“E-Energy”, the German Smart Grids initiative

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Agenda

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1. Is one worldwide definition of “Smart Grids“ possible?
2. Motivation for “Smart Grids” in Germany
3. “E-Energy“, the German Smart Grids initiative
4. First results in “E-Energy“
5. Outlook and my research activities

1. Is one worldwide definition of "Smart Grids" possible?

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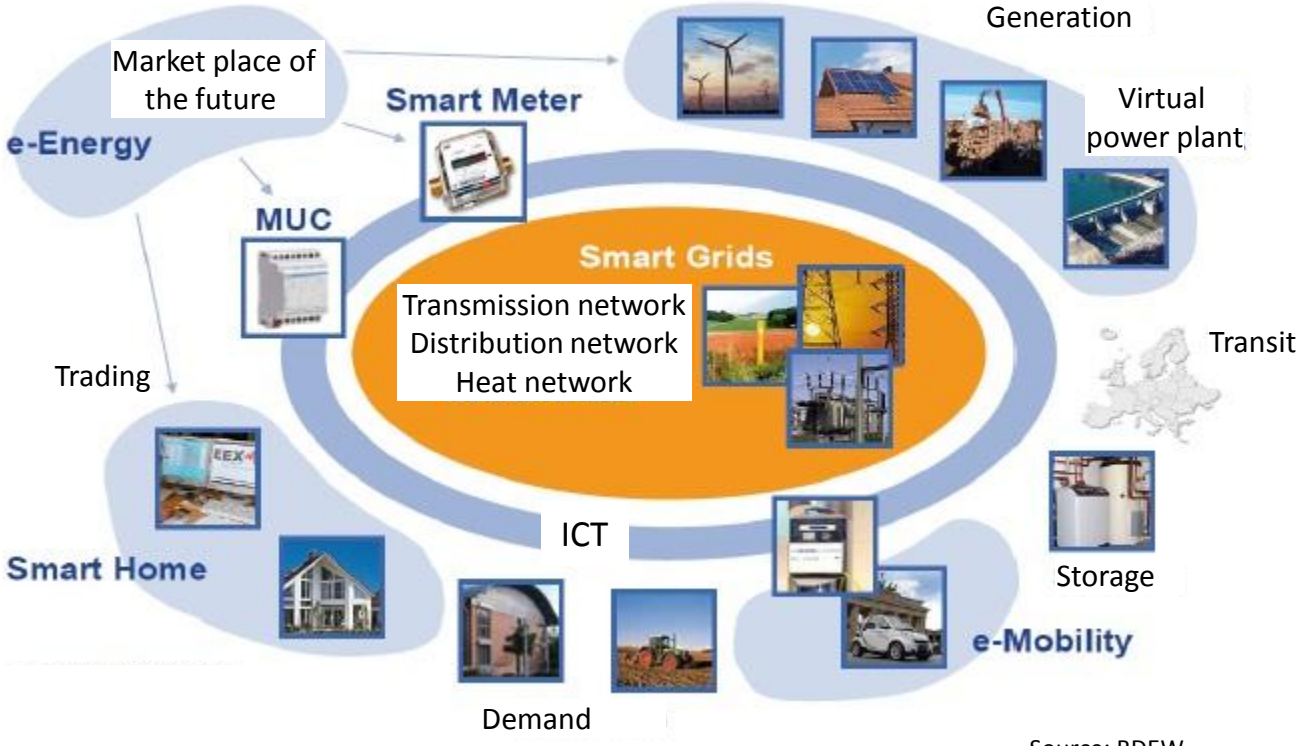
The definition of the term "Smart Grids" and the goal of "Smart Grids" depends on the structure of the regional energy system and the energy demands which vary from country to country.



Source: BDEW

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2. Motivation for Smart Grids in Germany

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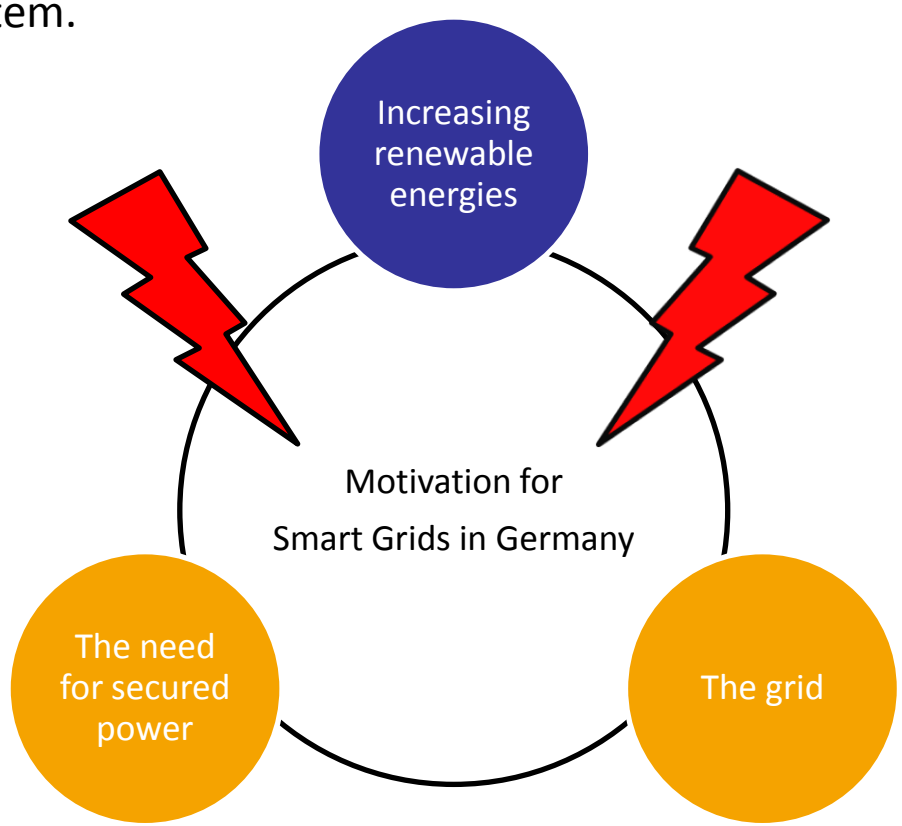
The German government has ambitious goals regarding energy efficiency and environment protection.

- Energy efficiency aims of the German government from 1990 until 2020:
  - About 40% reduction of CO2 emissions
  - About 25% increasing of renewable energies
  - About 14% increasing of renewable energies in the heat sector
  - About 25% increasing of the cogeneration of heat and power
  - A gradually shut down of coal and nuclear power plants

2. Motivation for Smart Grids in Germany

The activities for reaching the government's goals are rivaling fundamental aspects of the German energy system.



2. Motivation for Smart Grids in Germany

Germany has experienced a massive development regarding the renewable energies especially photovoltaic and wind power since 2000.

- Development concerning photovoltaic:
  - 7-8 GW in 2010
  - Currently installed 17 GW (including the development in 2010)
- Development concerning wind power:
  - 1.5 GW in 2010
  - Currently installed 27.2 GW (including the development in 2010)

➔ Development based on the feed-in-tariff (EEG)

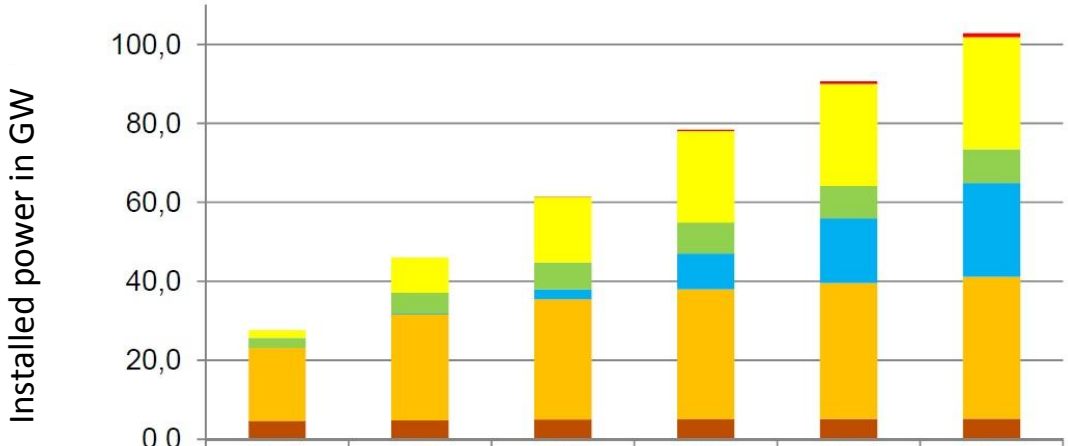
2. Motivation for Smart Grids in Germany

The development concerning renewable energies is based on the German feed-in-tariff regulated by law (EEG).

