Success factors of high energy efficient buildings in Germany

Closing Seminar of Thai-German Programme on Energy Efficiency Development Plan (TGP-EEDP), 03.06.2016

Dr.-Ing. Robert Himmler
Sustainable buildings and neighborhoods

Theory…

• **Energy Plus Buildings**
  Energy and sustainability concept for zero and plus energy buildings

• **Life Cycle Costs of Buildings**
  Calculation of economic efficiency of energy saving measures

• **Master of Sustainable Design**
  Development of a new Curriculum “Master of Sustainable Design”

… and Practice!

• **EGS-plan Germany**
  More than 60 engineers working on zero energy and energy plus buildings

• **EGS-plan Bangkok**
  Newly established subsidiary to provide engineering and consulting services:
  - Energy and sustainability concepts
  - Building simulation
  - Quality control
  - Green building certification
Weather in June 2016 in Thailand and Germany

Rainy Season in Thailand

Summer in Germany
German National Energy Plan – Long Term Objectives

- Electricity consump. - 25%
- RE + 60%
- Primary energy consump. - 50%
Development of the Energy Demand of Buildings in Germany

- WSVO space-heat requirements
- EnEV PE-energy requirements
- Construction practice
- Research (demo projects)
- Solar houses
- Low-energy houses
- 3-liter houses
- Zero-heating energy houses
- Plus energy houses

Primary energy demand [kWh/(m²a)]

Year

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Market acceptance of Energy Efficiency is as stubborn as a donkey!

- education
- promotion
- emotion
- financial incentives
- laws
- regulations
- codes
- standards
Laws, Standards, Regulations
Laws and regulations regarding energy efficiency in buildings

**EPBD**

**EnEG**
Energy Saving Law

**EEWärmeG**
Renewable Energy Law (Heating)

**EEG**
Renewable Energy Law

**EnEV**
Building Energy Code

Building Envelope

Primary Energy

Solarthermal

Biomass

Grid

PV

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Energy Saving Decree and Calculation according to German Standard DIN 18599

DIN V 18599: Energy Assessment of New Buildings

Calculation of primary-, end- and use-energy demand

- In accordance with EU‘s EPBD
- Whole building approach
- Primary energy demand for heating, cooling, ventilation, domestic hot water and lighting
- Applies to residential and non-residential buildings as well as for new and existing buildings
Energy Passport for New (DIN 18599) and Existing (Energy Bills) Buildings

**ENERGEIAUSWEIS** für Nichtwohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom 1

Berechneter Energiebedarf des Gebäudes

Registriernummer

(oder: „Registriernummer wurde beantragt am...“)

Primärenergiebedarf

**CO₂-Emissionen** kg/(m²·a)

Primärenergiebedarf dieses Gebäudes

0 100 200 300 400 500 600 700 800 900 ≥1000

Anforderungen gemäß EnEV

<table>
<thead>
<tr>
<th>Anforderung</th>
<th>Wert</th>
<th>Einheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primärenergiebedarf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niveau (Vergleichswert)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modernisierter Neubau</td>
<td>kWh/(m²·a)</td>
<td></td>
</tr>
<tr>
<td>Mittlere Wärmedurchgangskoeffizienten</td>
<td></td>
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</tr>
<tr>
<td>Sommerlicher Wärmeschutz (bei Neubau)</td>
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</tbody>
</table>

For Energiedarbedarfeberechnungen verwendetes Verfahren

- Verfahren nach Anlage 2 Nummer 2 EnEV
- Vereinfachungen nach § 9 Absatz 2 EnEV
- Vereinfachungen nach Anlage 2 Nummer 2.1.4 EnEV

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Penalties regarding BEC for new and existing residential and non-residential buildings

