

# Creating value for a sustainable energy system

Prof. Dr. Armin Schnettler

“We will promote  
a revolution  
in energy production and consumption,  
and build an energy sector that is  
clean, low-carbon, safe, and efficient.”

*President Xi Jinping  
at the 19<sup>th</sup> National Congress of the Communist Party of China  
October 18, 2017*



**+78%**

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Global electricity  
generation growth  
until 2040

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**1,7 Mio.**

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Individual  
power producers  
in Germany (2018)

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**< 2**

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USct/kWh,  
lowest solar prices  
ever

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# 3D – Decarbonization, Decentralization and Digitalization – The current energy world is being heavily disrupted



## From

Predominantly fossil

Centralized energy production

Vertically integrated utility



## To

Renewables + Storage

Consumers become prosumers

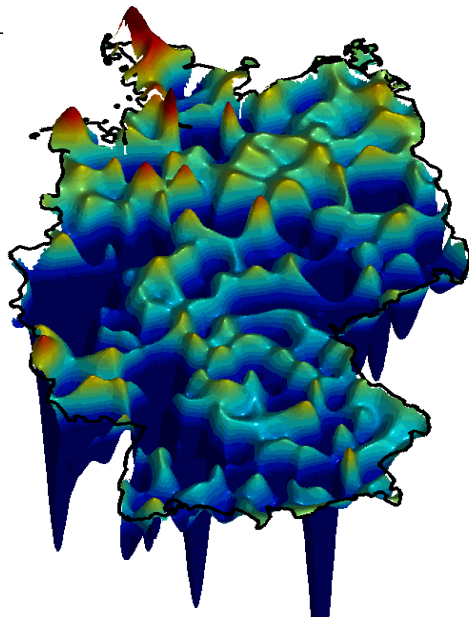
Energy trading platforms  
→ digital utilities

# Residual loads set power generation and transmission demand – increased complexity by storage systems & sector coupling



$$(PV) + (Wind) - (Consumption) = \text{(Residual load)} = f(t)$$

Tag 130  
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Past

Production follows consumption



Today

Production / consumption mismatch

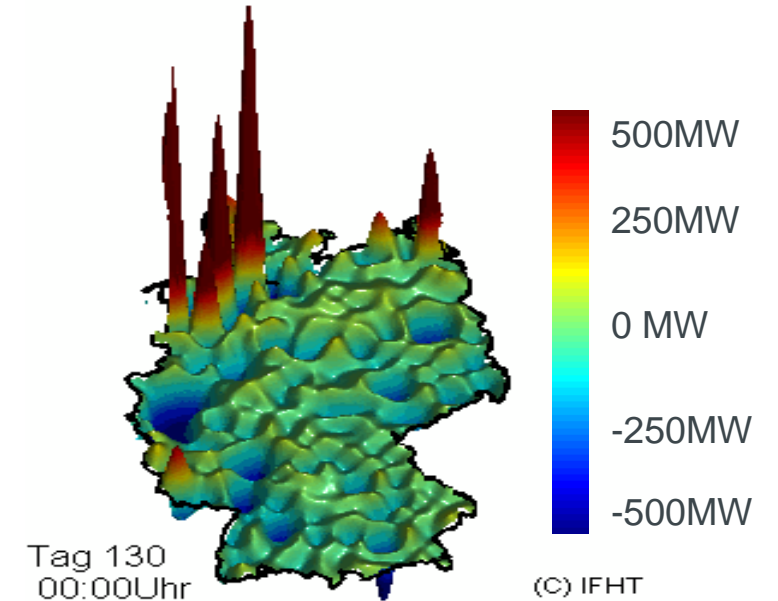
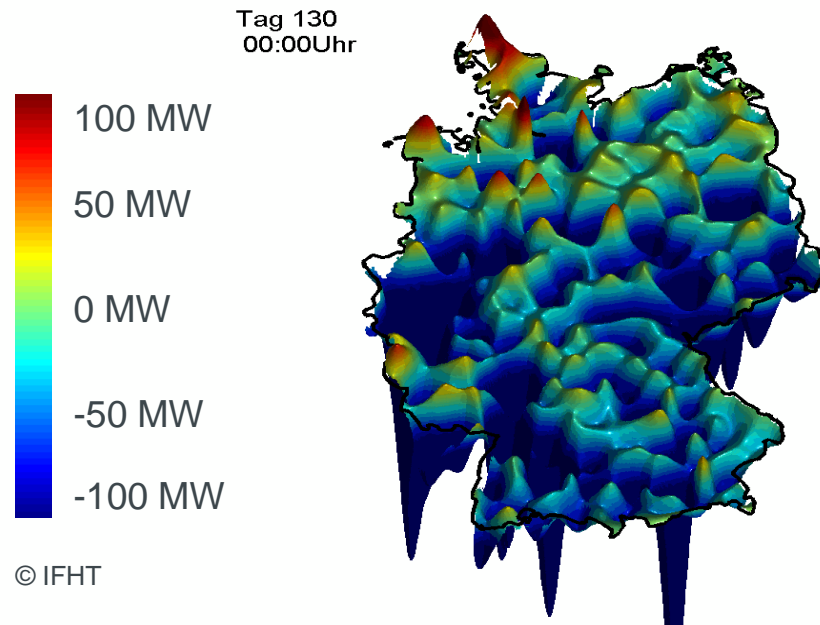
Planned transmission grid extensions (2025)

