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Steps towards the energy transition with a focus on decarbonization

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INNOVATION BRINGS A NEW TOMORROW

Interoperable Smart Energy Grids

- Smart Grids
- Microgrids
- Interoperability & interconnectivity
- Demand Response
- Transactive grids

Positive Energy Communities

- Smart Cities
- Smart Buildings
- Mobility
- Energy Efficiency
- Communities & P2P

RES Technology

- On- / Offshore Wind
- Ocean Energy
- PV / Floating PV
- Innovative RES O&M

RES Integration & Flexibility

- Flexibility
- Energy Markets
- Virtual Power Plants
- Battery Storage Technologies
- Green Hydrogen

Digital Energy

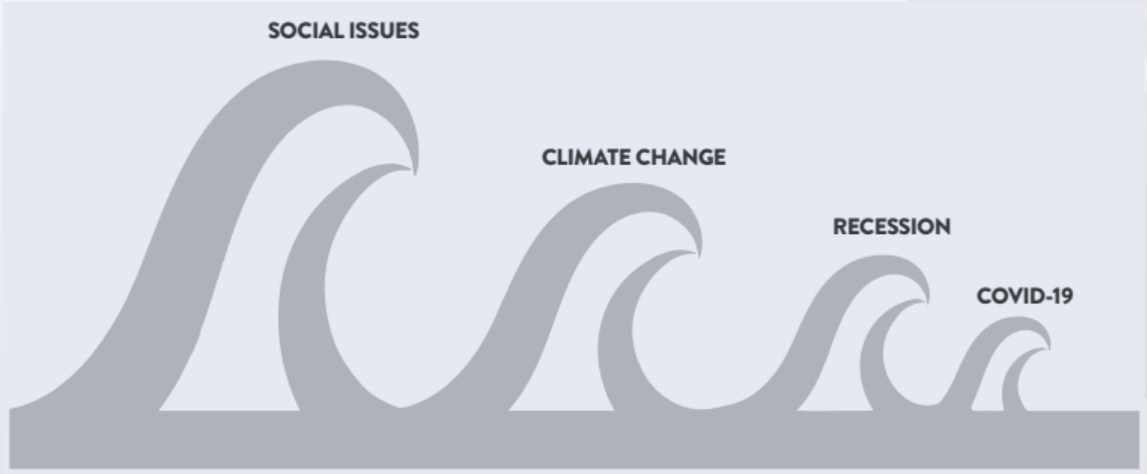
- Big Data & Analytics
- AI / Machine Learning
- Cybersecurity
- IoT, Cloud / Fog, Edge Computing
- 5G and ICT

The Green Deal

- Introduced in 2019;
- Making Europe climate neutral by 2050;
- Bringing new regulatory frameworks and funding to incentivize research and development;
- Use this transition as an opportunity for the industry and the economy;

The pathway for the transformation of the global energy sector!

