21ST ENERGY EFFICIENCY COORDINATION GROUP MEETING AND WORKSHOP

Towards the EPBD Implementation - a practical software approach for an EPC calculation

November 20th 2019, Vienna
Venue: Energy Community Secretariat

Simon Wössner
Hans Erhorn

Building on knowledge
Bigger picture

- Incentives
- Monitoring
- Training
- Methodology/Assessment
- Software
- Legal frame
- Awareness
Legal frame
Background

Development of Energy-saving Construction

Primary energy need semi-detached house – heating [kWh/m²a]
German history of energy requirements in Buildings
The implementation of the EPBD in Germany

**EPBD**

Energy Conservation Act

Renewable Energies Heat Act

Energy Saving Ordinance (EnEV)

Technical rules, Standards

DIN V 18599 „Energetische Bewertung von Gebäuden“, DIN 4108-6, DIN 4701-10
How to determine the overall energy performance?

Comparison with reference building approach:

Reference Building

- Reference-air handling
- Reference heating
- Reference hot water
- Reference illumination

Planned Building

- $H_{T,\text{ref}}$
- $H_{T,\text{real}}$
- $f_{p,\text{AHU, real}}$
- $f_{p,\text{Heat, real}}$
- $f_{p,\text{DHW, real}}$
- $f_{p,\text{Light, real}}$

Utilization specific:
- Interior temperature
- Exchange of air
- Utilization period
- Requirement of hot water

$Q_{p,\text{ref}} = Q_{p,\text{max}}$

$Q_{p,\text{real}} \leq Q_{p,\text{max}}$
Cost optimal procedure for setting energy performance requirements for Luxembourg

- Batch calculation tool using the same calculation method as the programme for EPC Calculation.
- Over 5600 variations of buildings, envelope classes and technical systems have been calculated for Luxembourg.
Questions/Remarks
Methodology/assessment
CEN Series 520xx
<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Standard</th>
<th>Module</th>
<th>Description</th>
<th>Standard</th>
<th>Module</th>
<th>Description</th>
<th>Standard</th>
<th>Module</th>
<th>Description</th>
<th>Standard</th>
<th>Module</th>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Concrete</td>
<td>EN 1993</td>
<td>2</td>
<td>Concrete</td>
<td>EN 1994</td>
<td>2</td>
<td>Concrete</td>
<td>EN 1995</td>
<td>2</td>
<td>Concrete</td>
<td>EN 1996</td>
<td>2</td>
<td>Concrete</td>
<td>EN 1997</td>
</tr>
<tr>
<td>5</td>
<td>Building</td>
<td>EN 1993</td>
<td>5</td>
<td>Building</td>
<td>EN 1994</td>
<td>5</td>
<td>Building</td>
<td>EN 1995</td>
<td>5</td>
<td>Building</td>
<td>EN 1996</td>
<td>5</td>
<td>Building</td>
<td>EN 1997</td>
</tr>
</tbody>
</table>

- 100 Standards in 11 modules with approx. 50% Technical Reports (TRs)
Replacing a module with a non-EN or EN-ISO-standard one

- Possible **thanks to the modular structure**
- ... but the I/O structure has to be respected
- Needed info can be found both in the accompanying XLS and in the specific I/O clauses in the EN or EN-ISO standard
Set of EPB standards: unambiguous but flexible
(allowing national choices, boundary conditions and input data)

➔ Each EPB standard contains:

• **Annex A (normative):** template for choices and input data needed for using the standard

• **Annex B (informative):** informative default choices and input data

• In general:
  – Each individual user of the EPB standard is free to create his/her own data sheet according to the template of Annex A
  (~ replace the default choices and values of Annex B)
The Directive (EU) 2018/844 of the European Parliament and of the Council of 30. May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (further on referred as EPBD) defines the determination of the energy efficiency and the calculation methodology. It defines that “Member States shall describe their national calculation methodology following the national annexes of the overarching standards, namely ISO 52000–1, 52003–1, 52010–1, 52016–1, and 52018–1, developed under mandate M/480 given to the European Committee for Standardisation (CEN). This provision shall not constitute a legal codification of those standards“.

(b) point 2 is replaced by the following:

‘2. The energy needs for space heating, space cooling, domestic hot water, ventilation, lighting and other technical building systems shall be calculated in order to optimise health, indoor air quality and comfort levels defined by Member States at national or regional level.’
Currently the standards of mandate 480, also considering the national appendencies A, may not be used for calculations regarding the laws on energy savings in buildings.
Questions/Remarks
Methodology/assessment

DIN V 18599
The German calculation approach - DIN V 18599
Energy demand of buildings

Joint working group of standardisation committee for buildings and buildings envelope (NABau), technical systems (NHRS) and lighting (FNL)

Main features:
- Final energy demand for heating / hot water demand / ventilation / lighting / cooling / building automation
- Produced energy from renewables
- Energy need, energy use, delivered energy, primary energy and CO₂ demand for building services