Source: German Power Network Development Plan

# Residual loads set power generation and transmission demand – increased complexity by storage systems & sector coupling

$$(PV) + (Wind) - Consumption = \text{(Residual load)} = f(t)$$

80% share of renewables 2035+



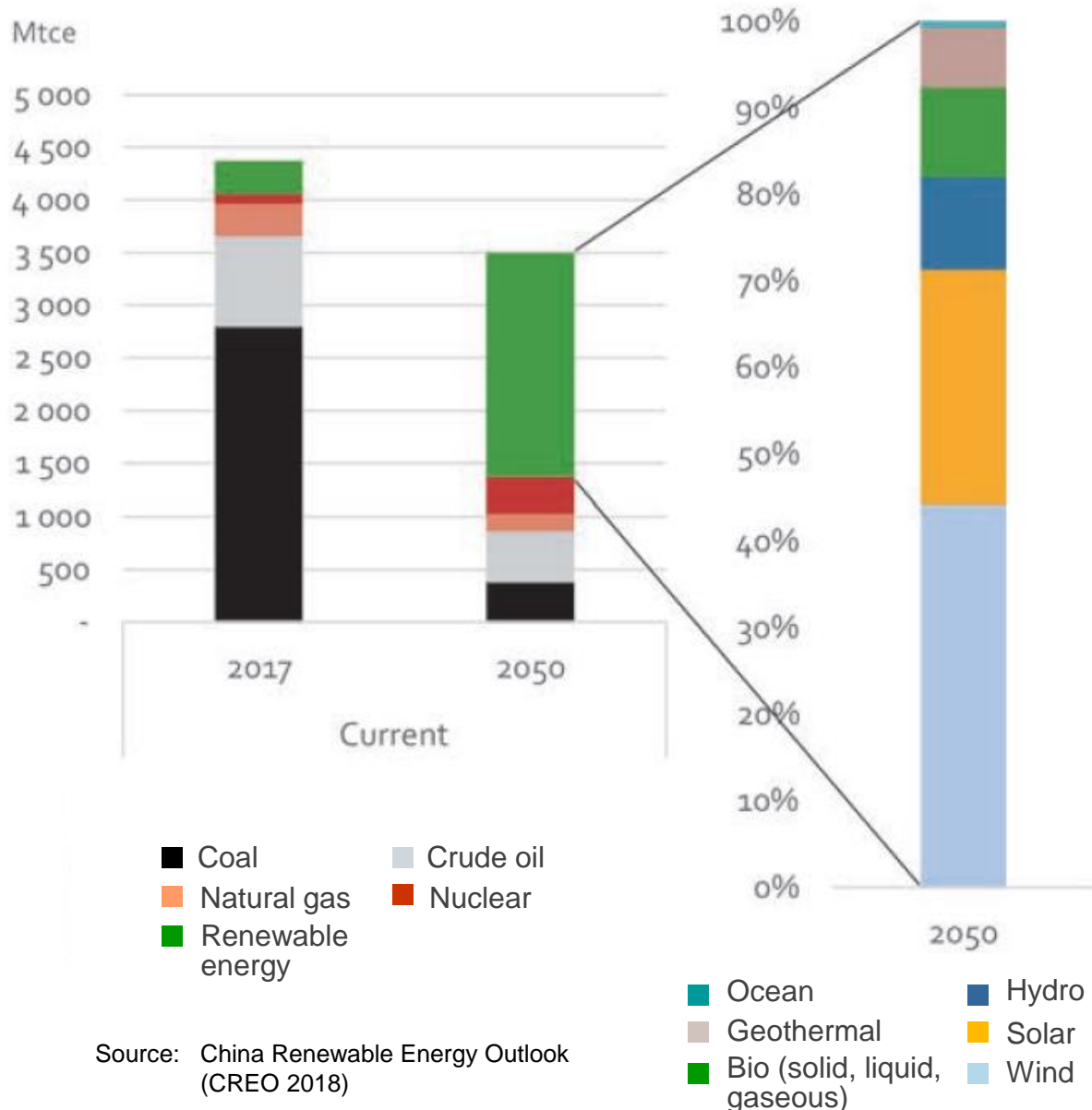
**Past**  
Production follows  
consumption

**Today**  
Production / consumption  
mismatch

**Future**  
Production / consumption  
decouple

Source: German Power Network Development Plan

# The primary energy consumption in China



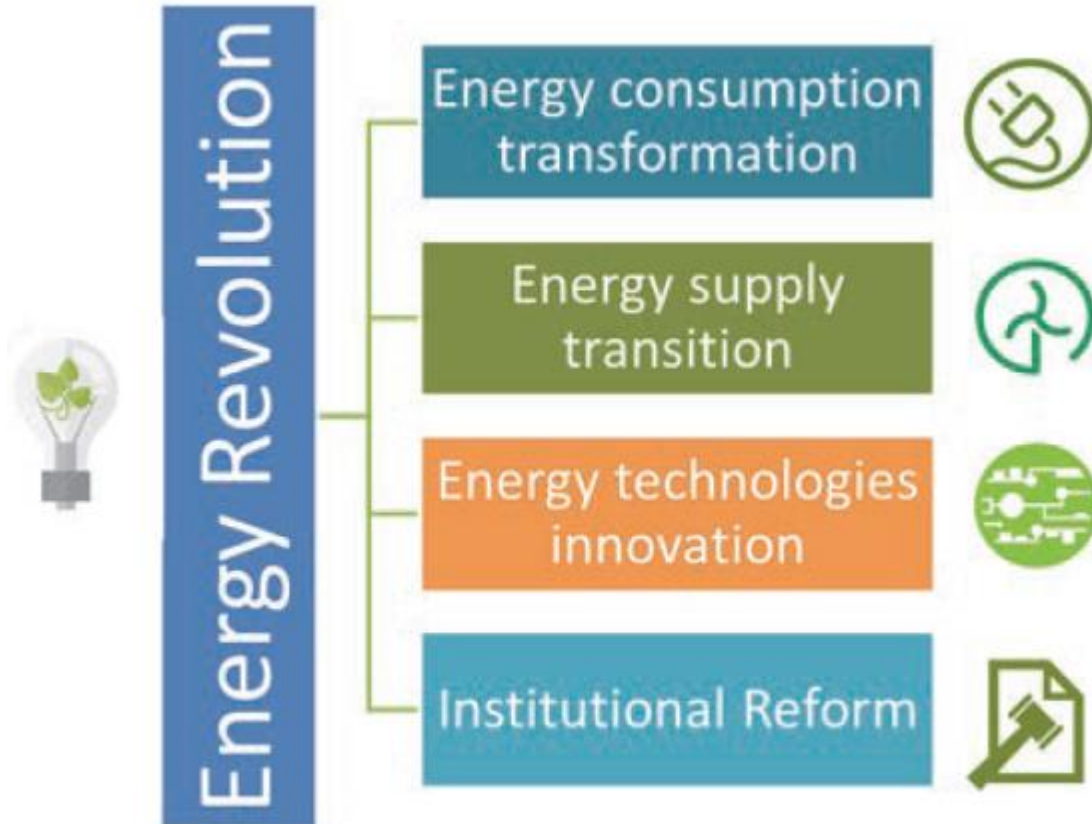
Ensuring reliable energy supply and efficient system integration of renewables is the biggest challenge

