Flexibility choices for distribution networks

New roles and tasks for the DSOs to facilitate markets

Energiforsk- EFORIS

Conference Evolving the market – matching the future needs

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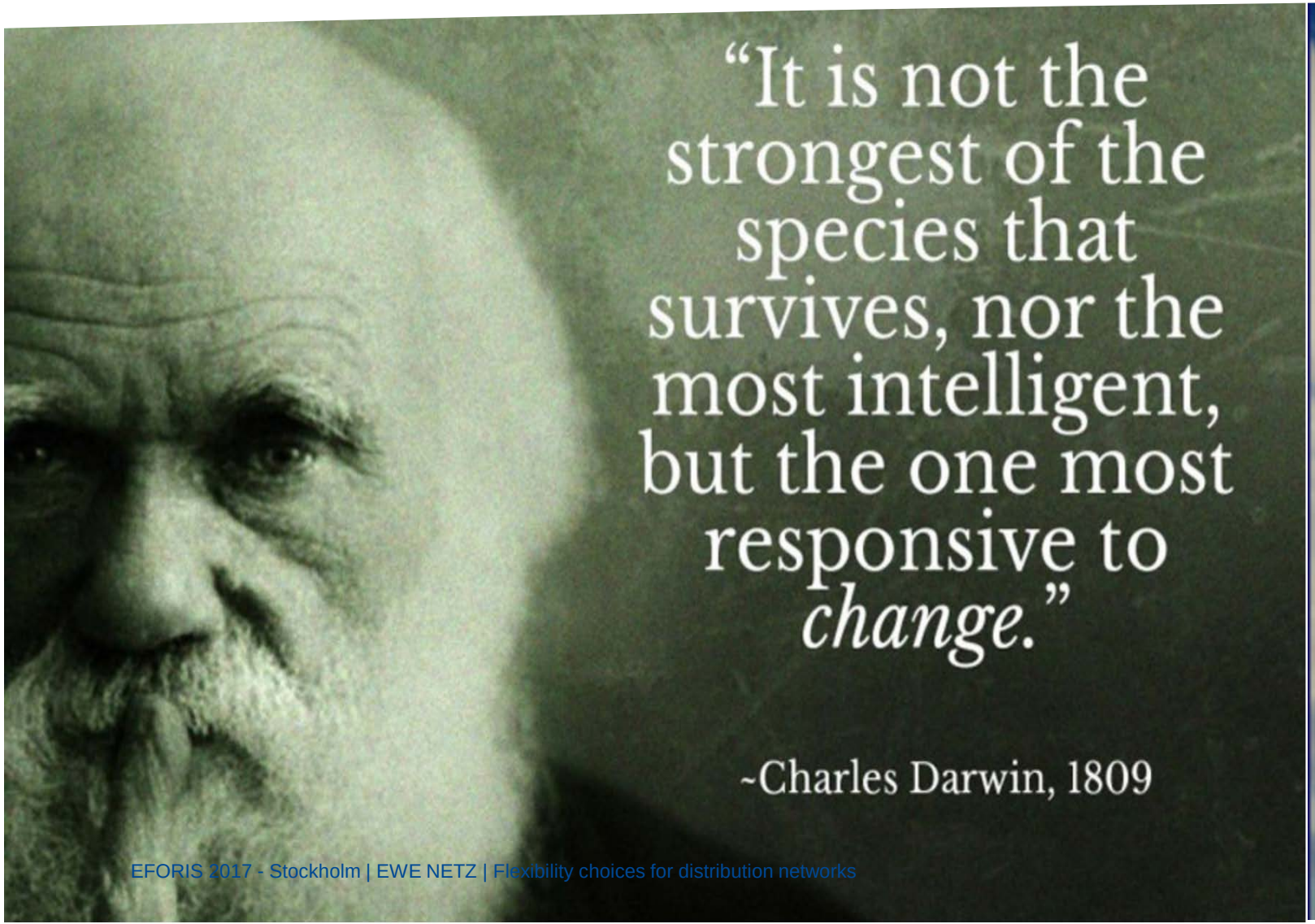
Marcus Merkel

Senior Advisor to the Board of Management

EWE NETZ GmbH

Germany

Evolution is about to embrace to change & be the one most responsive to change ....



Game changers ahead: The energy transition implies changes for network operators and the power sector

