



# Sustainable Power Grid Technologies



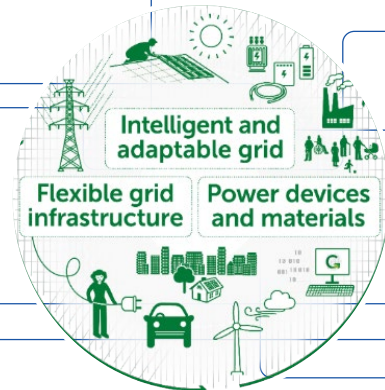
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CET2022, September, 23, 2022, Oskarshamn

# Thanks – let us join to solve the energy crisis!

- ❑ Keep overall goals to reach the sustainable development goals
- ❑ Target European energy independence
  - Long term plans and a new energy agreement
  - Collaboration between actors and sectors
  - More electricity generation
  - More Power Grid Capacity
  - Acceptance from society



DN, September 21, 2022



# KTH Energy Platform - dialogues



- The role of the platform is to provide new opportunities for KTH's energy research and innovation.
- Inclusive platform for everyone interested in energy research at KTH.
- Platform for exchange of knowledge (examples from 2021)
  - Seminar giving input for the national electrification strategy (Jan)
  - Seminar arranged in the parliament with “Rifo” (June)
  - Dialogue seminar about nuclear power and the climate transition (Dec.)
- KTH Energy Dialogue in November 17, 2022
  - More information: [www.kth.se/energydialogue2022](http://www.kth.se/energydialogue2022)

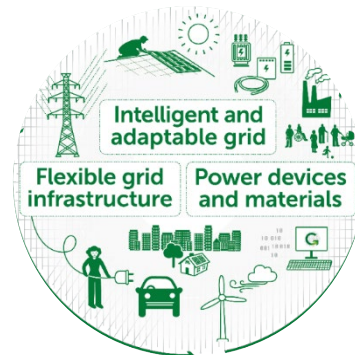
# Overall targets to reach the SDGs



# Key Messages



- ❑ Global targets for sustainable developments
  - 100% renewable energy system
  - Increased electrification in transport and industry
- ❑ Target for energy independence
- ❑ Challenges from the electricity grid's perspective:
  - need for flexibility
  - capacity shortage
  - new market solutions with prosumer
  - circular economy
- ❑ Examples *GreenGrids* and TYNDP2022



# Sustainable power grids

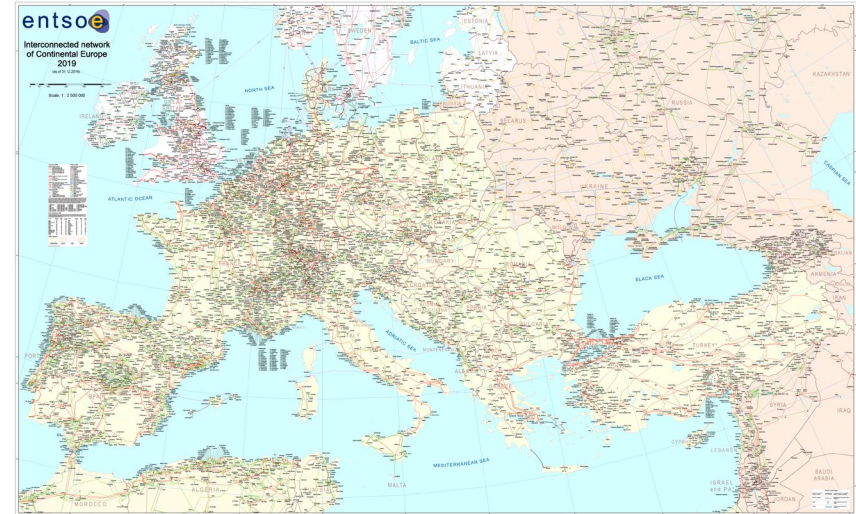


- ✓ Huge increase in electricity generated from wind and solar
- ✓ Reduction of use of fossil fuel
- ✓ Electrification of transportations and industrial processes

# Sustainable power grids

## Interconnected power grid in Europe

- ENTSO-E is the European association for the cooperation of transmission system operators (TSOs) for electricity
- A much deeper coordination between operators close to real-time is needed to integrate more renewables into the grid and reduce carbon emissions cost-effectively and in all security.



# Sustainable power grids

## Interconnected power grid in Europe

- Urgent request by Ukrenergo and Moldova for emergency synchronization due to the war
- TSOs of Continental Europe agreed to start on 16 March 2022 the trial synchronisation of the Continental European Power System with the power systems of Ukraine and Moldova.
- contribute to a stable and efficient electricity supply in the Ukrainian power grid.