<table>
<thead>
<tr>
<th>New Buildings</th>
<th>Parties involved</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Building not according to BEC</td>
<td>Owner and Consultants</td>
<td>2 Mio. THB</td>
</tr>
<tr>
<td>Non-Residential Building not according to BEC</td>
<td>Owner and Consultants</td>
<td>2 Mio. THB</td>
</tr>
<tr>
<td>No Energy Passport</td>
<td>Owner</td>
<td>600.000 THB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Existing Buildings</th>
<th>Parties involved</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Passport was not shown</td>
<td>Seller, Landlord</td>
<td>600.000 THB</td>
</tr>
<tr>
<td>Energy Passport was not handed over</td>
<td>Seller, Landlord</td>
<td>600.000 THB</td>
</tr>
</tbody>
</table>
EEWärmeG - Renewable Energy Law (Heating)

EEWärmeG: Possibilities to fulfil

• Use one of the following renewables:
  - solar thermal collector 0.04 m² per m² floor area
  - Heat pump SEER > 3.5
  - Wood pellet heating
  - Add biogas or biooil
  - Undercut BEC
  - Combined heat & power (CHP)

• Alternatives:
Financial Incentives
EEG Renewable Energy Law (feed-in tariff)

Electricity price/feed-in tariff [ct/kWh]

Feed-in tariff  
( PV < 30 kWp )

electricity prices ( household )

Start of operation

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Financial Incentives for Energy Efficiency in Buildings

Funding by KfW and on-lending through retail banks

State liability
Institution owned by Federal Republic and federal states

Funding by KfW
AAA Rating

Capsule market

Refinancing loan
Interest rate

Margin for credit risk and handling

Loan to customer
Interest rate

Retail bank

German Government or KfW
Promotional mandate defined by KfW Law

Advantages:
• No distortion of competition
• Concentration on core competences
• Diversification of risks
Financial Incentives for Energy Efficiency in Residential Buildings through KfW

- KfW-Effizienzhaus XX: Primary energy demand for heating, cooling and ventilation < XX kWh/m²a
- KfW-Effizienzhaus 100: New German single family house, which fulfils requirements of BEC
Education, Promotion
KfW Information Activities

Public Relations
- Internet
- Press
- Trade fairs
- Print media

Customer Relations
- Call center
- Counseling center
- Partner liaison
- Retail banks

Lobbying
- Politics
- Government
- Associations etc.

Awards

KfW Academy

Assistance to Marketing partners

Advisor data base

Equity holding

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Information and Consulting through DENA (German Energy Agency)
Emotion
Pilot and Demonstration Projects

- WSVO space-heat requirements
- EnEV PE-energy requirements
- research (demo projects)
- construction practice
- solar houses
- Low-energy houses
- 3-liter houses
- zero-heating energy houses
- plus energy houses
Energy Plus Buildings as Demonstration and Pilot Projects

Renewable Energy
Generation

Renewable Energy generated onsite and supplied to grid

Renewable Energy generated and consumed onsite

Energy Saving

Energy Demand
SMA Solar Academy Kassel, Germany
Plus Energy Concept

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Single Family House Berghalde, Leonberg, Germany
Energy Plus Concept
The Pruksa+ Project in Bangkok

Idea:
Design of a single family house, which fulfils the highest sustainability and energy requirements.

Implementation:
- 50 % reduction of cooling energy demand by passive measures
- 50 % of total energy demand (cooling & household appliances) will be covered by solar energy
- DGNB Gold sustainable building certification anticipated
Building Physics

Roof:
Mineral Wool
(10 cm, U < 0.3 W/m²K)

Wall:
Mineral Wool
(5 cm, U < 0.6 W/m²K)

External Shading

Back-ventilated Roof

Window:
Glazing: \( U_g = 1.7 \text{ W/m}^2\text{K} \); \( g = 0.33 \); \( \tau = 0.66 \)
Frame: \( U_f = 1.5 \text{ W/m}^2\text{K} \)
Energy Supply with 5 kW PV field and a 1000 l ice storage

- PV Field (5 kW)
- Public Grid
- Dry Heat Rejection
- Domestic Hot Water Storage
- Water cooled Cold Water Chiller
- 1000 l Ice Storage
- Fan Coils (10 kW)
- Household appliances
- Bathroom

➢ Energy Costs: 10,000 THB/a
Measurement and Verification

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Thank you for your Attention!