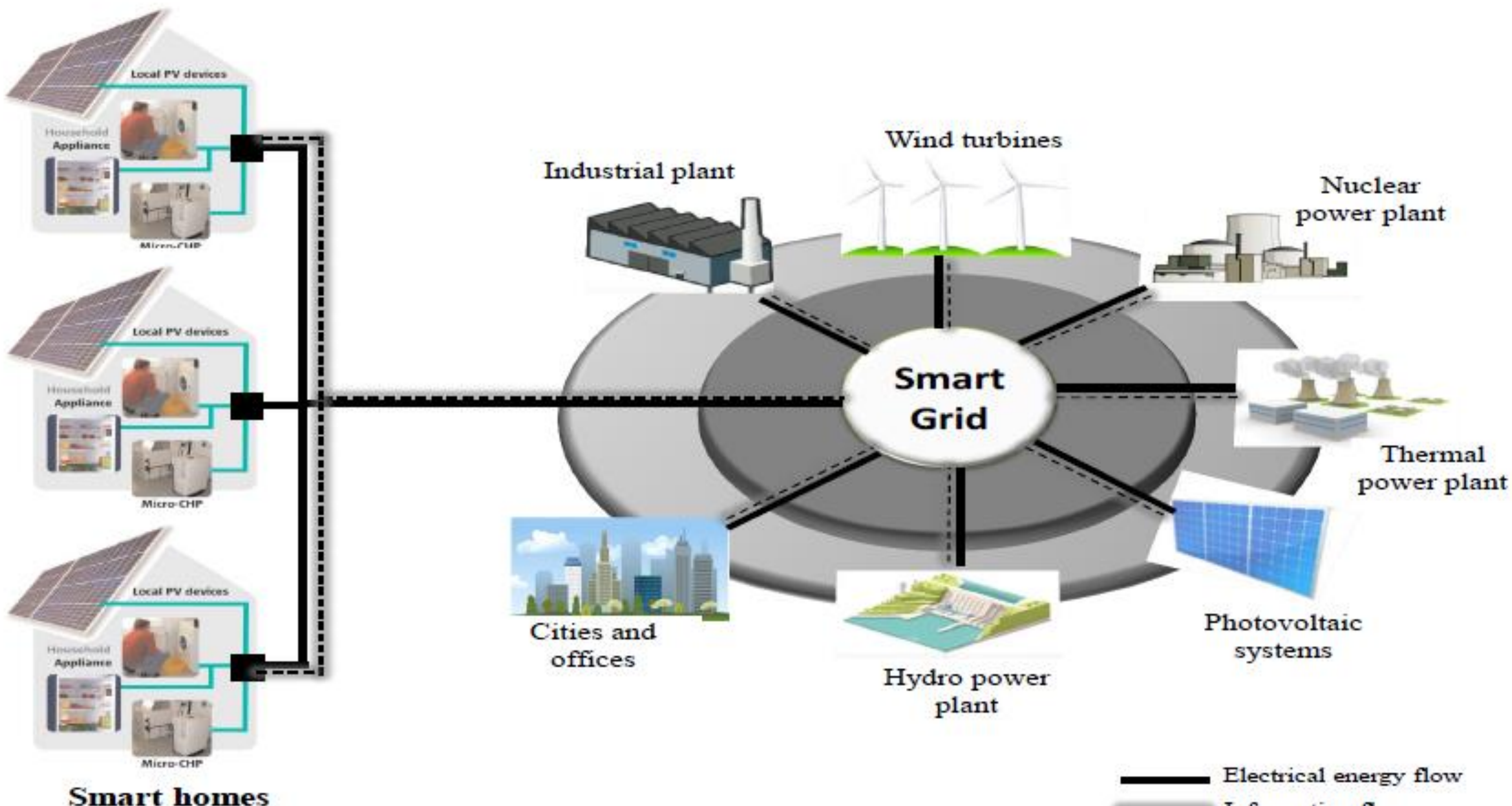
technische universität dortmund

Institut für Energiesysteme, Energieeffizienz und Energiewirtschaft