China energy system 2050 characteristics:

- Lower final energy consumption
  - Coal and oil consumption reduced to a minimum; domination of wind and solar
  - Electrification of industry and transport sectors
- Completely different energy balance and high system complexity

# China Energy Revolution Strategy released in 2017

**SIEMENS**  
*Ingenuity for life*

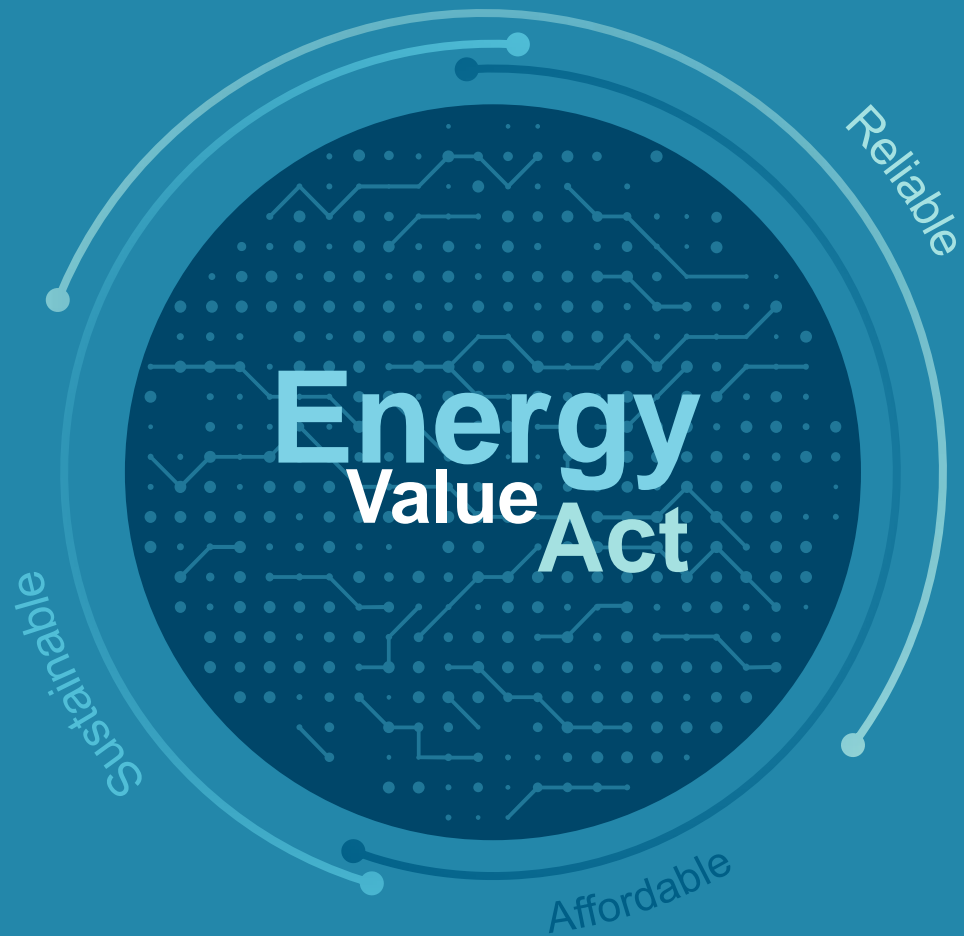


Creating value for a sustainable energy system by leveraging three main levers:

- secure sustainable supply
- deliver future-proof infrastructure
- empower energy users

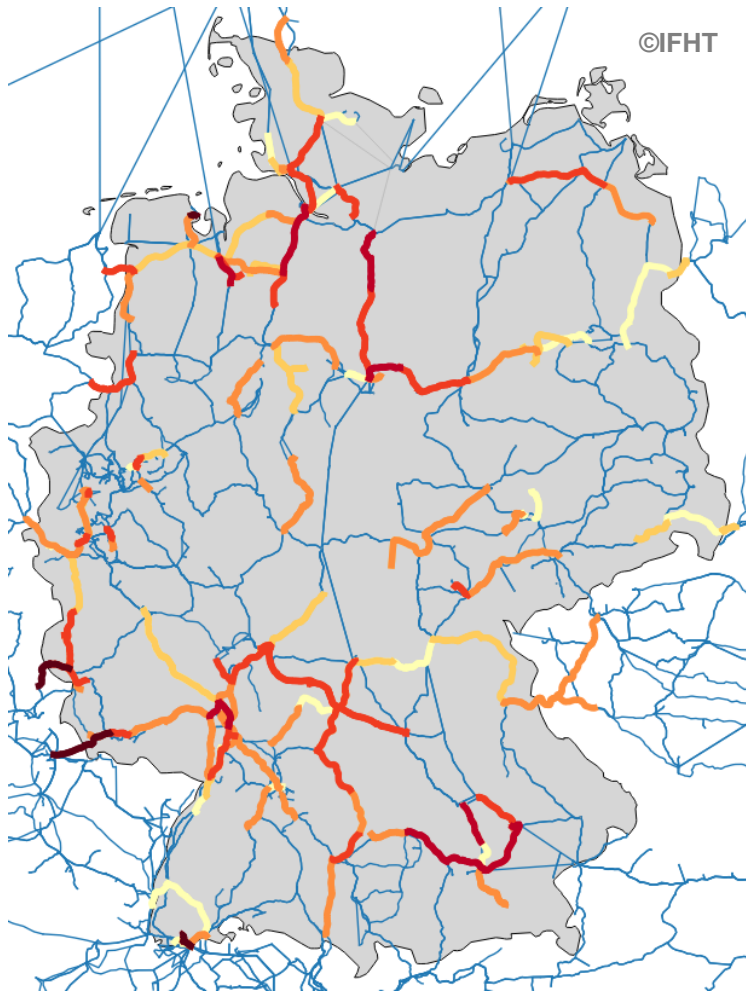


# Creating value for a sustainable energy system



## Secure sustainable supply

- 1** Ensure well-balanced energy and generation mix
- 2** Keep coal reduction as a key priority and secure system stability
- 3** With new energy market design put a price on secured energy provision



