Energy intelligence in buildings
Factor of success for decentralized energy generation and consumption

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Chapter 1: Framework and environment of energy

- European Legislation
- National Legislation
- Technology

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EU 20-20-20 energy targets

20% reduction in CO_2 emissions

20% of European energy consumption to come from renewable energies

20% reduction of primary energy consumption by improving efficiency

−14 %

18 %

−38,3 Mteo

Political targets to transform fossil-based energy systems

2011: 20.35 % renewables

2011: 12.84 % renewables

Germany	France
Onshore wind 36 GW	Onshore wind 19 GW
Offshore wind 10 GW	Offshore wind 6 GW
PV 52 GW	PV 5,4 GW

feed-in tariffs for renewable energies

energy savings through insulation of residential buildings

| no nuclear power plants after 2022 | −50 % nuclear power by 2025 |

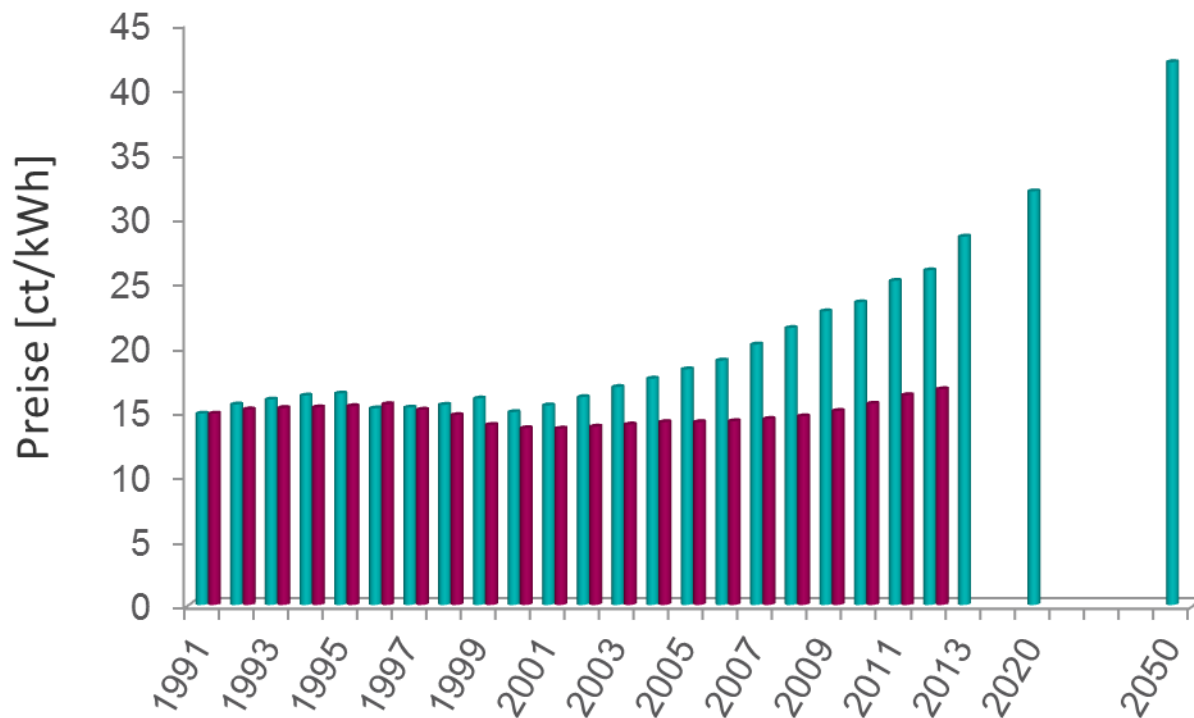## Consumer prices for electricity in Germany and France

Preise [ct/kWh]

