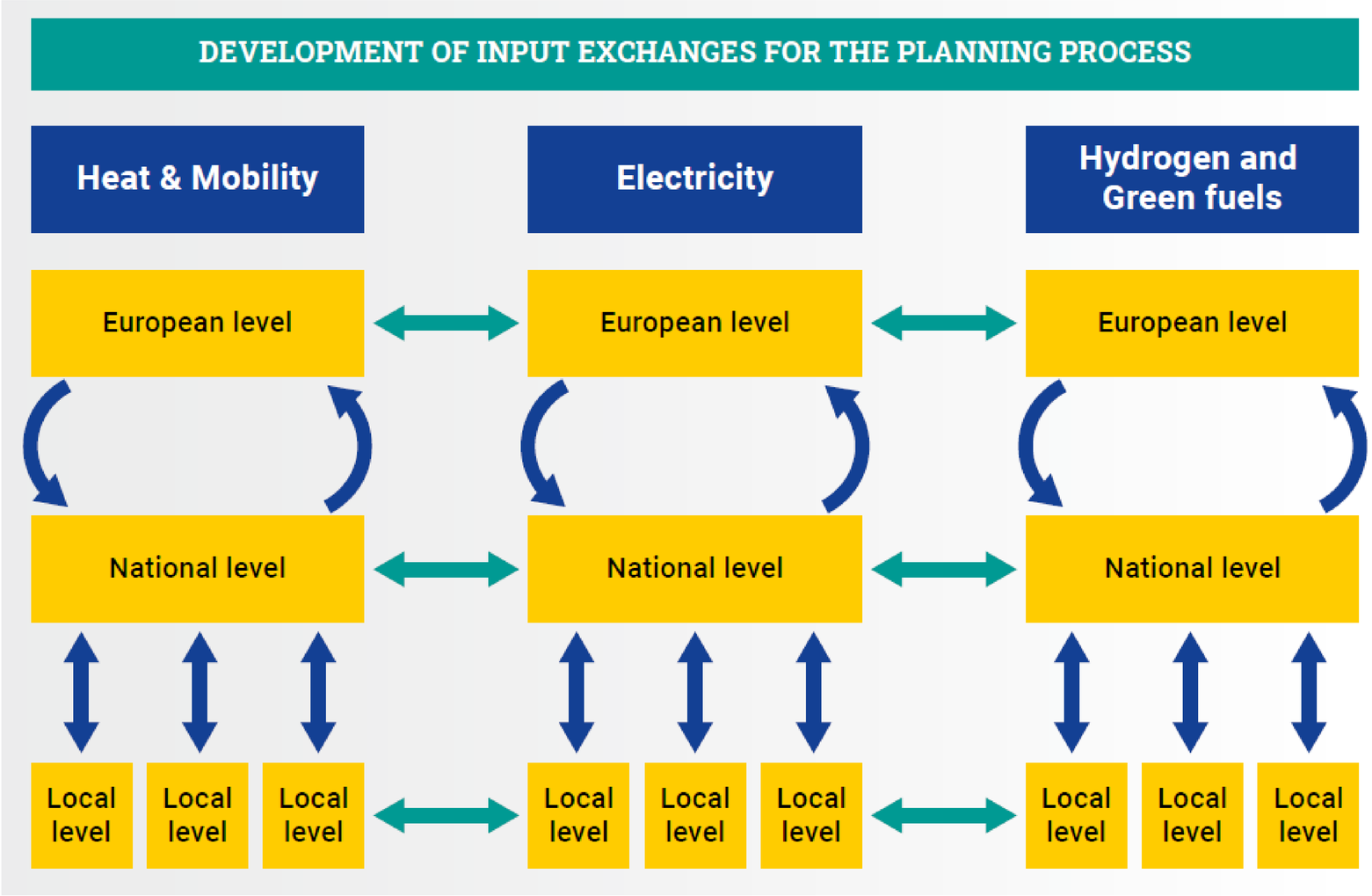
Energy Infrastructure & Investments – planning processes

The future system will be **operated to its utmost limits** using all technological and organizational advances available, but significant investments are still needed