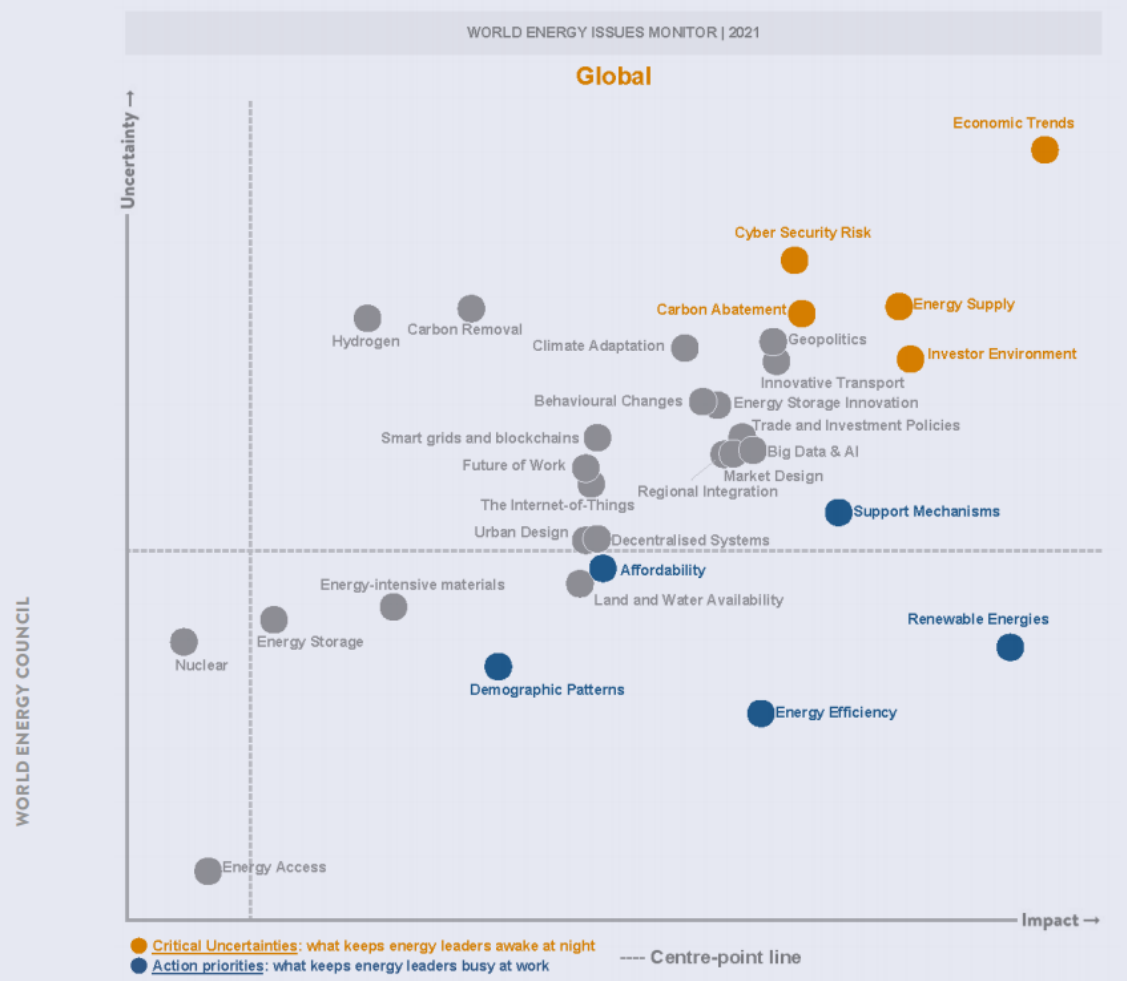
Energy transition – so it begins…



Decarbonisation of the energy sector requires urgent action on a global scale!

Source: 2021 World Energy issues Monitor – Humanising Energy, World Energy Council