45
40
35
30
25
20
15
10
5
0

1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2020 2050
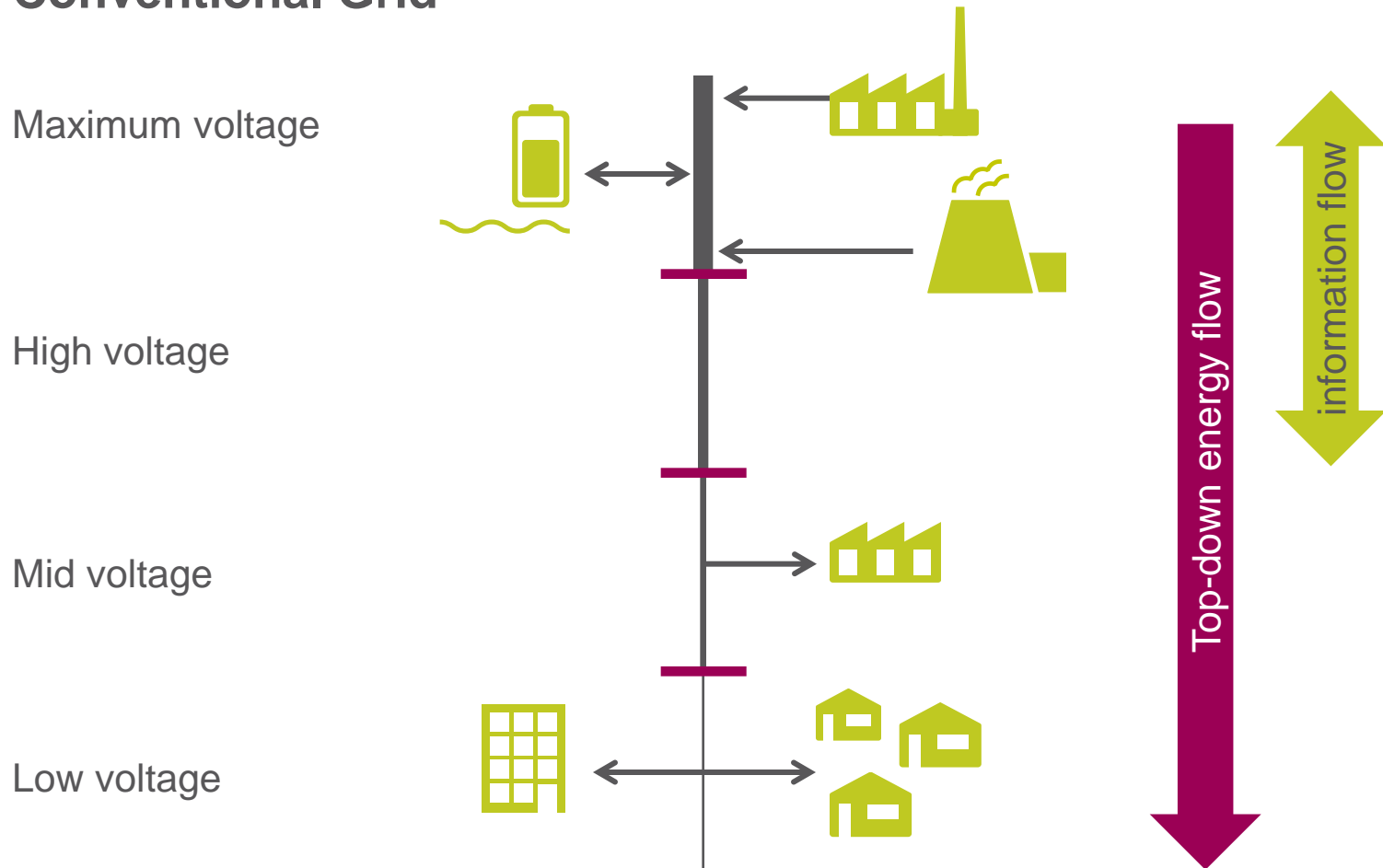
Price increase
from 2000 to 2013

in Germany

+91 %

in France

+8 %

Sources:
BDEW-Strompreisanalyse Januar 2013 Haushalte und Industrie; Ministère de l'Écologie, du Développement Durable et de l'Énergie – tarif bleu option base 6 kVA