Opportunities of Smart Buildings in Smart Urban Grids

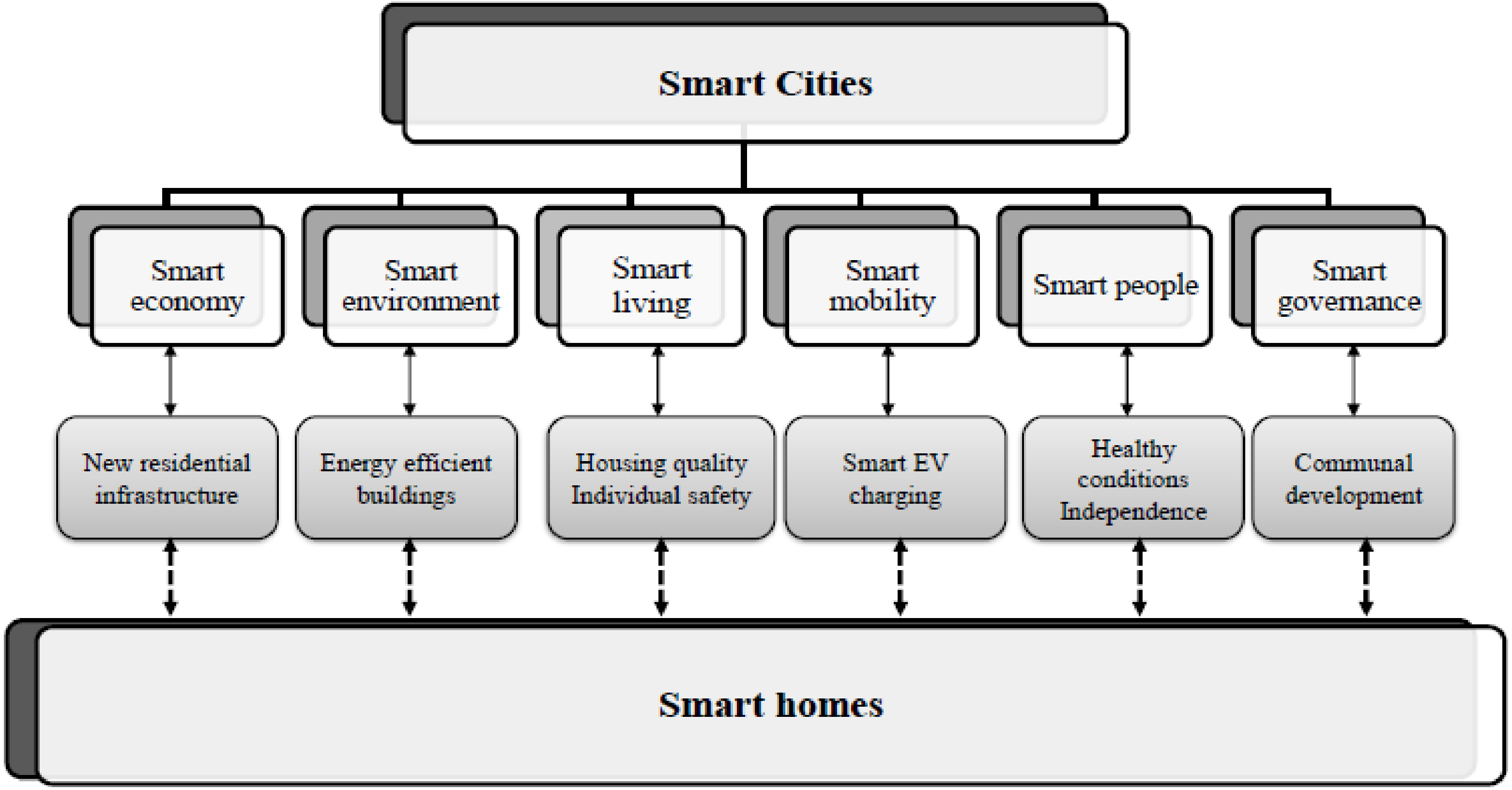
Prof. Dr.-Ing. Johanna Myrzik, 21.04.2015

