Assessment of EPC input data based on recalculation and on-site validation:

Reasons behind and lessons learnt from the QUALICHeCK case study carried out in the Salzburg region of Austria

Susanne Geissler
ÖGNB – Österreichische Gesellschaft für Nachhaltiges Bauen
(Austrian Sustainable Building Council)
geissler@oegnb.net

10th May 2016
Content of presentation:

• Background information on Austrian framework conditions

• Background, objectives and content of the Austrian QUALICheck case study carried out in Salzburg region

• Summary of results
Austria is one of nine EU member states involved in QUALICHeCK and carried out a new study on EPC quality.
Background information on framework conditions in Austria:

9 Austrian regions - 9 Austrian provinces in charge of building legislation and building related subsidy schemes
Case study region: province Salzburg
9 provinces - 9 building laws - 1 guideline:

- All provinces are represented in OIB
- OIB develops and issues OIB Guideline 6 and Technical Guideline to comply with EPBD
- Provinces provide input to guideline development and integrate OIB Guideline 6 into their building legislation (fully or with amendments)
- Subsidy legislation builds on the EPC

OIB Guideline 6 as basis for revision of building legislation in the provinces

Input to development / revision of OIB Guideline 6

OIB Guideline 6 refers to Austrian Standards; thus Austrian Standards become part of the legislation automatically if OIB Guideline 6 is integrated into building legislation.
Background information

Relation between building legislation and energy-related building subsidy scheme:

• In the federal province of Salzburg, the EPC is necessary to receive an energy-related subsidy.

• The legal framework conditions for the EPC required by the subsidy scheme and required by the building legislation are the same, only energy performance requirements are more ambitious than energy performance requirements to comply with the building legislation, and the two-step EPC-procedure has to be followed (since 2011 not only required by subsidy scheme but also by building law).

• To receive construction permission, the authority must accept the planning EPC. Additional changes during the implementation planning have to be considered in the updated EPC (in this paper called “completion EPC”), which proves whether the final planning and completion of the building still meets the requirements in terms of energy performance in order to receive the subsidy. The subsidy is paid after completion of the building provided that all requirements are met.

• In Salzburg, the regional EPC database is used for automatic compliance checks in terms of meeting energy minimum requirements (e.g. energy performance indicator, U-values, n50 requirements) and EPC availability. At present, compliance of determining EPC input data is not checked on a regular basis.
Two-step EPC in Salzburg region

Preliminary EPC (Design EPC; limited validity)
Based on design documents

Final EPC (Completion EPC, validity according to EPBD)
Based on final building documents and random site visits

Reasons for checking EPC quality and updating preliminary EPC:

Range of interpretation / lack of quality of input data: EPC could be C or B

Deviation from plan (design changes): Different products with worse energy efficiency performance than planned

Lack of quality of the works: Mistakes during construction (leakages, wrong installations, etc.)

Building design/ EPC calculation

Material/component procurement

Building construction

New buildings and major renovations

May 2016
Motivation, objectives, scope

Motivation of the study
In Austria, there are concerns related with EPC market acceptance and evaluation of EPC statistics for policy making. Concerns refer to:
• the range of interpretation when choosing EPC input data,
• the quality of EPC in relation with the as-built situation, and
• regional differences regarding quality of EPC.

Objectives of the study
• To analyse the range of deviation of EPC energy performance indicators depending on the quality of input data, the type of EPC, and the legal framework applied to assess compliance (regional and federal level).

Scope of study
• 26 multi-unit new residential buildings in rural and urban areas
• Constructed between 2009 and 2014 in the province Salzburg
• Well documented with EPC issued after 2009 (design EPC and completion EPC)
• Approximately total gross floor area 30,000 m²
Four focal points of analysis

1. **Comparison of the planning EPC and completion EPC** of 26 multi-unit residential buildings in terms of quality and compliance of input data according to OIB Guideline 6 and adaptations on federal province level; evaluation and analysis of deviations;

2. **Recalculation of the completion EPCs of 26 multi-unit residential buildings** by an independent team according to OIB Guideline 6 and information specifically collected for this purpose such as implementation plans; evaluation and analysis of deviations;

3. **Detailed technical investigation of compliant input data** concerning the impact of compliant default input values stated in OIB Guideline 6 compared to compliant specific input values according to detailed calculation procedures following OIB Guideline 6 including references to Austrian and ISO standards;

4. **On-site investigation of 11 selected buildings** out of the 26 multi-unit residential buildings.
Project team study Austria