Conventional Grid

Maximum voltage

High voltage

Mid voltage

Low voltage

Top-down energy flow

information flow

Smart Grid

Maximum voltage

High voltage

Mid voltage

Low voltage

Bidirectional energy flow

Information flow
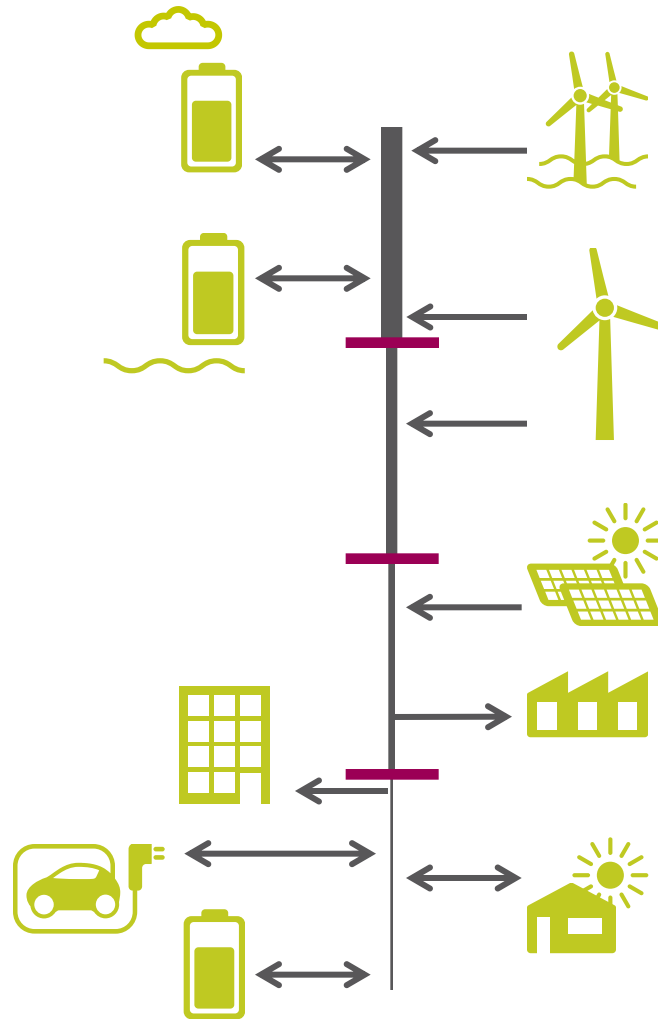
Key elements in the new energy system

- **Smart Grid**
  - High voltage system / Medium voltage system / Low voltage system
  - Target: Managing the mix of renewable and conventional energies
  - Task: Consumption oriented generation and generation oriented consumption
- **Decentralised energy generation and consumption**
  - **PROSUMER** solutions (end customer as a **pro**ducer and con**sumer** of energy)
  - Local usage of generated energy through storage
- **Energy efficiency**
  - Innovative solutions for reducing energy consumption in all electrical products
  - Energy management solutions for building and industrial applications

Target: Predictable, flexible and calculable energy system

In this energy system the smart building with its high energy consumption plays a very important role