## Germany - National & Utility Level InnoSys 2030 – Next Generation System Control

**Joint collaboration** of Siemens with 10 industrial and 4 academic partners

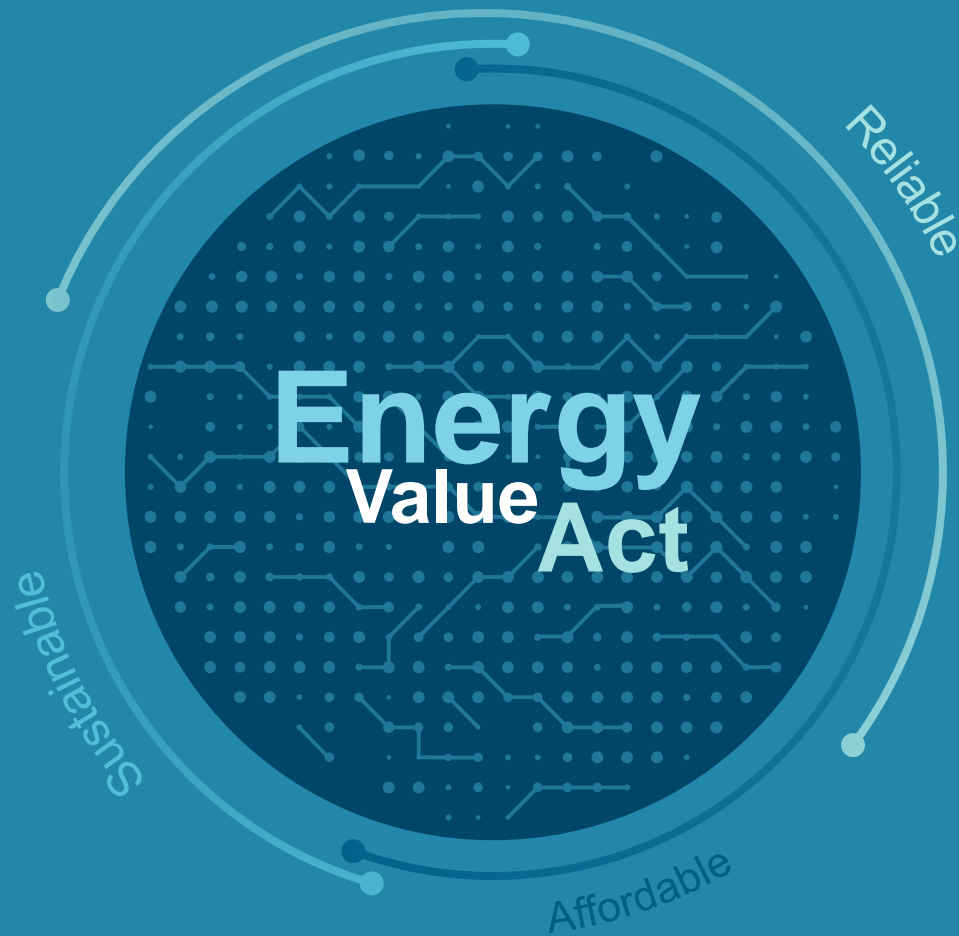
**Siemens contribution:** simulation of optimal placement & dimensioning of assets and aggregation of flexibility from underlying grids

**Customer value – project objectives:**

- **Macroeconomic savings of > 100' €/a** on re-dispatch and infrastructure costs (**savings of > 400' €/a** incl. phase shifters)
- Operation of transmission systems with **higher system loads** at the same **safety** level



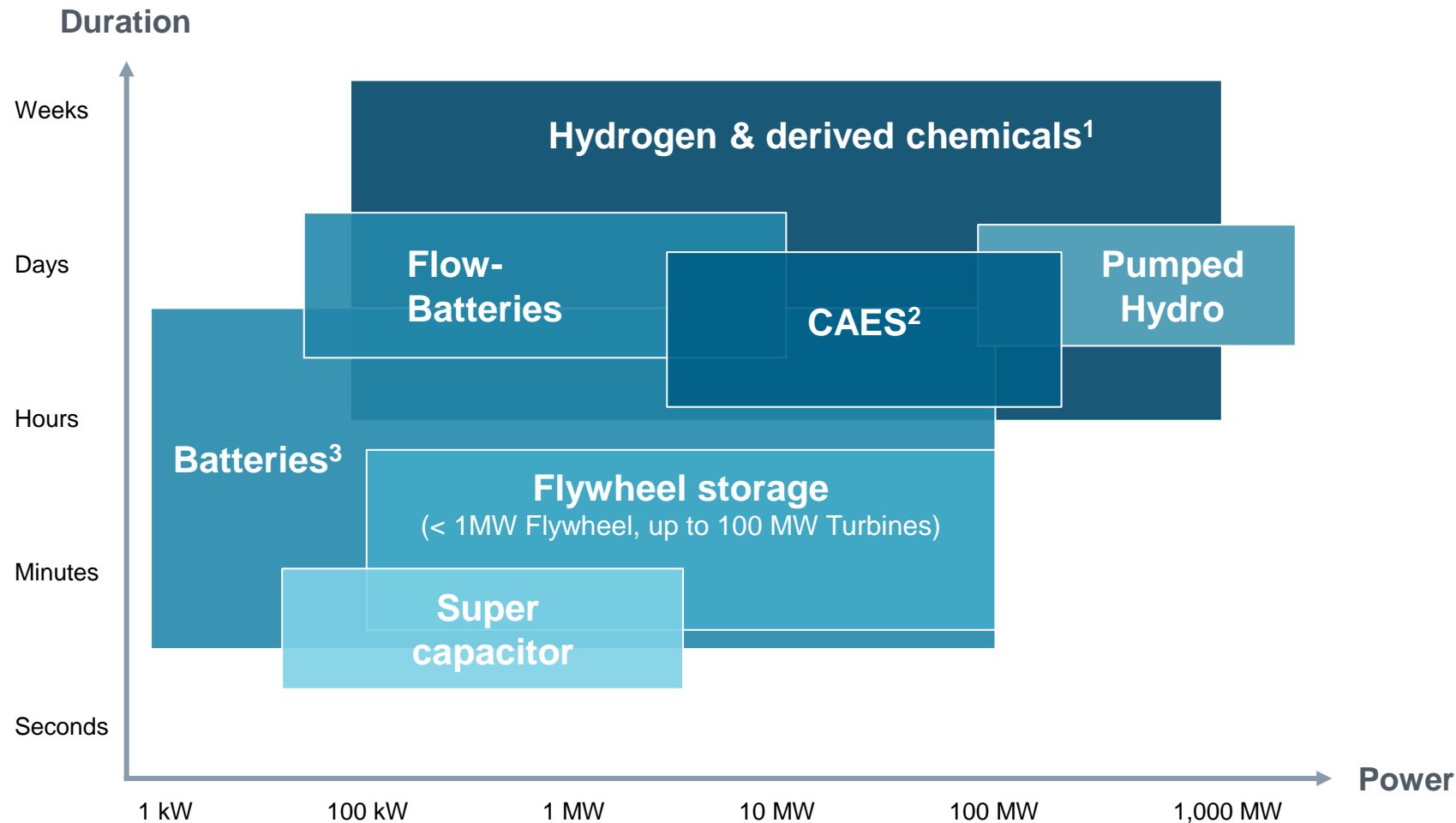
# Creating value for a sustainable energy system