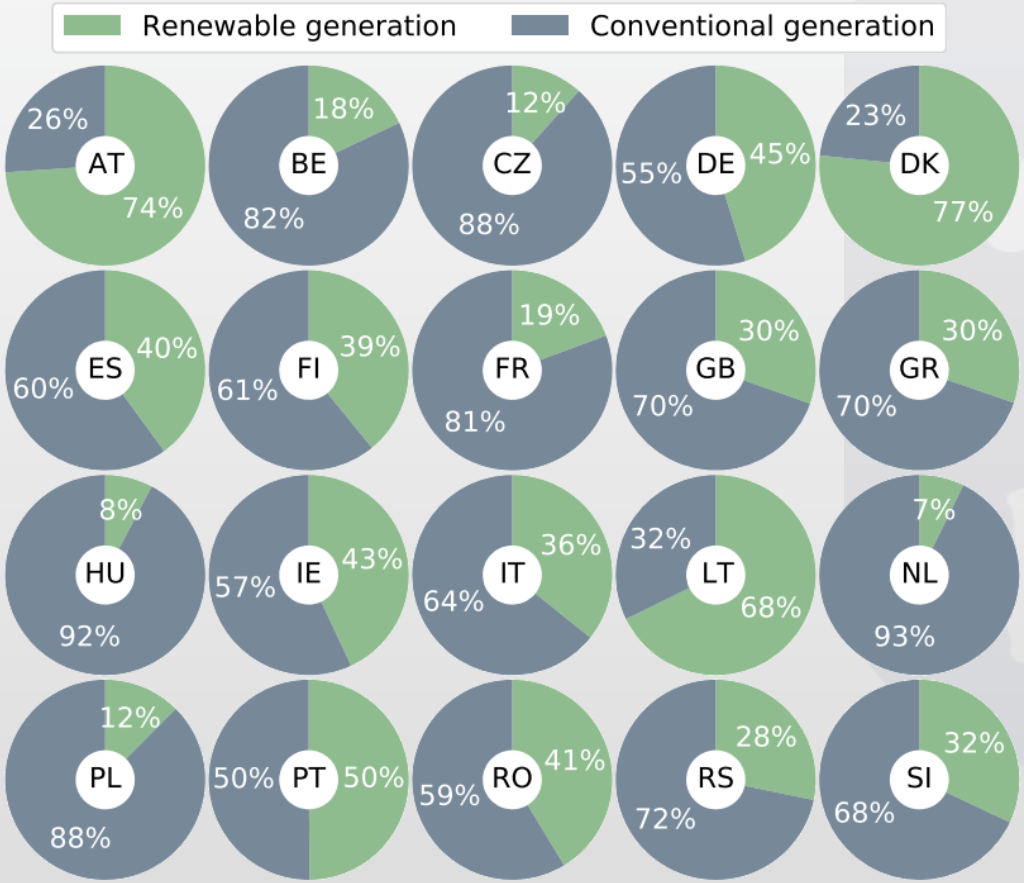
Energy transition – so it begins…



Source: 2021 World Energy issues Monitor – Humanising Energy, World Energy Council

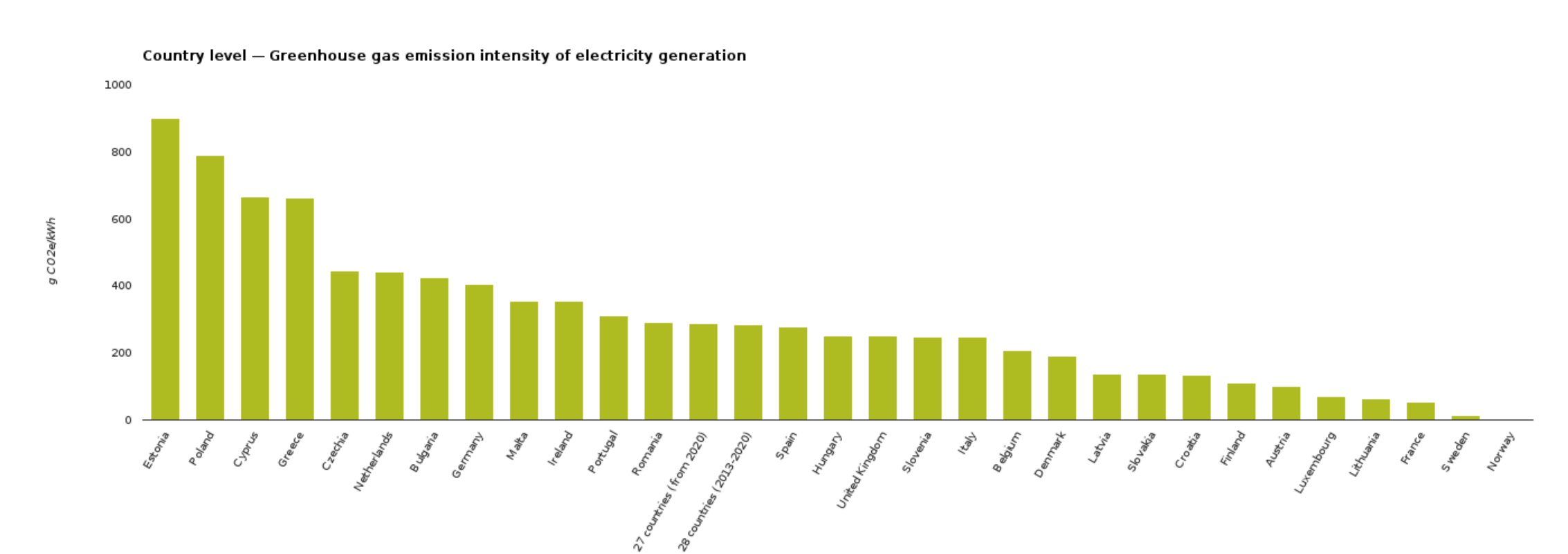
Power systems – where are we?