- General information:
  - Start of the EEG April 2000
  - To cope with the improvements and challenges of the dynamic development, two amendment has been announced since 2000
  - Next amendment in January 2012
- How does it work?
  - Preferential buy-off concerning the generated power (RE)
  - For operators: fixed gratification per fed-in kWh for 20 years (now: 28.33 €Cent/kWh [Photovoltaic on the roof < 30kW])
  - Level of gratification depends on technology, size and location
  - Gratification decreases with a specific percentage each year
  - Degression of the gratification incentivizes reducing costs

2. Motivation for Smart Grids in Germany

The massive development will not be finished within the next 10 years.



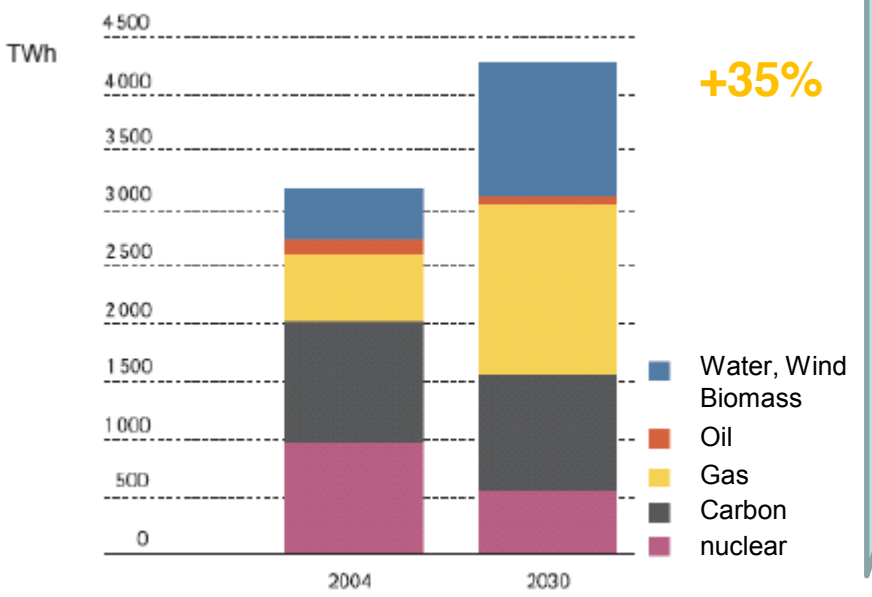
	2005	2010	2015	2020	2025	2030
Geothermal energy	0,0	0,0	0,1	0,3	0,65	1,0
Photovoltaic	1,9	8,9	16,6	23,2	25,8	28,4
Biomass	2,6	5,3	6,8	7,9	8,2	8,5
Wind offshore	0,0	0,2	2,5	9,0	16,4	23,8
Wind onshore	18,4	26,8	30,5	32,9	34,4	35,9
Hydro power ((w/o) pump)	4,7	4,8	5,0	5,1	5,15	5,2
SUM	**27,6**	**46,0**	**61,5**	**78,4**	**90,6**	**102,8**

Source: Routing scenario 2009 (Federal Ministry for Environment, Nature Conversation and Nuclear Safety)

2. Motivation for Smart Grids in Germany

The structure of the German/European energy generation system is changing.

Expected power generation in EU-25 in 2030



Source: DENA

Renewable energies ↑

Nuclear and coal power ↓

Volatile structures ↑

2. Motivation for Smart Grids in Germany

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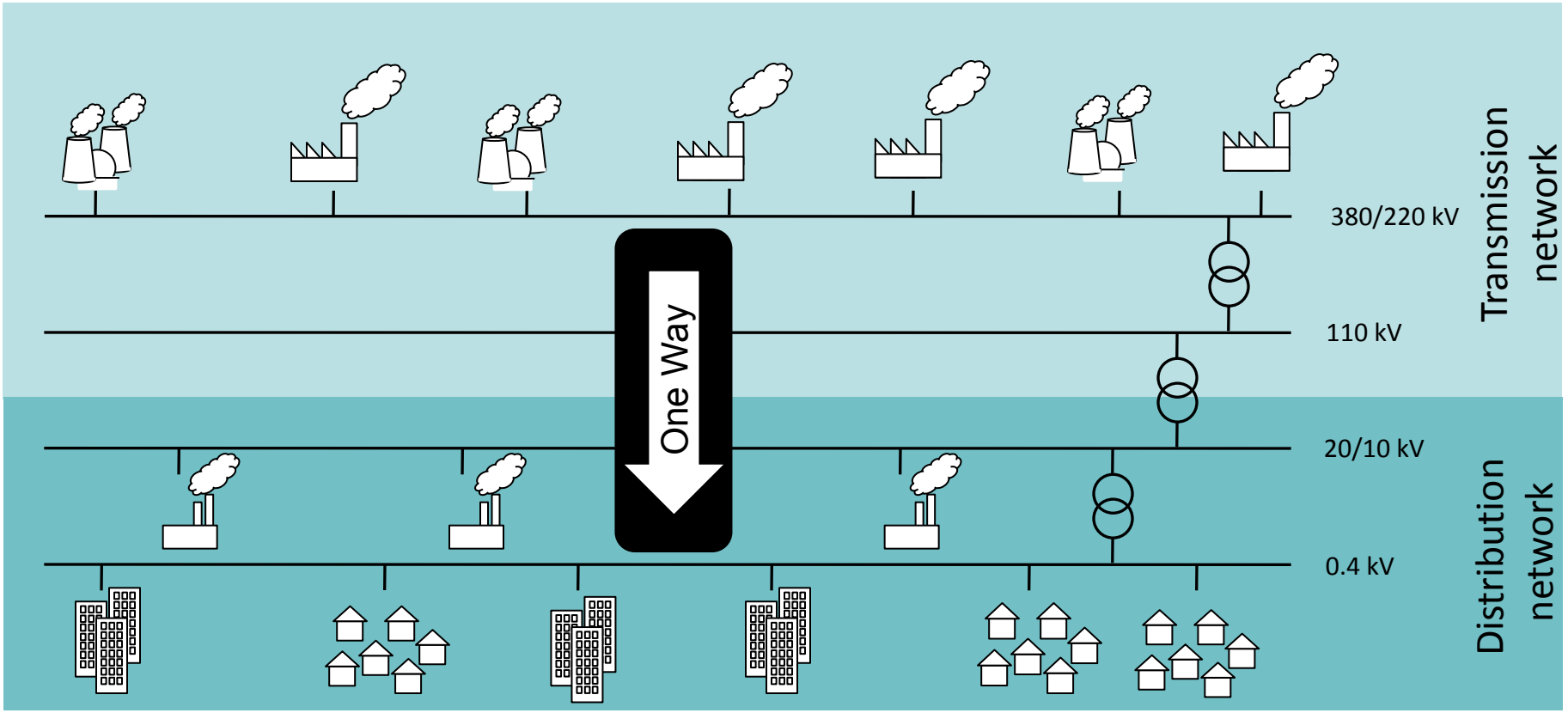
In the past the grid has to handle an unidirectional power flow.



