DESIGNING NEW NEIGHBOURHOODS: CHALLENGES AND PERSPECTIVES

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Conférence en ligne sur la transition énergétique à l’échelle du quartier

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Agenda

1) Key elements of new and future-proof neighbourhoods
2) How to design a climate-neutral energy system for neighbourhoods
3) Examples for climate-neutral neighbourhoods
4) Conclusions

Key elements of new and future-proof neighbourhoods

Key Objectives for new neighbourhoods

Society & economy

Sustainable ecosystem for work and wealth

Residents and user

High quality of life

Natural environment

Climate neutrality

Technical systems to achieve climate neutrality

Climate-neutral energy system

Sustainable mobility

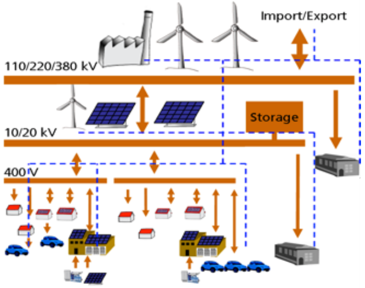
- Multimodal mobility
- Electric vehicles
- Open space for people with less cars / 15-minute city

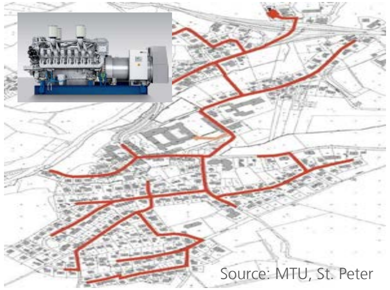
Digitalisation (Smart City)

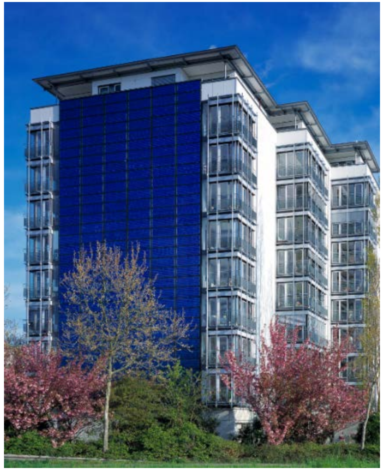
- Smart and connected solutions to enable an efficient and sustainable infrastructure and digital services for the residents and user
- Digital solutions must offer added value to residents, data security, data protection and data autonomy must be guaranteed

Challenges to achieve climate neutrality

- **Replacing fossil energy sources** within 2-3 decades
- **Increasing share of fluctuating** renewable energies
- **Decentralization** of generation („prosumers“)
- Additional electricity load by **electric vehicles**
- Increased use of **electricity for heating and cooling**
- **Sector coupling**: electricity, heating, cooling, mobility
- **Competing energy infrastructure** (electricity, heating, cooling and gas grids) at the background of decreasing energy demand (at least for space heating)
- Need for strong **efficiency** improvements
- Energy market liberalization & **new business models**, e.g. trading of energy between neighbours (blockchain)







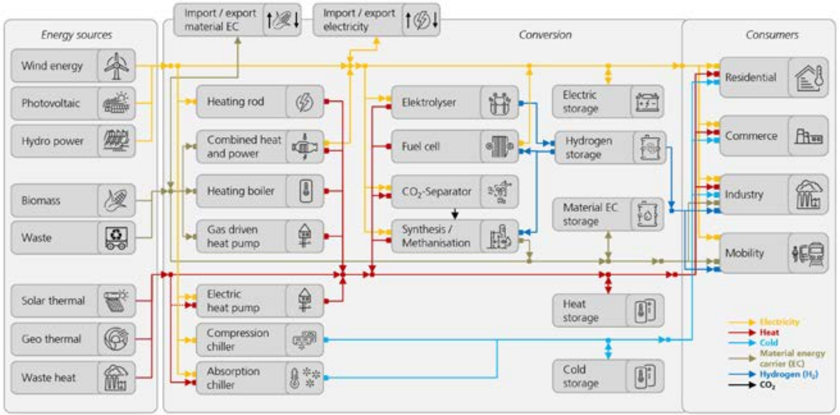
Key componentes of climate neutral energy systems

