Bucharest 2018 Symposium on Microgrids, 2-6 September 2018
University Politenica of Bucharest, Romania

The future of Microgrids in Europe – The 2050 ETIP SNET Vision

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European R&I energy policies

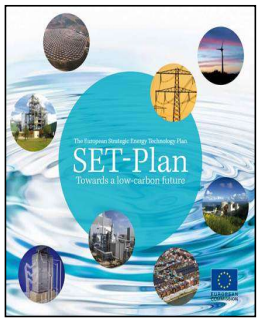
2008: The SET Plan

-20 % GHG Emissions*

20% Renewable Energy

20 % Energy Efficiency**

binding



2014: Towards an Integrated Roadmap

- Individual Technologies → Energy system
- Policy challenges
  - Consumer at the centre
  - Energy efficiency (demand)
  - System optimisation
  - Technologies (supply)

-40 % GHG Emissions*

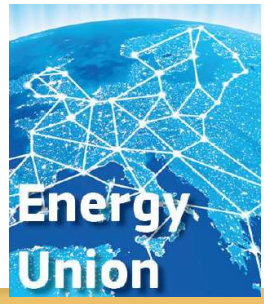
27% Renewable Energy

27 % Energy Efficiency**

Not binding

2015: Energy Union – Priorities

- Energy security, solidarity and trust
- A fully integrated European energy market
- Energy Efficiency (EE) first: moderation of demand
- Transition to a low-carbon society: decarbonising the economy,
- **Research, Innovation and Competitiveness**

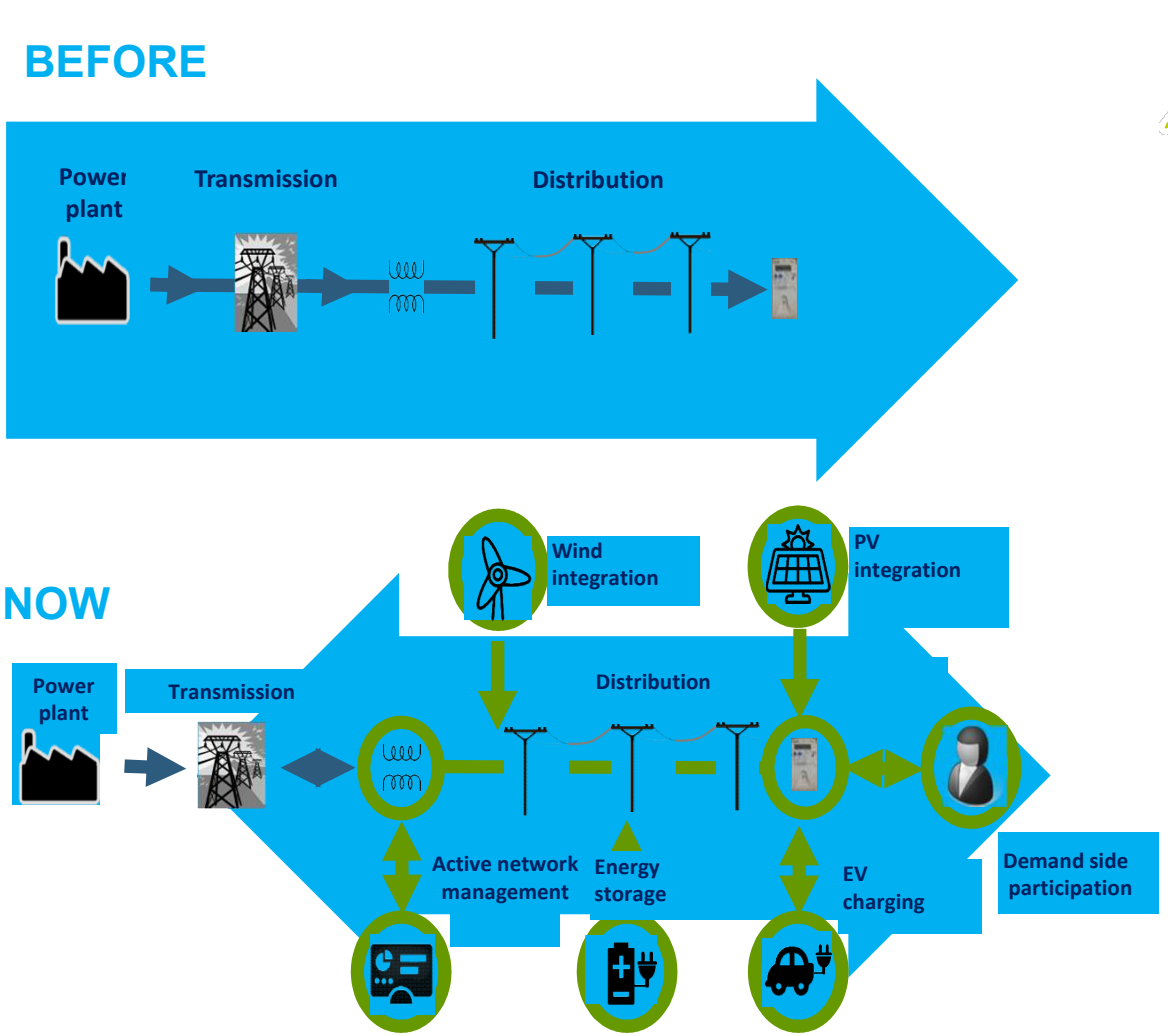


* Compared to 1990 ** compared to BAU

2015: Energy Union
Clean Energy for all Europeans
The Winter Package

Electricity Market Regulation
- Tariffs
- Network Codes
- Innovation

Electricity Market Directive
- DSO Entity
- Storage
- Tasks of DSOs
- Local Energy Communities
- Smart Meter Functionalities
- Data Management
- Cyber Security
- Flexibility



HEDNO

Distribution is the area of drastic changes, where the vast majority most of Distributed Energy Resources, including Distributed Generation, Active Customers, Distributed Storage, EVs, etc., are connected. DSOs are the key enablers for a successful energy transition. They act as neutral market facilitators and guarantee distribution system stability, power quality, technical efficiency and cost effectiveness in the future evolution of energy networks towards a smarter grid concept.