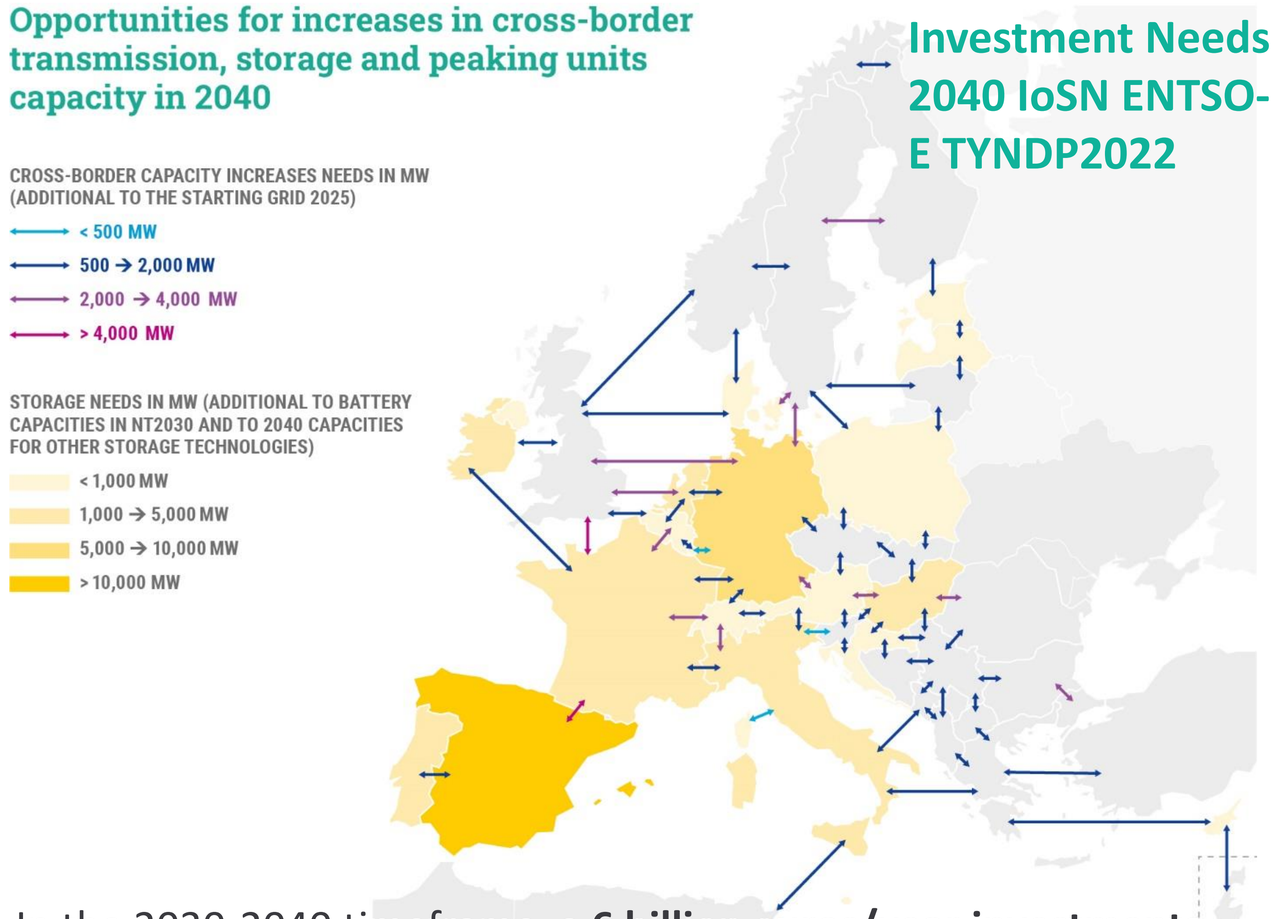
Integrated planning processes to achieve a true System of Systems

