Mathematical Optimization Modeling of Energy Hub Management Systems

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Energy Hub

- Single or multi-carrier energy system for:
  - **Residential**
  - **Institutional - Commercial**
  - **Industrial**
  - **Agricultural**

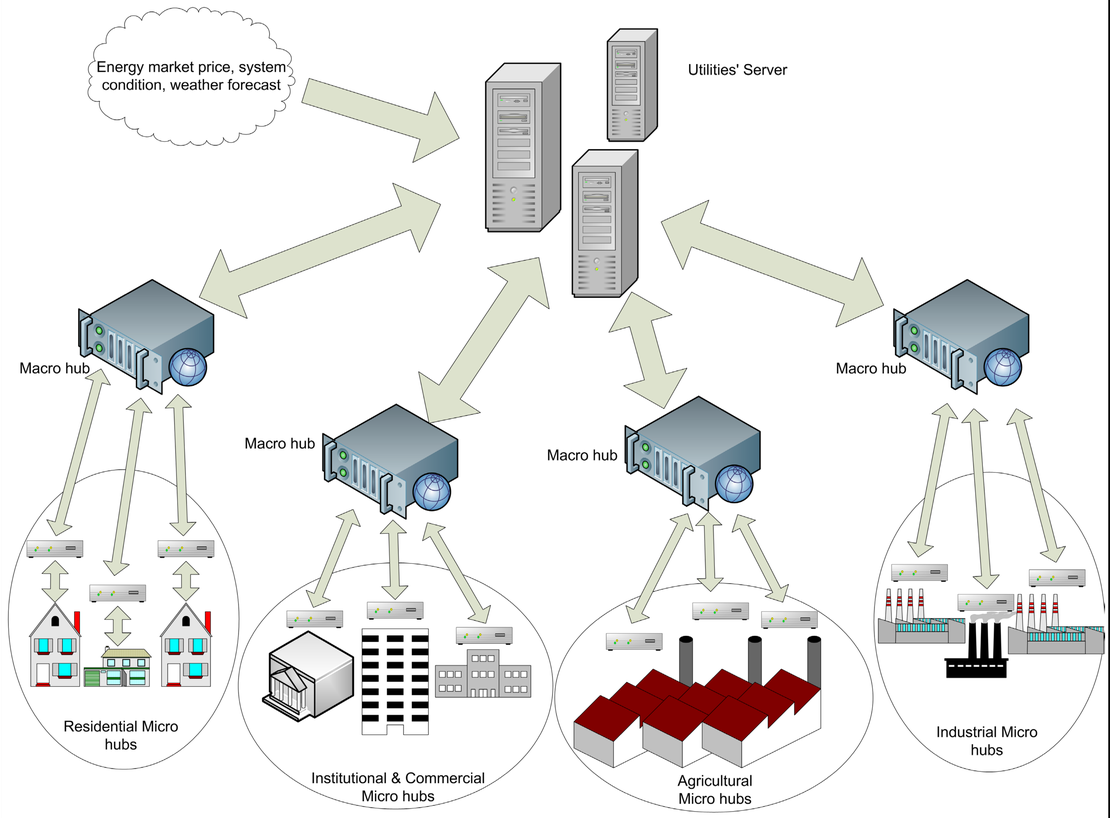
Energy Hub Management System

- Incorporated into automated operational decision making structures
- Part of a Smart Grid
  - **Smart meters**
  - **Two way communications**