## Deliver future-proof infrastructure

- 1** Keep highest priority on grid expansion and implement innovations
- 2** Develop green hydrogen towards an energy carrier of the future
- 3** Strengthen the grid connection between countries to materialize the Belt&Road initiative

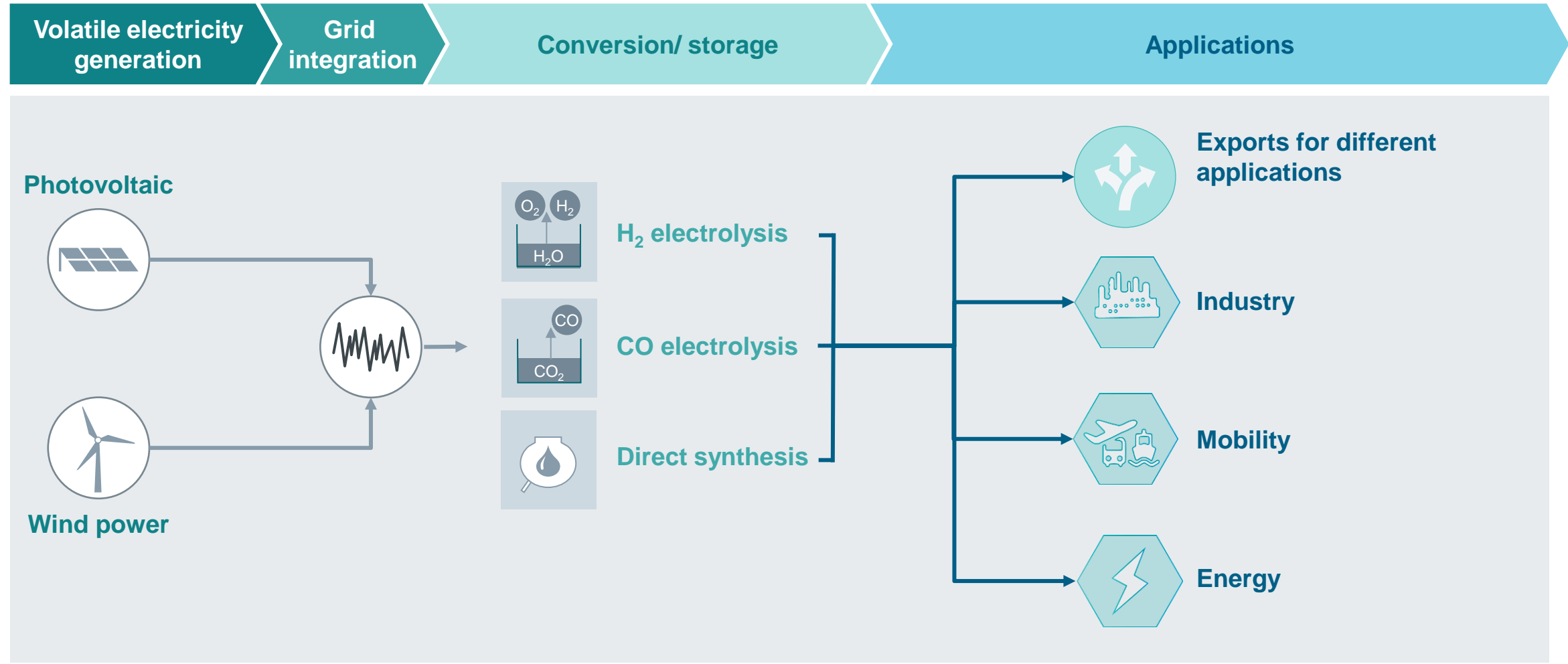
# Different storage technologies for different applications – hydrogen for large-scale and long-term energy storage



**Hydrogen can be used cost-effectively on a large scale.**

<sup>1</sup> such as Ammonia, Methanol or others;  
<sup>2</sup> Compressed Air Energy Storage;  
<sup>3</sup> Li-Ion, NaS, Lead Acid, etc.