EDSO for smart grids

2015: Energy Union
Clean Energy for all Europeans
The Winter Package

Electricity Market Regulation
- Tariffs
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Electricity Market Directive
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Definition of

LOCAL ENERGY COMMUNITIES (LEC)*

Electricity Directive COM(2016) 864 final/2

An association, a cooperative, a partnership, a non-profit organisation or other legal entity which is effectively controlled by local shareholders or members, generally value- rather than profit-driven, involved in distributed generation and in performing activities of a distribution system operator, supplier or aggregator at local level, including across borders

Local Energy Communities are based on Microgrids

Important Note. Most EU DSOs are not allowed to own or operate DER, and thus Microgrids

*** Long Tradition in Europe**: in **Germany** over 650 Stadtwerke (local utility companies that provide heat and electricity) , in the **Netherlands**, over 200 local initiatives involved in RE, including over 55 registered cooperatives, in **Denmark** 100s of electricity production (CHP) and community district heating (CDH) systems, 100 wind cooperatives.

Microgrids Market Models

- Investments in Microgrids can be done in multiple phases by different stakeholders: end consumers, energy suppliers, DSOs,etc.
- The operation of the Microgrid will be mainly determined by the ownership and roles of the various stakeholders. Three general models:
  - Integrated Utility or DSO owns and operates the Microgrid. Not possible in EU regulation
  - Prosumers own and operate DER to minimize electricity bills or
    - maximize revenues (Local Energy Community Microgrid)
  - Market Aggregators (ESCOs) maximize the value of the
    - aggregated DER participation in local energy markets.

Microgrids ≠ Local Energy Communities

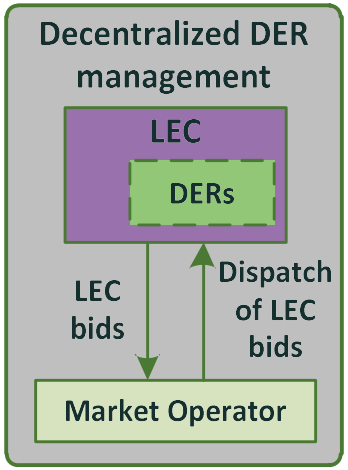
Market Models

Centralized model

- Dispatch of DERs performed by the Market Operator through the market clearing process

Decentralized model –LEC

- Price signals to DERs
- DERs decide their own dispatch



- Lower marginal prices (due to non-commitment of expensive central units)

All consumers benefit from the lower marginal prices.

G. Asimakopoulou, N. Hatziargyriou, "Evaluation of Economic Benefits of DER Aggregation", IEEE Trans. STE, 2017

EDSO position paper on local energy communities (*June 2017*)

- Support for the Clean Energy Package proposals on LECs:
  - foster customers' active participation in electricity markets.
  - facilitate the energy transition, particularly in promoting the wider uptake of renewable energy
  - new energy services at the citizens' level.
- Key role in facilitating processes to empowering prosumers, either individually or collectively (LECs) participating in electricity markets. Support of LECs by offering adequate grid infrastructure solutions and other services.
- Clear rules and responsibilities for all market players are needed to foster a clear and sound regulatory framework, ensuring fair participation and conditions for all customers. Respect rights of the connected customers, not taking part in LECs.
- Increase in self-consumption and LECs will affect the use of the distribution system, may be a risk of reducing the recovery of network costs and other charges, which may raise the issue of additional investments needs for the DSOs.
- Regulation must avoid any type of discrimination regarding costs, obligations and rights, and ensure an equal and efficient level playing for all market participants.

Microgrids in the EU future

ETIP SNET

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#Vision2050

formed in 2016

The INTENSYS4EU Project supports ETIP SNET activities and has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 731220

ETIP SNET's mission

- **Set-out a vision for RD&I for Smart Networks for Energy Transition** and engage stakeholders in this vision.
- **Prepare and update the Strategic Research and Innovation Roadmap**.
- Report on the **implementation of RD&I activities at European, national/regional and industrial** levels.
- Provide **input to the SET Plan action 4** which addresses the technical challenges raised by the transformation of the energy system.
- **Identify innovation barriers**, notably related to regulation and financing.
- Develop enhanced knowledge-sharing mechanisms that **help bring RD&I results to deployment**.
- Prepare **consolidated stakeholder views** on Research and Innovation to European Energy Policy initiatives.

formed in 2016

ETIP SNET's stakeholders

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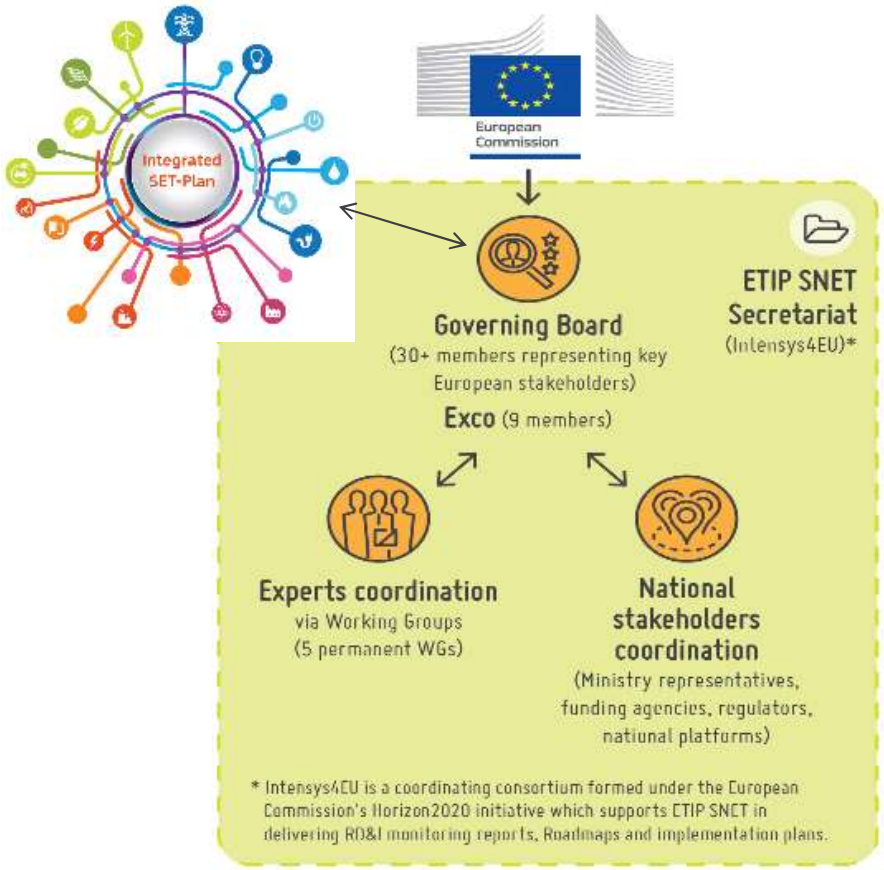
- Transmission System Operators (TSOs)
- Distribution System Operators (DSOs)
- National Representatives
- Research & Academia
- Storage (technology and services providers)
- Consumers (aggregated and not aggregated)
- Thermal Generation (flexible)
- Renewable Energy Sources Generation
- ICT, Network and Software providers
- Equipment manufacturers and suppliers (non-ICT)
- Interface to Other Energy Carriers (Heat, Transport, Gas, ...)
- Regulators