ÖGNB (QUALICHeCK project partner)
  • Susanne Geissler and Peter Wallisch

UAS Technikum Vienna (University of Applied Sciences, subcontract for study)
  • Lukas Maul, Marc Wohlschak (Lecturers/scientists)
  • Students attending the programme „Urban Renewable Energy Technologies“:
    Fabio Denner, Christian Handschuh, Simon Hinterseer, Marina Kreuzinger, Jan Schindl, David Stuckey

Region Salzburg (implementing the EPBD and running the regional EPC-database)
  • Georg Thor and colleagues
  • Franz Mair

Salzburg Wohnbau (building owner)
  • Bernhard Kaiser

GEQ - Zehentmayer Software (EPC calculation software company)
  • Josef Zehentmayer
1. Comparison of the planning EPC and completion EPC of 26 multi-unit residential buildings in terms of quality and compliance of input data according to OIB Guideline 6 and adaptations on federal province level:

Although required, the EPC input data had not been updated in 5 buildings out of 26 (buildings 6, 13, 15, 16, 21). The deviation between the planning and the original completion EPCs is of less than 5% for 17 out of the remaining 21 buildings, mainly due to design changes. Reasons for strong deviations are changes in regulation and software updates between issuing the planning EPC and the completion EPC. The comparison is based on the energy performance indicator SHD [kWh/m2GFAa] (Space Heating Demand in kWh per m2 Gross Floor Area and year).
2. Recalculation of the completion EPCs of 26 multi-unit residential buildings by an independent team according to OIB Guideline 6 and information specifically collected for this purpose such as implementation plans:

The re-calculated (within the study) EPCs deviate from the original completion EPCs between -29 to 38%. Main reasons are different interpretation of rules and compliant multiple data input options (default values, calculated values, simulation results). These deviations and the weaknesses concerning input data are mainly caused by unclear definitions and misinterpretations by EPC experts, especially regarding the reference area for the energy performance indicator.
Buildings 3, 4, 5 - Reasons of deviation (recalculated indicator is much worse than original):
• Part of conditioned area not taken into account
• Geometry of windows not correct
• Only one type of wall construction instead of different types (deviations in U-values)
• Only one type of floor construction instead of different types (Deviations in building volume)

Building 10 - Reasons of deviation (recalculated indicator is a little bit better than original):
Mistakes balance each other:
• Part of conditioned area not taken into account
• Indoor wall defined as outdoor wall, therefore 27% more outdoor wall (U-values)

Building 14 - Reasons of deviation (recalculated indicator is a little bit worse than original):
• Differences in window area
• No zoning between residential and commercial building part
3. Detailed technical investigation of compliant input data:

Several procedures of determining input data are compliant: methods of detailed calculation of input data as well as considering default values stated in the respective documents. The study investigated several methods of determining compliant input data for the following parameters:

- Thermal bridges
- Shading coefficient
- Building services such as photovoltaics and solar thermal systems

To determine the input values for thermal bridges, **three different options are compliant and eligible to be chosen by the EPC expert:**

- Default EPC calculation with predefined ψ-values from Table 1 in ÖNORM B 8110-6
- EPC calculation with default ψ-values specified for reference constructions in ÖNORM EN ISO 14683
- Dynamic calculation of ψ-values following the calculation method stated in ÖNORM EN ISO 10211

**Specific determination of input values compared to default values improves the Space Heating Demand SHD between 8 to 38 %.”**
4. On-site investigation of 11 selected buildings out of the 26 multi-unit residential buildings:

The on-site investigation of 11 selected sample buildings showed minor deviations comparing as-built situation and implementation plans. Deviations concern window installations and building services.

The deviations between EPC data and as-built situation cannot be directly linked with the quality of the works, but can be explained by limitations set by the EPC software.
# Overview and basic data of the investigated building sample