# Power2X from renewables enables large scale long term storage and sector coupling





Hamburg, Germany

# PEM Electrolysis with Silyzer 200

**Hydrogen production** using electricity from renewables

**Joint collaboration** of Siemens and H&R oil refinery

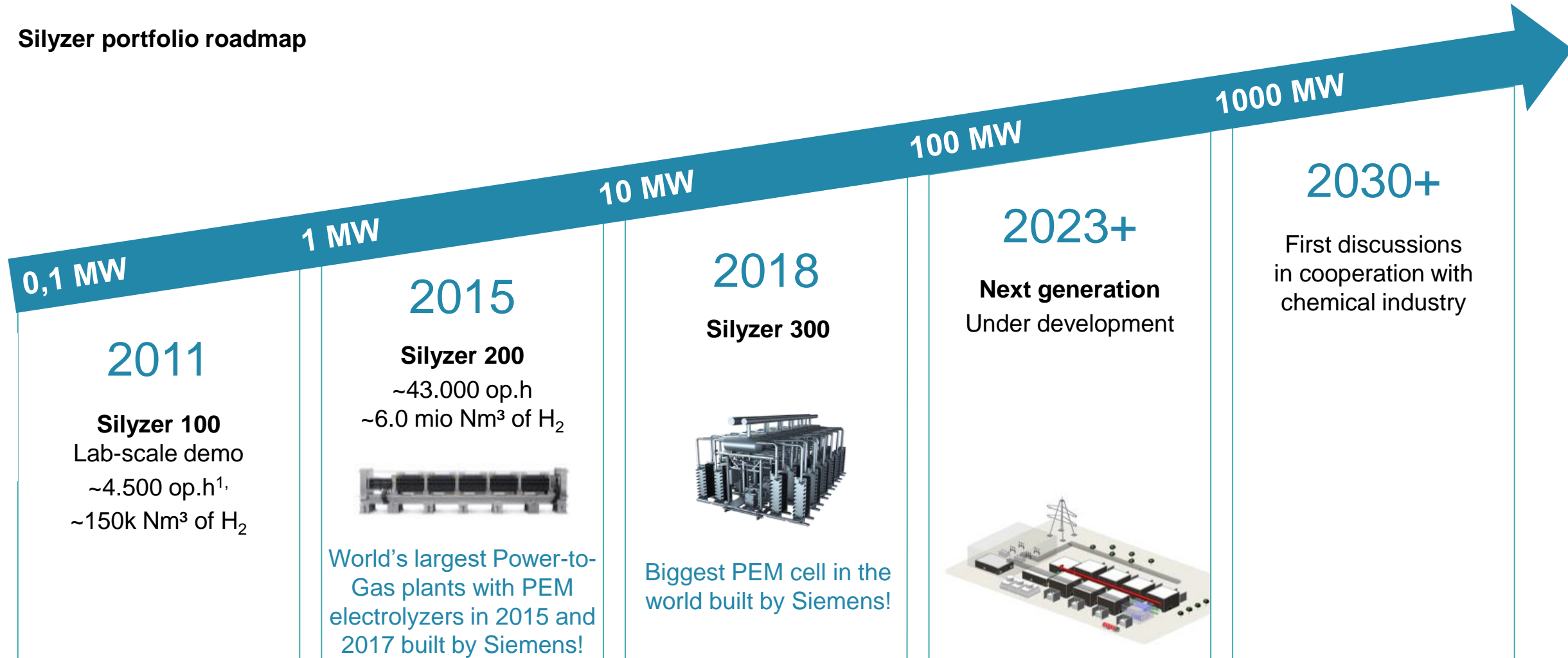
## Customer value:

- World's largest operating PEM electrolyzer system with **5 MW capacity**
- High-pressure **efficiency** in the MW range
- Production of **20 kg hydrogen per hour**
- **Start up time** from cold stand-by **< 10 sec**

# Silyzer portfolio scales up by factor 10 every 4-5 years driven by market demand and co-developed with our customers

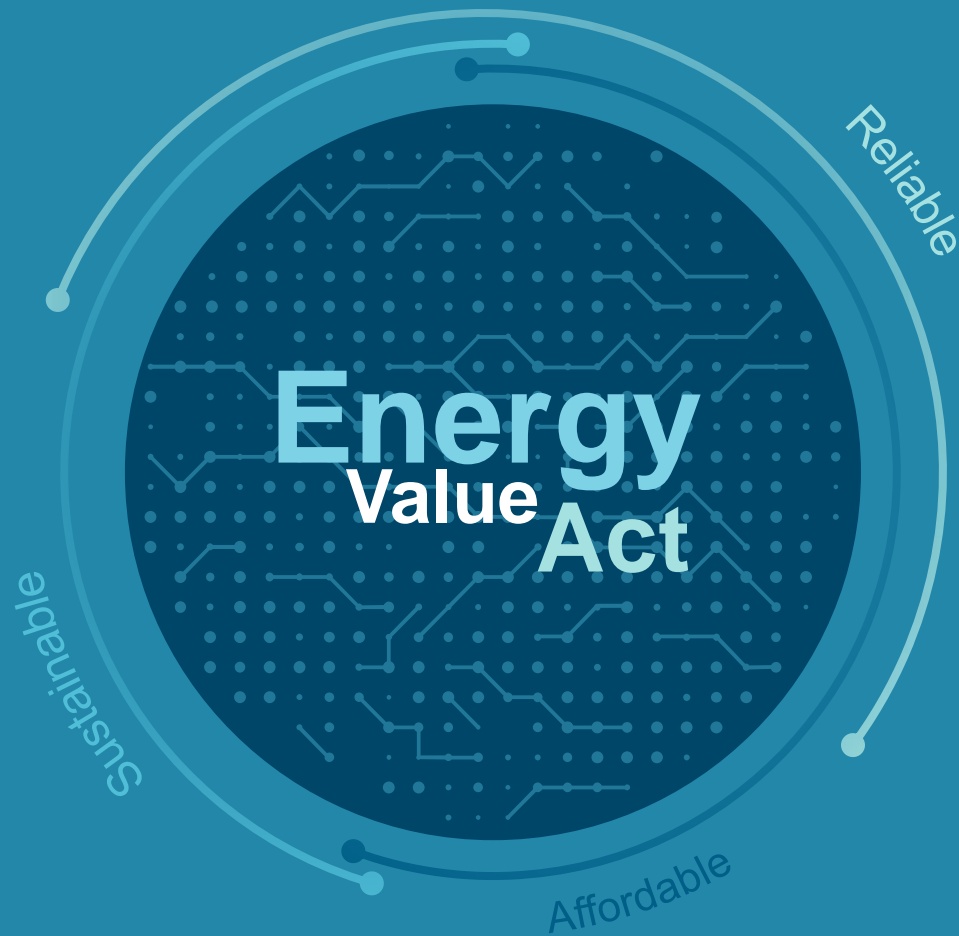


## Silyzer portfolio roadmap



1) op.h.: operating hours as of Oct. 2018  
 Restricted © Siemens Ltd., China 2019