2. Motivation for Smart Grids in Germany

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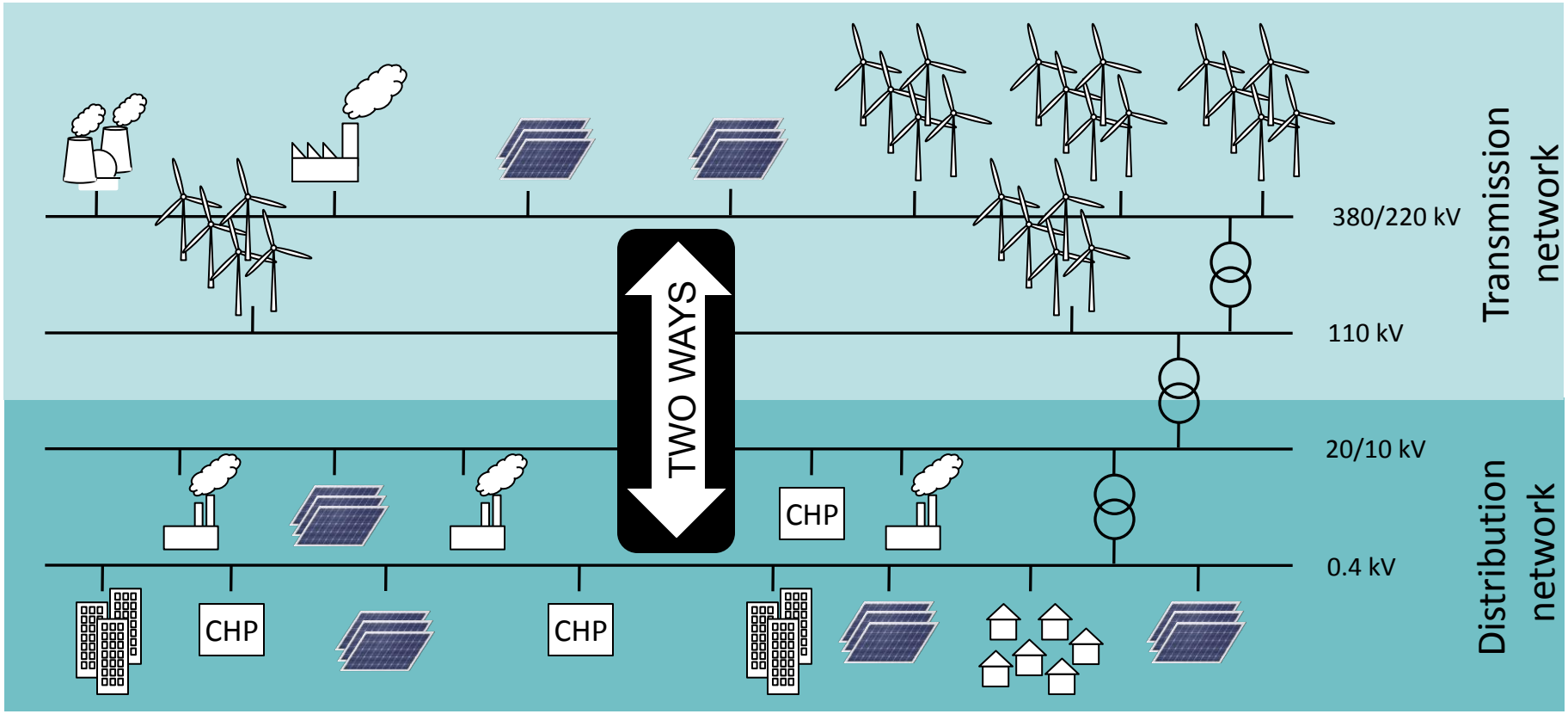
Now, with the increasing use of renewable energies the grid has to cope with bidirectional power flow.



2. Motivation for Smart Grids in Germany

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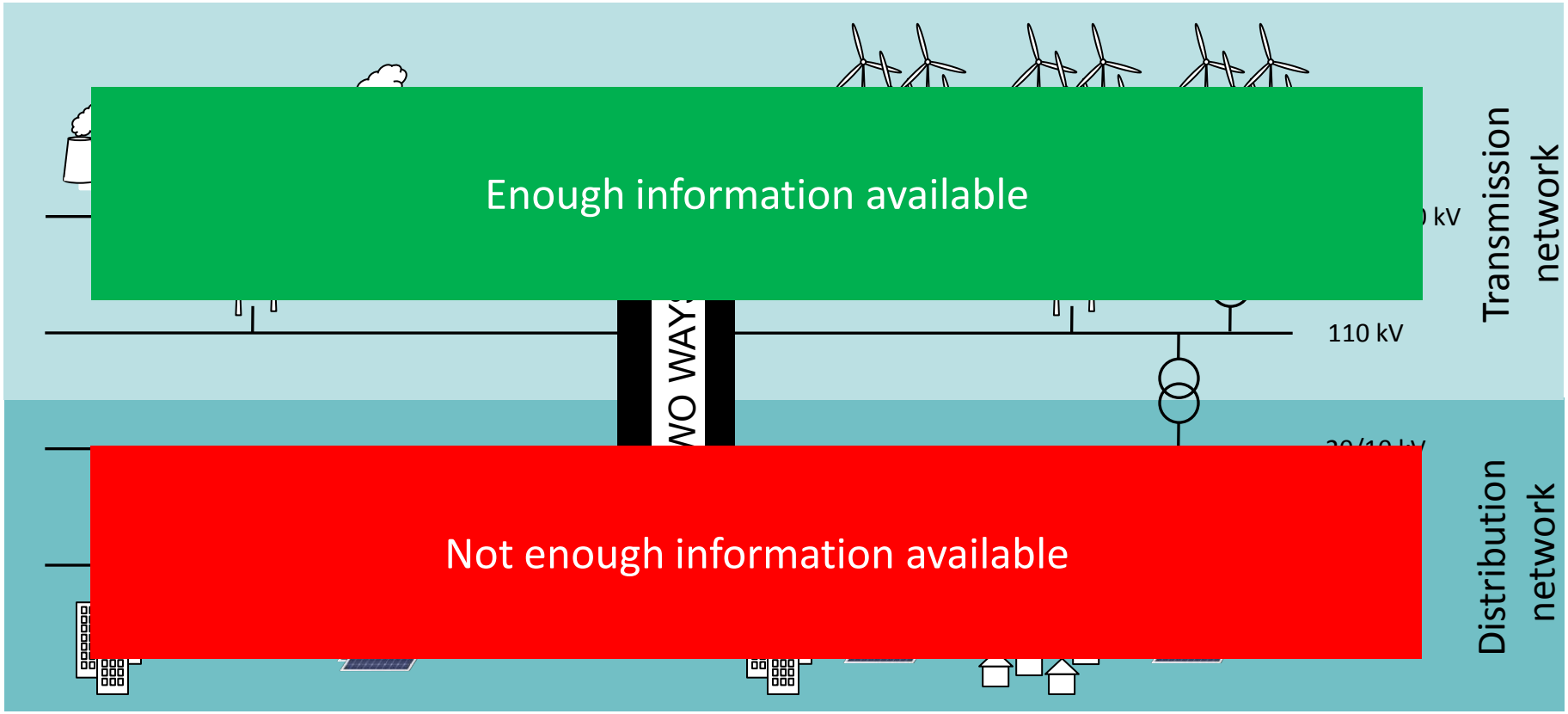
At the moment the DSO does not have detailed information available. This circumstance causes significant problems with capacity utilization of the grid.