Basics:
- Use of existing rules as far as possible
- Take care of European harmonisation
- Use simplifications for certification as much as possible
- Uniform holistic approach for all building types and ages
Holistic calculation approach for overall energy performance calculation – DIN V 18599
Structure of DIN V 18599

Part 1:
- General balancing procedures
- terms and definitions
- zoning
- evaluation of energy sources

Part 2: Net energy demand for heating and cooling of zones
Part 3: Net energy demand for air conditioning
Part 4: Net and final energy demand for lighting
Part 5: Final energy demand of heating systems
Part 6: Final energy demand of ventilation systems and air heating systems for residential buildings
Part 7: Final energy demand of air-handling and air-conditioning systems for non-residential buildings
Part 8: Net and final energy demand of domestic hot water systems
Part 9: Final and primary energy demand of power generation plants
Part 10: Boundary conditions of use, climatic data
Part 11: Building automation
User profiles define indoor quality/comfort requirements

May not be changed for EPC calculations (at least in Germany, Luxembourg and Montenegro)

Ensure that requirements/comfort level of buildings are comparable
## Comparison with other standards (ASIEPI, 2008)

<table>
<thead>
<tr>
<th>country</th>
<th>Belgium</th>
<th>Czechia</th>
<th>Denmark</th>
<th>Finland</th>
<th>France</th>
<th>Germany</th>
<th>Greece</th>
<th>Hungary</th>
<th>Italy</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Luxembourg</th>
<th>Malta</th>
<th>Netherlands</th>
<th>Norway</th>
<th>Poland</th>
<th>Portugal</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>demand depend. Ventilation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>decentralized ventilation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>passive double façade</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>active double façade</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>innovative paints</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>air tightness products</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>micro CHP</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>absorption heat pump</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>gas driven heat pump</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>heat recovery</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>countercur. heat exchanger</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DC ventilators</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>energy management systems</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>daylight sensors</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>presence detection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3-pane glazing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Insluted frames</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>sun screening glass</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Modifications / international applications

- Luxembourg
  - Modifications in national regulation RGD (PV / Simplifications / ...)
  - Use of german climate / user profiles

- South Korea
  - for non-residential buildings (DIN V 18599:2007)
  - Thinking about update to DIN V 18599:2018
Modifications / international applications

- Montenegro
  - DIN V 18599:2018 used for national software
  - Modifications
    - 2 or 3 climate zones
    - User profiles are adjusted to montenegrin conditions

- General
  - DIN V 18599 in progress of being translated to English
  - Pre standard in order to keep the standard up to date easier
  - Can be referenced in regulations of other countries without licence fees to DIN
Questions/Remarks
Software
Calculation library for DIN V 18599

- First release in November 2005, now Version 5 in development
- Included in most German calculation programmes for calculating the energy performance
- Automatic generation and calculation of the reference building for Germany and Luxembourg
- Constantly validated, improved and updated
- Currently adaption for Luxemburg and Montenegro in progress
ibp18599kernel: calculation library for DIN V 18599 quality control procedures
IBP:18599 Software for Germany - Characteristics

- Aiming at energy efficiency specialists
- Showing all final and intermediate results
- Designed for in depth analysis of the calculated energy demand

- Mode for certification
  - Fixed user profiles, fixed climate, generating EPCs and uploading it to the registry for automated checks

- Mode for consulting
  - User profiles can be adapted
  - 15 climates zones available
IBP:18599 Software for Germany
IBP:18599lux Software for Luxembourg - Characteristics

- Based on the German programme
- Several simplifications included: building envelope defined for whole building and distributed to zones / HVAC assistant
- Reference building and EPC according to RGD 210
- Aiming at nearly zero energy buildings (NzEBs)

- Mode for certification
  - Fixed user profiles, fixed climate, generating EPCs and uploading it to the registry for automated checks

- Mode for consulting
  - User profiles can be adapted
  - 15 climates zones available
IBP:18599lux Software for Luxembourg
IBP:18599lux Software for Luxembourg

<table>
<thead>
<tr>
<th>Fläche im gesamten Gebäude</th>
<th>Flächenanteil in der Zone</th>
<th>Fläche in der Zone [m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Außenwand</td>
<td></td>
<td>497,70 [m²]</td>
</tr>
<tr>
<td>Dach</td>
<td></td>
<td>294,00 [m²]</td>
</tr>
<tr>
<td>Fußboden</td>
<td></td>
<td>294,00 [m²]</td>
</tr>
<tr>
<td>Fenster N</td>
<td></td>
<td>60,50 [m²]</td>
</tr>
<tr>
<td>Fenster NO</td>
<td></td>
<td>0,00 [m²]</td>
</tr>
<tr>
<td>Fenster O</td>
<td></td>
<td>47,70 [m²]</td>
</tr>
<tr>
<td>Fenster SO</td>
<td></td>
<td>0,00 [m²]</td>
</tr>
<tr>
<td>Fenster S</td>
<td></td>
<td>56,40 [m²]</td>
</tr>
<tr>
<td>Fenster SW</td>
<td></td>
<td>0,00 [m²]</td>
</tr>
<tr>
<td>Fenster W</td>
<td></td>
<td>56,30 [m²]</td>
</tr>
<tr>
<td>Fenster NW</td>
<td></td>
<td>0,00 [m²]</td>
</tr>
</tbody>
</table>
IBP:18599lux Software for Luxembourg
IBP:18599lux Software for Luxembourg