# Creating value for a sustainable energy system



## Empower energy users

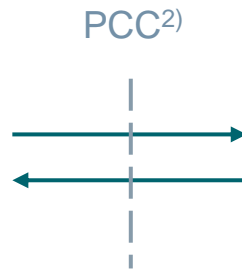
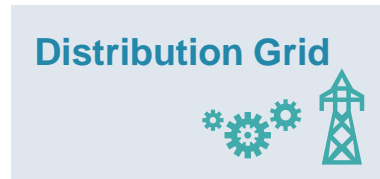
- 1** Create showcase opportunities for microgrids and distributed energy solutions
- 2** Enable »Around the Meter« business models
- 3** Reform holistically fees and taxes *(to enable sector coupling in decentral energy systems)*



# Smart Building is all electrified and sector coupled - Consumers are becoming prosumers!

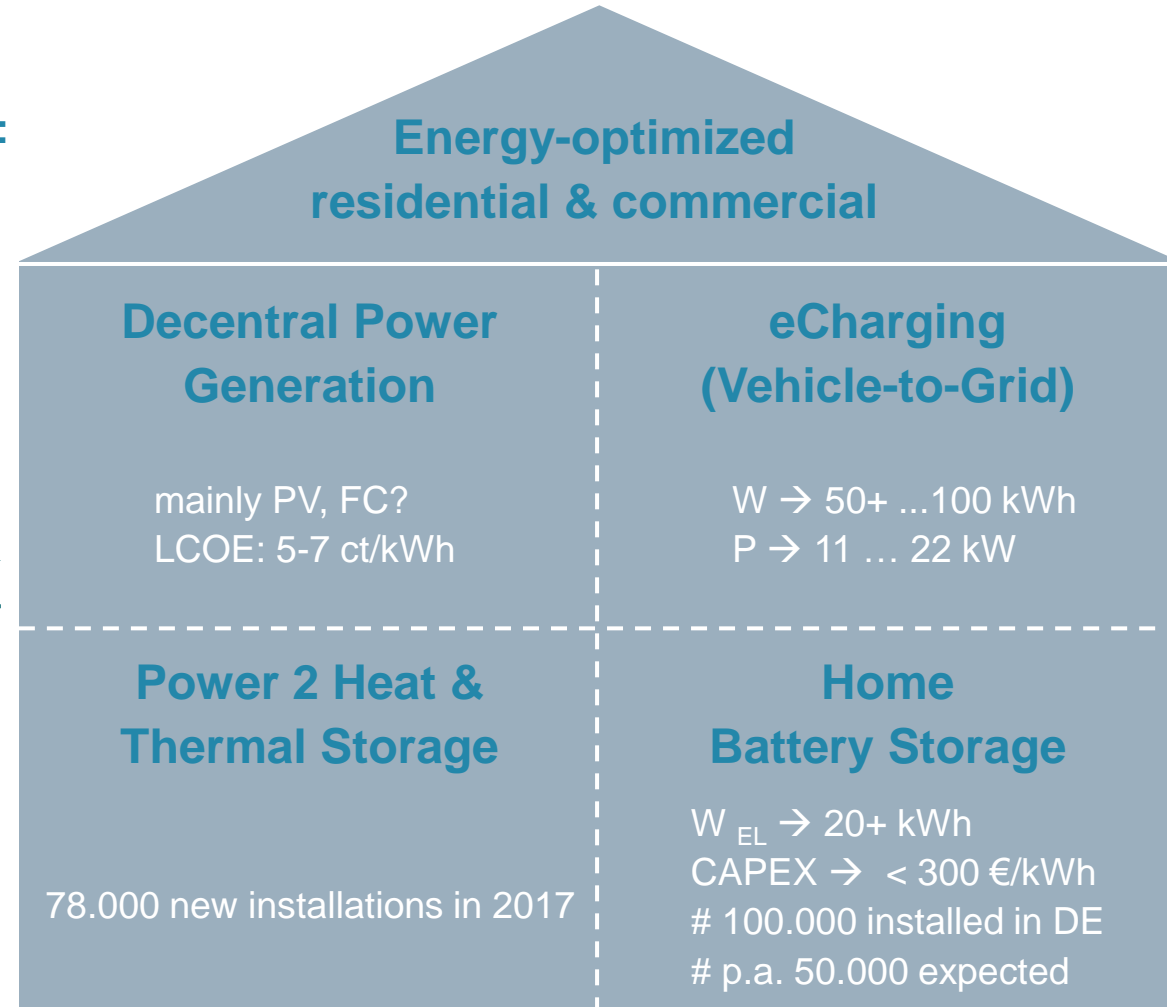
## Key requirements of prosumers:

