Exemplary Results of the German Eneff:Stadt Research Program: Strategies, Technologies and Tools
IEA-EBC Annex 73

Dr.-Ing. Rita Streblow
## Initial Situation

<table>
<thead>
<tr>
<th>Goals</th>
<th>2020</th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse gas emission in comparison to 1990</td>
<td>At least -40 %</td>
<td>At least -55 %</td>
<td>At least -80 to 95 %</td>
</tr>
<tr>
<td>Increase the share of RE in energy consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of RE in gross energy consumption</td>
<td>18 %</td>
<td>30 %</td>
<td>60 %</td>
</tr>
<tr>
<td>Reduction of energy consumption and increase in energy efficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction of primary energy consumption compared to 2008</td>
<td>- 20 %</td>
<td></td>
<td>- 50 %</td>
</tr>
</tbody>
</table>
### Necessary Primary Energy Factor

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary Energy Consumption in TWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>967</td>
</tr>
<tr>
<td>2015</td>
<td>243</td>
</tr>
</tbody>
</table>

*Heat pump with SPF = 3.5*

- Frankfurt
- Hamburg
- Berlin
- Hannover
- München
- Münster

*Primärenergieverbrauch*
Planning Structure for Germany

Climate Action Program 2020

- Federal spatial planning
- State spatial planning
- Regional planning
- Local planning

Conferences of Ministers of Spatial Planning

Public agencies

Adaptation

National Action Plan on Energy Efficiency (NAPE)

Sectoral planning

Mutual feedback
Federal Ministries in the field of urban and energy planning

■ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB)
  ≡ Create the framework conditions for good living standards and intact cities
  ≡ Promote the high level of construction technology and building materials in Germany

■ Federal Ministry for Economic Affairs and Energy
  ≡ Demonstration and pilot processes
  ≡ Systemic approaches to energetic optimization at city district level
  ≡ Development of new technologies and planning tools
Master Plan Communities
Distribution of the Research Projects

- Buildings: 100
- City quarters: 44
- Supply grids: 42
- New technologies: 204
- Tools and software: 81
- Methods and concepts: 129

Specification in number of projects
Multiple choice considered
From Research to Practice

Network solutions

Isolated consideration

Coupled consideration

2018

2050
From Research to Practice

City district

A

B

Static planning

Dynamic planning

City district

A

B

ENERGIEWENDE
From Research to Practice

2018

2050

Communication

Everyone alone

Smart City
Research Fields

Simulation

Evaluations

Web application

Interfaces
Simulations with Physical Models

GIS-Data -> Database model

Additional infos

Building data:
- Year of construction
- Type
- Floor space
- Number of floors
- ...

Building models

Building simulation
Load curves:
- Room heat
- Electricity
- Hot water
Web Services

- Integration of the user

<table>
<thead>
<tr>
<th>Building Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Data</td>
</tr>
<tr>
<td>Simulation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>BWZK Classification</td>
</tr>
<tr>
<td>Year of construction</td>
</tr>
<tr>
<td>Measured Height</td>
</tr>
<tr>
<td>Storeys above ground</td>
</tr>
<tr>
<td>Storeys below ground</td>
</tr>
<tr>
<td>Net floor area</td>
</tr>
</tbody>
</table>
Database

- **Database (PostgreSQL, Influx)**

  - **Static data**
    - Year of construction
    - Floor space
    - ...

  - **Dynamic time series**
    - Heat demand
    - Electricity demand
    - ...

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**PostgreSQL**

[https://www.postgresql.org/](https://www.postgresql.org/)

**InfluxDB**

[https://www.influxdata.com/](https://www.influxdata.com/)
Building Models

Need a building model or heat demand profile? Take one!
TEASER helps building engineers and researchers to quickly generate dynamic building models and heat demand profiles. You can try the TEASER Web App below or click here to Learn More

Parameterization
Enter your Building Information

Choose your building usage type:
- Single family house

Your year of construction:
1952

Your number of floors:
2

Your net leased area:
110

Your height of floors:
2.0

Your name of the Building:
BuildingDemo

Your methodology:
Tabula DE

You just created a simulation model with:

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Type</th>
<th>Year</th>
<th>Area</th>
<th>Nr. Floors</th>
<th>Height of Floors</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>single_family_house</td>
<td>1952</td>
<td>110</td>
<td>2</td>
<td>2.0</td>
<td>BuildingDemo</td>
</tr>
</tbody>
</table>

https://github.com/RWTH-EBC/TEASER
http://teaser.eonerc.rwth-aachen.de/

Results
How would you like your results?

Models & Model:
- AoLib-Model
- BPSA-AoLib-Model
- BPSA-Buildings-Model
- BPSA-BuildingsSystems-Model
- BPSA-IDBSA-Model

Other options:
- Download TEASER Project File?
- Simulate Model Online?

Download
Optimization of Energy Concepts for Different Settlements

1. Terraced houses with 35 single family houses
   - Heat demand: 847 MWh
   - Electricity demand: 129 MWh

2. Block structure with 16 multi family houses
   - Heat demand: 1.329 MWh
   - Electricity demand: 214 MWh

3. Block development with 36 multi family houses
   - Heat demand: 2.851 MWh
   - Electricity demand: 582 MWh
Optimization of Energy Concepts for Different Settlements

- Conventional supply
- Optimized decentral supply
- Optimized central supply
Virtual Property as Planning Instrument

Virtual property

Dynamic model

Analysis, optimization

Feedback
Cloud-Services: Optimization

- City district solutions

Zielfunktion
- Min. CO2
- Min. Kosten

Anlagenauswahl
- Kessel
- Thermischer Speicher
- Blockheizkraftwerk (BHKW)
- Wärmepumpe (Luft/Wasser)
- Wärmepumpe (Wasser/Wasser)
- Photovoltaik (PV)
- el. Batterie
- Nahwärmenetze (NWN)
- el. Heizer

- Invest building energy systems
- Operating costs building energy systems
- Subsidies
- Construction costs grid
- Energy losses grid
Cloud-Services: Physical Model

- Simulation of alternative solutions/ retrofit
Cloud-Services: Physical Model

- Simulation of alternative solutions/ retrofit
  - Insulation
  - Window change
Cloud-Services: Physical Model

- Simulation of alternative solutions/ retrofit
  - Insulation
  - Window change

![Simulation diagram with boiler, window change, and insulation](image-url)
Cloud-Services: Optimization

- Use case with a city district of 50 buildings

```
Boiler +TES

CHP+boiler+ TES

CHP+boiler+ TES + district heating

Boiler +TES
```
Research Fields

Simulation

Evaluations

Web application

Interfaces

Cloud energy management

- Control of BES
- Control of heating/cooling grid

Heat
Cold
Power
Towards Near Zero Energy Resilient Neighborhoods

- System stability
  - Missing evaluation methods and control signals

- Energy management systems

- Data- and service platforms
  - Missing operator models, legal and security

- Thermal electrical plants
  - Classical business models and missing qualified personnel

- Static procedures for single buildings

- Evaluation methods

- Static signals and missing correlation between costs and emissions

- Control signals

- Static concepts for dimensioning

- Storage systems

- Evaluation methods

- Static concepts for dimensioning

- User behaviour

- Control signals

- Static signals and missing correlation between costs and emissions

- Static procedures for single buildings
Kontakt

E.ON Energy Research Center
Mathieustraße 10
52074 Aachen
Germany

Rita Streblow
T +49 241 80 49767
F +49 241 80 49769
rstreblow@eonerc.rwth-aachen.de
http://www.eonerc.rwth-aachen.de