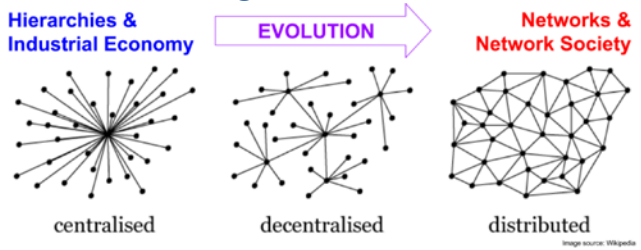
ENERGIEWENDE

... = KICK start

towards decentralization,
decarbonisation,
smart systems & digitalisation

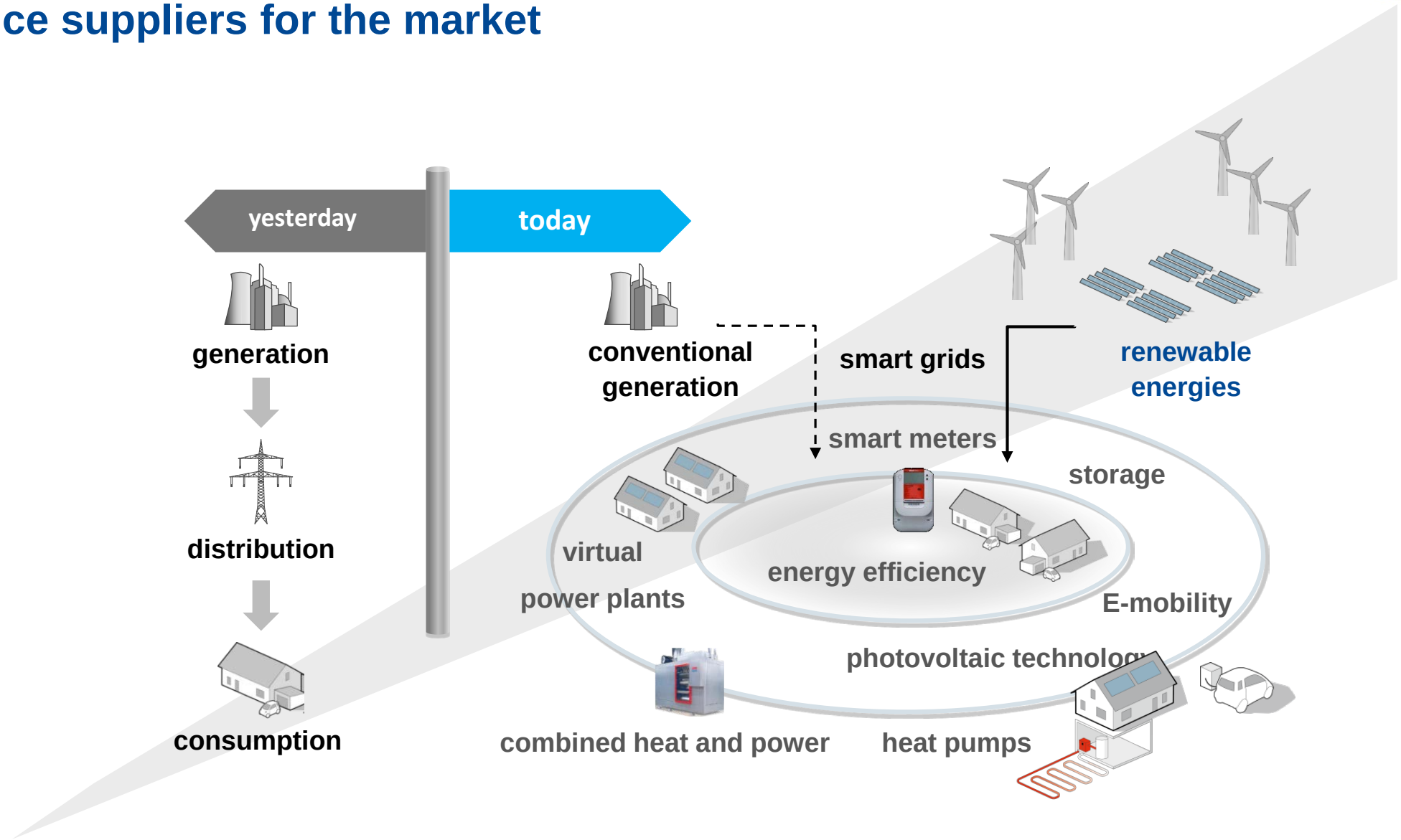
DIGITALISATION

... = INCUBATOR of the Energy transition "Energiewende"

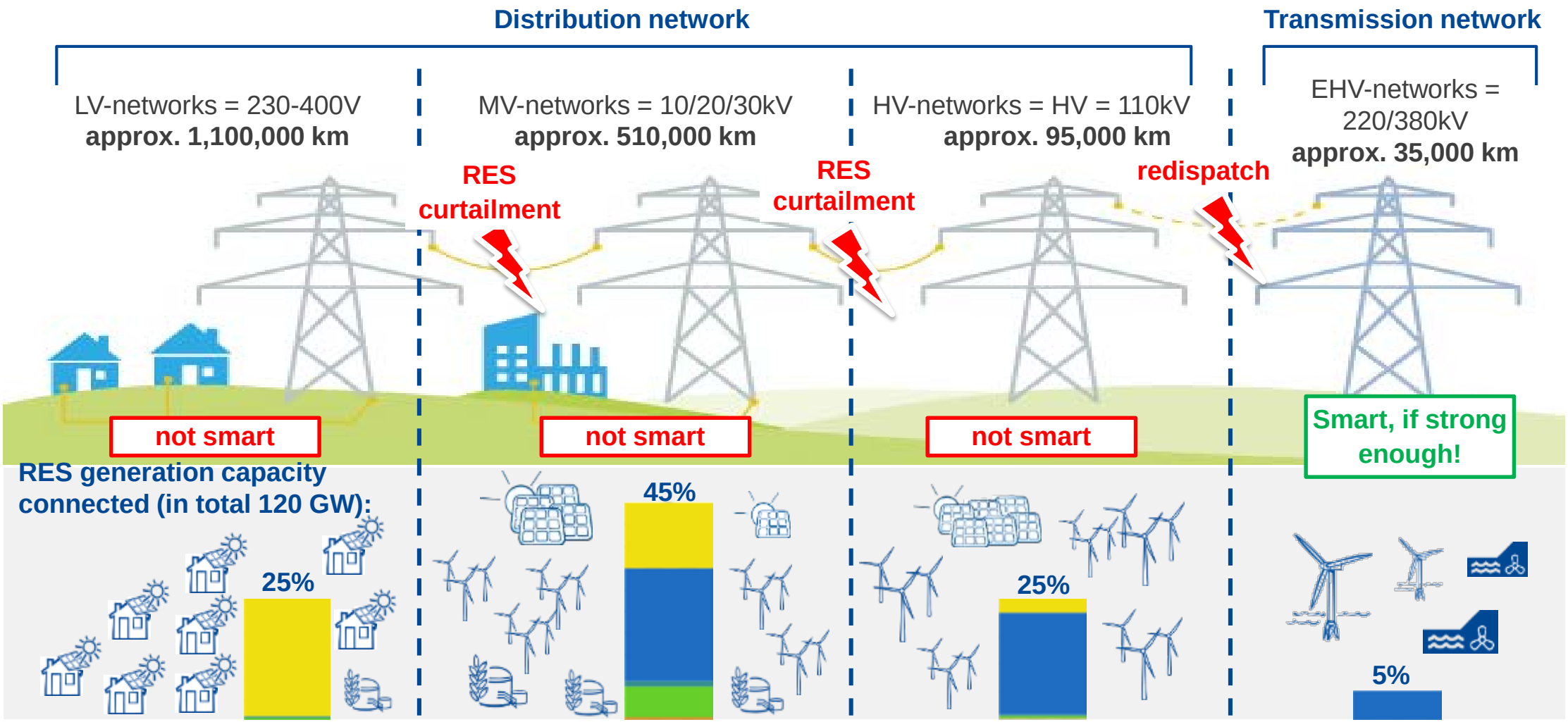


DSOs are on their way to embrace the changes ahead. But their roles and responsibilities within the regulated domain need as well to be adjusted at EU and Member State level.