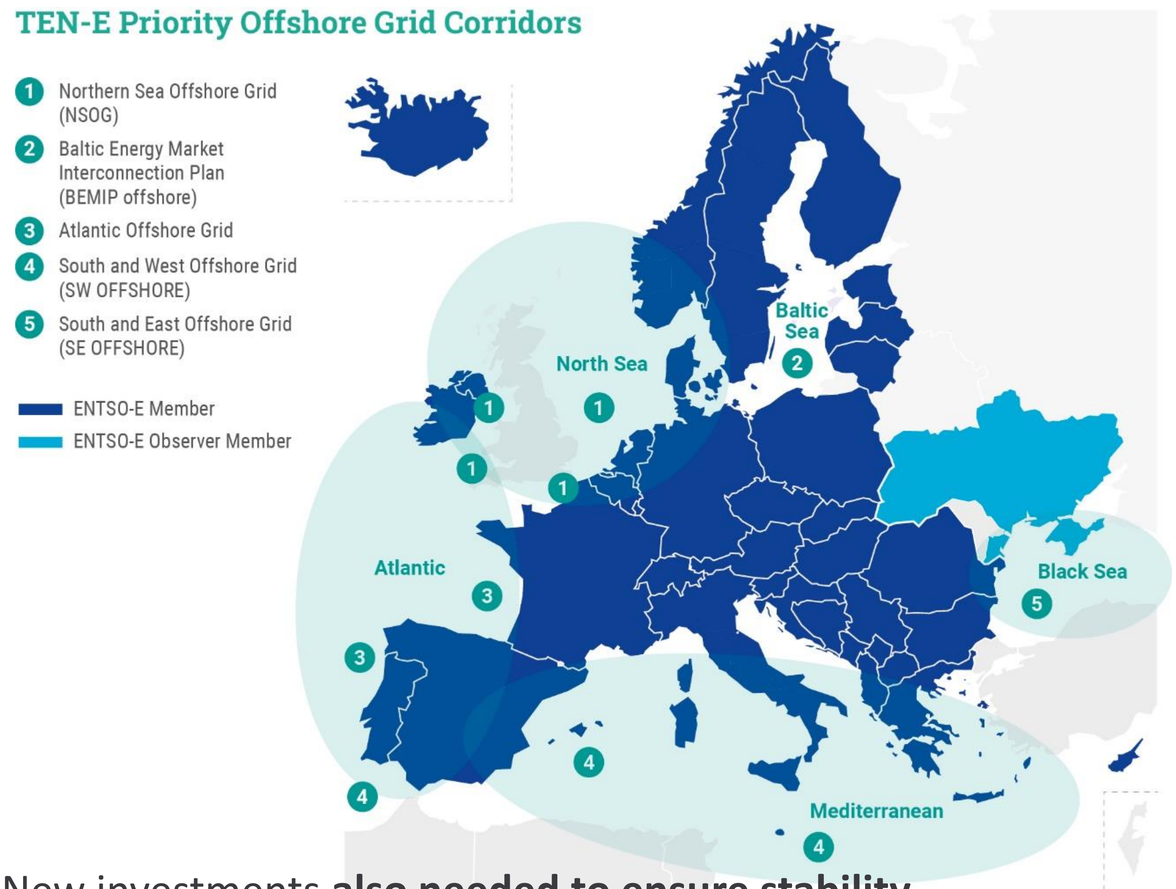
- onshore and offshore
- across sectors (horizontal)
- across voltage levels (vertical)



Energy Infrastructure- Investments in electricity grids

The transmission system will evolve both onshore and offshore





In the 2030-2040 timeframe, a **6 billion euros/year investments** (in cross-border capacity, storage and peaking units) **produces a 9 billion/year increase in socio-economic welfare.**

New investments **also needed to ensure stability management** along with new capabilities to be provided by grid users

Energy Infrastructure & Investments – a necessary condition

Improved regulatory framework and stakeholder engagement for timely development

- The regulatory framework should further **promote public acceptance and permitting** and incentivize effective and most importantly **timely infrastructure financing, development and innovation**.

- It is also necessary to have measures in place that guarantee **adherence to the planned timelines** through:
  - **maximum binding timelines**
  - **dialogue** between the promoter and the different authorities,
  - **silent consent provision** for some authorizations,
  - **introducing simplified environmental assessment** procedures for pre-existing assets.

- **Support from communities** hosting the infrastructure is crucial, also as final beneficiaries of a timely evolution of the energy transition.