In Germany and France about 40% of energy are consumed in buildings

German energy consumption

Building (residential/ commercial) — 40 %
Services — 10%
Industry — 25 %
Traffic/transport — 25 %
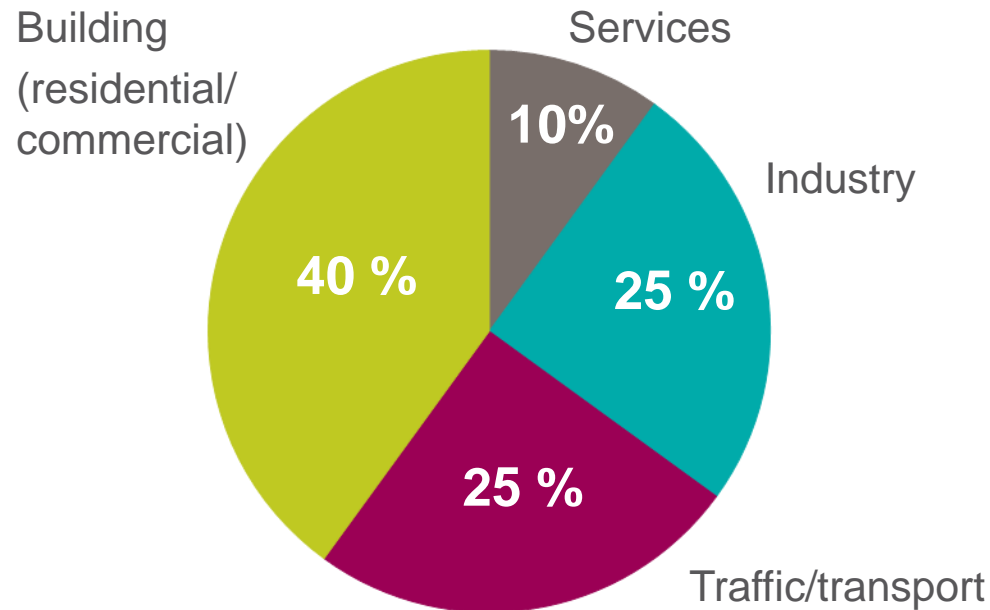
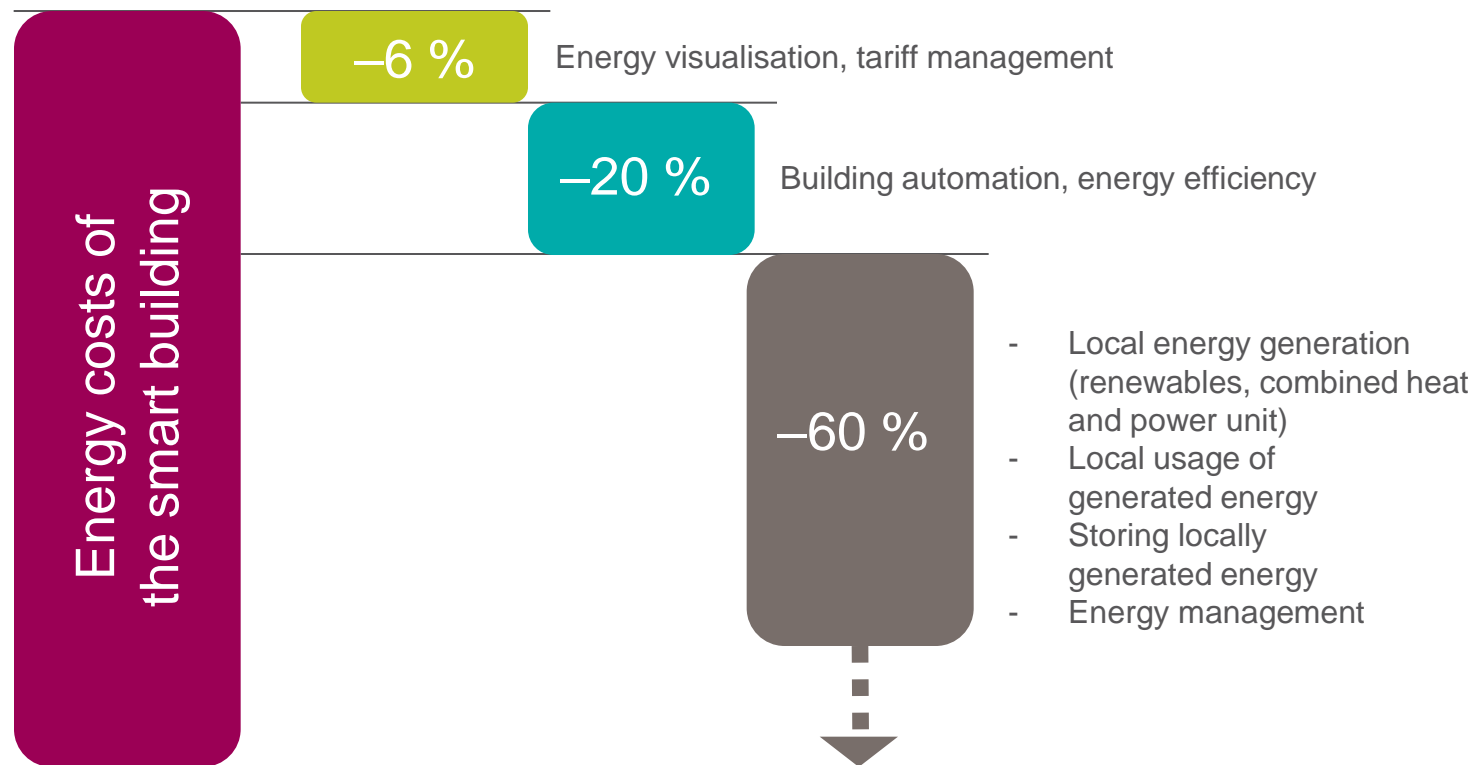**Possible applications in the smart building**