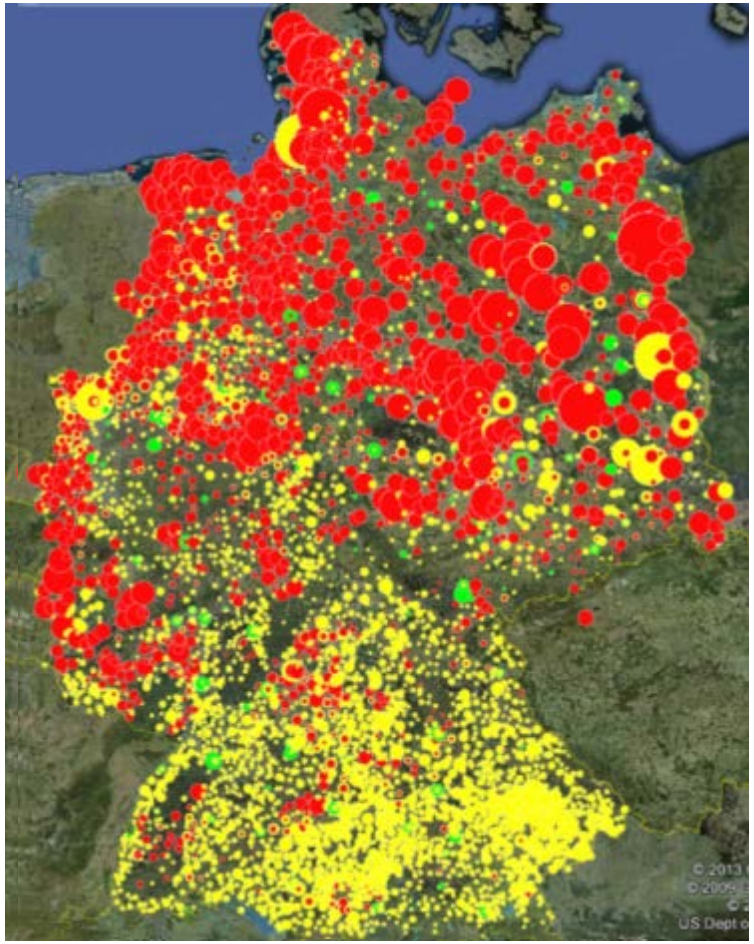
Our mission: DSOs act as neutral and efficient infrastructure service suppliers for the market

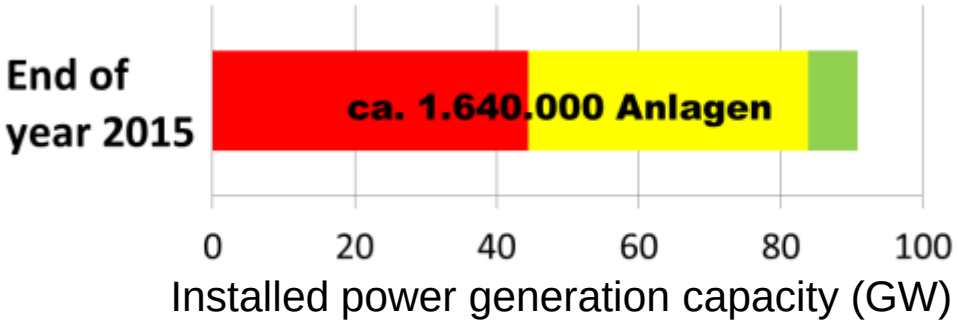


In Germany > 95% of RES power generation capacity is connected to distribution networks. That's >114 GW!



Energy market in Germany in evolution
Increased decentralisation of power generation