Smart energy buildings as integral part of smart grids



B. Asare-Bediako: Smart Energy Homes and the Smart Grid, PhD Thesis, Eindhoven 2014

Smart buildings are part of smart cities



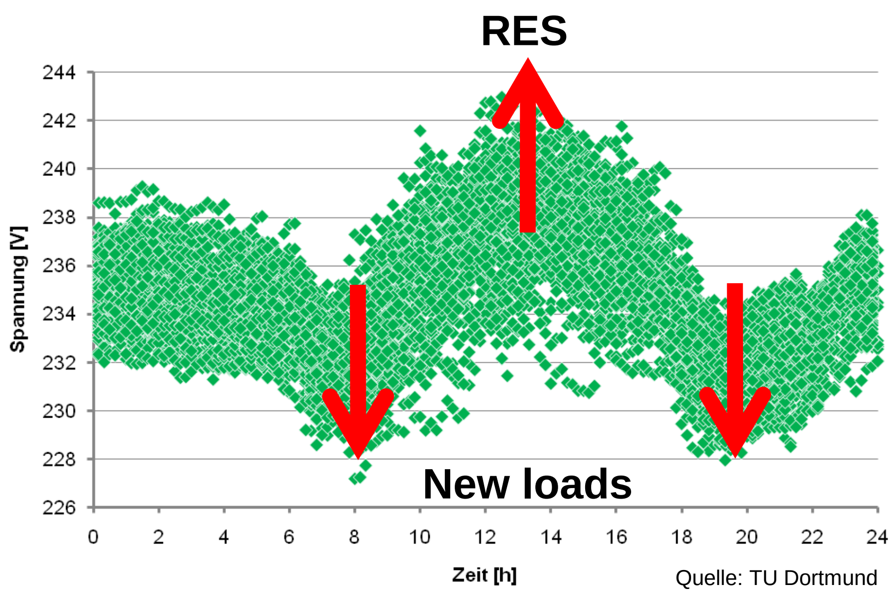
European Smart City Model, 2014

The characteristic of future smart and sustainable supplied buildings

- Electricity and heat supply cannot seen separately if certain efficiency measures should be achieved
- Integration of a big variety of different technologies
  - Electrical and thermal solar energy
  - CHP technologies (biogas, waste)
  - Heat pumps
  - Electro mobility
  - District heat and cold
  - Heat and cold storage
  - Electrical storage
  - Smart equipment, meters and EMS

The characteristic of future smart and sustainable supplied buildings

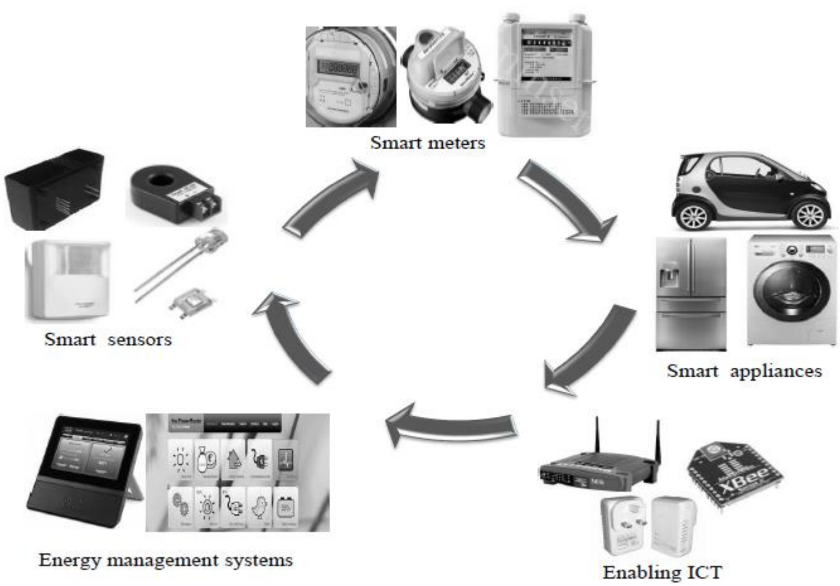
- Changing profiles and uncertainties by
  - Energy efficiency measure
  - E-mobility and heat pumps
  - Autonomous supply
  - Increased demand of electricity by decreasing the need of heat