- decentralised energy generation and consumption
- energy efficiency
- energy management
- building automation

Chapter 2: Requests to Smart Buildings

- Economy
- Technology

Local energy generation and usage offer the greatest cost savings

Economic target: – reduce energy consumption
                   – reduce energy imports from the public grid

Energy costs of the smart building

−6 % — Energy visualisation, tariff management

−20 % — Building automation, energy efficiency

−60 %
- Local energy generation (renewables, combined heat and power unit)
- Local usage of generated energy
- Storing locally generated energy
- Energy management

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To achieve the economic target the smart building needs an intelligent energy management system

Technology target: Sustainable optimisation of energy consumption and energy generation

Generation of photovoltaic energy

Generation of wind energy

Generation of CHP energy

Energy Intelligence

Energy consumption
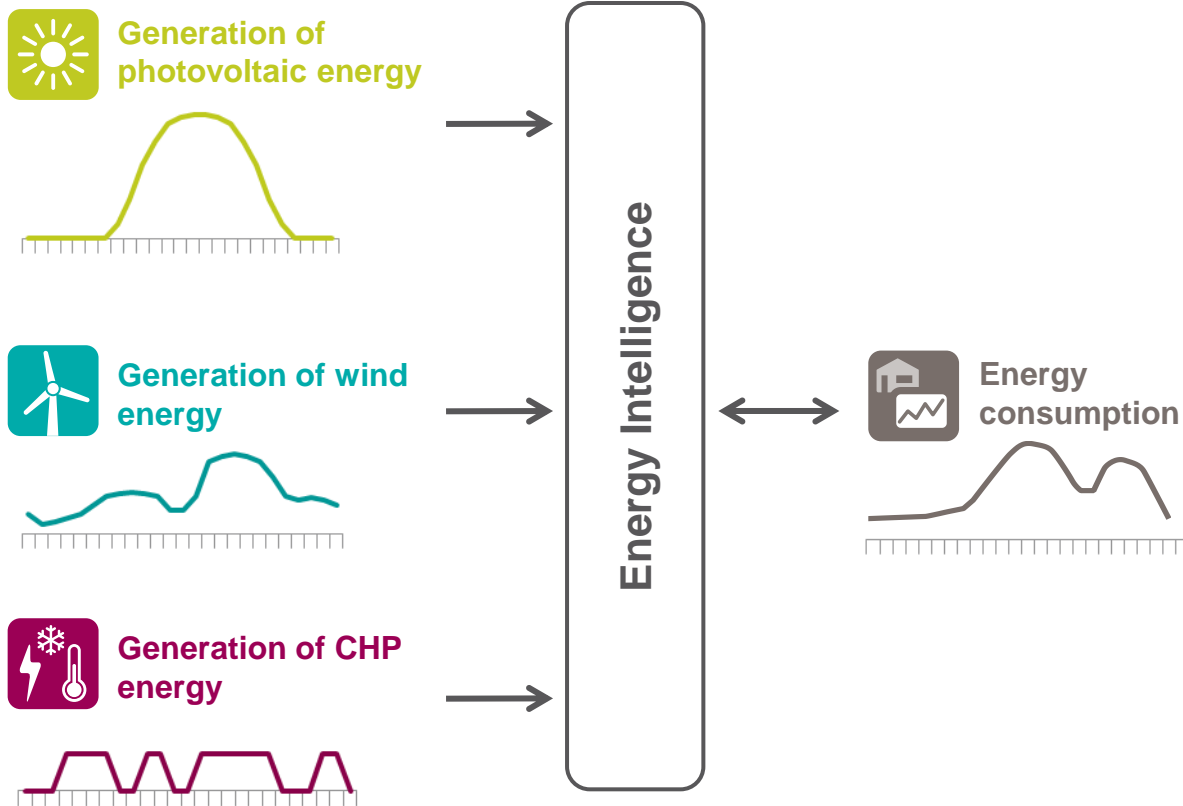
- Analysis of local energy consumption
- Predictable energy consumption
- Building automation
- Flexible tariff management
- Analysis of local energy generation
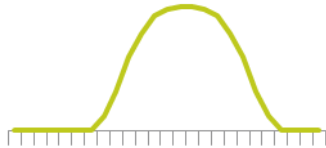- Predictable energy generation