2. Motivation for Smart Grids in Germany

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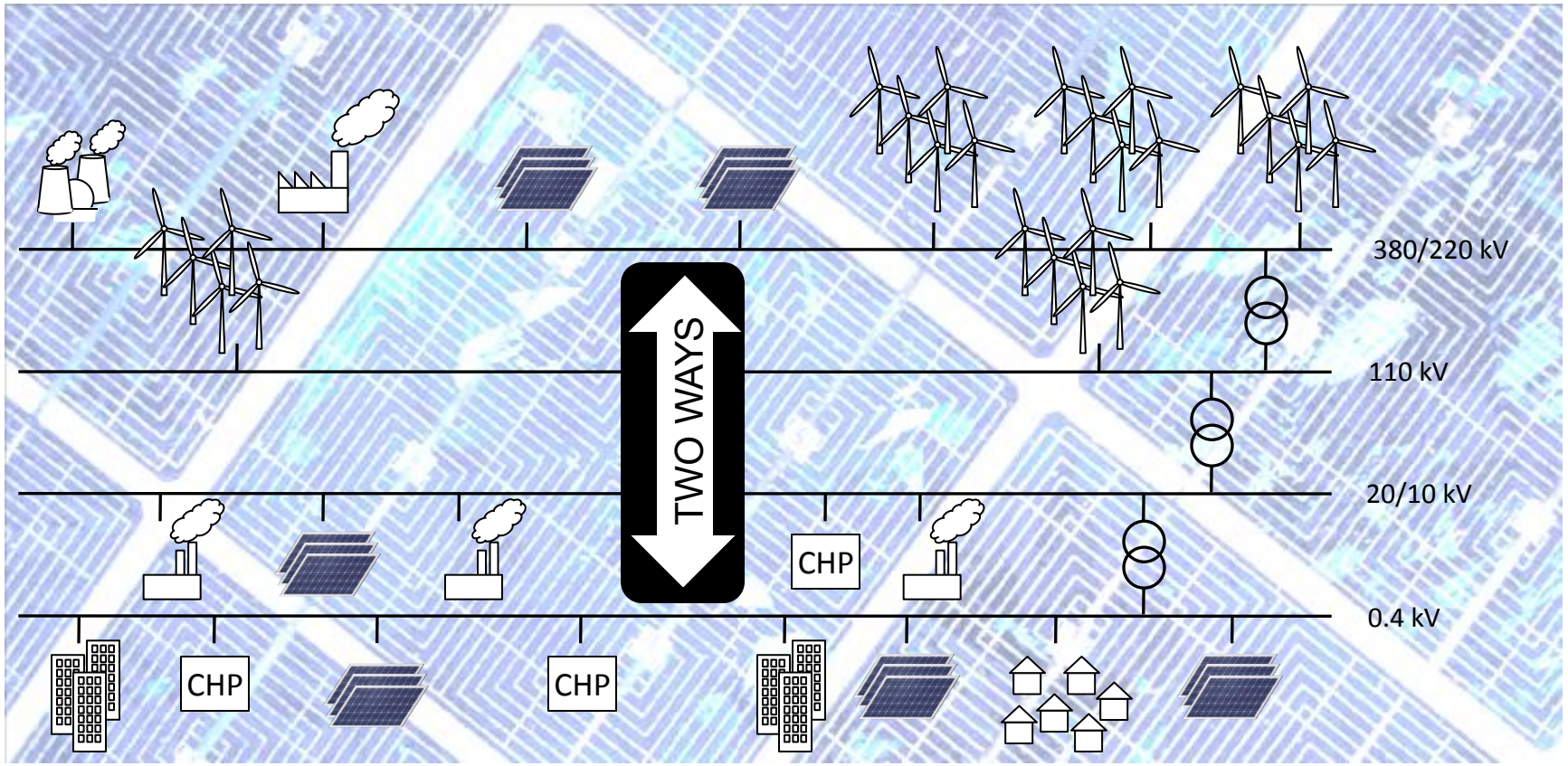
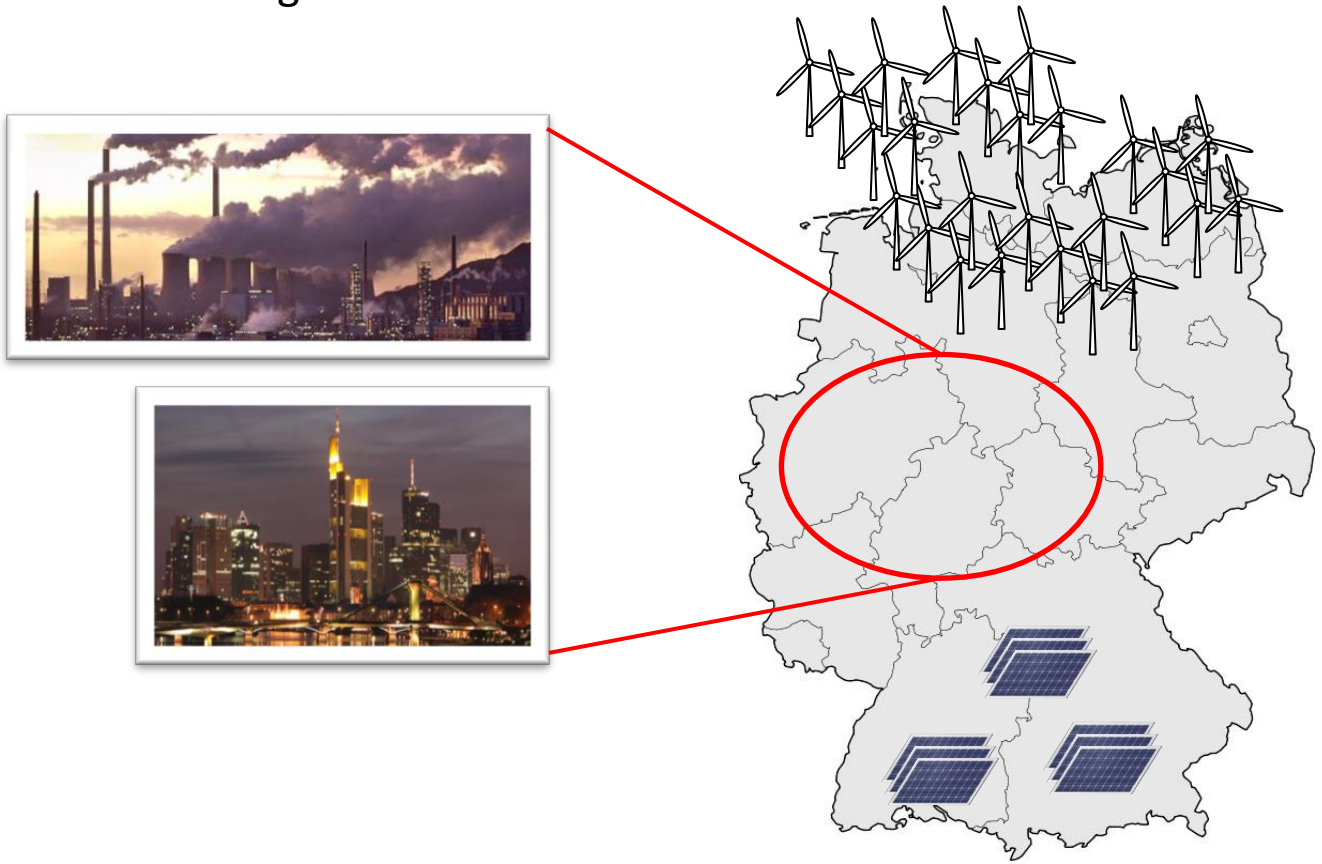
To cope with the new way of power generation and demand we need a power grid with more information.



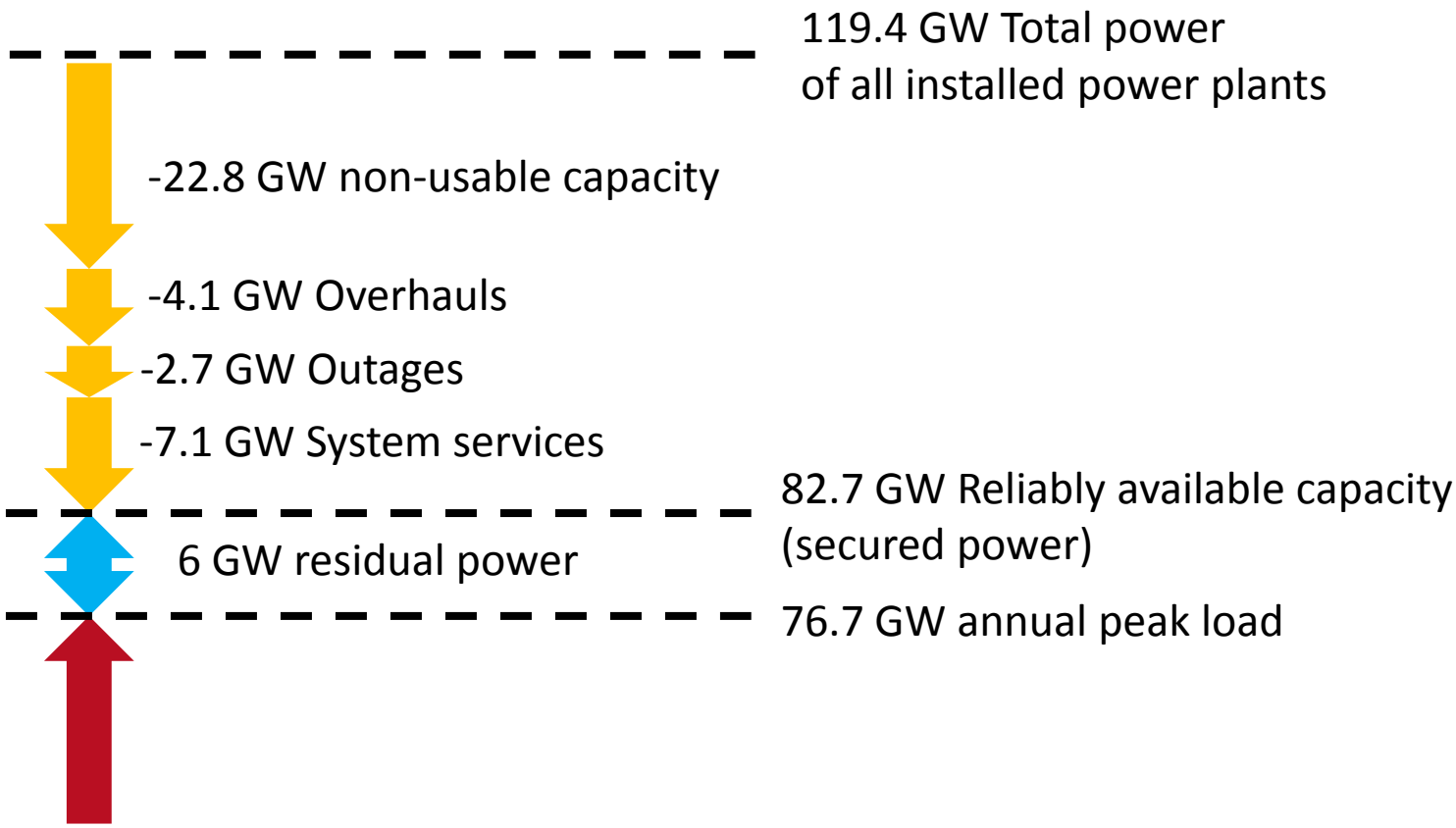
2. Motivation for Smart Grids in Germany

