Characterisation and quantification of flexibilities in the energy exchanges between buildings and the energy system(s)

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Energy services

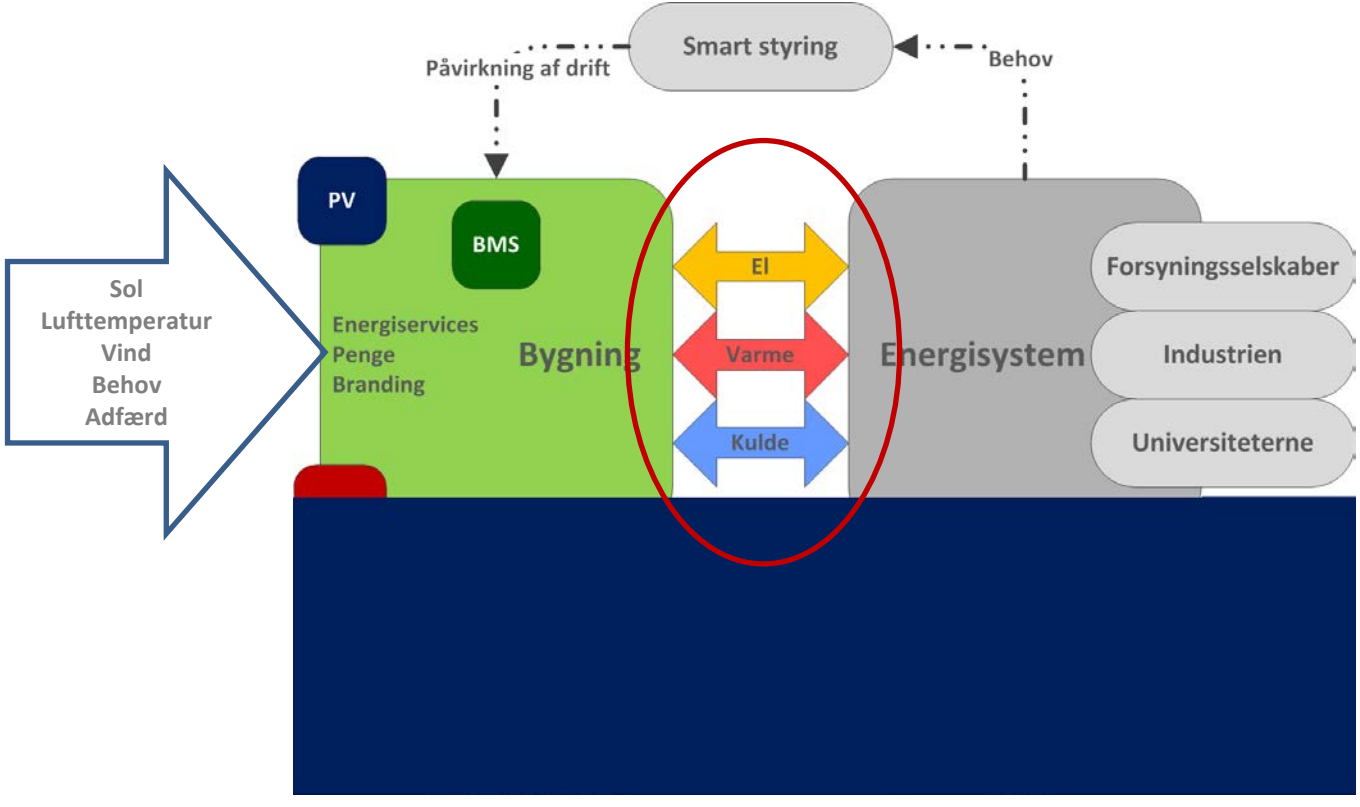
Requested

- Indoor climate
- Mobility

Solutions

- Building design (heating / cooling / forced ventilation)
- Urban planning (bycycle roads / public tansport / energy efficient vehicles)

Energy exchange



Energy flexibility – low hanging fruits

- Freezers / fridges
- Hot tap water production
- Space heating / cooling (by external energy)

Energy flexibility

Generic

- Define
- Classify
- Characterise
- Valuing
- Pricing / costs

Example

- Electrical & water heated hot tap water supply unit
- Daily demand: 100 l @ 55°C
  20 MJ / 5.5 kWh
- Storage tank: 100 l
  (ideal storage: always 55°C in the top)
- Electrical heater: 1 kW
- Water heater: 1 kW @ >60°C

Energy flexibility

Definition

- Energy flexibility is an energy system service provided by a customer.
- For each energy carrier:
  The amount of power and energy within a given period that can be changed on request – either permanently (fuel shifted) or temporary (time shifted).

Example

- Power flexibility:
  1 kW_e + 1 kW_t
- Energy flexibility:
  5.5 kWh within 24 h

Classification

Generic

- Given energy, given period, flexible power.

Example

- Given amount of energy to be provided, but at any time within a given period.
- The energy may be provided either as electrical energy or as heat.
- The amount of flexibility depends on the state of the tank.

Characterisation

Generic

- Fuel shift

Example

- Full flexibility between electricity or heat (>60°C)

Value

Generic

- Market value
- Energy system value (needs)

Example

- Customer controlled:
  - Energy purchased at lowest cost
- System controlled:
  - Energy provided when most convenient for the system (time flexibility) at the most convenient form (electricity / heat) (fuel flexibility).

Cost

Generic

- Additional investment costs
- Additional operation costs

Example

- Investment:
  - Energy infrastructure
    - + District heat connection
  - Fuel shift:
    - District heat unit:
      + electrical heater
    - Electrical unit:
      + water coil
- Operation:
  - Local controller with remote communication interface
  - Communication of control signal (e.g. dynamic energy prices (indirect control) or regulation requests (direct control))