Energy storage is absolutely necessary due to fluctuated energy
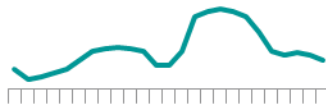
Technology target: Consumption oriented generation and generation oriented consumption
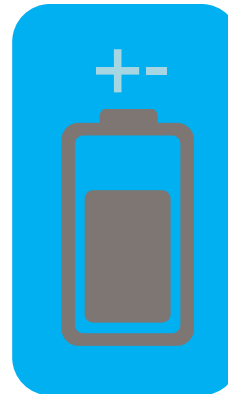
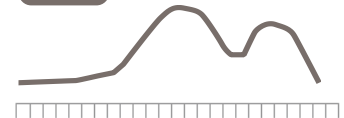**Generation of photovoltaic energy**

Generation of wind energy

Generation of CHP energy

Energy storage

Energy consumption

Chapter 3: Solutions for Smart Buildings

- Analysis of energy consumption and generation
- Predictable energy consumption and predictable energy generation
- Energy storage

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Energy analysis and prediction are the basis for a better understanding of energy consumption

Analysis of energy consumption
- Detailed information about energy use and corresponding costs
- Analysis and evaluation of total energy consumption
- Comparison of singe days and weeks

Prediction of energy consumption

- Identification of reasons & importance of influences
- Correlation / recognition of pattern
- Individual recommendations for energy savings

Control by Building Automation

- Automated smart control of appliances
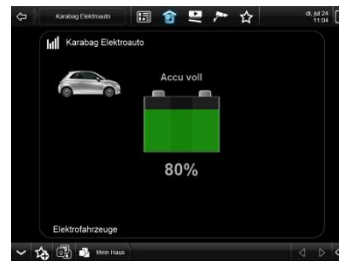- Load shifting by time controlled or storage capable devices

Efficient – intuitive – automatic – simple – safe

- Comfort
- Safety
- Energy efficiency
- Assisted living, AAL
- …

See, understand, control intuitively
– with tebis KNX domovea

Quelle: Hager

Local energy generation and consumption reduce significantly energy import from public grid

Generation of Photovoltaic energy

Generation of wind energy

Generation of CHP energy

Analysis of energy consumption

- Analysis and evaluation of different kinds of energy generation
- Visualisation of actual status of consumption and generation

20% of energy supply can be reduced

Prediction of energy consumption

- Prediction of generated energy for the next 3 days
- Load shifting of energy consumption to times of enery generation