Share of renewables vs conventional generation in 2019



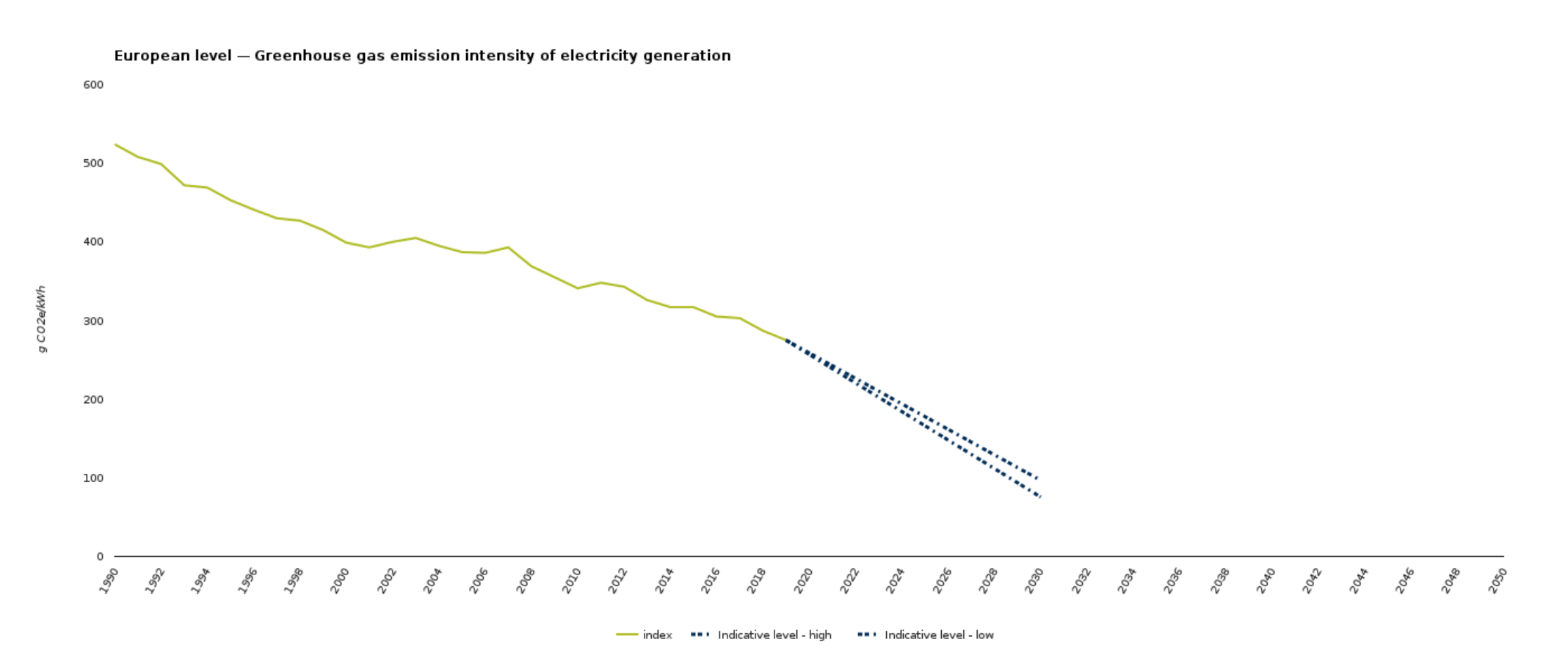
Source: “The effect of price-based demand response on carbon emissions in European electricity markets: The importance of adequate carbon prices” Fleschutz M, et al., 2020

Power systems – where are we?



Source: European Environment Agency. Figure refers to 2018

Power systems – where are we?



Source: European Environment Agency

Power systems – the current trends

- Investments in more wind and solar
  - Wind and solar power tend to be complementary, with strong wind blowing more strongly at and in the winter, when solar energy is weaker
- Nevertheless, not all countries have the same potential for RES generation
  - A strong investment in interconnection capacities is needed to optimise the potential of the different countries
- Local is good!
  - Several research projects on microgrid and smart cities, allowing for dynamic load management to follow local RES supply
- Bringing the consumer at the centre of the transition
  - Different initiatives to allow consumers to become prosumers and be an active part in this transition