Due to the geographical distribution of the new power generation and the load center, there is a need for an enlargement of the German transmission network.



2. Motivation for Smart Grids in Germany

The German energy system holds out more than 105 % secured power.



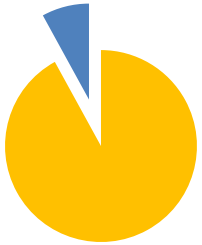
2. Motivation for Smart Grids in Germany

The biggest disadvantage of the renewable energies especially photovoltaic and wind is the lack of secured power.

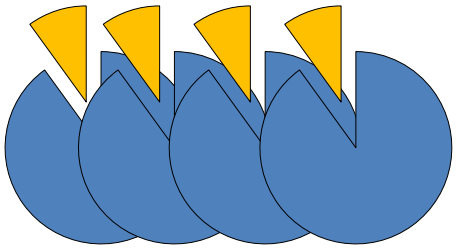
	Availability	Secured power
Hard coal	91.2%	86.0%
Brown coal	95.3%	92.0%
Nuclear power	95.5%	93.0%
Combined gas and oil	91.4%	86.0%
Domestic gas	56.1%	42.0%
Running-water power station	40.0%	40.0%
Biomass	90.0%	88.0%
Wind power	95.0%	7.0%
Photovoltaic	N/A	1.0%
Geothermal energy	90.0%	90.0%
Pump storage	97.0%	90.0%
Combined heat and power	97.0%	86.0%
Mirco-combined heat and power	97.0%	78.0%

Source: dena

Coal power plant with >90% secured power (1000 MW)



Wind power with <10% secured power (10 000 MW)



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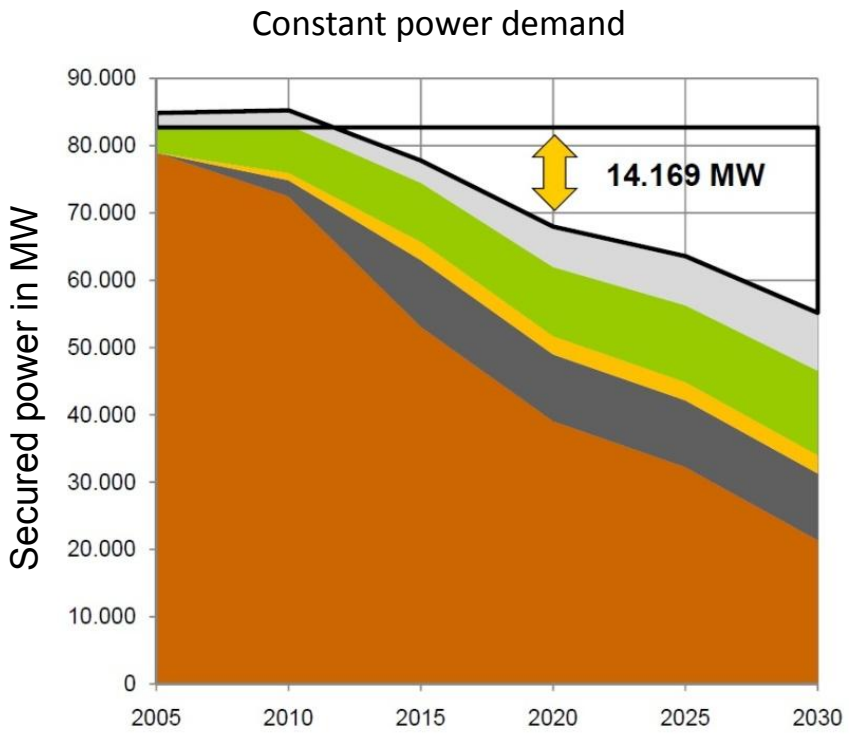
2. Motivation for Smart Grids in Germany

The secured power in Germany until 2030 does not cover the maximum annual load.



Source: dena

- Secured power by cogeneration of heat and power
- Secured power by renewable energies (incl. biomass)
- Secured power by planned power plants (high probability of implementation)
- Secured power by actual built power plants in 2005
- Secured power by existing conventional power plants

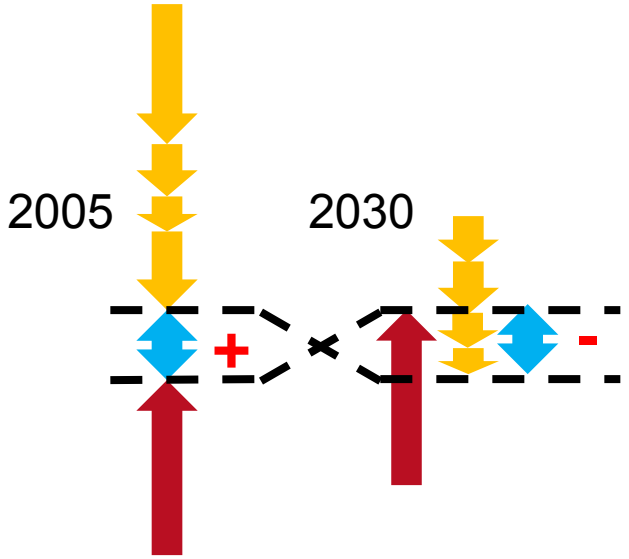
2. Motivation for Smart Grids in Germany

What needs to be done?

- New strategies for managing volatile energy structures need to be found
- The total lack of secured power resulting from a new energy generation structure needs to be balanced
- Energy efficiency strategies are necessary to work against an increasing demand of energy and thus also against an increase of the annual maximum load

➔ **The power supply of tomorrow needs to become more efficient on generation and consumption side**

➔ **Smart grids and smart homes can be an opportunity**



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3. The leading German Smart Grid program "E-Energy"

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Two federal ministry are funding this program.

- A four year term initiative by the German Federal Ministry of Economics and Technology and the German Ministry of Environment, Nature Conservation and Nuclear Safety

Federal Ministry of Economics and Technology

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

- Funded with over €140 million Euro

➔E-Energy develops an Information and Communication Technology which supports the energy system

➔E-Energy develops the intelligent integration of electric vehicles (E-Mobility) into the energy system

3. The leading German Smart Grid program “E-Energy”

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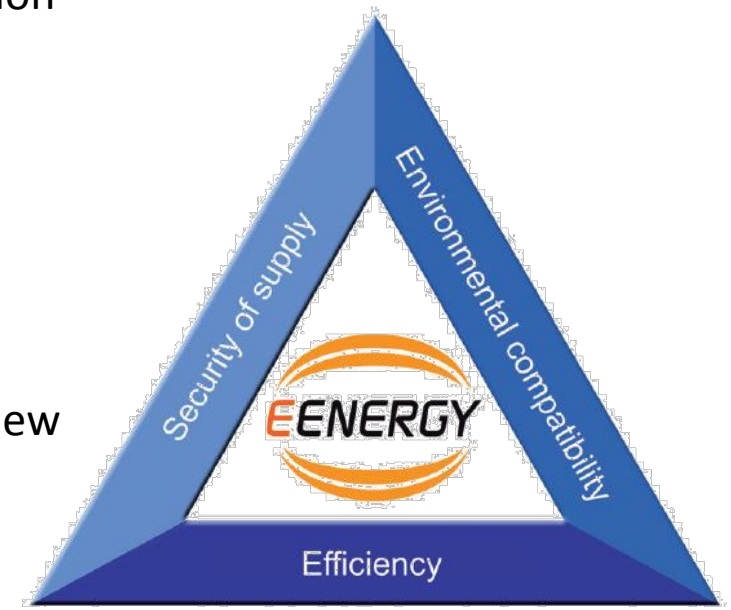
The main political goals of E-Energy cover different areas of the energy industry.