Onshore-wind

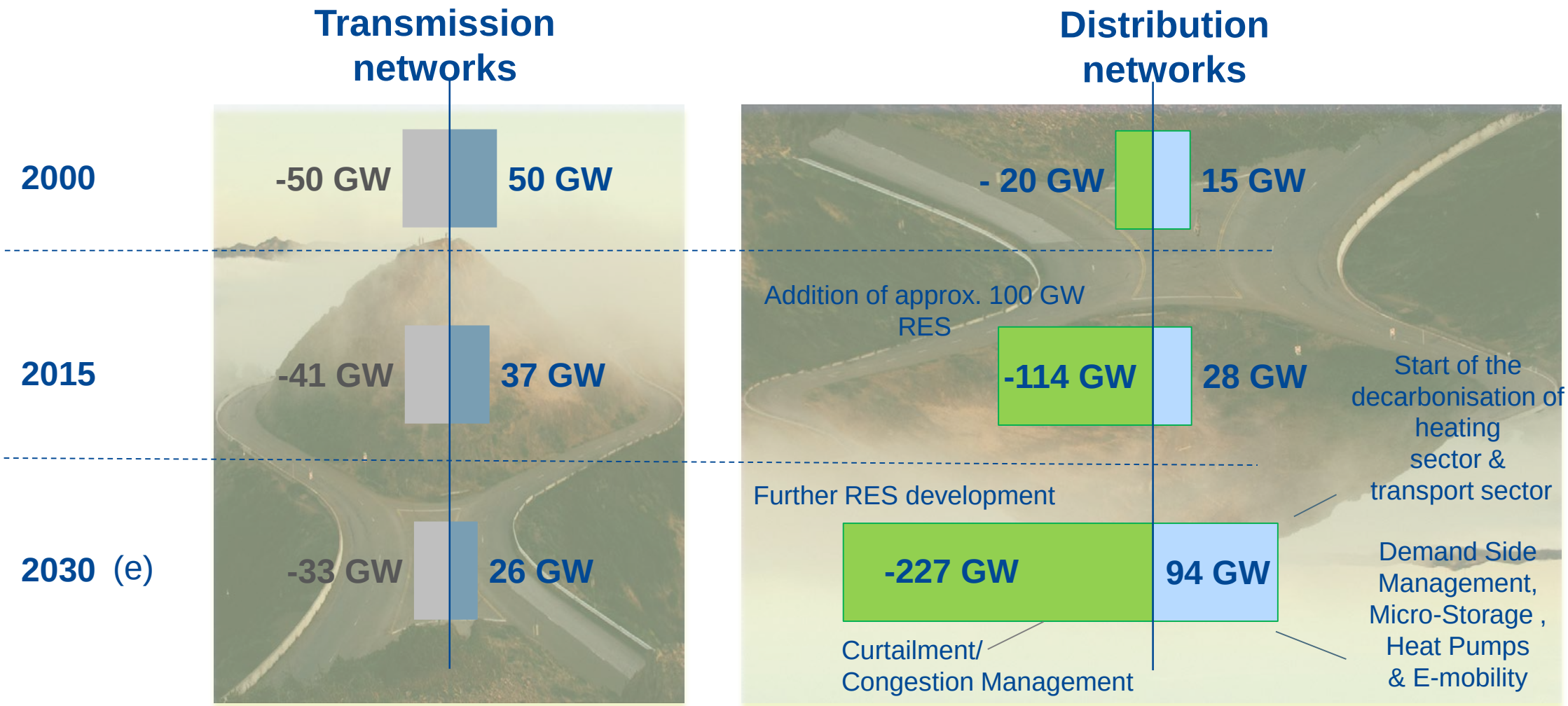
Photovoltaics

Biomass

Circle area is proportional to the installed capacity

Source: Data of 50Hertz, TenneT, Amprion, TransnetBW, VKU e.V. Germany

Further evolution of distributed & flexible loads in Germany - utilization towards 2030 is the next smart challange to facilitate



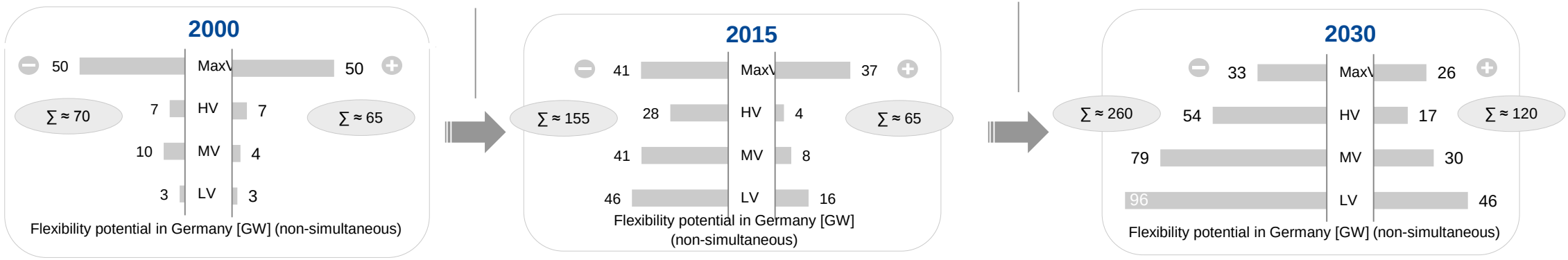
Source: Own graph based on E-Bridge Study 2017 „Ausgestaltung eines zukunftsgerichteten Rollenzuschnitts des Verteilnetzbetreibers in der Energiewende“

The value of flexibilities varies across time AND location on the different voltage levels of the German power system

There will be sufficient flexibilities in the grid: By 2050, more than 60 million[1)] facilities will be connected to the grid of German DSOs, which can/have to be actively controlled.

Additional 100 GW of installed RES capacitythe distribution system

Additional capacity from RES, electrification and digitization of heat generation and transport



Consequences

DSO Redispatch process is needed

- DSO shall perform own redispatch fully automated. Selection based on minimum costs.