- High level of **energy efficiency**
- **Locally generated renewable energy** (mainly solar)
- **Energy import** from renewable energy (preferred from the region)
- **Smart energy system**
  - Smart grids (electricity, heating)
  - Integration of storage
  - Coupling of energy sectors
  - Intelligent energy management
- **New business models**: local & renewable energy communities
- **Positive Energy Districts**: the neighbourhood has a positive impact on the surrounding energy system (provides flexibilities)

Solar thermal roof, Source: Schüco International

Solar facade Volksbank Karlsruhe, Source Schüco International

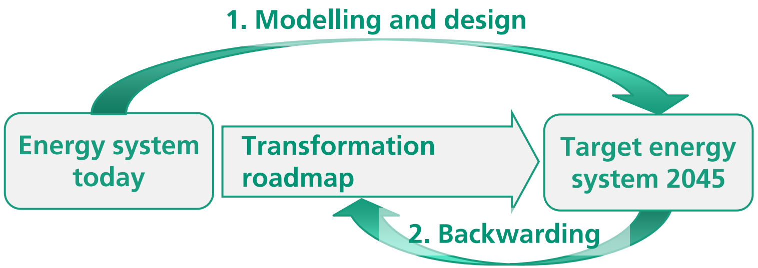
Generic design of a climate-neutral energy system for municipalities and districts



How to design a climate-neutral energy system for a district

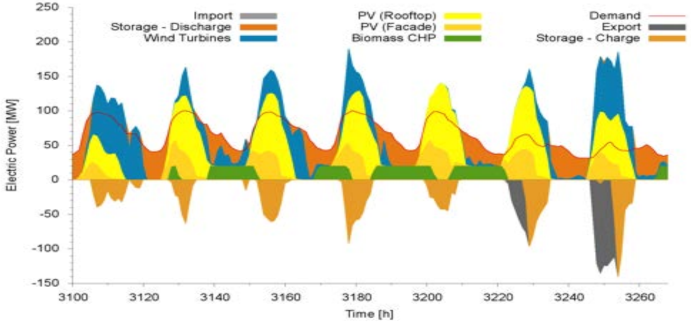
New planning tools and processes

1. Calculation of **cost-optimized target energy system design**
   - with hourly resolution due to fluctuating energy sources
   - sector coupled (electricity, heating, cooling, mobility)
2. Development of a transformation / implementation **roadmap**
3. **Integrated urban planning and energy planning** from the beginning



Output of new energy system modelling tools*

- Cost-effective **energy system design**
- Optimal energy system **structure**
- Generation and storage **capacities**
- Effective **operation strategy**
- Remaining **energy import/export**
- Investment and operation **costs**



Example result graph: Electricity generation mix for one week

*Fraunhofer ISE developed the tool KomMod = Urban Energy System Modell

Example 1: Energy system design of the district Patrick-Henry-Village in Heidelberg, Germany