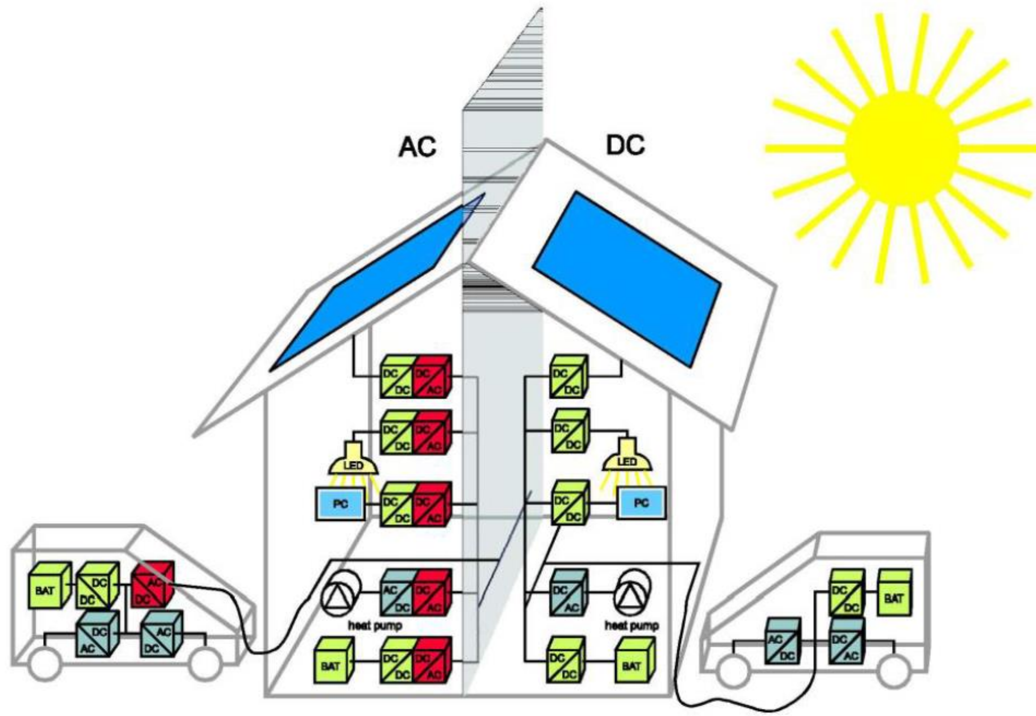


Quelle: TU Dortmund
RWE Deutschland AG

Consequences, new technologies and integration challenges

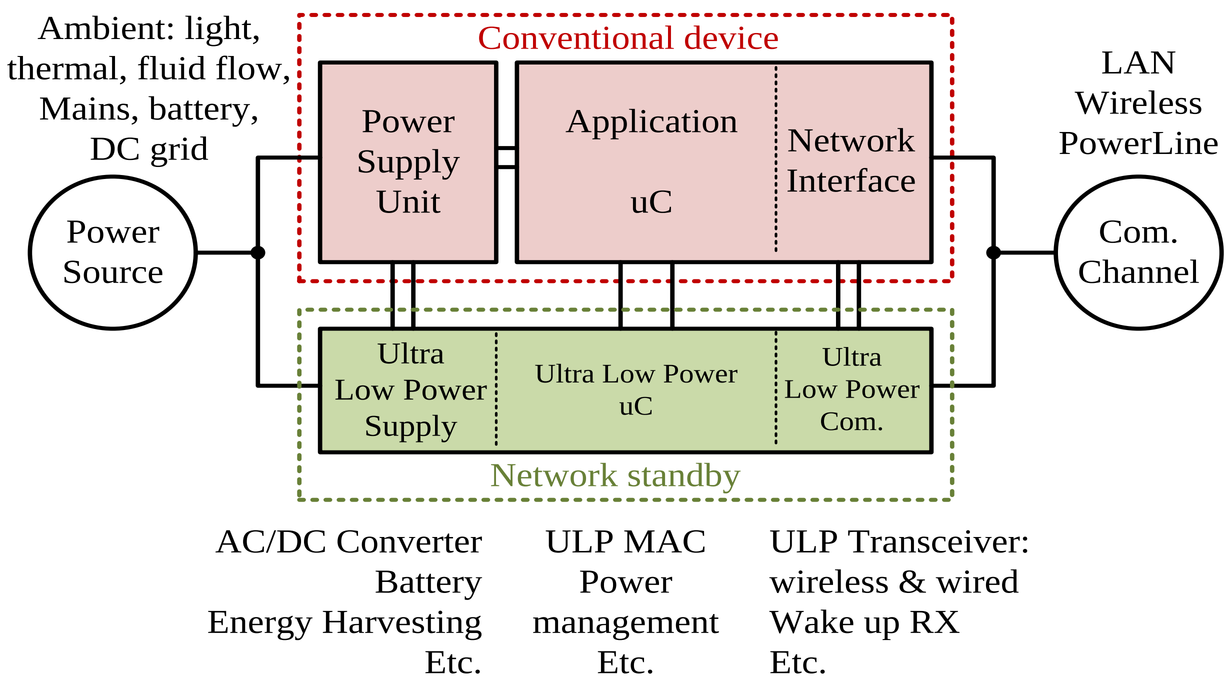
- Consequences for Infrastructures
  - Which energy infrastructure will survive, which should be developed
  - Information and communication technologies