# Sustainable power grids - RePowerEurope

**REPowerEU: Joint European Action for more affordable, secure and sustainable energy, May 18, 2022.**

- objective of breaking away from Russian energy ASAP.
- Member State interventions, whether fiscal or regulatory, will be necessary in order to secure affordable prices for end consumers and to prevent energy poverty
  - care must be taken not to discourage investments by energy companies in low-carbon solutions.
- A versatile energy palette must be used in order to secure energy supply to European households and businesses. It is important to make use of the wide variety of low-carbon energy, that fit economically and ecologically within an energy system.
  - need to remove unnecessary administrative barriers in order to accelerate rollout of renewables.

# Sustainable power grids

## European Green Deal

- European Green Deal Call: €1 billion investment to boost the green and digital transition (launched 22 Sept. 2020)
- boost the efficient use of resources by moving to a clean, circular economy restore biodiversity and cut pollution
- The plan outlines investments needed and financing tools available. It explains how to ensure a just and inclusive transition.



# Sustainable power grids

A 360 degree view on electrification ingredients for a sustainable society with 100% renewables.

## ❖ Intelligent and adaptable grid

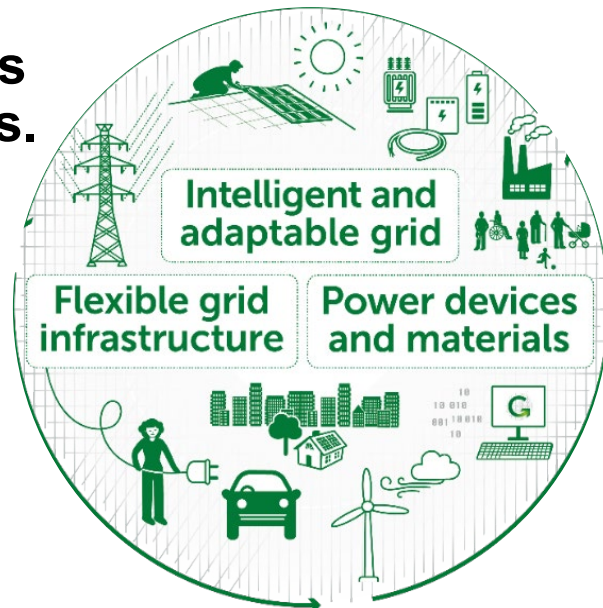
- *to create new values for utilities and customers*

## ❖ Flexible grid infrastructure

- *to be ready for power grids evolution and decarbonization trend*

## ❖ Improved power devices and materials

- *for enhanced material capability and circular economy!*



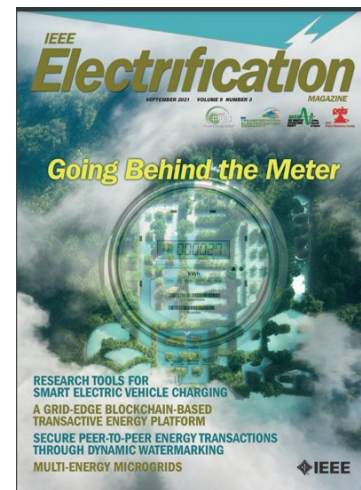
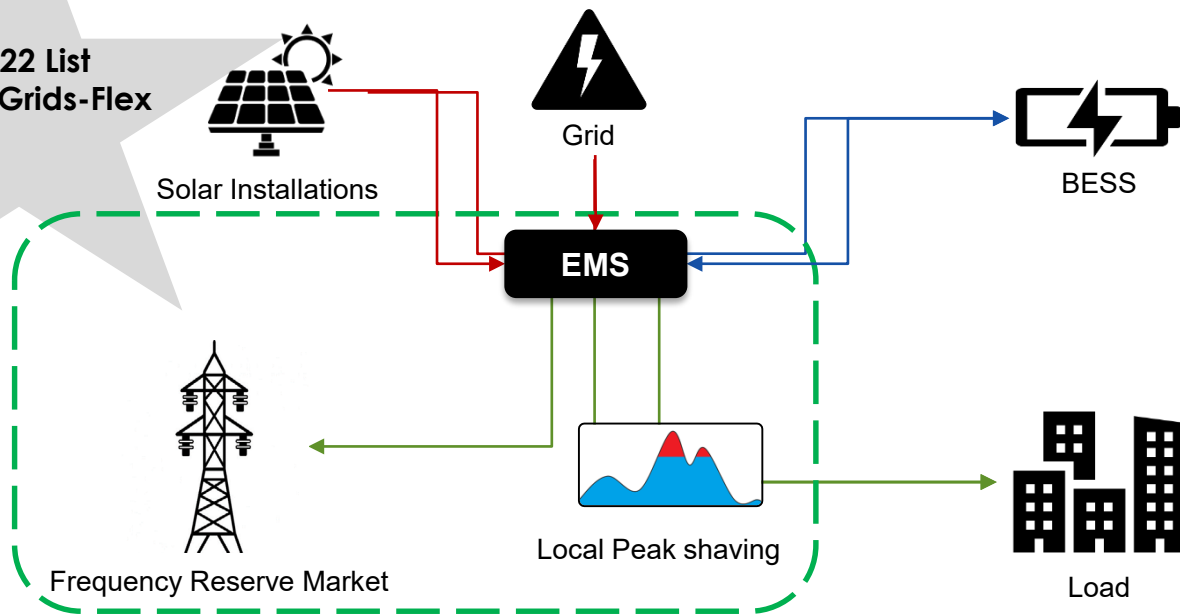
GreenGrids initiative