- Comfort
- Safety
- Security
- Efficiency



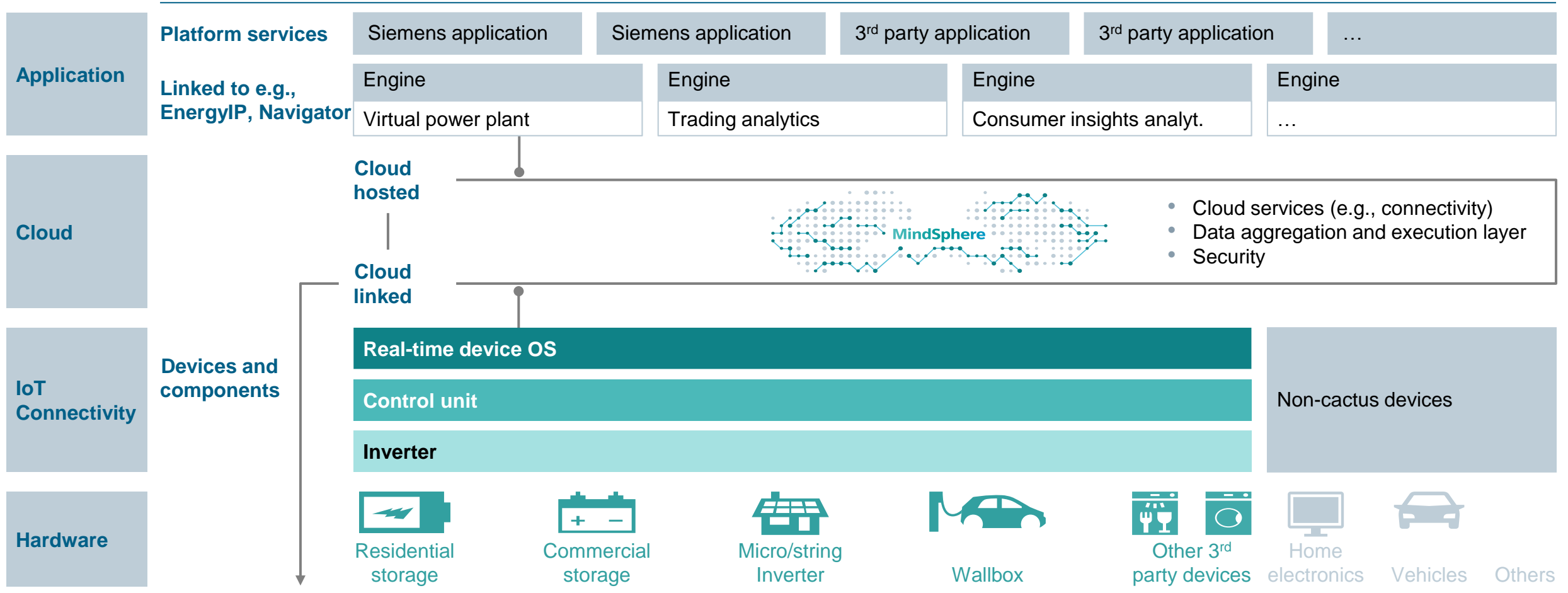
## Key requirements of grid operators:

- Grid stability
- System reliability
- New market designs



- (PH)EV registrations in DE: # 5000 p.m.
- Public charging stations: 2018: 14.000, 2020: 20.000
- Requirement<sup>1)</sup>: 80.000 chargers per 1' EV

# One real-time operating system & standard framework for Behind The Meter Applications



## Value proposition of CACTUS as strategic control point

- Competitive cost due to usage of standards wherever reasonable
- Plug and play installation and cloud-based configuration and deployment

## Cactus is the operating system & framework for distributed energy systems

- Open, scalable and secure systems architecture (AWS/MindSphere)
- Siemens brand standing for reliability



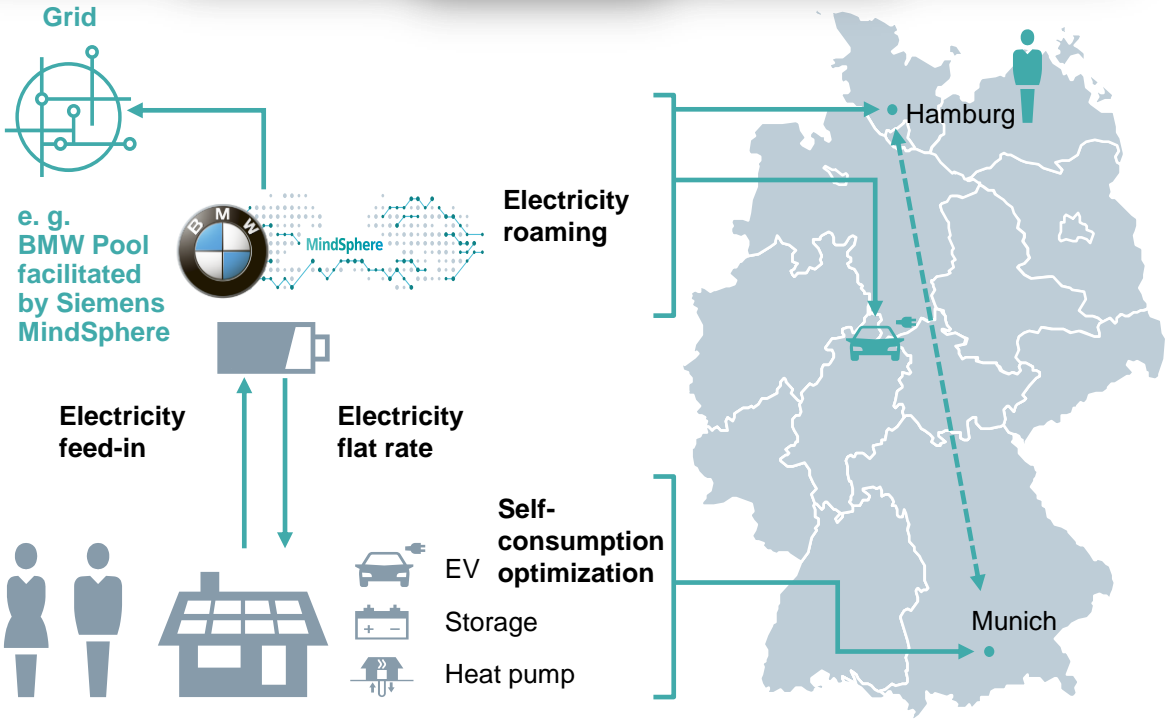
# Germany & Austria (as first rollout targets) App controlled distributed energy

Software defined inverter and one real-time operating system & standard framework for "Around The Meter" Applications

First HW vertical (*Junelight* residential energy storage) is currently being rolled out

**Customer value – project objectives:**

- **Use cases** (e. g. energy autarchy or community & roaming) driven by apps offered on **secure Siemens platform**
- **Flexible app development** by Siemens or external partners (e.g., utility, automotive OEM) on Siemens engines





## Austria – Utility & Local level Living Lab Aspern

**Holistic analysis and optimization** of the interplay between smart user/ building/ grid in the new Vienna district, Aspern

**Joint collaboration** of Siemens with Wien Energie and Wiener Netze

**Customer value – project objectives:**

- **Reliability of supply** through system integration and intelligent control of renewable and low voltage grid
- **Energy savings** with intelligent control of distribution networks and buildings

That's why  
**Siemens is the**  
trusted partner for a  
sustainable energy system

And a thought leader in the field of digitalization, we are leading the path forward toward future energy markets – for the societies, our customers and for Siemens.

**Thank You!**