ETIP SNET's organisation



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WG1
Reliable, economic and efficient smart grid system

WG2
Storage technologies and sector interfaces

WG3
Flexible Generation

WG4
Digitisation of the electricity system and customer participation

WG5
Innovation implementation in the business environment

NSCG
National Stakeholders Coordination Group

Microgrids in the ETIP SNET activities

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- Microgrids addressed in the ETIP SNET R&I Roadmap 2017-2026
- Microgrids in ETIP SNET regional workshops
- Microgrids in projects listed in ETIP SNET Project Monitoring Report
- Microgrids and Local Energy Management addressed by BRIDGE working groups

2050 VISION GOAL

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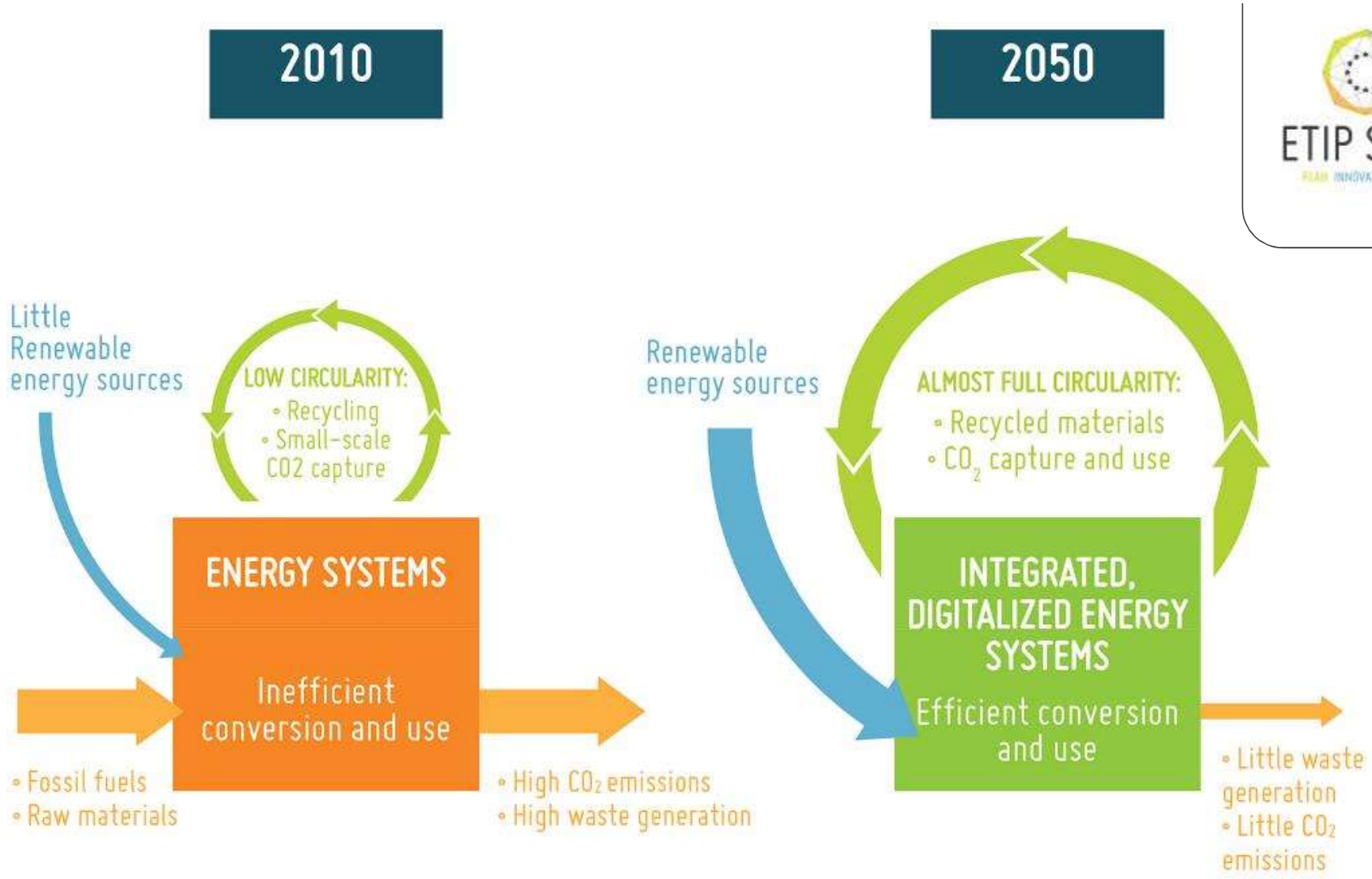
A low-carbon, secure, reliable, resilient, accessible, cost-efficient, and market-based **pan-European integrated energy system**

supplying the whole economy and paving the way for a **fully CO2-neutral and circular economy by the year 2050**,