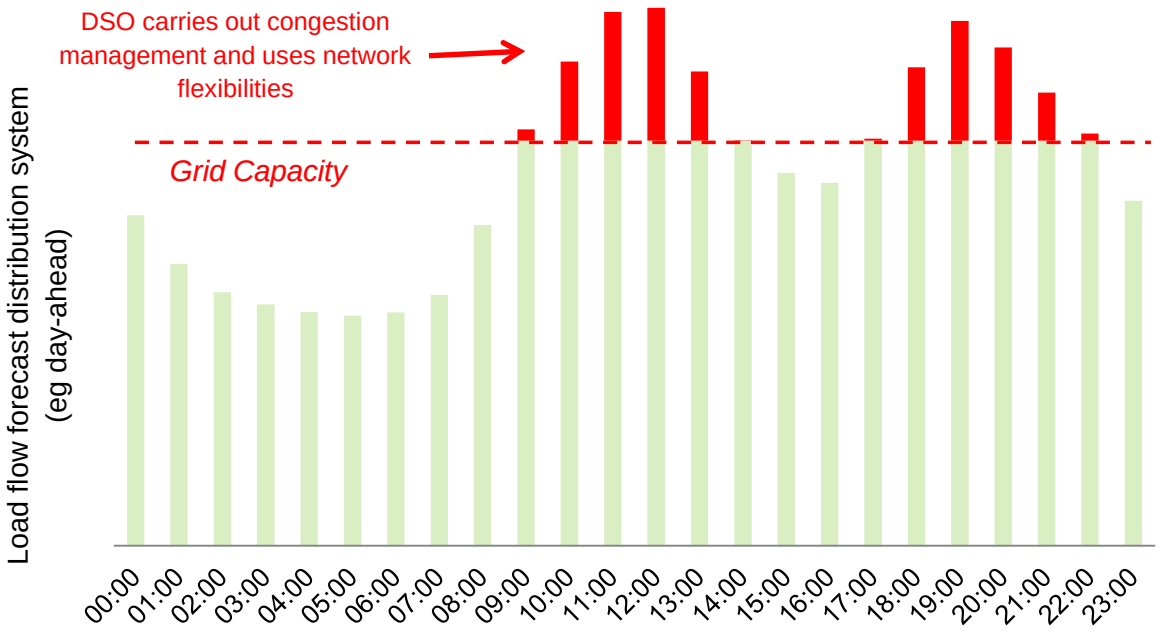
DSO Red Flag Process is needed

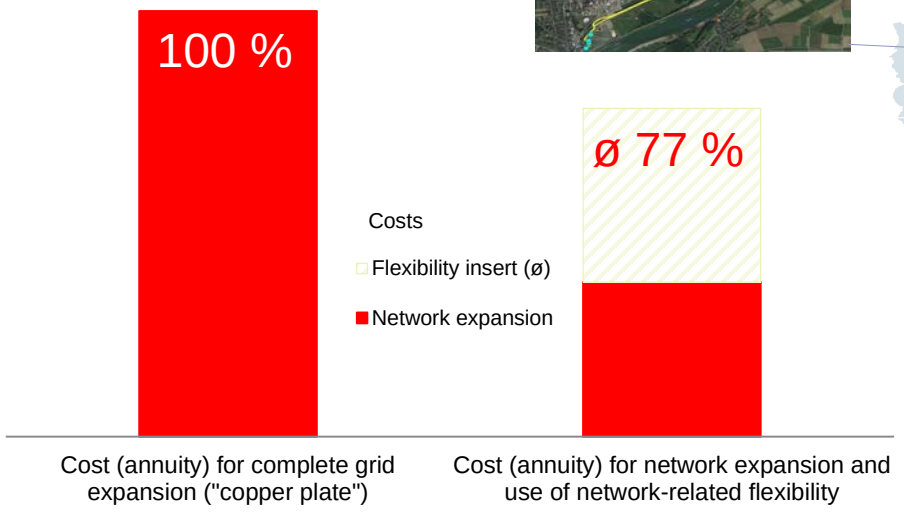
- DSO must be able to limit the use of flexibilities connected to its own network to ensure safe and secure operation or this would otherwise be endangered.

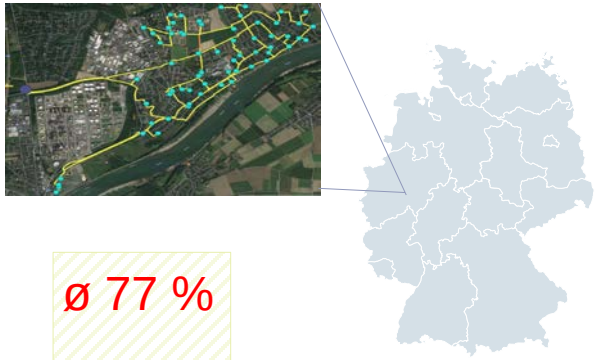
[1)] More than an additional 40 million electric cars, more than 15 million additional electric heating solutions, more than 5 million additional generation facilities and storage facilities in the distribution system.

Congestion Management will become a common task for DSOs throughout Europe

- Network infrastructure is planned and built for a low „load factor“ of demand (< 10 % in LV networks).
- The future development of demand requires network expansions also in urban areas.
- **Network simulations show that 85 % of the congestions occur during less than 5 % of the time.**
- The DSO must establish an effective congestion management based on increased smartness **and were appropriate utilize capacity/flexibility to run an overall efficient power system**







Urban Grid (2035)

15,000 inhabitants

10 MW PV power

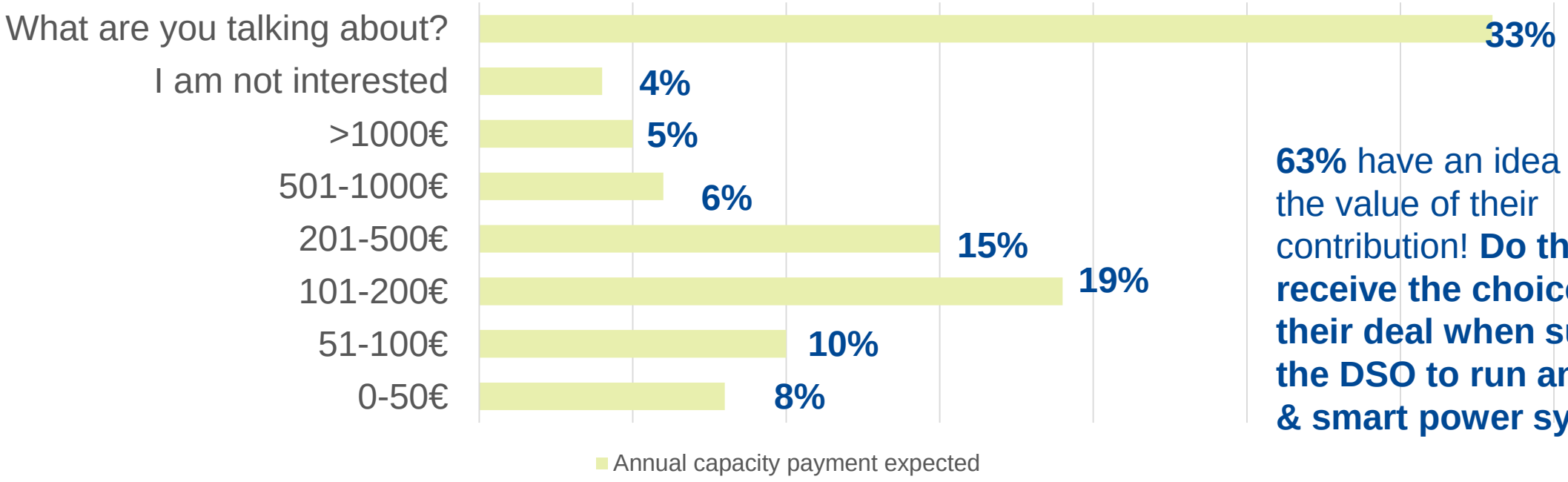
1,500 electric cars

850 heat pumps

300 small storages

Fine, but .... asking those who should have the choice and who have the future means .... the connected grid users