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Market Design for Net-Zero

Gerard Doorman

ENTSO-E Vision Project Team Member

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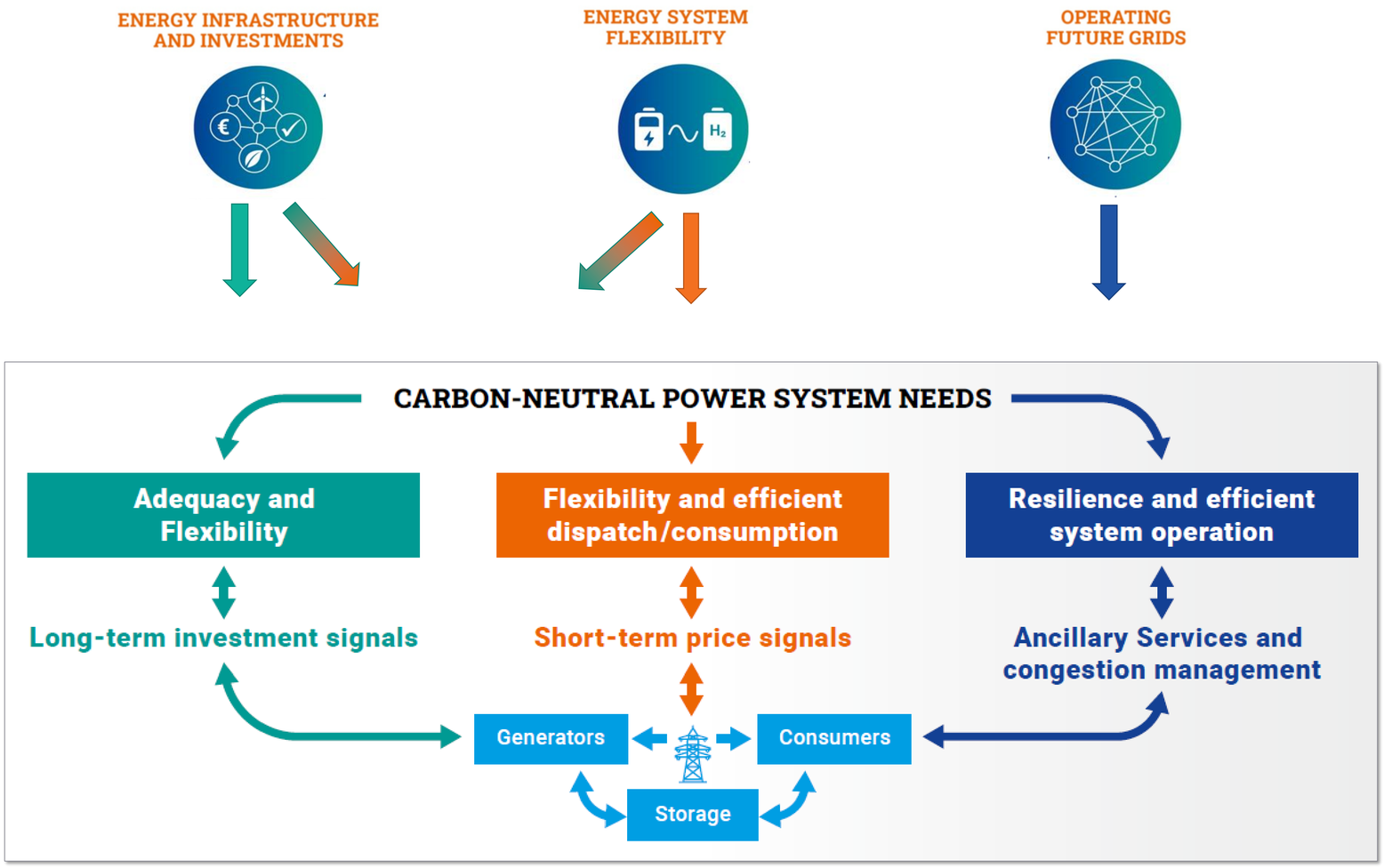
Market Design for a carbon-neutral energy system - Key Challenges



Ensuring resource adequacy & long-duration flexibility

- Financing massive RES development
- Remunerate complementary sources for adequacy & flexibility

Incentivising short-term flexibility

- Efficient price signals & improved products
- Optimised interaction between sectors, grid levels and markets

Facilitating Resilience & System Operation

- Reflect grid congestions and other operational constraints

Affordability & consumers' needs

- Aim at affordability & limit consumers' exposure
- Facilitate emergence of new services, incentivise demand response and energy savings

A market design fit for a carbon-neutral energy system

Rethinking Market Design

Today market design is **not fully fit for delivering a climate neutral energy system** and needs to adapt to upcoming challenges and opportunities.

Optimal value allocation

Electricity market design should **allocate value to what is most needed** for the energy system (adequacy, flexibility, resilience) in each timeframe and at each location.