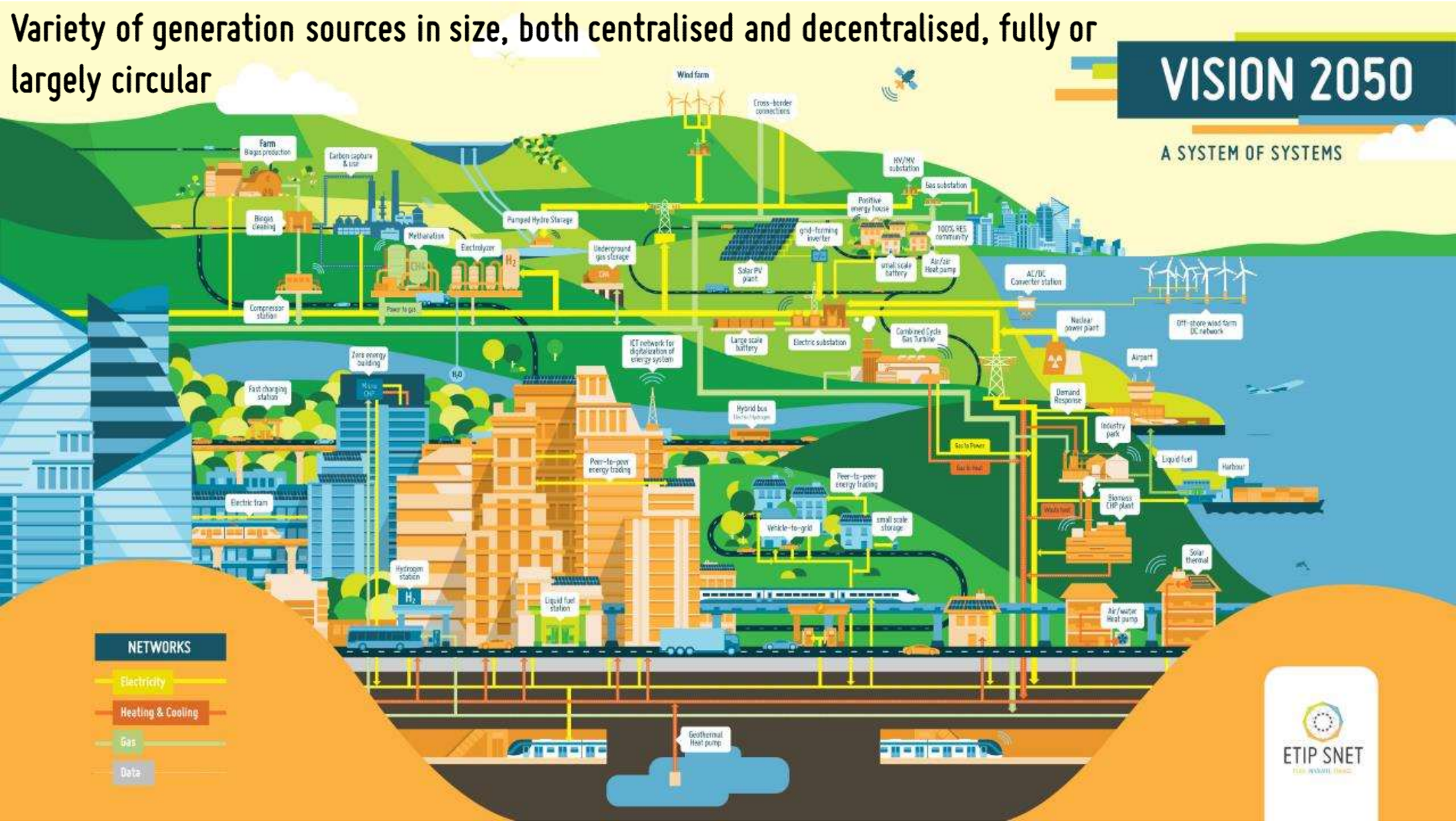
while **maintaining and extending global European industrial leadership** in energy systems during the energy transition.


2010
2050
ETIP SNET
Little
Renewable
energy sources
LOW CIRCULARITY:
• Recycling
• Small-scale
CO2 capture
ENERGY SYSTEMS
Inefficient
conversion and use
• Fossil fuels
• Raw materials
• High CO_2 emissions
• High waste generation
Renewable
energy sources
ALMOST FULL CIRCULARITY:
• Recycled materials
• CO_2 capture and use
INTEGRATED,
DIGITALIZED ENERGY
SYSTEMS
Efficient conversion
and use
• Little waste
generation
• Little CO_2
emissions