- Security of supply, efficiency and climate protection with digital networking of the power providing system
- Optimization of the energy supply system using modern Information and Communication Technologies (ICT)
- New interdisciplinary jobs in the fields of renewable energies and communication and new market for high-tech solutions
- Progress in liberalization and decentralization of the energy market



3. The leading German Smart Grid program "E-Energy"

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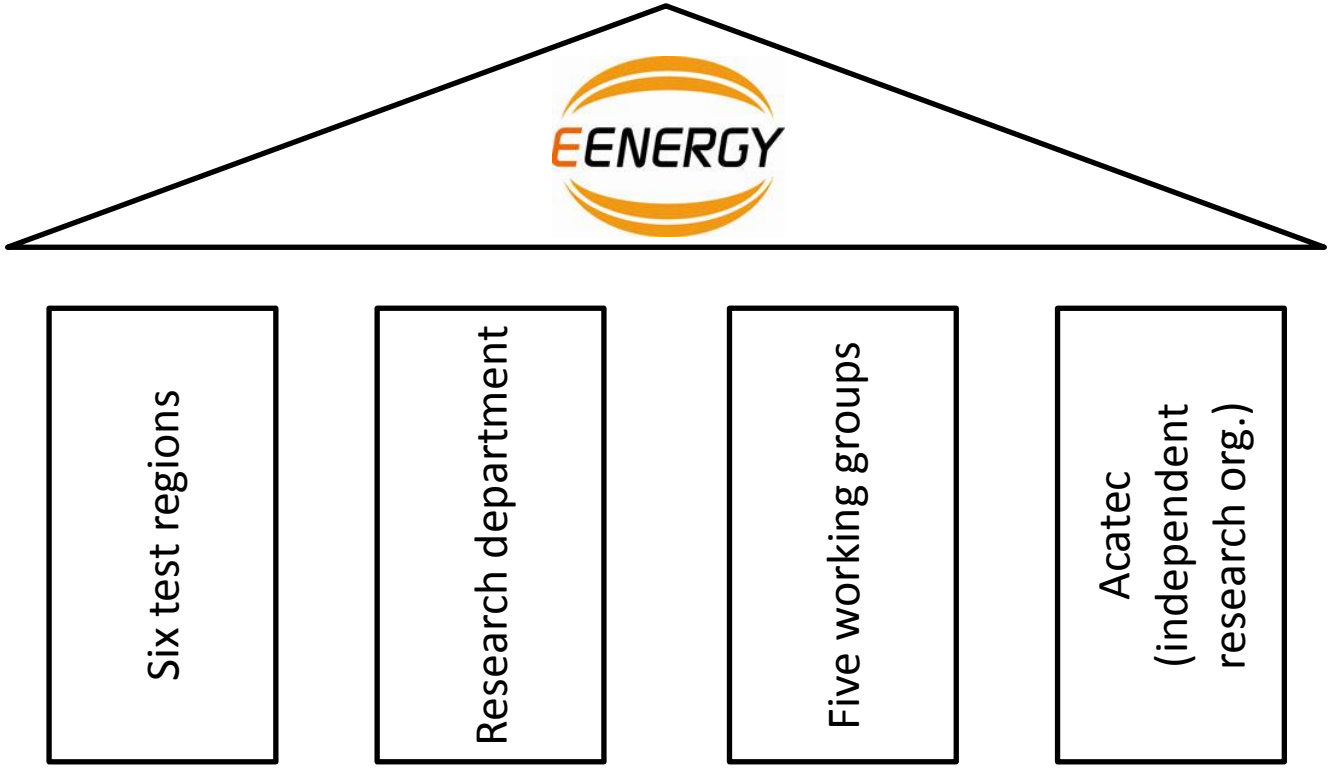
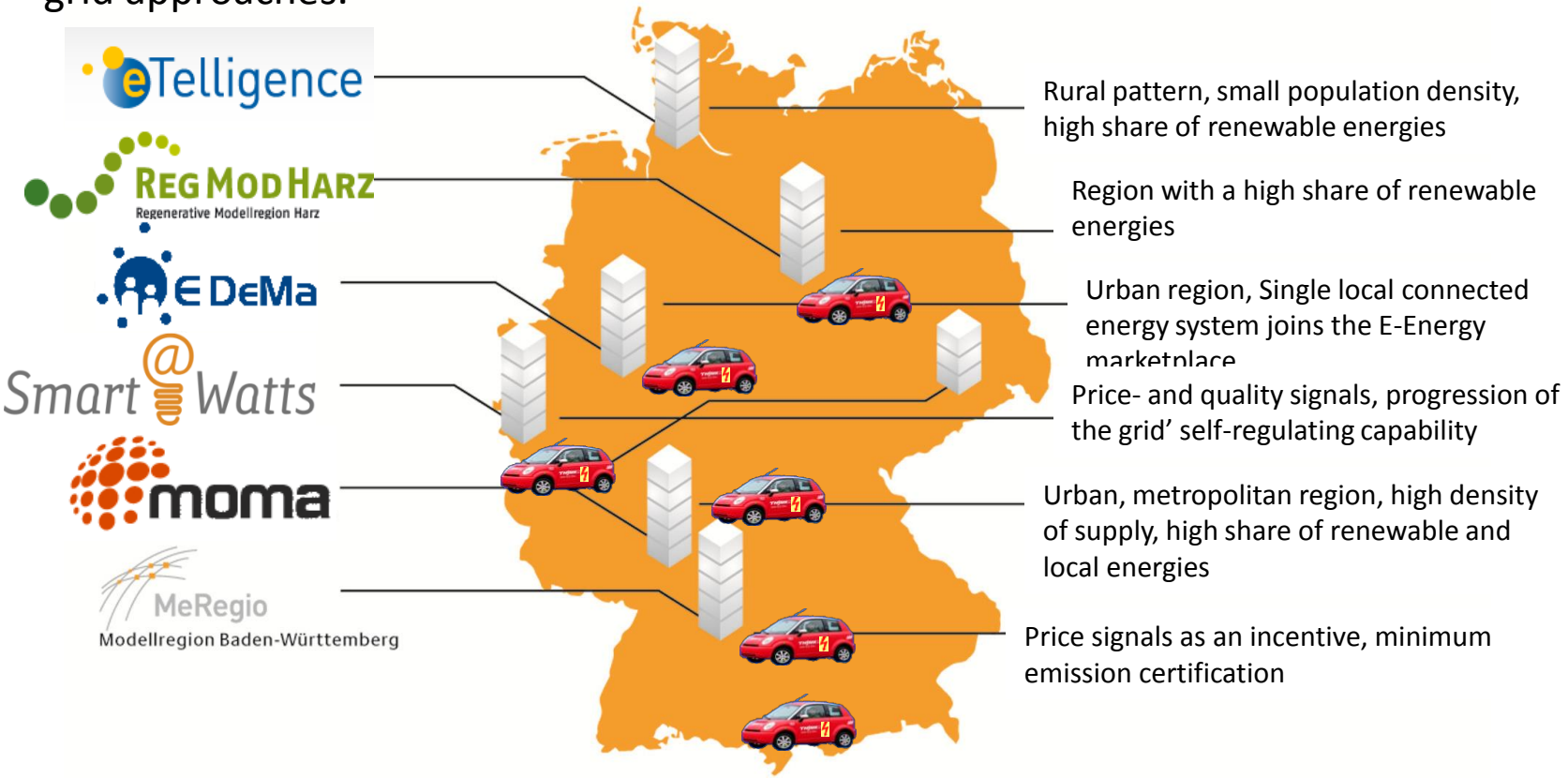
The "E-Energy" house is based on four columns.



