

# Power-to-Heat & Power-to-Gas

in District Heating systems

## 1 Introduction & basic principle behind Power-to-Heat technology

- P2H applications are capable of converting electrical current into thermal energy
  - smaller private applications:
    - night storage heater
    - heat pump heating system
  - large-scale applications:
    - central electric or electrode boilers
    - Large-scale heat pumps
- Usually, such applications are integrated into a heating network
- **Sector coupling:** interconnecting the electric sector with the heating sector

### 1.1 The integration of P2H within the sectors of heat and electricity

The balancing power market is constantly stabilizing the targeted 50 Hz frequency within the power network:

- **positive balancing energy** (e.g. by a CHP-plant) = surplus of electricity to balance out peaks in the consumption
- **negative balancing energy** = higher output than consumption makes the usage of the surplus of electricity necessary (e.g. through P2H, storages, DH-networks)
- Due to the increasing amount and integration of mostly volatile renewables energies into the power market, power-to-heat technologies could have an important impact as an important instrument for the balancing power market in future

## 2 Power-to-Heat applications – an overview

- Electric (heating element) heaters
- Electrode boilers
- Electrically operated compression heat pumps

**Summary:** If generated from renewable energies, electrically generated heat can make a significant contribution to reduce and replace the use of fossil in future systems

## 3 The basic principle of Power-to-Gas



Figure 2: Simplified Power-to-Gas process (AGFW, 2019)

**Main advantage of this technology:**

- high energy storage density of hydrogen and methane
- **Methane** has similar properties to natural gas
  - can **be stored** and transported with the already **existing gas network**
  - can replace the use of natural gas in all previous applications

## 4 Comparing P2H & P2G technologies and their potentials

- In general, **Power-to-Gas** with the usage of the synthetic gas in the heating sector also competes with direct **Power-to-Heat** technologies
- **Power-to-Heat:**
  - direct utilisation is more efficient compared to the combustion technologies
  - disadvantage with regard to long-term energy storage
- **Power-to-Gas:**
  - Gas has a higher energy storage density compared to batteries or water (thermal storage)
  - the production of synthetic gas represents an unnecessary conversion process (low efficiency)
  - However, it adds more flexibility (in terms of time between supply and demand), but also for further fields of application of the synthetic gas