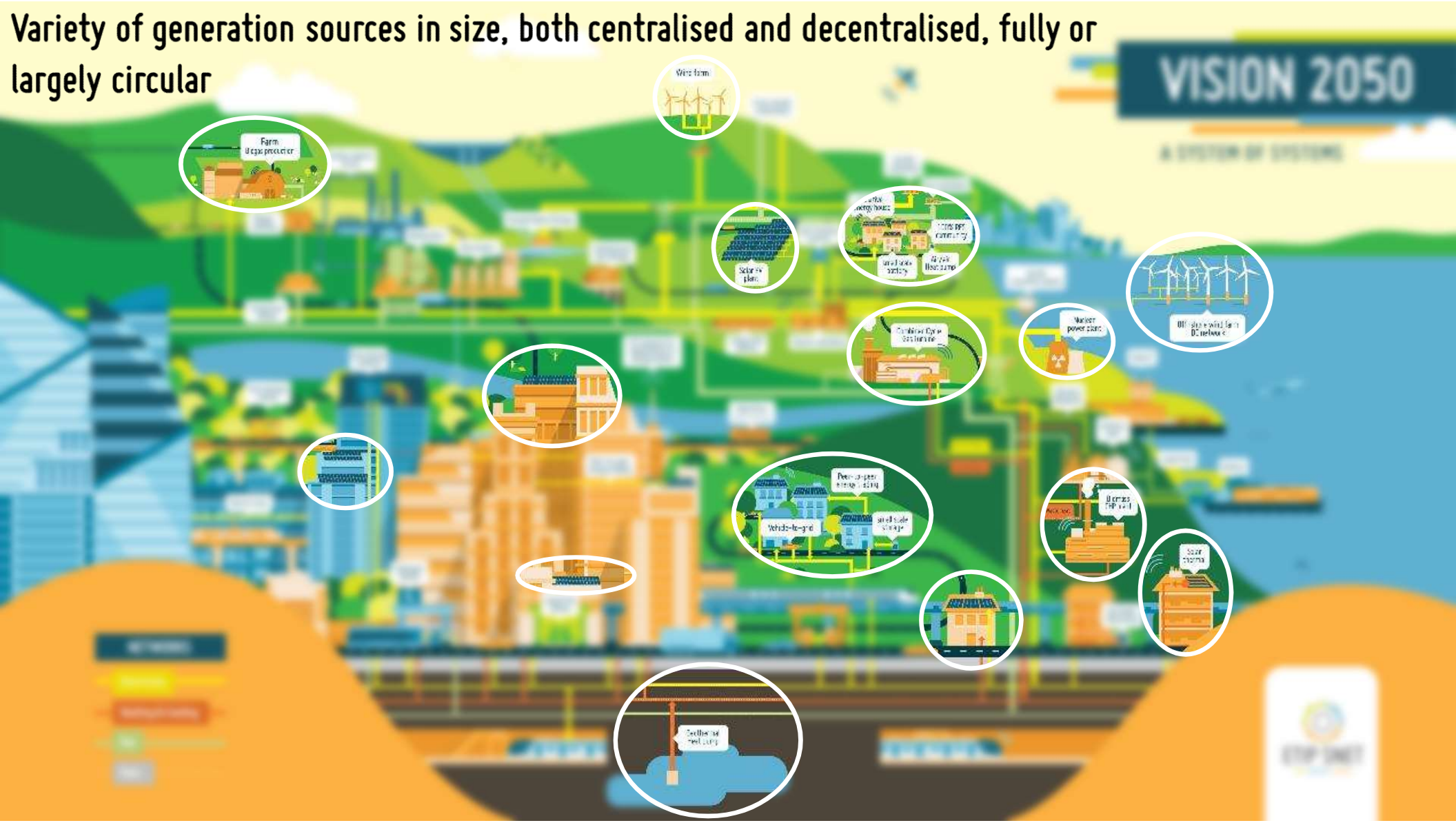
Vision ETP SG 2030


VISION 2050
A SYSTEM OF SYSTEMS
Wind farm
Cross-border connections
Farm
Biogas production
Carbon capture & use
Biogas cleaning
Methanation
Electrolyzer
Pumped Hydro Storage
Underground gas storage
Compressor station
Power to gas
HV/MV substation
Gas substation
Positive energy house
grid-forming inverter
100% RES community
small scale battery
Air/air Heat pump
Solar PV plant
AC/DC Converter station
Nuclear power plant
Off-shore wind farm DC network
Combined Cycle Gas Turbine
Large scale battery
Electric substation
ICT network for digitalization of energy system
Zero energy building
Fast charging station
Hybrid bus
Airport
Demand Response
Industry park
Gas to Power
Liquid fuel
Harbour
Peer-to-peer energy trading
Biomass CHP plant
Electric tram
Vehicle-to-grid
small scale storage
Hydrogen station
Solar thermal
Liquid fuel station
Air/water Heat pump
Geothermal Heat pump
NETWORKS
Electricity
Heating & Cooling
Gas
Data
ETIP SNET

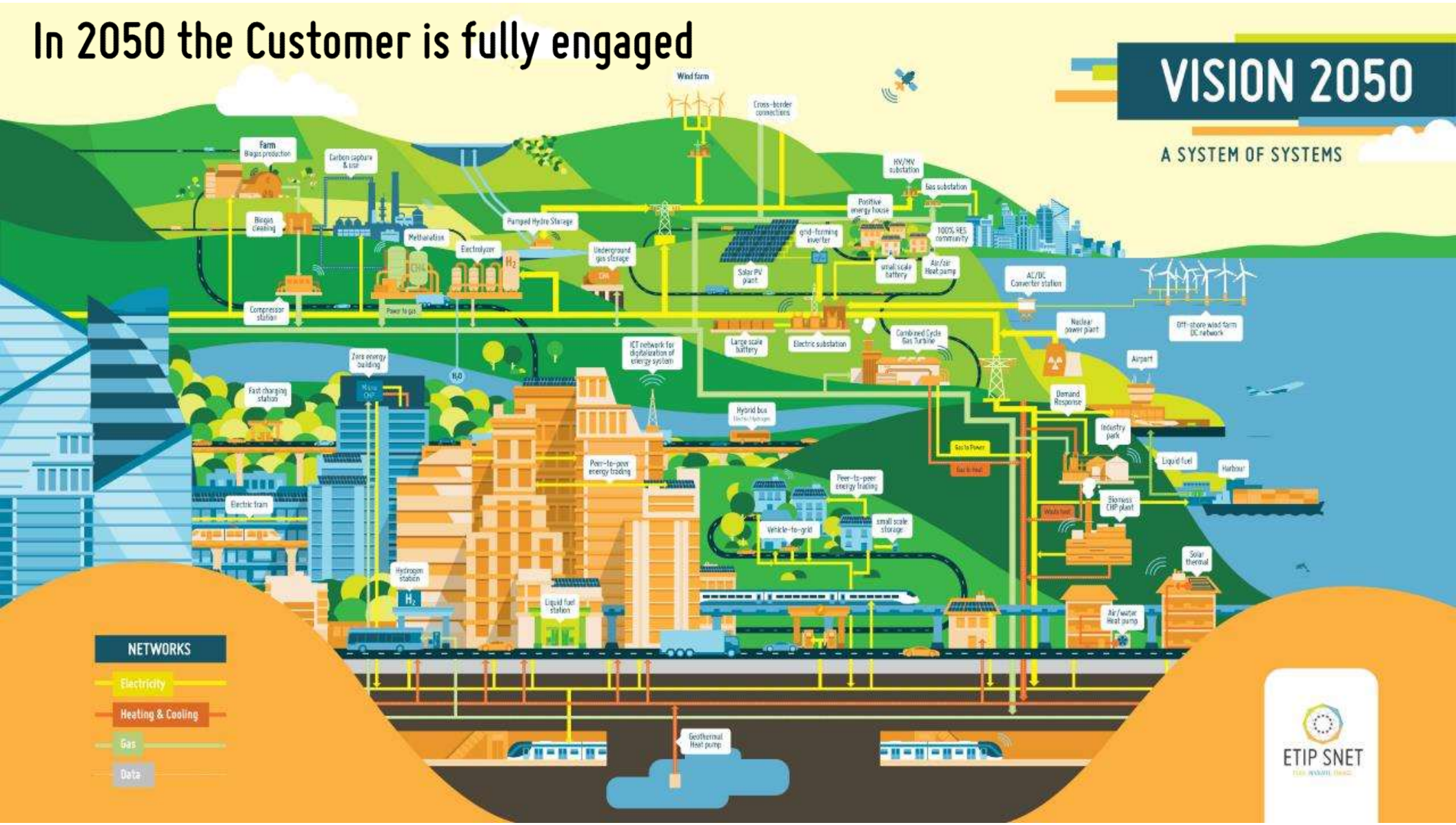
Variety of generation sources in size, both centralised and decentralised, fully or largely circular