3. E-Energy – Six test regions

These regions have been chosen in a competition and are implementing different smart grid approaches.



3. E-Energy – Research department

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B.A.U.M. Consult GmbH, Munich / Berlin

TU München, Institute of Computer Sciences

TU Darmstadt, Institute of Renewable Energies

incowia GmbH, Ilmenau

LoeschHundLiepold Kommunikation GmbH, Munich

3. E-Energy – The five task forces

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Beside the technical realization it is necessary that this work needs to be done.

- System architecture
- Interoperability
- Legal framework
- Market development
- D-A-CH-Cooperation

3. E-Energy – The future

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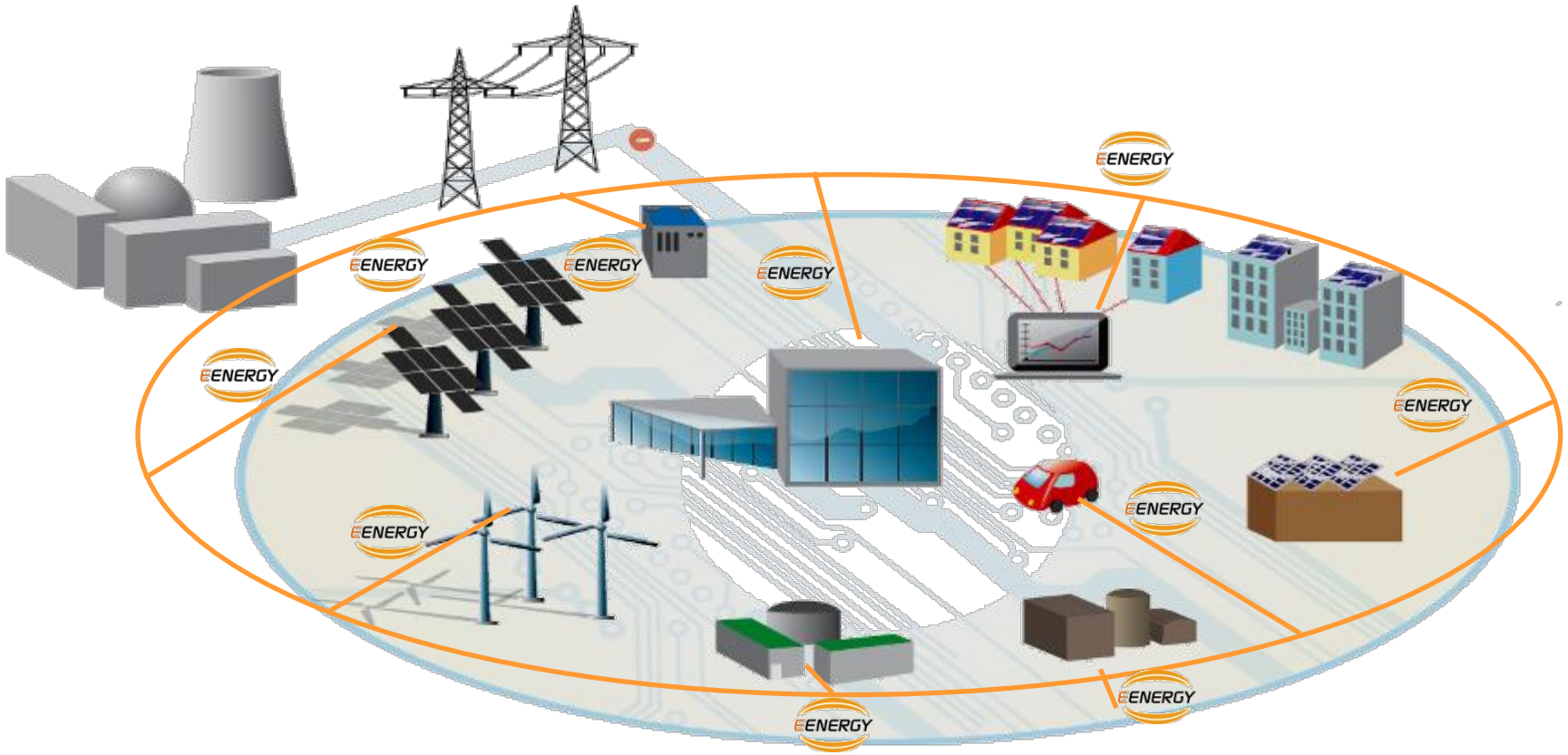
This model may be real in some day.



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4. E-Energy – Strategic alliance

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- Alliance for smart energy solutions founded on Nov, 11th 2010 between KNX and E-Energy EEBus stakeholder Kellendonk Elektronik GmbH (Test region Smart Watts)
- KNX: Nearly 22 000 companies in 109 countries

4. E-Energy – Evaluation

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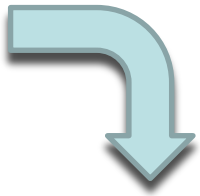
The method of our evaluation.

Step 1: Determination of projects settings

- ❑ Technical framework of the completed field test respectively simulations
- ❑ Empirical framework of the completed field test respectively simulations
- ❑ Reference-scenario

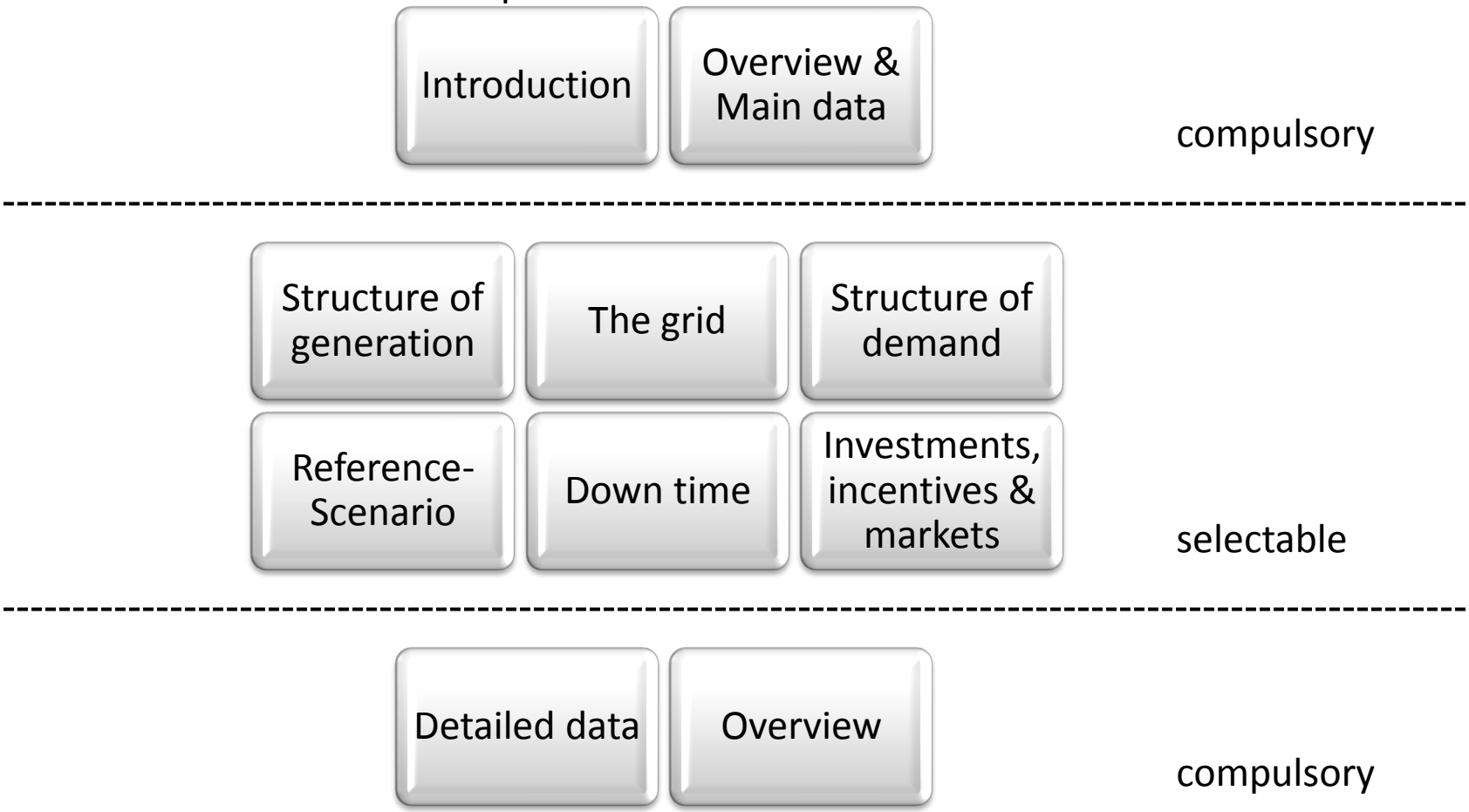


Step 2: Determination of results and measured data

- ❑ Based on investigated data of step one
- ❑ More detailed data are required
- ❑ Broad and verified data basis
- ❑ Overview

4. E-Energy – Evaluation

The structure of our evaluation questioner.