  - DC and AC infrastructure in pa



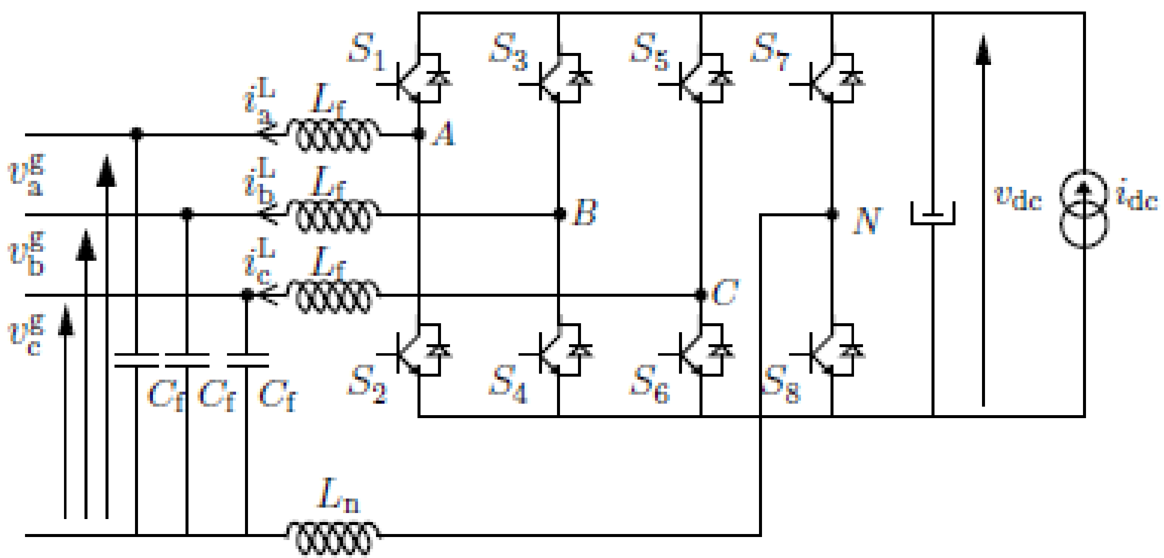


Consequences, new technologies and integration challenges

- Power electronics as bridging technology between the energy generation, the ICT infrastructure and DC or AC power grid
  - Highly integrated and efficient, ultra low power supply, with “no” stand by losses