Stronger long term price signals for RES & LD flexibility

Strengthen long-term price signals and provide stable regulatory framework to reduce capital costs to accelerate investments in both RES & complementary long-duration flexibility resources.

Efficient ST markets for dispatch & flex

Efficient short term price signal remain essential. To increase short duration energy system flexibility, wholesale and balancing markets need to be made fit for the future generation mix and new market actors, optimising the integrated energy system of systems.

Efficient use of grid capabilities

To facilitate system resilience and efficient use of infrastructure, market design should better **reflect grid constraints and operational challenges** via requirements, locational price signals and products, coordinated with DSOs when needed, and new ancillary services.

Affordability & Consumer needs

To meet the different **needs and preferences of consumers**, market design should facilitate consumers engagement and the provision of new services, while aiming at simplicity of use, transparency and affordability, and duly protecting specific categories of consumers.

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Conclusion and Recommandations

Damian Cortinas

ENTSO-E Vision Project Manager, ENTSO-E

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Game Changers Analysis

Nuclear renaissance

Fusion reaching commercial viability or wide deployment of new generation Fission plants

Superconductivity

Technology becoming very widely applied for new lines

Slower uptake of Hydrogen

High present expectations materialise only partially

Carbon Capture & Storage

Achieving cheap & wide application to fossil plants

Supergrid

Deploying continental overlaying HVDC grid, including neighboring countries

Prosumers, Microgrids

High uptake of local systems, complementing present top-down grid architecture

Cheap short & long storage

Becoming widespread in all use cases as prominent provider of flexibility

Deep digitalisation

Pervasive modifications of most devices, systems and processes

Conclusions – what the future will look like

In a fully carbon-neutral economy, **electricity** will be the main and most efficient energy carrier, and it will need to be coupled with other energy sectors. The system of the future will be based on 3 key elements, all **essential** for a sustainable, resilient and affordable power system:

- **Carbon Neutral Energy Sources**, providing the bulk of the power generation, and for the most part weather-dependent.
- **System Flexibility Resources**, to efficiently complement the variability of generation and consumption, and to address the increase in overall system complexity.
- The **Power Grid**, connecting generators, consumers and flexibility resources across Europe, and enabling a fully integrated European Energy Market.

The future power system in Europe will be:

- A **System of Systems**, which will need strong cooperation between transmission and distribution, and amongst different energy systems. All operators will be key enablers and facilitators to make this future energy system work.
- At the same time more **European** and more **Local**, with TSOs providing a critical interface between both dimensions.

Conclusions – how do we get there

A Power System for a Carbon Neutral Europe is within our reach

Four key elements will need to change to make this new reality possible:

- The development of significant system **flexibilities**, both short and long duration, that will need to be timed with the phase-out of fossil fuel generation.
- An **operation** of the system that will rise up to the challenge of this much more dynamic System of Systems, including the management of flexibilities, through innovation and cooperation.
- A regulatory framework, planning and permitting procedures that will facilitate the timely deployment of the necessary **investments**, and encourage efficiency and innovation.
- A **market design** that must evolve to allocate value where it will be most needed for the energy system, while reflecting different consumers needs and preferences.

The scale of change is such that **we need to act now**.
To transform this vision into reality as soon as possible, we will need a strong cooperation across the whole energy industry, and a permanent dialogue with consumers, stakeholders and public authorities

TSOs, through ENTSO-E, propose this work as a basis to start building this future together

Our Recommendations

General recommendations

1. The future will be a **System of Systems**, which means that:
   - **TSOs, DSOs, and other energy sectors** should cooperate to make the most efficient use of all types of flexibility resources and coordinate the planning and operation of the different systems.
   - Energy markets should be designed to ensure seamless **market integration** between transmission and distribution and across sectors.
2. Within this System of Systems, an adequate level of **system resilience** should remain a priority for TSOs, other operators, policy makers and stakeholders.
3. All proposals and actions for the future system should take into consideration their impact on the **affordability** of the system for European consumers, as well as a **sustainability** assessment.
4. Given the scale and urgency of change, we all need to **act now** to make this future possible.