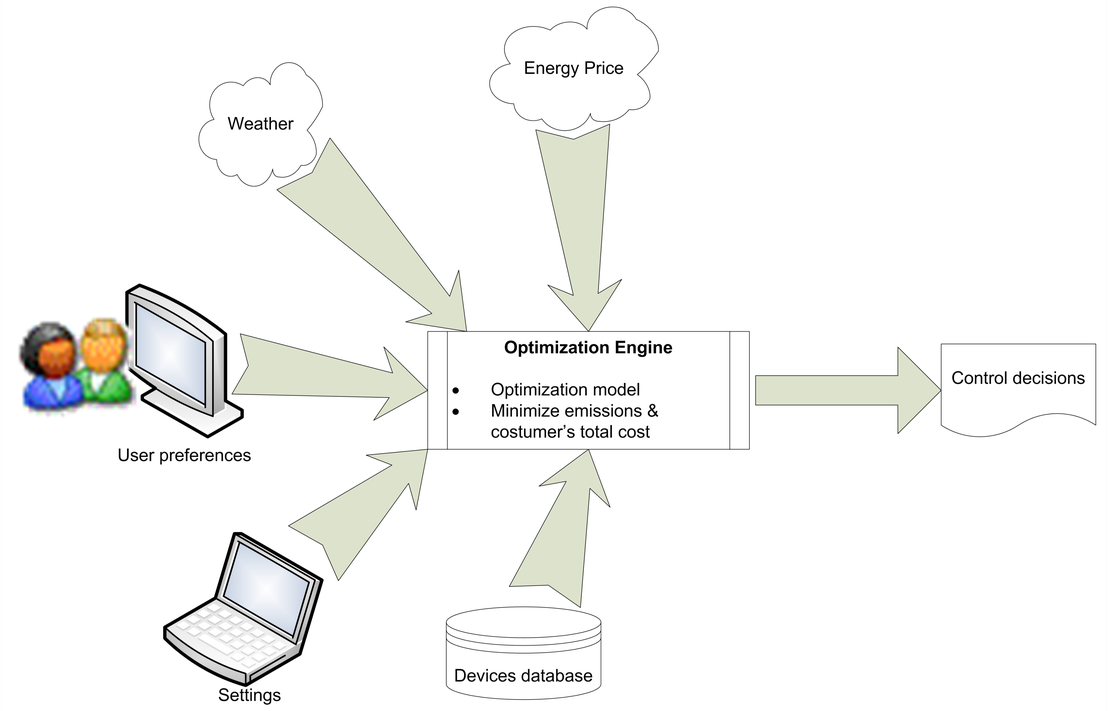
Residential Energy Hub

- The energy system of a single detached house including electricity, gas and related green house emissions.
- Mathematical models of major household components, for example:
  - **AC**
    - **Min. and Max. temperature**
    - **Outdoor temperature**
    - **Occupancy pattern**
  - **Water heater**
    - **Hot water usage pattern**
    - **Min. and Max. temperature**
    - **Min. up time, Min. down time**
  - **Energy generation / storage**
    - **Discharge rate**
    - **Min. storage level**
    - **Min. connection time, Min. disconnection time**

Overall Structure

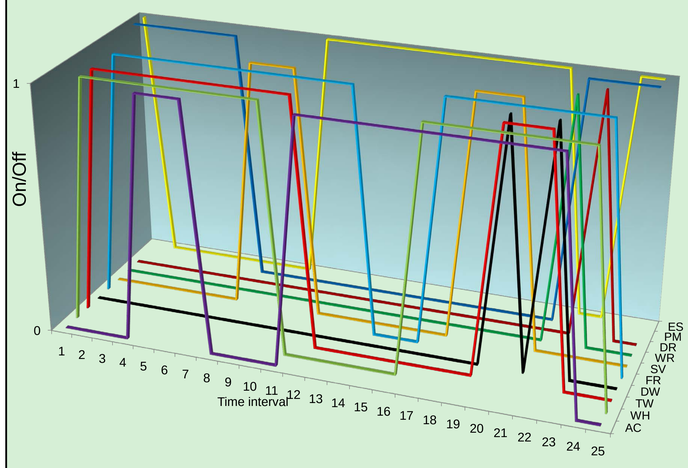


Micro Hub Model

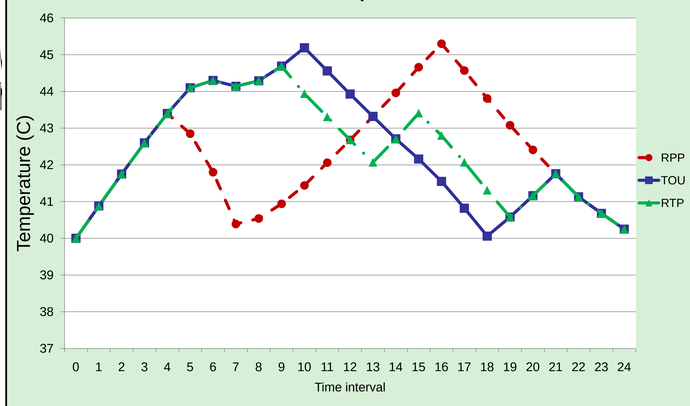


Results

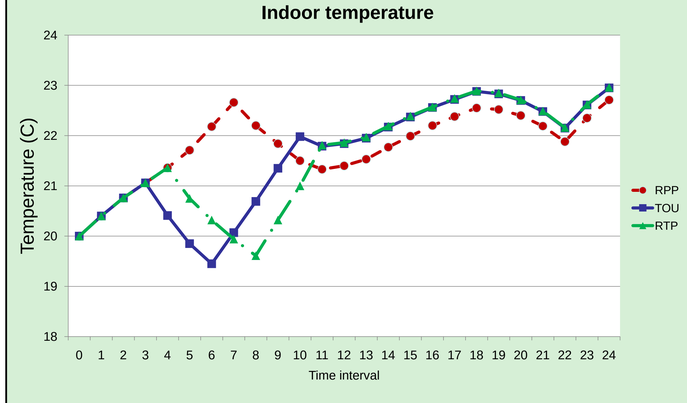
On/Off schedule



Water temperature



Indoor temperature



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