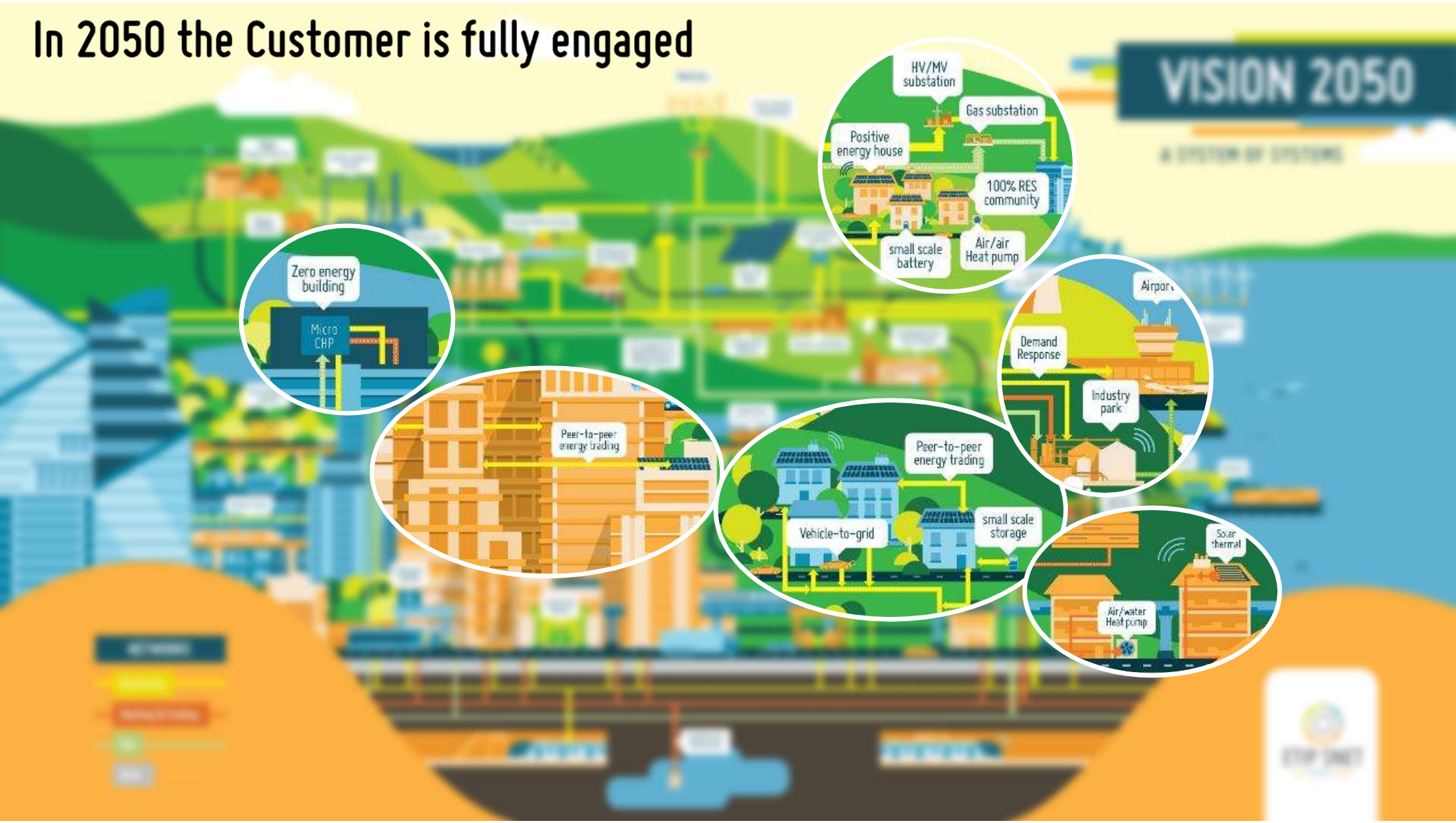
Variety of generation sources in size, both centralised and decentralised, fully or largely circular