30% of energy supply can be reduced

Target: Consumption oriented generation and generation oriented consumption

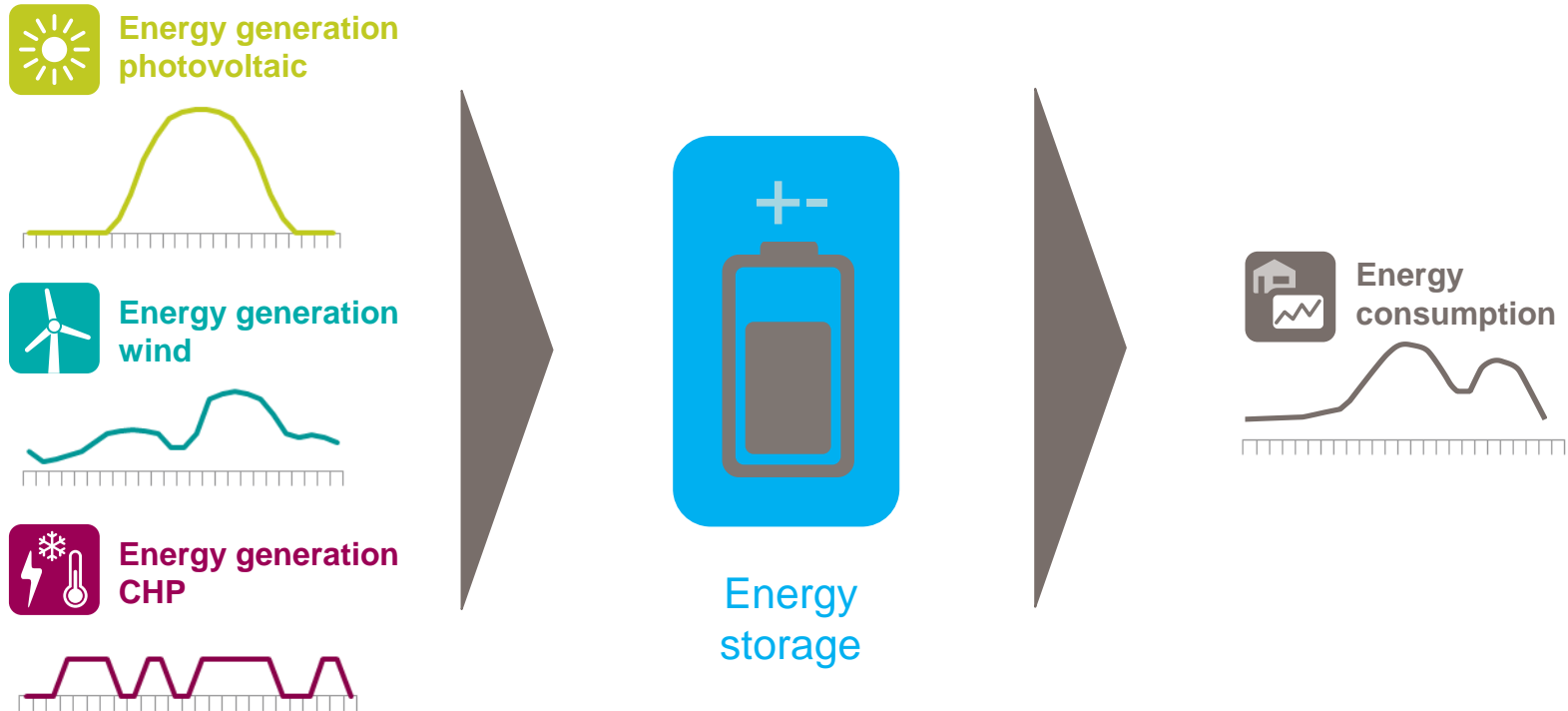# For the end customer the economical optimum will be reached by energy storage

Energy generation photovoltaic

Energy generation wind

Energy generation CHP

Energy storage

Energy consumption

- Excessive energy of local generation will be stored in battery
- Depending of state of charge (SOC) battery provides energy for local consumption

70% of energy supply can be reduced

Energy consumption

Generation of photovoltaic energy

Generation of wind energy

Generation of CHP energy

Energy intelligence

Analysis Prediction Control

Stored energy

Stored heat energy

E-Mobility with energy storage

Customer generation

E-Mobility

Renewable energies

Energy management

KNX

IP

Conventional energies

Home networking – structured data wiring

Micro combined heat and power (CHP) or heat pump

Controllable consumer appliances as per Section 14a of the Amendment to the German Energy Act