Annual capacity payment expected in Euro for providing PV, EV or storage and **% of people would be willing to provide flexibility in terms of capacity based on their own assets**



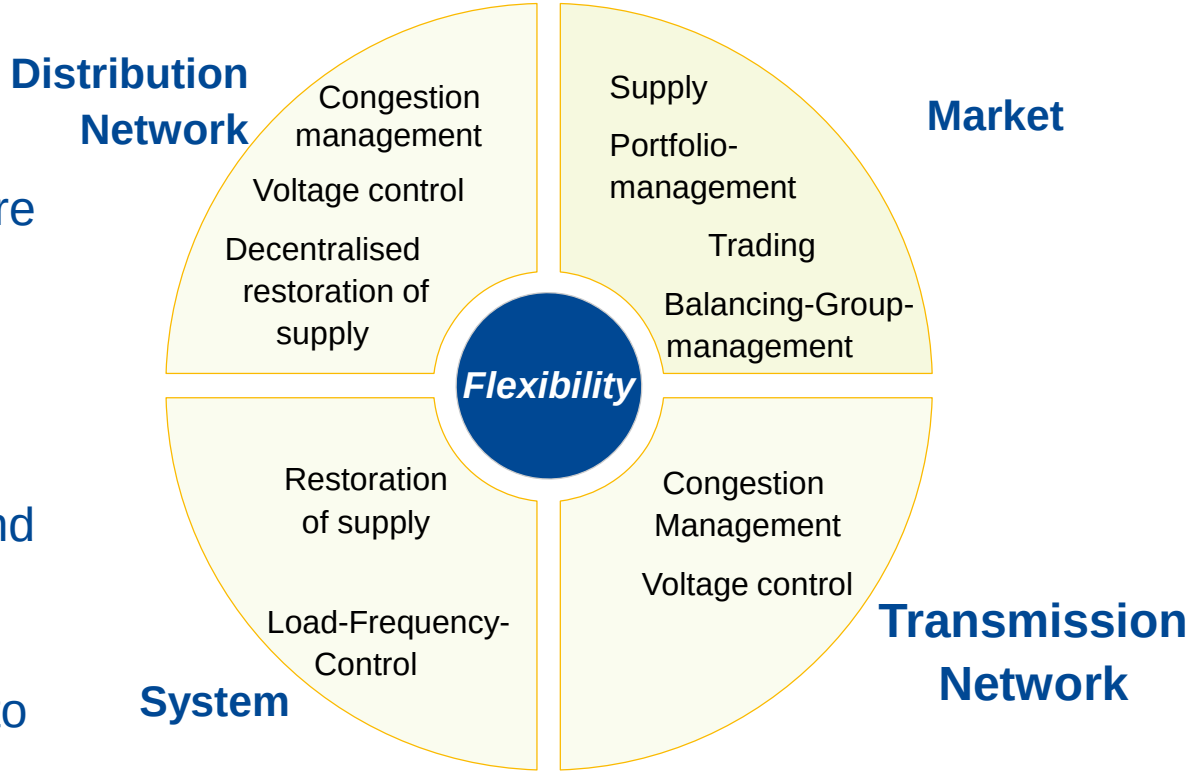
63% have an idea about the value of their contribution! **Do they will receive the choice to make their deal when supporting the DSO to run an efficient & smart power system?**

DSOs must be fully responsible for switching and operations in their own grids

How could a system look like, where multiple operators may try to conduct the system at the same node?

The flexibilities in the DSO network are utilized by different parties – an intelligent coordination mechanism is required

- Large-scale generators are replaced by small-scale distributed generation.
- Decentralized generation in the DSO networks – together with distributed load and storage facilities – are the source as flexibilities to the entire system.
- These facilities are needed for different purposes by different parties.
- Access to these flexibilities has to be coordinated to ensure a safe and secure operation of the networks and the system.
- Such a coordination mechanism is lacking → DSO is only required to react. No transparency about access to the flexibilities or the services sold.



A technically reliable and economically efficient access to the flexibilities must be guaranteed by any new coordination mechanism to come.

Highly efficient coordination mechanisms between network operators are necessary and will be a core requirement

- **Clear access rules for system responsibility** in the future decentralized energy industry with millions of prosumers and mobile consumers!
- **Everyone is responsible for a secure and efficient energy supply in his network.**
- **Coordination of access to network-oriented flexibility is** the **central task of the distribution network operators.**
- Clear **definition of tasks and responsibilities at the interface between distribution** and **transmission networks**.
- **Cascading principle for operation and data provision to ensure system services**

Outlook: System stability has to be organized with DSOs !

DSOs will increasingly take advantage of flexibility for efficient network operation

Grid and system state	DSO activities
System stability endangered • Acute congestion or overload • Market flexibility exhausted	• Non marked-based congestion management, e.g. by peak load capping
Congestion foreseen • Some system states • Market flexibility available	• Marked-based congestion management, e.g. by buying flexibility
Normal operations • Generation and consumption balanced by market participants • Sufficient reserves and market flexibility available	• Optimized grid control • DSO acts as a market facilitator through grid enforcements

An active grid optimization is the responsibility of the DSO – including the choice of the right tools and flexibility measures

The roles of DSOs increase in size and complexity – platforms will emerge and will be interconnected to ensure market facilitation

Key roles of DSOs: Network & System Operation

1. ***Plan, build and optimize the grid infrastructure*** *according to market needs*
2. ***Connect new customers to the grid*** *and manage grid fees in a non-discriminatory way*
3. ***Operate the grid*** *in a safe, secure and efficient way*
4. ***Provide system services*** *from the distribution grid for the energy system*