Power supply

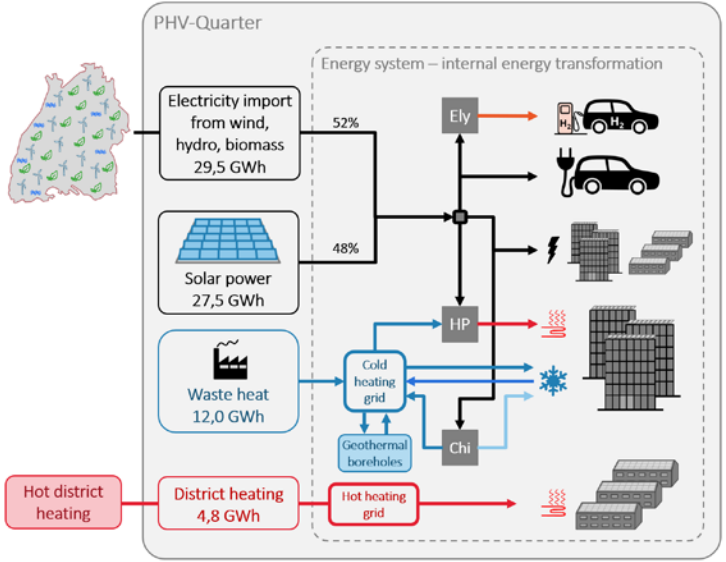
- 48% Self-supply with solar power

Heating and cooling supply

- Hot heating network for existing buildings (import of CO_2-neutral district heating)
- Cold heat network for new buildings:
  - heat in winter provided by heat pumps (HP)
  - cold in summer directly from the grid and with compression chillers (Chi)
  - waste heat utilization
  - seasonal heat storage with geothermal boreholes

Mobility

- 90% electric vehicles (based on mileage), 10% hydrogen vehicles (hydrogen-electric)
- hydrogen produced with electrolyser (Ely)



Final energy demand:	73,8 GWh/a
Generation within the district (incl. waste heat):	39,5 GWh/a
Share of self-supply:	53,5%
Share of self-supply without mobility:	70,8%

Example 2: EnStadt:Pfaff Living Lab Project in Kaiserslautern

Reallabor PFAFF

Lighthouse Project for a climate neutral neighbourhood

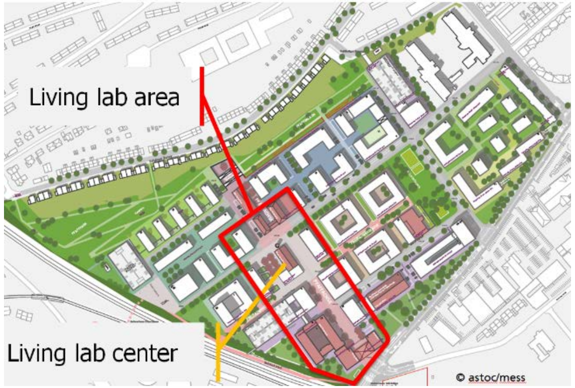
- Funded by the German Ministries for Economy and Energy as well as for Research (BMWi and BMBF)
- Project leader: City of Kaiserslautern
- Scientific leader: Fraunhofer ISE
- 8 Partners (City, industry, research)
- Duration: 5 years
- Investments: € 28M / Public funding: € 21M
- Total area: 18 ha
- **Target: Develop a carbon-neutral district** in the area of a former sewing machine factory
- **Technologies:** Energy, buildings, electric mobility, ICT, social science aspects
- **Research, development, demonstration, monitoring, optimization**

Source: Astoc Mess

Example 2: Integrated hybrid energy system
demonstrated in the EnStadt:Pfaff living lab

Reallabor PFAFF

- Photovoltaic combined with green roofs on all buildings (obligatory)
- Innovative PV façade
- Batteries on district level and building level
- Bi-directional charging of electric vehicles
- Low-temperature district heating system, supplied by industrial waste heat
- Heat pumps for sector coupling
- Smart grid (electricity and heating)
- Agent-based district energy management system based on blockchain technology (peer-to-peer trading of energy)
- Smart home technology
- Digital platform
- …



Conclusions

- New neighbourhoods require **integrated solutions** to achieve climate neutrality, future-oriented living and working, and a high quality of life
- **Climate-neutral energy systems** are the prerequisite for sustainable neighbourhoods
- Their key components are **renewable energies, energy efficiency and smart energy system technology**
- Planning and development of climate-neutral energy systems requires **new tools and processes**

Source: Morgenstadt / Fraunhofer IAO

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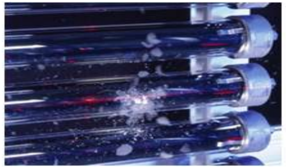
Thank you very much for your attention



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