Beta test successful
EPC Software Montenegro – Characteristics

- Currently in development (Cooperation Ministry of Economy / Directorate for Energy Efficiency, Montenegro/IBP/ Fichtner/KfW)
- Release expected begin of 2020
- Tailored to Montenegrin needs
  - Three Climate zones
  - User Profiles adapted to Montenegrin rulebook
  - Typical constructions
- Generation of Montenegrin Energy Performance Certificate will be included
- Upload to national registry of EPCs is forseen
- Multilingual support built in, the software *EPC Software Montenegro* will be available in English and Montenegrin language
EPC Software Montenegro – Characteristics

- Completely new software and not based on existing German software

- Main goal was to enable energy auditors to calculate energy demand with the new software with a very gentle learning curve
  - Input similar to calculations with EN ISO 13790
  - Expert mode included (especially for HVAC part)

- Ensure calculation is in accordance with the rulebook/national regulations without necessarily having to look at the rulebook/national regulations for the calculation itself
  - User profiles with all requirements on temperatures, occupancies, lighting levels, air volume flows, etc. included
  - HVAC efficiencies not an input to the calculation, but a result of the calculation
EPC Software Montenegro – Costs, licence and timeframe

- Custom tailored software for a specific country, not a “one for all” software!
  - Regular phone calls with ministry
  - Consulted by an experts panel from Montenegro (Architects and HVAC specialists)
  - EPC for country will be included, upload to registry possible

- Additional services included for Montenegro
  - Check of climate, user profiles
  - Cooling study on impact of hourly calculation
EPC Software Montenegro – Costs, licence and timeframe

- The energy auditors can download and use the software free of charge!

- Initial costs for developing the software less than 200,000€

- Maintenance contract can be offered in various levels (regular maintenance / with or without third level support/…)

- Major updates with added functionality possible based on expenses (Fraunhofer is a non-profit organization!)

- Work started 04/2019, Beta Version for field test ready 12/2019
EPC Software Montenegro

Mode for:
- certification: fixed user profiles, etc to ensure calculation is done according to laws / rulebooks
- consumption: not measured consumption, but calculation with free conditions (user profiles can be adapted)

Instant update of results
EPC Software Montenegro

PRAVILNIK
O MINIMALNIM ZAHTJEVIMA ENERGETSKE EFIKASNOSTI ZGRADA

I. OSNOVNE ODREDBE

Predmet

Član 1

Ovim pravilnikom utvrđuju se minimalni zahtjevi po pitanju energetske efikasnosti zgrada, vrste zgrada koje u skladi sa namjenom ne moraju da ispunjavaju minimalne energetske karakteristike i metodologiju izračunavanja energetskih karakteristika zgrada.

Tabela 3: Infiltracija (orijentacione vrijednosti)

<table>
<thead>
<tr>
<th>Minimalne vrijednosti</th>
<th>Infiltracija n [h⁻¹]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Svi tipovi zgrada (radno vrijeme/van radnog vremena)</td>
<td>0.5 / 0.3</td>
</tr>
<tr>
<td>Procijenjene vrijednosti prema stanju i položaju objekta</td>
<td>Infiltracija n [h⁻¹]</td>
</tr>
<tr>
<td>Stanje zgrade</td>
<td>Otvoreno</td>
</tr>
<tr>
<td>Prozori i spoljašnji zidovi u lošem stanju</td>
<td>1.4</td>
</tr>
<tr>
<td>Prozori i spoljašnji zidovi u normalnom stanju</td>
<td>0.9</td>
</tr>
<tr>
<td>Prozori i spoljašnji zidovi dobro zaprti</td>
<td>0.6</td>
</tr>
<tr>
<td>Infiltracija na osnovu Blower-door Testa</td>
<td>Faktor položaja objekta (Ke0)</td>
</tr>
<tr>
<td></td>
<td>14.1</td>
</tr>
</tbody>
</table>

Infiltracija

Location of building | Very sheltered |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition of building</td>
<td>Windows and façade walls in bad condition</td>
</tr>
<tr>
<td>Air change rate</td>
<td>0.50 1/h</td>
</tr>
</tbody>
</table>
Check maximum U-values according to rulebook
Three modus (wizard / use wizard to start detailed modelling / no wizard at all)
EPC Software Montenegro
Bigger picture

- Incentives
- Monitoring
- Software
- Training
- Methodology/Assessment
- Legal Frame
- Awareness
Simon Wössner / Hans Erhorn
Fraunhofer Institute for Building Physics
simon.woessner@ibp.fraunhofer.de
www.ibp.fraunhofer.de/eer