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# Sustainable power grids

## Example: local generation and battery storage

IVA 2022 List  
GreenGrids-Flex



\***EMS:**  
Energy Management System

\***BESS:**  
Battery Energy Storage System

H. Shafique *et al.*, "Behind the Meter Strategies Energy management system with a Swedish case study," *IEEE Electrification Magazine*, vol. 9, no. 3, s. 112-119, 2021.

# Ten-Year Network Development Plans

## Gas and electricity joint Scenario Report.

- Result from collaboration between ENTSG and ENTSO-E to develop scenarios for the whole energy system
  - Input from ~ 80 TSOs and > 35 countries
- “ambitious and technically robust scenarios which are fully compliant with the Paris Agreement and with the European ambitions for achieving climate neutrality by 2050”
- Scenario work is the first important step to capture the interactions between the gas and electricity systems!



[TYNDP 2022 Scenario Report |](#)  
[Version, April 2022 \(entsos-](#)  
[tyndp-scenarios.eu\)](#)

# TYNDP2022 – in brief



- In view of the 1.5 °C target of the Paris Agreement and the EU Climate Law ambition of minimum 55 % GHG emission reductions by 2030 and net zero by 2050, the ENTSOs have developed the Global Ambition and Distributed Energy Scenarios using a top-down approach with a full-energy perspective.
- New features in the scenarios include:
  - sector-coupling methodologies and dedicated modelling tools both to optimise overall system efficiencies and flexibility use as well as to capture better the interactions and new dynamics at the interfaces between various end-use sectors (e.g. vehicle-to-grid and prosumer modelling), at various geographical scales (e.g. district heating) and with other carriers (Power-to-Gas and Power-to-liquid).
  - hydrogen and electrolysis at pan-European scale.

# TYNDP2022 – Executive summary



- ❑ Net-zero can be achieved by 2050 while ensuring the security of energy supply
- ❑ Energy efficiency is key to achieve the EU long-term Climate and Energy objectives
- ❑ Ambitious development of renewable energy across Europe
- ❑ Sector Integration provides efficient decarbonisation solutions
- ❑ Integrated energy systems: hydrogen is a game changer for gas and electricity systems
- ❑ Innovation is key to achieve a sustainable energy future