Optional activities of DSOs related to market facilitation

- ***Metering and SM-gateway administration***
- ***Plan, build and operate e-mobility infrastructure***
- ***Plan, build and operate digital communication infrastructure***
- ***Integrate storages***

…

DSO's responsibility: providing system services beyond the DSO grid borders needs to be ensured

In a decentralized electricity system, the system stability can only be ensured together with DSOs

Operating the own distribution grid

- Congestion management in the distribution grid
- Voltage quality management in the distribution grid
- Physical balancing of generation and load in the distribution grid*
- Restoring of supply in the distribution grid

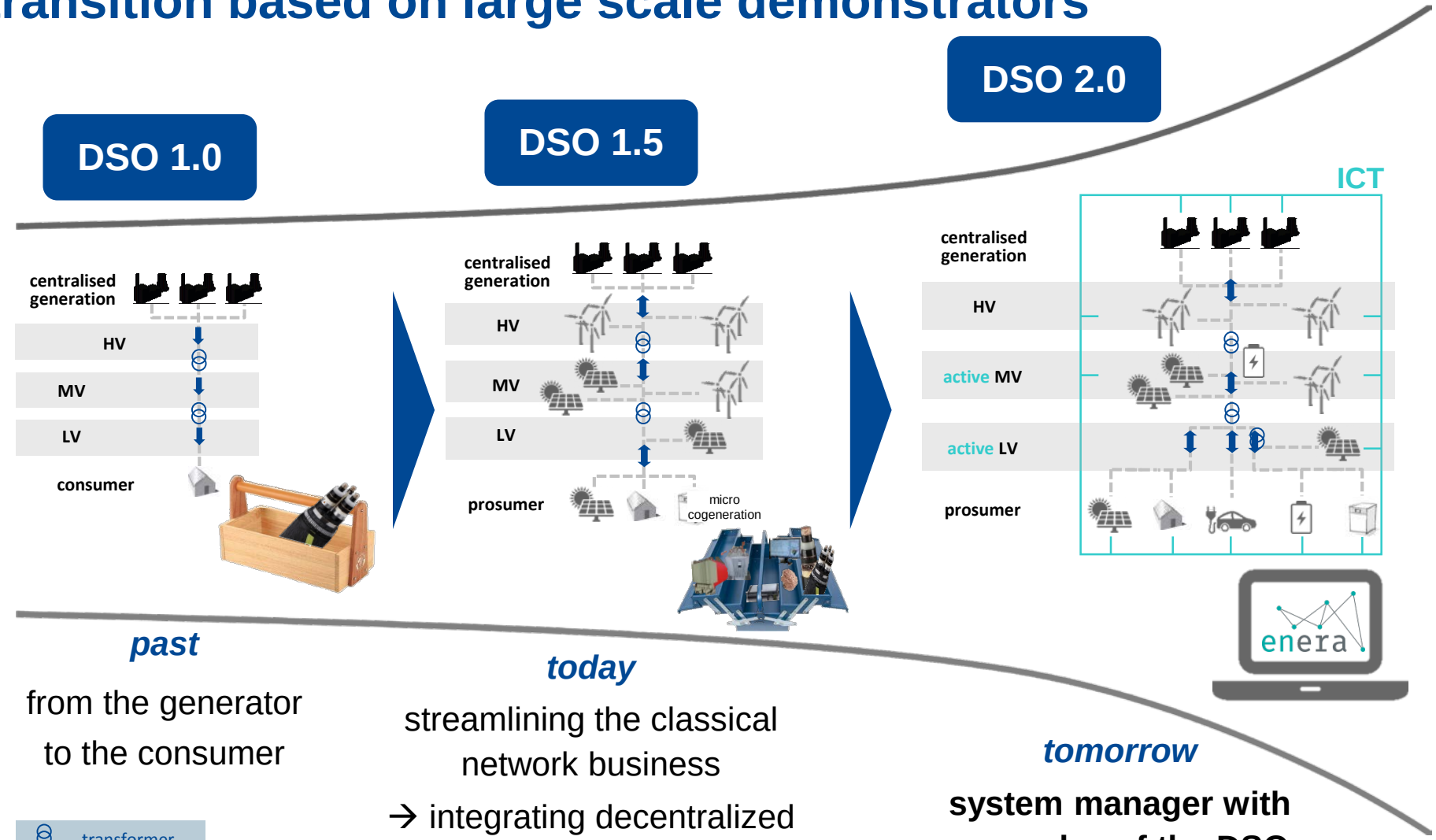
Providing system services beyond the own grid borders

- Congestion management in the transmission grid out of the distribution grid
- Voltage quality management in the transmission grid out of the distribution grid
- Balancing power for the transmission grid out of the distribution grid
- Restoring of supply in the transmission grid out of the distribution grid

* For separated, cellular subsystems

Highly efficient communication and data exchange between DSOs and TSOs is required

Conclusion: DSOs are shaping up for success in the energy transition based on large scale demonstrators