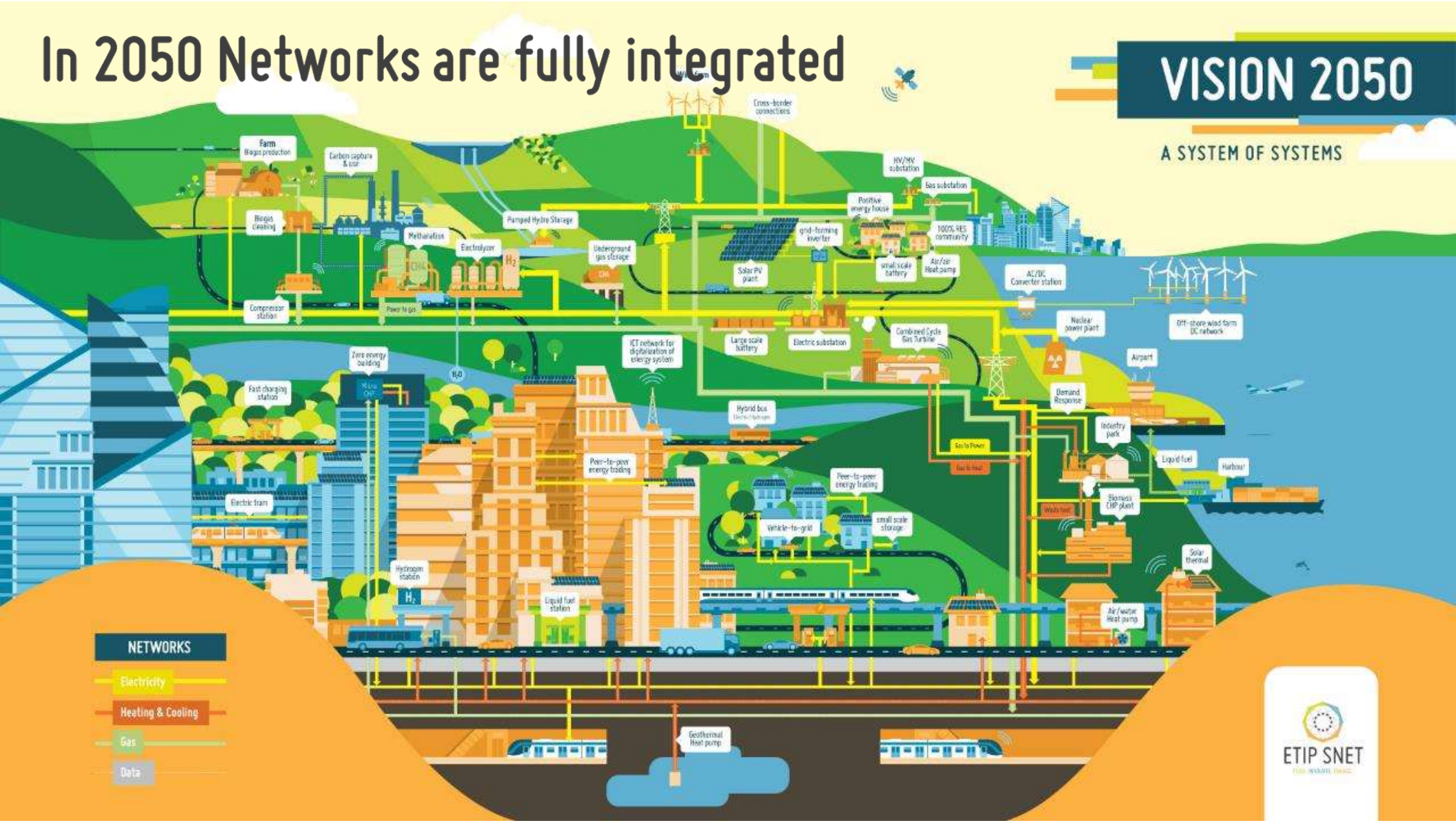
In 2050 the Customer is fully engaged



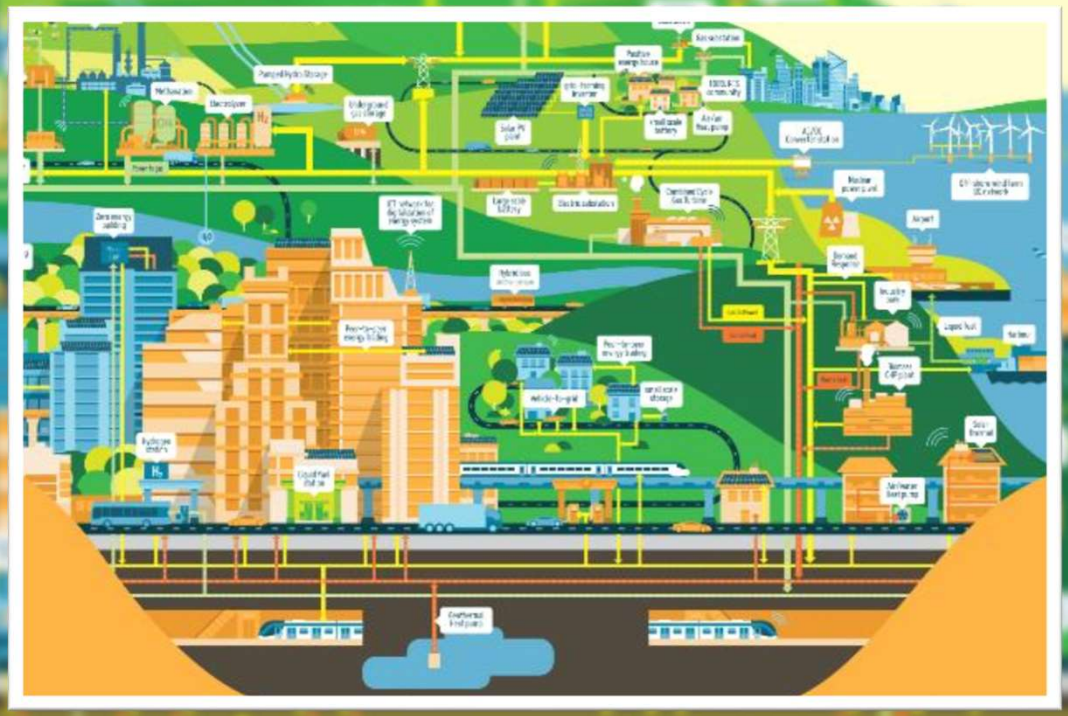
In 2050 the Customer is fully engaged



In 2050 Networks are fully integrated



In 2050 Networks are fully integrated



VISION 2050

NETWORKS

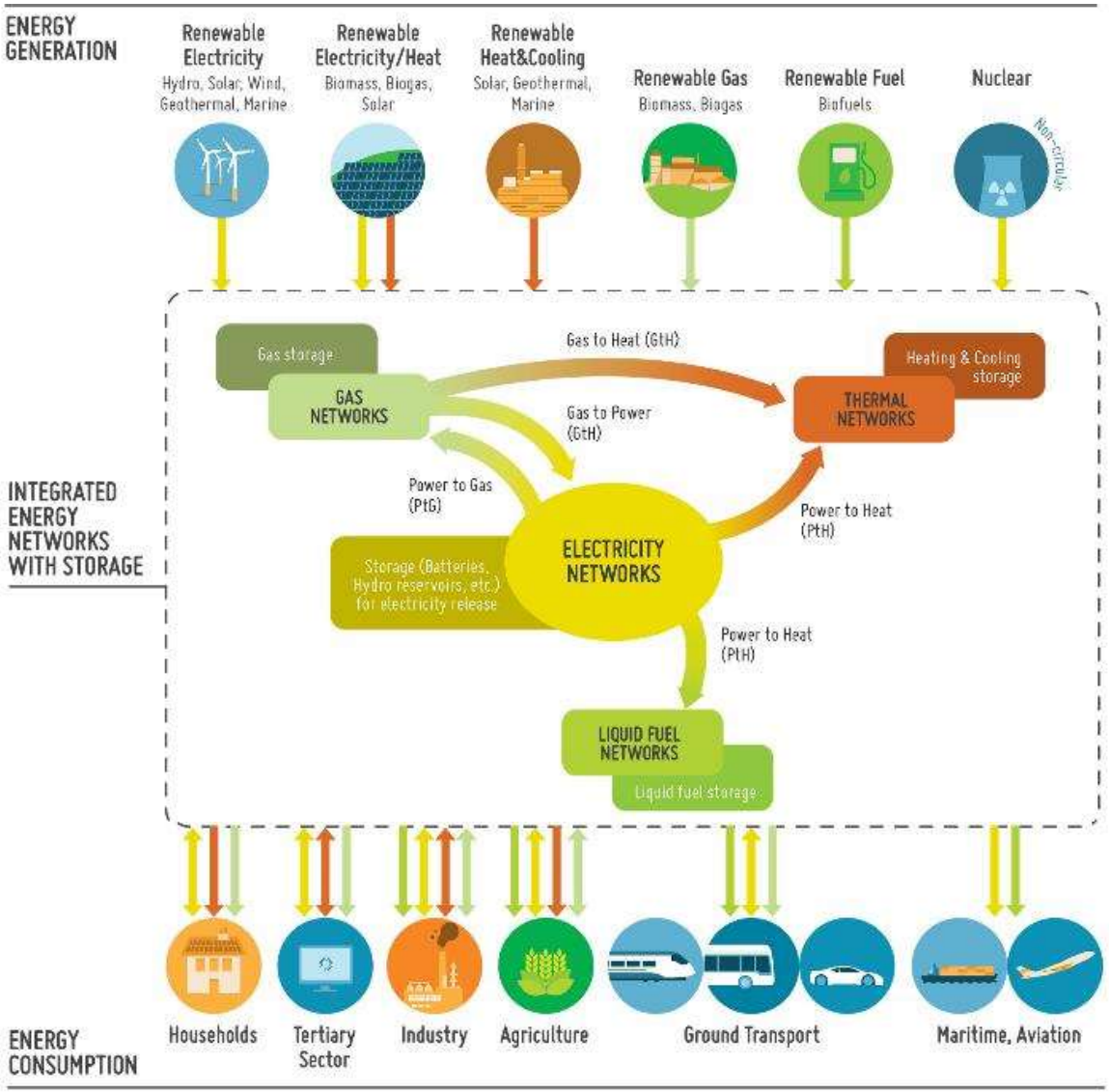
Electricity

Heating & Cooling

Gas

Data

The future integrated energy systems with conversion and storage devices



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Subsidiarity principle application to EU Energy Systems

The subsidiarity principle means that energy systems are operated in such a way that actions are optimised locally (at the most immediate level). Actions that cannot be handled locally are handled at the next level.

Monitoring and control of generation, conversion, storage and consumption in all energy sectors is done in an integrated, highly automated, fully-trusted way, within regions which are dynamically sized and cell-based.

A 'cell' refers to an integral element of a dynamically sizable energy system – from a single home to a region. A cell has the inherent ability to balance itself through the integrated and ICT-monitored and controlled use of all components.

A microgrid is a typical distribution network structure that satisfies this requirement. Interconnecting multiple of these cells offers significant benefits, amongst which balancing of energy supply and demand between different cells without causing congestions in the networks which connect them.

Microgrids in 2050 ETIP SNET Vision

In 2050, parts of the electricity grids are fully automated, with 'islanding' and reconnection capabilities to various grids, especially when local balancing can provide support to the upstream parts of the electricity systems.

Local energy communities based on microgrids are fully developed, where the stakeholders benefit, through informed and active participation, from the enabled services, resources, and forms of sharing energy.

This concept can be scaled to a self-adjusting whole energy system, an important step towards the energy system in the year 2050. How to coordinate the different cells from a grid, system and markets perspective is an important RD&I topic today to be solved well before 2050.

Conclusions

Local Energy Communities are an important cornerstone for the EU Energy Transition Policies

Microgrids comprise the technological infrastructure for the operation of LECs and not only.

The crucial Role of DSOs in facilitating and operating Microgrids

Microgrids as integral part of the 2050 ETIP SNET vision through the subsidiarity principle

Back up slides

ETIP SNET projects

Microgrids in projects listed in upcoming **ETIP SNET Project** Monitoring Report (1/4)

118 projects in the scope of the ETIP SNET are presented in the upcoming report **"Presentation of recent and ongoing R&I projects in the scope of the ETIP SNET"**

- **Types of technologies and services tackled by the projects** explained
- **Benefits brought by the projects** assessed
- **Projects' key exploitable results** detailed, including exploitation prospects and barriers to exploitation

→ Subscribe to ETIP SNET newsletter to be informed when the report is released!

Several of these projects are addressing microgrid issues (see on next slides)

Microgrids in projects listed in upcoming ETIP SNET Project Monitoring Report (2/4)