Application Smart Building

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Hager Group Research and Application Centre in Blieskastel

Energy consumption

Energy generation

Energie-intelligenz

Analyse Prognose Steuerung

Energy storage
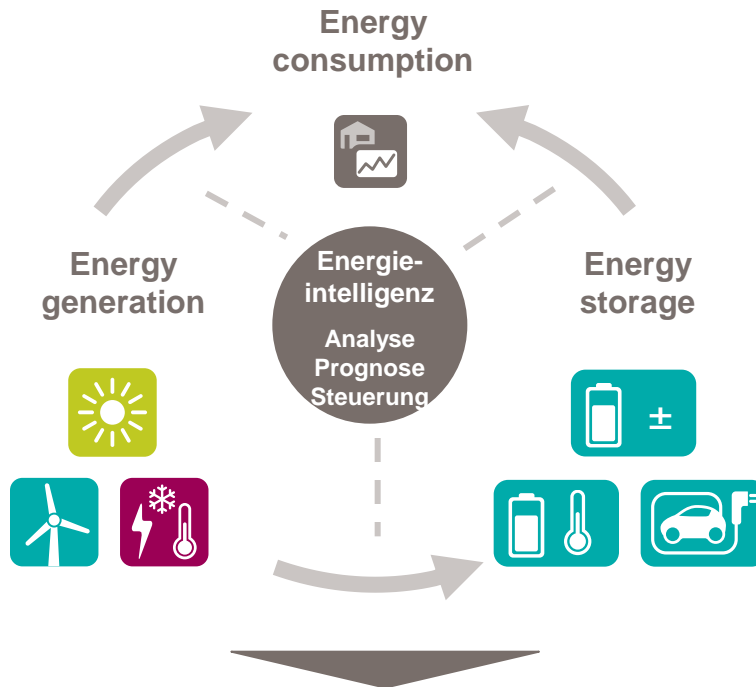
First application for energy intelligence

- New Hager Group building with 3,000 m²
  - Offices, labs and workshops
- Energy consumption:
  1.4 million kWh per year
- Energy generation
  - Photovoltaic: 100 kWp
  - Combined heat and power unit:
    120 kW electrical energy and 180 kW thermal power
  - Wind: 50 kW
- Energy storage: 100 kWh
- First step: reducing energy import by 70%
- Second step: reducing energy import by 100%

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Energy intelligence can be realised in local applications

Data - Cloud
- Service
- Meteorological data
- Tariff information
- Sharing point
- presence

Local application

- All applications of energy intelligence can be realised locally in Smart Building
  - Analysis
  - Prediction
  - Control
- Common access to information about
  - weather
  - utilities' tariffs
  - service
- Application: Single, independent buildings

Energy intelligence
Analysis
Prediction
Control

Energy intelligence can be realised in Cloud applications

Energy - Cloud
- Analysis, Prediction
- Energy management
- Evaluation
- Service, Appliations
- Sharing point

Cloud applications

- Energy cloud take different tasks of energy intelligence
    - Analysis
    - Prediction
- Interface between Energy cloud and Building Automation
- Local Building Automation
    - Control of energy storage or electrical vehicles
- Energy cloud can be used as a network of spreaded buildings
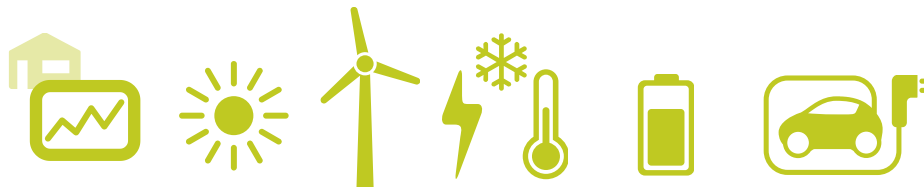
Energy intelligence

Control

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Conclusion

The building at the heart of our future energy system

Thank you for your attention !

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