past

from the generator to the consumer

today

streamlining the classical network business

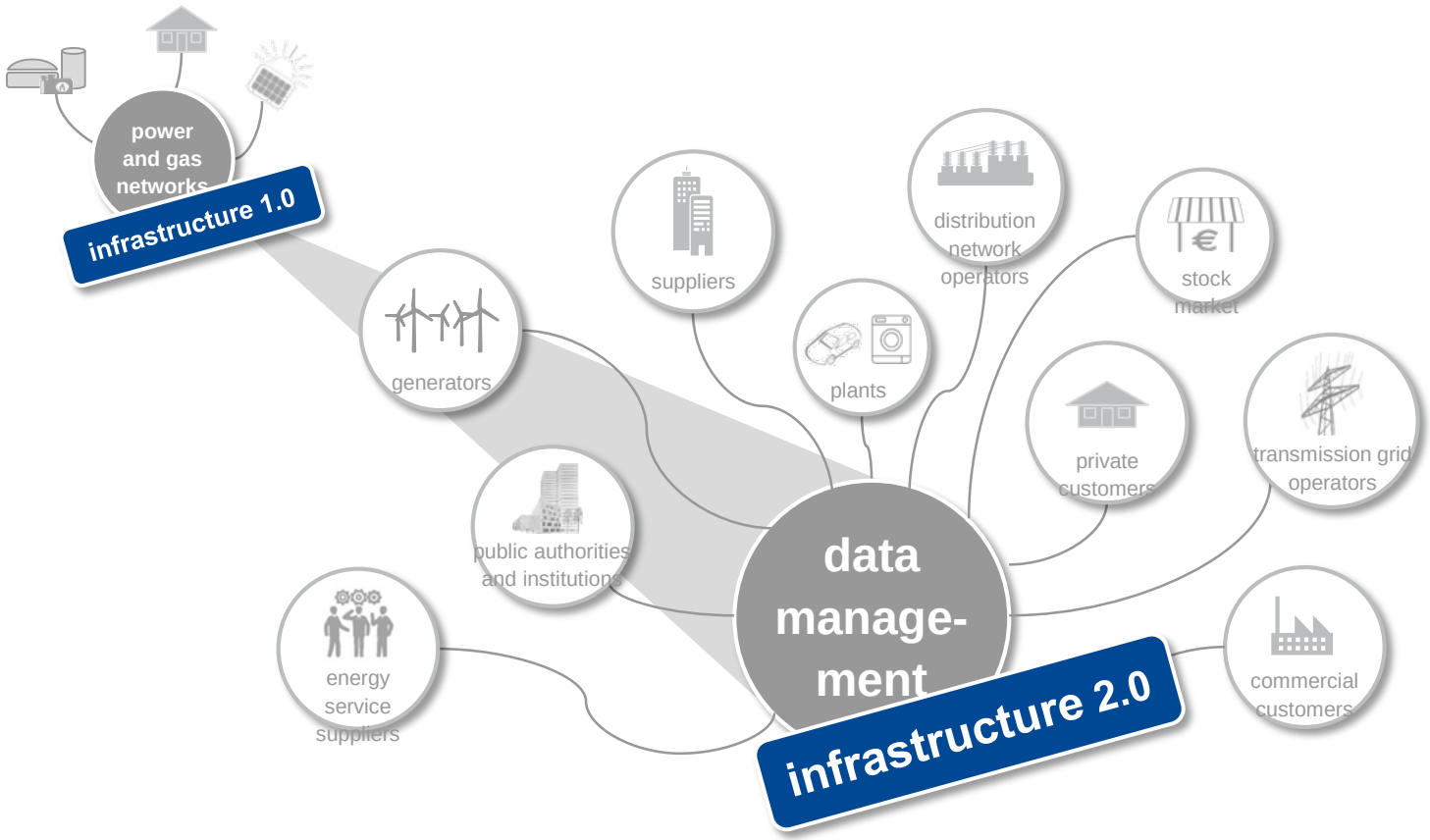
→ integrating decentralized generation

tomorrow

system manager with new roles of the DSO

transformer
energy flow

Data becomes key for system operators to optimize the network as infrastructure asset



DSOs must be responsible for their data management and their communication within their own network

Evolved TSO-DSO data management is required DSO and TSO have agreed on common principles

Report by DSO and TSO associations *on data management presented to EC*

Clear **need for improved TSO-DSO data management identified** in five use-cases:

- Congestion management
- Balancing
- Use of flexibility
- Real-time control and supervision
- Network planning

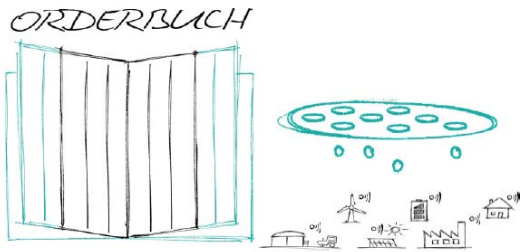
Shared key principles of TSO-DSO data management

- Guarantee data privacy, data / communication security
- Guarantee a fair, equal access to the data / information
- Deliver a non-discriminatory processing of the data
- Be of proven cost efficiency, as accepted by the National Regulatory Authorities (NRAs).
- Facilitate innovation by opening, as much as possible and legally allowed, the access to the data

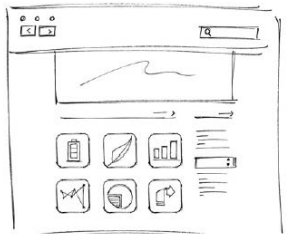
SINTEG-project enera will demonstrate the utilization of flexibility in a model region in northwest Germany

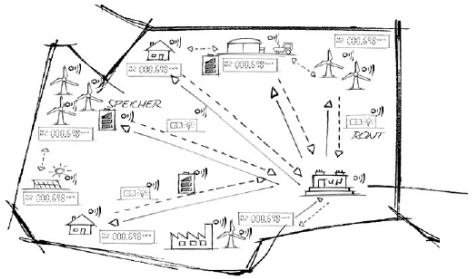
Core areas of the project

SMART MARKETS

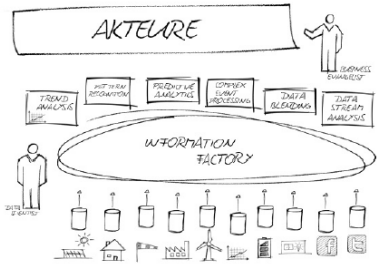


ENERGIEWENDE - APPSTORE





SMART GRIDS



BIG DATA + ANALYTICS

Objective Demonstration of the functional capability of the german energy transition in a model region

enera
www.energie-vernetzen.de

The model region:

- Districts of Aurich, Friesland & Wittmund
- City of Emden
- 2,665 km²
- 390,000 Inhabitants
- 200,000 households
- 1,75 GW of installed RES generation capacity
- 1,5 GW wind power capacity
- 170% share of RES

Thank you for your attention!

CONTACT:

Marcus Merkel

EWE NETZ GmbH

Cloppenburger Str. 302

26133 Oldenburg

Germany

T.: +49(0) 4 41 / 48 08-0

www.ewe-netz.de