# TYNDP2022 – Results – final electricity consumption

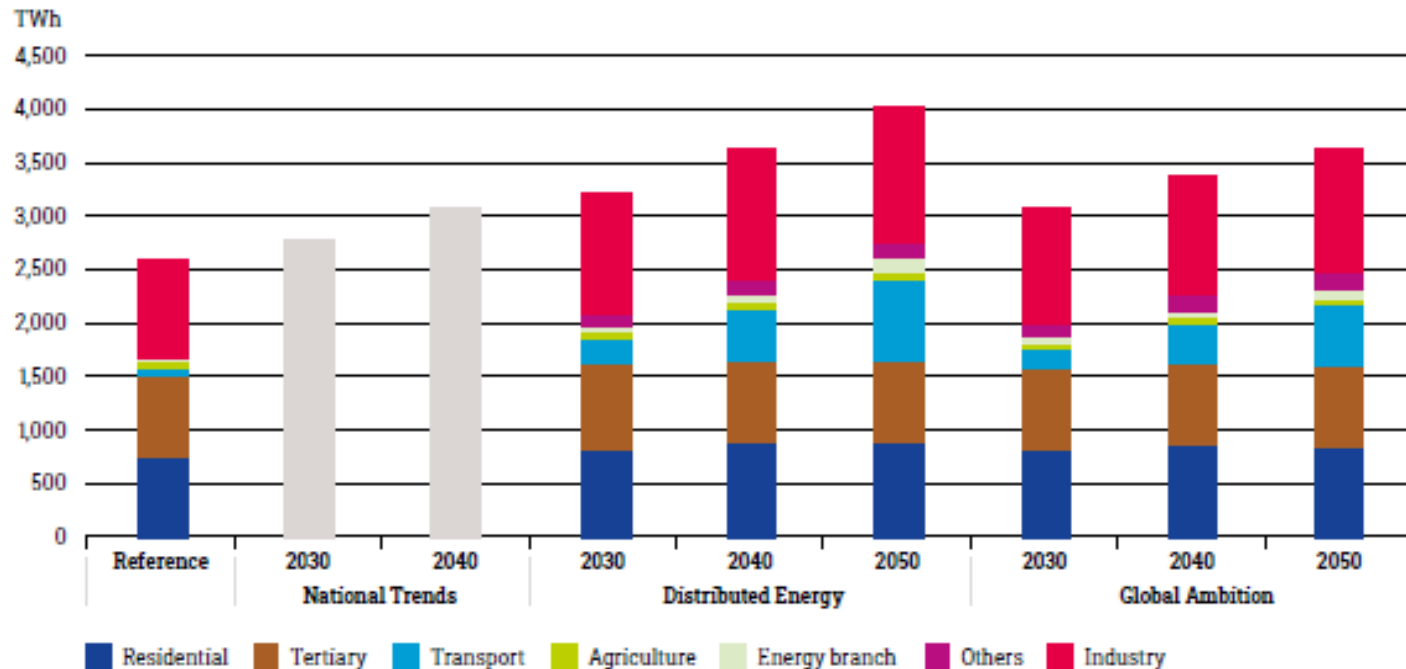


Figure 8: Final electricity consumption (excluding transmission and distribution losses) for EU27