H2020 projects

EMPOWER	**EMPOWER:** Facilitation of micro-generation and active participation of prosumers to exploit the flexibility created for the benefit of all connected to the local grid
FLEXCoop	**FLEXCOOP:** Introduction of an end-to-end Automated Demand Response Optimization Framework allowing energy cooperatives to introduce themselves in energy markets under the role of an aggregator
inteGRIDy	**INTEGRIDY:** Facilitating the optimal and dynamic operation of the Distribution Grid, fostering the stability of the electricity grid and coordination of distributed energy resources, Virtual Power Plants and innovative collaborative storage schemes within a continuously increased share of RES
InterFLEX	**INTERFLEX:** Investigation of the INTERactions between FLEXibilities provided by energy market players and the distribution grid. This project focuses on energy storage, smart charging of electric vehicles, demand response, islanding, grid automation and integration of different energy carriers

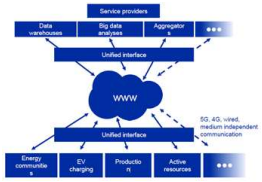
Microgrids in projects listed in upcoming ETIP SNET Project Monitoring Report (3/4)

H2020 projects *(continued)*

Nobel Grid Smart energy for people	**NOBEL GRID:** Provision of advanced tools and ICT services to all actors in the Smart Grid and retail electricity market in order to ensure benefits from cheaper prices, more secure and stable grids and clean electricity
SmarterEMC2	**SMARTER EMC2:** Implementation of ICT tools that support the integration of consumers through Demand Response services and the integration of DG/RES through Virtual Power Plants
TILOS	**TILOS:** Demonstration of the potential of local / small-scale battery storage to serve a multipurpose role within a smart island microgrid that features high shares of renewable energy and trades electricity with the main electricity network
wiseGrid	**WISEGRID:** Provision of a set of solutions and technologies to increase the smartness, stability and security of an open, consumer-centric European energy grid

Microgrids in projects listed in upcoming ETIP SNET Project Monitoring Report (4/4)

Other projects

CINELDI	**CINELDI (Norway):** Enabling a cost-efficient implementation of the future flexible and robust electricity distribution grid. This will pave the ground for increased distributed generation from renewable resources, electrification of transport, and more efficient energy use
	**HEILA (Finland)**: Construction of extensive business development platform, based on the integration of laboratories and simulation environments of the research centre VTT and universities. The platform includes real-life pilots for developing and testing the functions needed in the management of future energy system. One essential target is to build a virtual microgrid
factory microgrid	**FACTORY MICROGRID (Spain):** Demonstration, through the implementation of a full-scale industrial smart grid, that microgrids can become one of the most suitable solutions for energy generation and management in factories that want to minimize their environmental impact
uGRIP	**UGRIP (Croatia):** Development of a full-scale microgrid that consists of distributed generators, both renewable and controllable, storage units and flexible loads. A structure of the local, distribution-level market will be defined and demonstrated