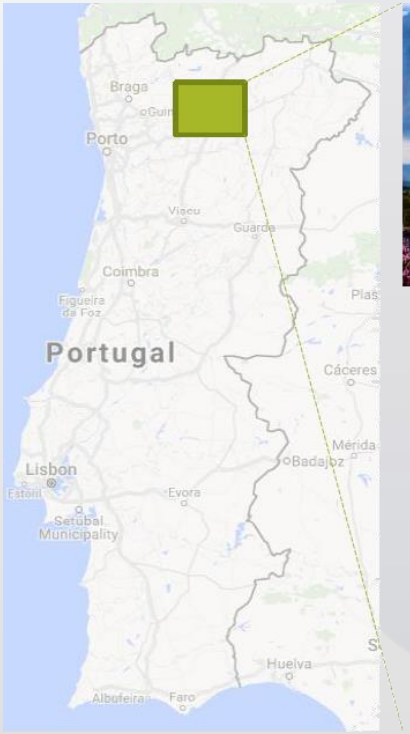
Power systems – problems we're facing

- Costs!
- Changing from a system that was historically designed to be centralized
  - Still some technical challenges to integrate high levels of decentralised RES
- Investment in new infrastructure means high costs and problems with public acceptance
  - Germany as a case study from generation on the north and demand on the south of the country.
- Self consumption of locally produced RES poses problems in terms of energy access
  - Not everybody has the financial capacity to install PV systems;
  - Fixed infrastructure costs remain to be paid.

The EU-Sysflex project

Demonstration of a Virtual Power Plant in Portugal

- The VPP provides flexibility from the pump storage power plant and the wind power plant;
- The hydro power plant compensates the possible deviations from the wind park;
- It also provides ancillary services for the system, ensuring system security



Venda Nova III (EDP Produção)
Var. speed pumped storage Hydro Plant
756 MW (2 x 378)

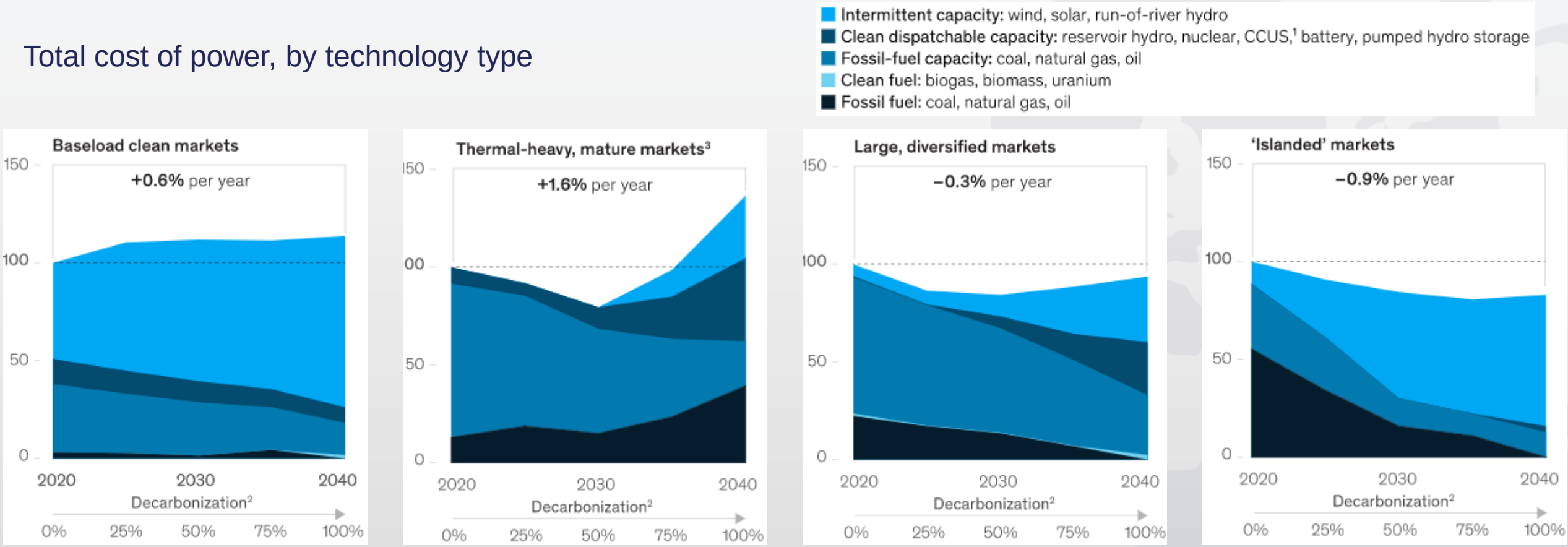
2 Wind Farms (EDP Renewables)
Alto da Coutada: 115 MW, 57 turbines
Falperra: 50 MW, 25 turbines

Total Resources: ~ 900 MW

Source: https://eu-sysflex.com/ This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773505.