<table>
<thead>
<tr>
<th>Building number</th>
<th>Photovoltaics (PV)</th>
<th>Solarthermal energy (ST)</th>
<th>Heating system (district heating – DH)</th>
<th>Position (urban, rural, valley, etc.)</th>
<th>Gross Floor Area GFA (according completion EPC) (m²)</th>
<th>Year of construction completion</th>
<th>Input data of Planning EPC (default, specific or no input)</th>
<th>Input data of Completion EPC (default, specific or no input)</th>
<th>Thermal bridges</th>
<th>Shading / solar gains</th>
<th>Building services</th>
<th>Thermal bridges</th>
<th>Shading / solar gains</th>
<th>Building services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>valley</td>
<td>1142</td>
<td>2013</td>
<td>specific, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>2</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>rural</td>
<td>1607</td>
<td>2013</td>
<td>default, default, no input</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>3</td>
<td>PV</td>
<td>no ST</td>
<td>DH</td>
<td>urban</td>
<td>1933</td>
<td>2013</td>
<td>default, specific, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>specific, default</td>
<td>default</td>
</tr>
<tr>
<td>4</td>
<td>PV</td>
<td>no ST</td>
<td>DH</td>
<td>urban</td>
<td>1584</td>
<td>2013</td>
<td>default, specific, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>specific, default</td>
<td>default</td>
</tr>
<tr>
<td>5</td>
<td>PV</td>
<td>no ST</td>
<td>DH</td>
<td>urban</td>
<td>1895</td>
<td>2013</td>
<td>default, specific, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>specific, default</td>
<td>default</td>
</tr>
<tr>
<td>6</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>valley</td>
<td>864</td>
<td>2013</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>7</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>valley / rural</td>
<td>1218</td>
<td>2012</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>8</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>valley</td>
<td>1499</td>
<td>2012</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>9</td>
<td>no PV</td>
<td>no ST</td>
<td>DH</td>
<td>valley</td>
<td>1234</td>
<td>2012</td>
<td>specific, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>10</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>rural</td>
<td>1393</td>
<td>2013</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>11</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>rural</td>
<td>811</td>
<td>2013</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>12</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>rural</td>
<td>819</td>
<td>2011</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>13</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>valley</td>
<td>1261</td>
<td>2011</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>14</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>urban</td>
<td>953</td>
<td>2011</td>
<td>default, default, no input</td>
<td>default, no input, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>15</td>
<td>no input</td>
<td>no input</td>
<td>no input</td>
<td>urban</td>
<td>731</td>
<td>2011</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>16</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>urban</td>
<td>990</td>
<td>2011</td>
<td>default, default, default</td>
<td>default, default, default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
<td>default</td>
</tr>
<tr>
<td>17</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>urban</td>
<td>519</td>
<td>2013</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>18</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>urban</td>
<td>1334</td>
<td>2011</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>19</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>urban</td>
<td>794</td>
<td>2014</td>
<td>default, default, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>20</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>urban</td>
<td>1049</td>
<td>2014</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>21</td>
<td>no PV</td>
<td>ST</td>
<td>DH</td>
<td>rural</td>
<td>601</td>
<td>2014</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>22</td>
<td>no PV</td>
<td>no ST</td>
<td>DH</td>
<td>rural</td>
<td>978</td>
<td>2011</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>23</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>rural</td>
<td>1049</td>
<td>2014</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>24</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>rural</td>
<td>601</td>
<td>2014</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>25</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>rural</td>
<td>601</td>
<td>2014</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>default</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
<tr>
<td>26</td>
<td>no PV</td>
<td>ST</td>
<td>Pellets</td>
<td>rural</td>
<td>1049</td>
<td>2014</td>
<td>specific, default, default</td>
<td>default, specific, default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
<td>specific</td>
<td>default</td>
</tr>
</tbody>
</table>

The indication “no input” results from the fact, that no input data for building services was entered by the EPC expert in the planning EPCs. Grey cells indicate buildings visited on-site.
Conclusions

• Despite of deviations, all investigated buildings still meet the mandatory energy performance minimum requirements. In this regard, compliance rate is 100%.

• With regard to compliance of input data, there are obvious mistakes but also different viewpoints, depending on the interpretation of the rules.

• E.g. Different interpretation of “conditioned area” on province level compared with the guideline on federal level which aims at regional harmonisation, and thus contradicts this objective.

• Apart from unclear rules, it is also difficult to control compliance of input data due to several compliant options how to determine input data.

• Use of compliant default input data can result in compliant EPCs far from reality ("unrealistic" EPC), because energy performance minimum requirements are met.

• EPC related standards and calculation programs show considerable weaknesses regarding the as-built description of building services systems in the EPC.
Recommendations

Compliant input data and methods how to determine them

- Default values have to be reviewed and revised, especially the shading factor.
- In new buildings, it should not be allowed to use default values for thermal bridges, but detailed calculation should be required.
Recommendations

• It is important to implement a control mechanism that allows checking whether design changes have been actually and fully updated in the completion EPC or not.

• This can be solved by using the automatic check of a few selected crucial EPC parameters (input data connected with building services products) during uploading the planning EPC and completion EPC into the EPC database, e.g. by connecting the building services products database with the EPC database.
Recommendations

Additional training / education programs for Austrian EPC experts

• Currently, EPC experts are entitled by defined types of professional licenses and do not have to attend an additional training or pass an additional examination.

• However, quality of EPC input data especially concerning correct interpretation of requirements and correct determination of input data could be improved with additional trainings and compulsory minimum educational requirements in addition to professional licenses. Specific knowledge is necessary especially regarding the correct presentation of building services systems in the EPC.
Thank you for your attention!

More information: office@oegnb.net