Specific recommendations

1. ENTSO-E will produce with relevant stakeholders a pan-European **assessment of flexibility needs** for the whole timespan of the energy transition, to guide a cost-efficient deployment of flexibility resources.
2. Appropriate market mechanisms should be developed to ensure that both short and long duration flexibility resources are **timely deployed and efficiently procured** where and when needed.
3. The **regulatory framework** should evolve to value innovation, facilitate financing and permit fast and clear authorization processes that are respectful of environmental requirements.
4. TSOs will further enhance the planning processes to increase **transparency** and **inclusiveness** for local communities and stakeholders.
5. TSOs, DSOs, manufacturers and research centres should further develop knowledge and tools to **optimise the operation** of the systems, including advanced modelling and decision support.
6. TSOs and relevant operators of the System of Systems should increase cooperation with standardisation bodies and IT vendors to create standard rules, protocols and digital platforms enabling **interoperability** and **cross sector overview**.
7. Strengthen **investment signals** for carbon-neutral energy and flexibility sources by facilitating the introduction of well-designed two-way Contract for Differences and where necessary capacity remuneration mechanisms.
8. Increase accuracy of **short-term price signals** of day-ahead, intraday and balancing markets in space and time to optimise dispatch, flexibility and grid use.
9. Develop retail pricing solutions that facilitate **consumers engagement** and demand response while ensuring affordability and consumer protection.
10. TSOs will increase cooperation with all other operators, manufacturers, academia and policy makers to accelerate the **innovations** that will be needed to achieve an efficient energy transition:
    - Especially in storage and digitalisation technologies.
    - While monitoring trends for early spotting of new game changers.

Stay tuned: a series of 4 deep-dive webinars

11 OCT 2022

ENTSO-E VISION WEBINAR #1 (MORNING)
ENERGY SYSTEM FLEXIBILITY: THE KEY FOR RENEWABLE INTEGRATION

ENTSO-E VISION WEBINAR #2 (AFTERNOON)
OPERATING AND BUILDING THE GRIDS OF THE FUTURE

12 OCT 2022

ENTSO-E VISION WEBINAR #3 (MORNING)
A MARKET DESIGN FIT FOR A CARBON NEUTRAL EUROPEAN ECONOMY

ENTSO-E VISION WEBINAR #4 (AFTERNOON)
ADDRESSING THE UNPREDICTABLE: POSSIBLE GAME CHANGERS

Thank you for your attention

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Panel discussion on the key findings on the overall ENTSO-E Vision

Moderated by Sonya Twohig

Secretary-General, ENTSO-E

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Q&A

Moderated by Sonya Twohig

Secretary-General, ENTSO-E

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CLOSING REMARKS

Sonya Twohig

Secretary-General, ENTSO-E

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COME BACK AFTER THE BREAK!

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Session 2

Ensuring System Security and Pan-European Adequacy in challenging times

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INTRODUCTORY REMARKS

Hervé Laffaye

President, ENTSO-E

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KEYNOTE SPEECH

Claude Turmes

Minister for Energy, Government of Luxembourg

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KEYNOTE SPEECH

Mechthild Wörsdörfer

Deputy Director-General, DG ENER, European Commission

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PANEL DISCUSSION

Moderated by: Gerald Kaendler

Chair of SDC, ENTSO-E

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Close cooperation, coordination and solidarity at all levels needed to meet common adequacy challenges

Expectations for a tight situation this winter with substantial risk across Europe

- Reference case scenario illustrates many areas are stressed
- Additional risks can materialise
- Simultaneous scarcity situations and impacts need close attention
- Strong gas dependency remains a key constraint throughout the winter
- Certain measures can support the system (10% demand reduction, including peak shaving potential in the residential sector, reducing gas dependency, etc.)

SECURITY OF SUPPLY IS A COMMON GOOD –
ALL OF US HAVE A ROLE TO PLAY TO PRESERVE IT

- TSOs are pro-actively taking measures at the national level and tightly coordinating planning and short-term adequacy at regional level via RCCs and at pan-European levels in ENTSO-E
- Cross-border cooperation, close coordination, solidarity and appropriate mitigation measures will be key
- Efficient market integration is a valuable resource for adequacy support
- System adequacy relies on all market participants

ASK YOUR QUESTIONS ONLINE WITH SLIDO

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CONCLUDING REMARKS

Gerald Kaendler

Chair of the System Development Committee, ENTSO-E

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WRAP-UP

Sonya Twohig

Secretary-General, ENTSO-E

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SEE YOU TOMORROW!