Source: TYNDP 2022

# TYNDP2022 – Results – electricity demand

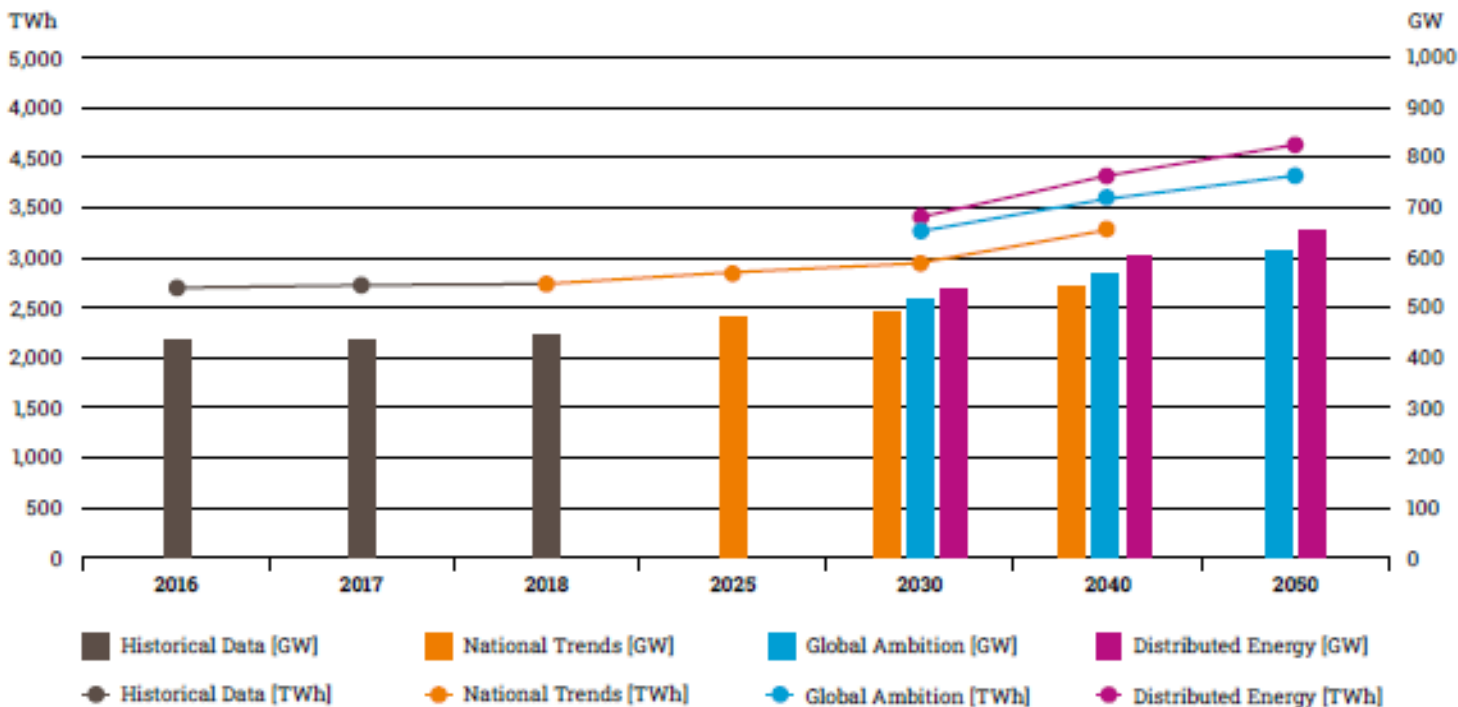


Figure 10: Evolution of average electricity demand and peak (including transmission and distribution losses)<sup>30</sup> for EU27

Source: TYNDP 2022

# TYNDP2022 – Results – power generation mix

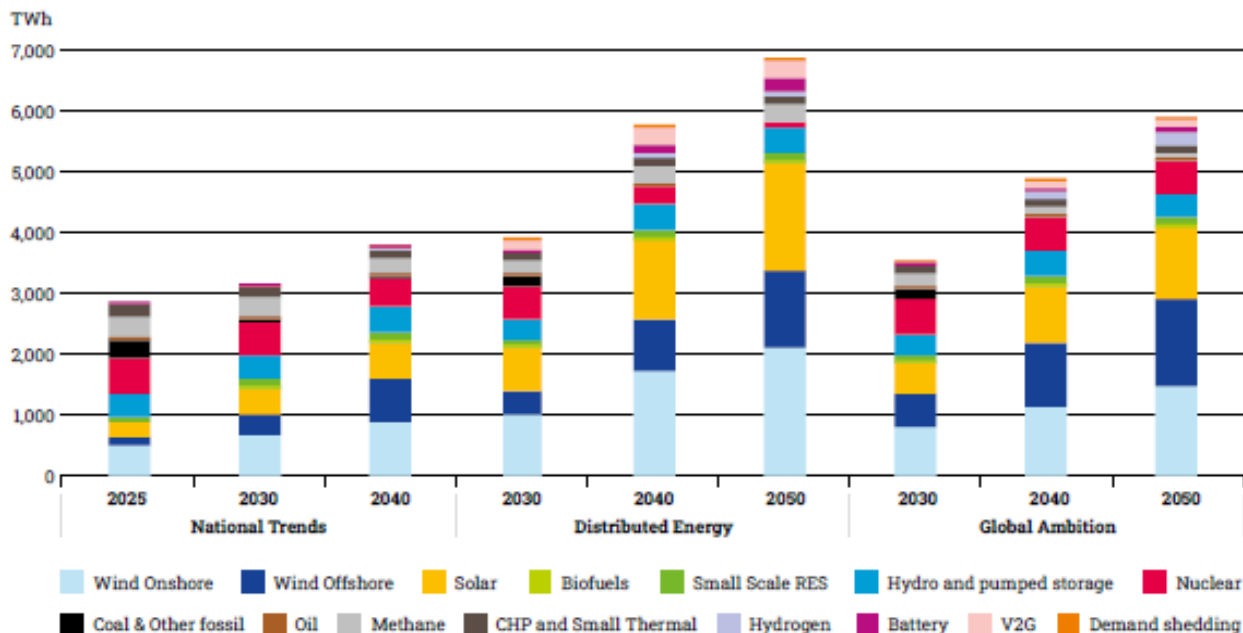
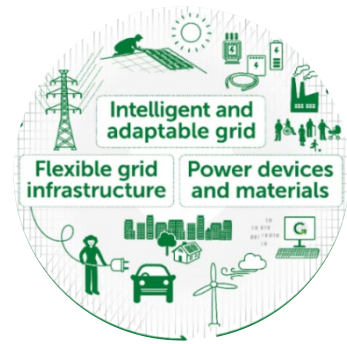


Figure 25: Power generation mix for EU27 (including prosumer PV, hybrid and dedicated RES for electrolysis)

Source: TYNDP 2022

# Summary



- Overall targets for the sustainable developments - SDGs
- Geopolitics with an urgent need for energy supply independence – speed up the energy transition and smart grid developments
- Solutions with European Green Package and Green Grids
- Key trends and technology areas:
  - I. Intelligent (software) – access to data e.g. condition monitoring, cyber security, internet of things
  - II. Flexible (hardware) –integration of storage, EVs, PV,..
  - III. Circular economics with recycling of material and second life time usage