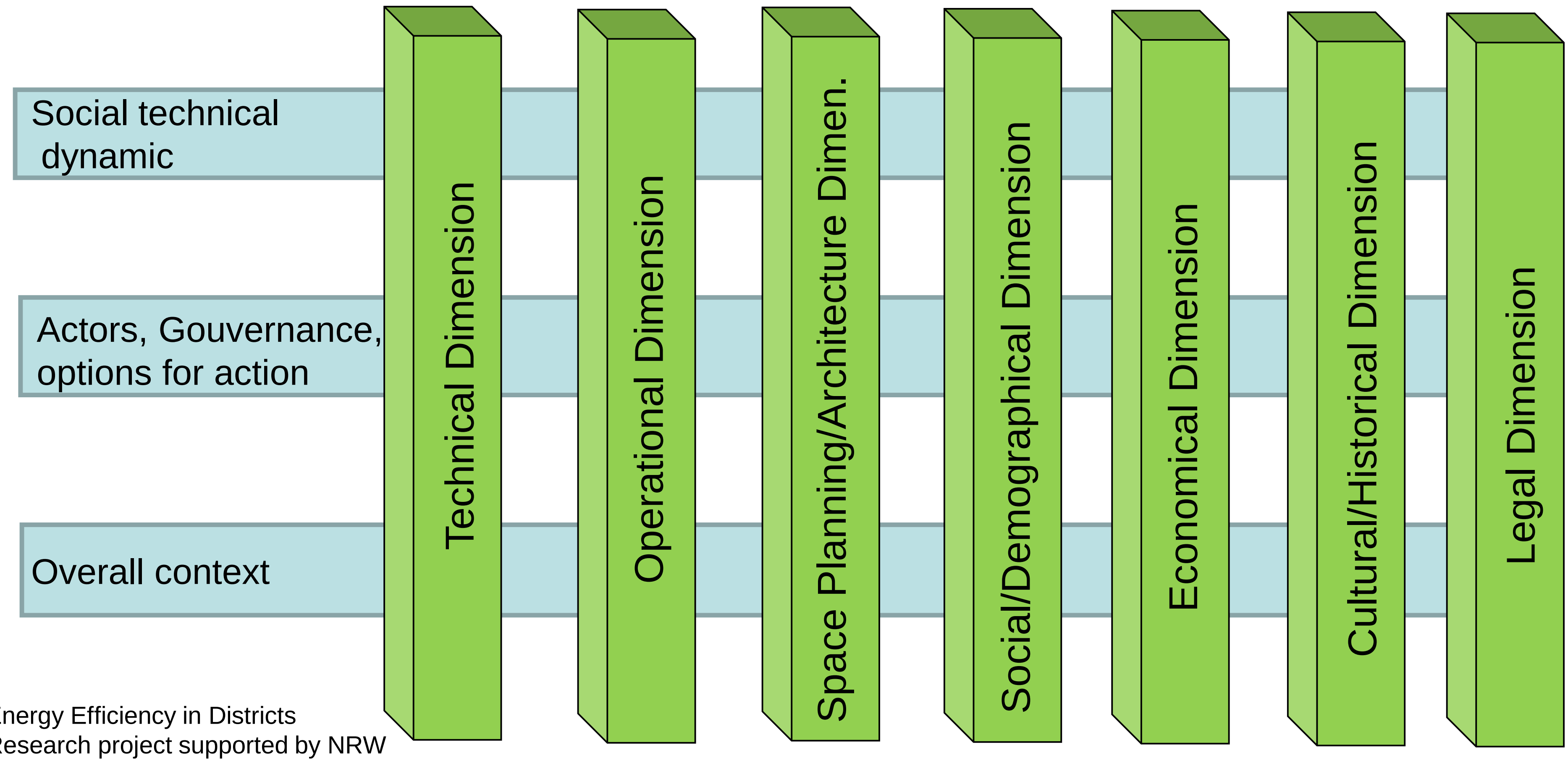


- New four leg multi functional converter topologies
  - Injection of currents into the neutral
  - Compensation of homopolair currents
  - Increasing active filter features
  - Increasing damping features
  - Solving unbalance problems