Looking at the whole picture – different realities

Total cost of power, by technology type



Source: How to decarbonize global power systems, McKinsey 2020

Looking at the whole picture – different realities

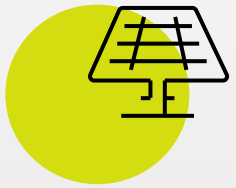
- Different realities in different countries;
  - “We are searching for greener energy, other countries are searching for energy”
- We are not alone on this transition
  - Continental Europe is not the only territory;
- Islanded territories
  - It is important to bring everybody onboard!

The IANOS project

Context

Almost 3,5% of Europeans citizens live in geographical islands

Energy production costs are up to ten times higher than on the mainland



Road to decarbonization

Large-scale deployment of local renewable energy sources and storage systems brings economic benefits and, at the same time, contributes to decarbonising the energy system of the island

Challenges

Specific energy related challenges are common to the majority of EU islands:

- High dependence on fossil fuels;
- Seasonality of demand;
- Increasing levels of non-controllable RES poses difficulties to system operation.

Source: https://ianos.eu/ This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957810.

Power systems – where are we?

2 Lighthouse Islands

Terceira (PT) and Ameland (NL)

3 Fellow Islands

Lampedusa (IT), Bora Bora (FR) and Nisyros (GR)

03/2021 – System Dimensioning

10/2021 – Deployment Plan and Risk Management

12/2021 – System implementation, Integration and Commissioning

07/2022 – Use Case Operation Performance and stakeholder engagement and monitoring

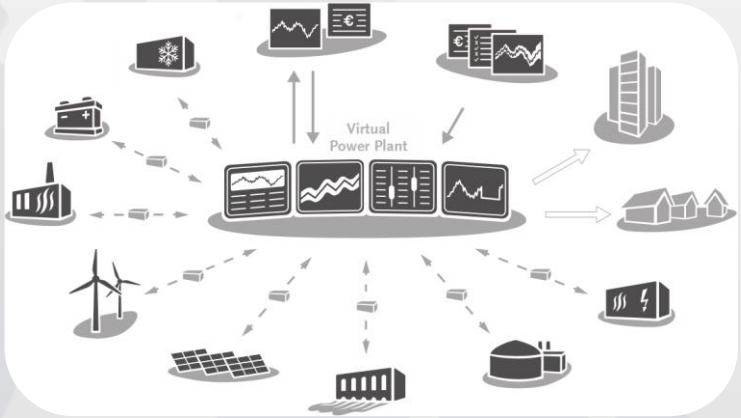
09/2024 – End of the project

Source: https://ianos.eu/

IANOS – The technological challenges

An example of one of the demonstrators

- PV panels with integrated microinverters: allowing for a better optimization of the generation in cloudy conditions;
- Smart Energy Router: uses consumers' flexibility to provide ancillary services to the grid;
- Hybrid Transformer: equipped with power electronics allows a stepless voltage control;
- Water heaters control algorithm: capable of providing flexibility to the grid;
- V2G Charging: allowing an integrated management of the EV charge;
- Electrochemical batteries + HEMS to allow the integration of the PV panels;
- Flywheel: with an hubless outer-rotor design, reduces radial stress and increases energy density;
- FOG enabled device: optimizing the control of multiple devices to provide flexibility as unique asset;
- Heat battery: innovative powerful heat exchanger material increasing capacity, overall efficiency and overall lifetime.



Source: https://ianos.eu/

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Final thoughts

- Decarbonisation of the energy sector requires urgent action on a global scale!
- We must accelerate the pace of this transition;
- Different vectors of decarbonization must be explored as every effort is important;
- R&D is and will remain important throughout this journey, breakthroughs are always needed;
- What are the costs we are ready to support for this transition? And are we ready to support the consequences of not engaging in this transition?
- We are in this together!

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