4. E-Energy – DKE Roadmap

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The goal of the DKE roadmap is standardization.

Source: IEC

4. E-Energy – DKE Roadmap

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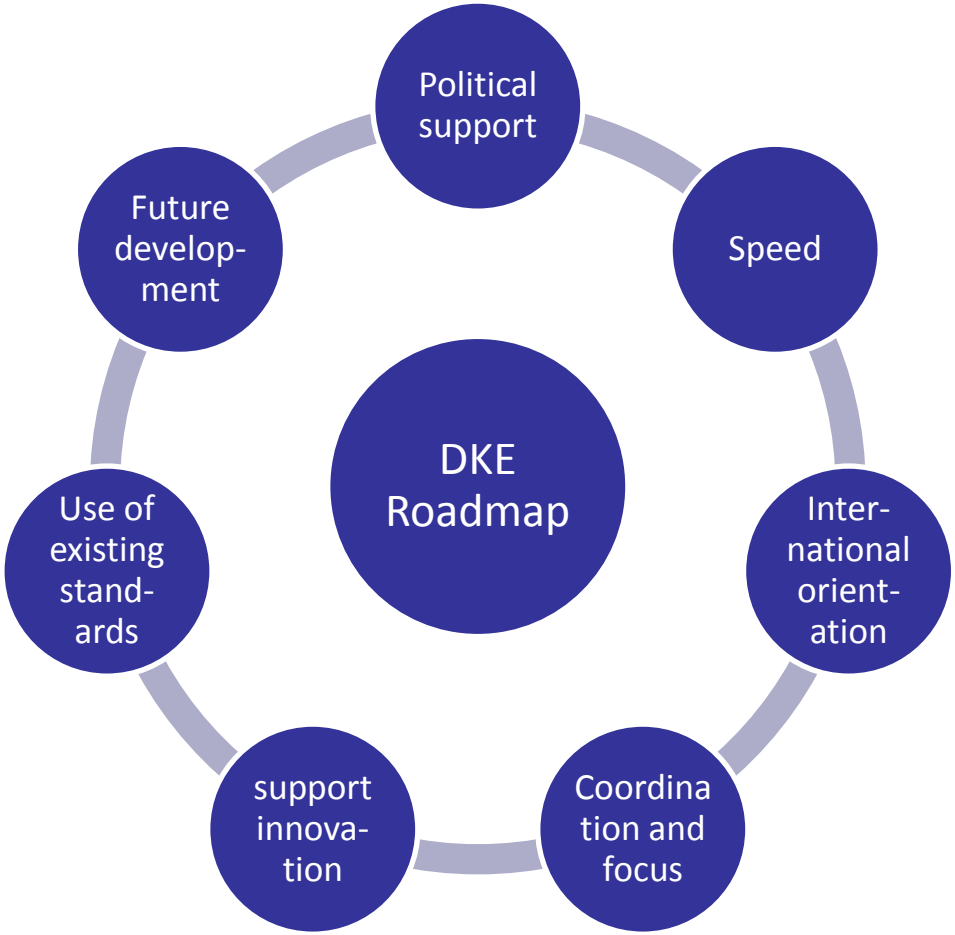
Why are we needing a roadmap?

In order to achieve the desired objective of **reshaping our energy system**, the corresponding preconditions must be established both on the technical side (**interoperability**) and on the commercial side (**security of investment and development of new markets**). Both these aspects can be served nationally, regionally and internationally by means of standardization.

Standardization in the field of Smart Grids is how ever characterized by a **number of features** which distinguish it from standardization as pursued to date. Here, **standardization activities** are marked by the **large number of players**, a lot of **regional and international activities**, the **enormous speed** and **huge economic effects** of the various standardization activities. Smart grid standardization is by no means business as usual. The focus must therefore be on the following activities:

4. E-Energy – DKE Roadmap



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5. Outlook and personal research

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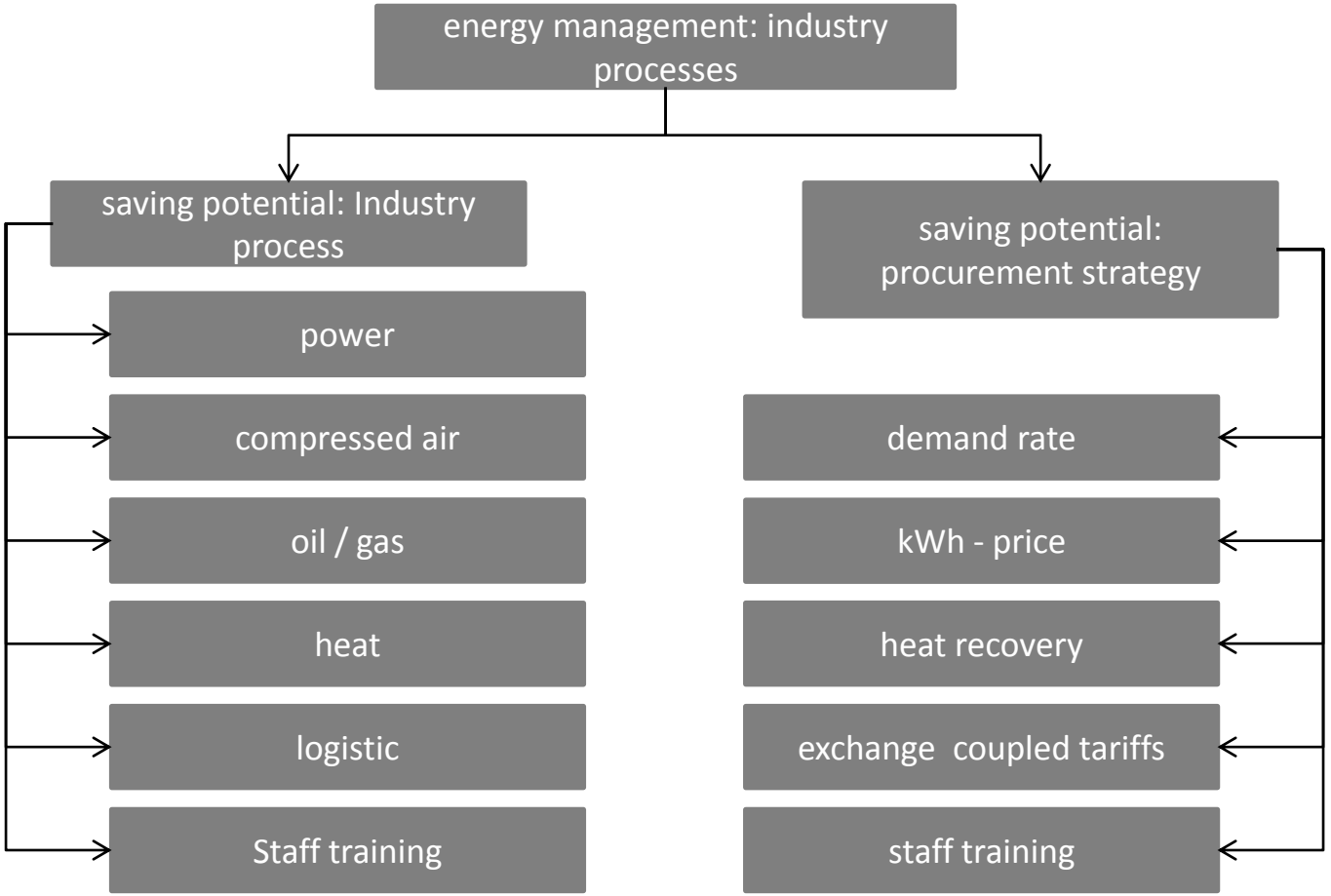
The options for energy management.



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E-ENERGY

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