Consequences, new technologies and integration challenges

- Integration into an urban environment will address 7 interdisciplinary dimensions



Need for new models

- Represent the variety of technologies
- Represent the complexity of different infrastructures
- Integration of different infrastructures
- Integrate the models of different dimensions
- Aggregation of models
- Handle the data flow

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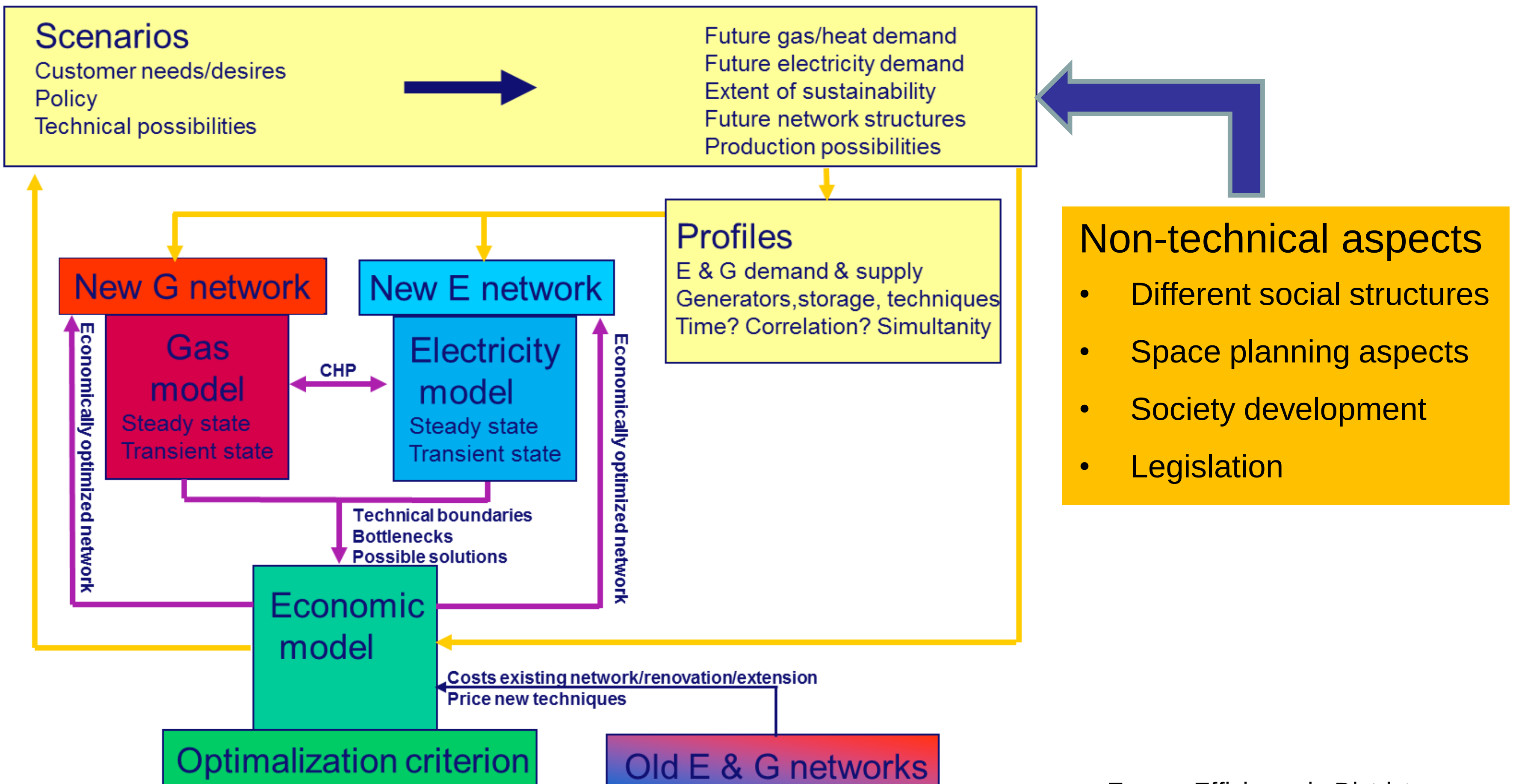
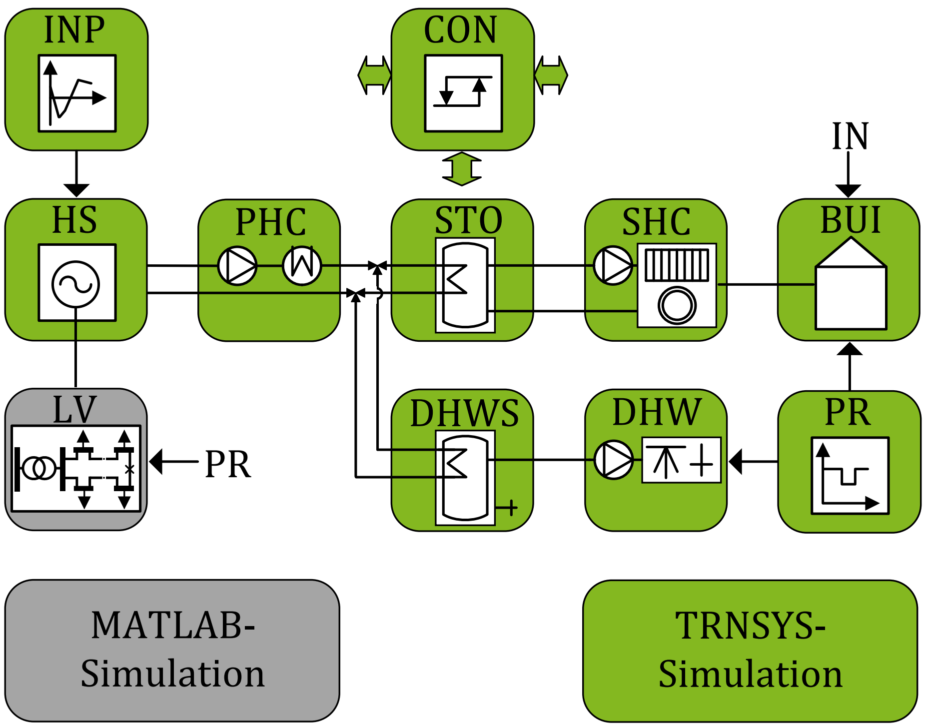
Integral Gas-Electricity-Heat-Socio-Technical-Economical model on district level for planning issues



Energy Efficiency in Districts
Research project supported by NRW

Using thermal heating systems for storage and load shifting application



- HS: Heating System
- PHC: Primary Heating Cycle
- STO: Hot Water Storage
- SHC: Secondary Heating Cycle
- BUI: Building
- DHW: Domestic Hot Water
- DHWS: DHW Storage
- PR: User Profiles
- INP: Input Data
- LV: Low Voltage Grid
- CON: System Control

L. Spitalny: Using residential heating systems for load management applications in smart cities, PES GM, Washington, 2014

Using thermal heating systems for storage and load shifting application

- Contribution to load management applications depends on energy need for heating
- Strong seasonality of thermal heat demand - high demand in winter / low demand in summer period
- Potential for management applications of a single house varies from 17.4kWh/day in December to 0.9kWh/day in August
- Increasing the storage size slightly increases the potential for load management application

Conclusion

- Smart urban grids are identified by
  - an enormous variety of technologies
  - Complexity of infrastructures
  - 2 technical and 5 non-technical dimensions
- Role of power electronics as bridge between infrastructure and applications
- New models for planning issues which incorporates different technologies and dimensions

THANK YOU FOR YOUR ATTENTION!