Energy, Comfort And Cost Optimization of a Net Zero Energy Building in Berlin

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Graphics by Braun-Kerbl-Löffler Architekten + Ingenieure
UBA – 1st Federal Net Zero Energy Building
- Project introduction

Tasks:
- approx. 30 work places
- green roof (100 % of roof area)
- bicycle-friendly
- high comfort (inside and outside)
- Accessibility
- Sustainability → BNB „Gold“
- Net zero energy building
- Monitoring

Results:
- areas: 1.076 m² net floor area
- prefabricated timber panels / ferro-concrete bottom slab
- highly insulated building envelope with cellulose
- ring-shaped arrangement of the main types of rooms due to aspects of energy and sustainability
- costs (gross): 5,0 Mio. € (KG 200 – 700)
  - KG 300: 2,0 Mio. €
  - KG 400: 1,5 Mio. €
  - KG 500: 0,5 Mio. €
  - KG 700: 1,0 Mio. €
- planning and construction time: 2009 to 2013 (2 years of construction)
- operation: since 30.08.2013
Energy Concept

Chart 5

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Photo by Andreas Meichsner
**UBA – 1st Federal Net Zero Energy Building - Energy Concept**

### Building envelope (U-Values):
- External Wall: 0.12 W/(m²·K)
- Roof: 0.08 W/(m²·K)
- Bottom Slab: 0.10 W/(m²·K)
- Windows: 0.80 W/(m²·K)

### Technical Systems:
- Lighting: electronic ballast; control depending on presence and daylight
- Ventilation: controlled high efficient fans; minimal pressure losses in the air system
- Auxiliary Energy: controlled, high efficient pumps
- Office equipment: high energy efficiency

### Electricity (Public Supplier, Battery)
- Electricity demand: ca. 46.000 kWh/a
- Predicted PV-generation: ca. 53.000 kWh/a

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**Chart 6**

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Results of Monitoring

Chart 7

Photo by Andreas Meichsner

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The calculated total energy demand (electricity) was approximately equal to the measured one. But there are differences between the calculated and the measured data for the certain technical processes. An optimization of the operation of the technical equipment is still in process.

In all years of operation the generation of electricity is higher than the consumption.

The predicted generation of electricity by PV is much less than the real generation. This is mainly caused by:

- Result of tender action,
- Design errors (software related and others)
UBA – 1st Federal Net Zero Energy Building
- Results of Monitoring

Thermal Comfort

1. W-Lan
2. Presence
3. Thermoanemometer
4. Thermometer and Humidity Sensor
5. Globe-Thermometer
6. CO₂-sensor

Vote:

• Relative Humidity: Category „A“ – good comfort (summertime)
  Category „C“ – limited comfort (wintertime)
• Air velocity: Category „A“ – good comfort

Green roof

October 2013

August 2014

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Chart 9
Optimization

- Decrease of the energy demand for the operation of the building
- Increase of the self-use of electricity generated by PV
- Options for decreasing the building costs
UBA – 1st Federal Net Zero Energy Building  
- Results of optimization process

### Building model:
- Design of the building model (DesignBuilder and EnergyPlus)
- Transient energy simulations
- Evaluation of the simulation results in comparison with the designed building (MBE: -1.2% - +1.9%, CV(RSME): +8%) and measured data (in progress)

### Costs:
- The specific costs for architectural works, systems and general equipment are approx. 35% higher compared to the analogous cost index for highly equipped buildings in Germany.
- Decrease of investment and/or lifecycle costs while achieving the same quality of the building
- Single measures and packages of the single measures were investigated.
- The best package in the study results in a decrease of the lifecycle costs by approx. 11%. The investment costs for that package is 2% less compared to the base case.
- Further measures have to be investigated.
Conclusions

- The building is well accepted by the users.
- The energetic aims are achieved in general already since the first year of operation.
- The building achieved the highest degree in certification of sustainability regarding BNB.
- Optimization process is running in cooperation with partners (Uni of Naples, Uni of Sannio).
Thank you

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