QUALICHeCK
Towards better quality and compliance

Which lessons can we learn from the studies on the ground – experiences in 9 EU countries

4 th QUALICHeCK conference 21 Feb 2017 Brussels

Jarek Kurnitski, Tallinn University of Technology

TALLINN UNIVERSITY OF TECHNOLOGY

Co-funded by the Intelligent Energy Europe Programme of the European Union

QUALICHeCK

QUALICHeCK approach Status on the ground

- Existing data analyses report based on 31 previous studies:
  - Measured performance
  - Reliability of input data
  - Quality of the works
  - Compliance frameworks
- 10 new data collection studies from 9 focus countries

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHeCK

QUALICHeCK approach Status on the ground

- Technology areas covered:
  - Transmission characteristics and air tightness
  - Ventilation systems
  - Summer thermal comfort solutions
  - Renewable systems (heat pumps, thermal solar, PV)

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHeCK

New data collection studies on

- EP compliance and EPC input data quality (5 studies)
  - Site visits
  - Check of design documentation
  - New EPC calculation
- Summer thermal comfort compliance (1 study)
  - Measurements, design documentation, temperature simulations
- Reliability of EPC issued with different methods (1 study)
- Transmission characteristics related studies (3 studies)
  - Cavity insulation: quality framework for cavity wall insulation
  - Windows: input data on window thermal performance
  - U-values compliance

→ Reports available in February 2017, see factsheets: http://qualicheck-platform.eu/

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHeCK

Some findings: Compliance frameworks

- Compliance frameworks may stop to scheme design/building permit; final design, construction and as built energy performance of buildings is not under control, i.e. the **compliance is controlled until issuing the building permit**

- Many of countries have no control mechanism for:
  - Final design/production information
  - Design changes during construction
  - Commissioning
  - ⟹ **As built energy performance not known**

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

4 out of 9 countries have compliance frameworks extended to final design and construction and commissioning phases

Assessment type[a] →	Calculated (asset)			Measured (operational)
Sub-type[a] →	Design		**As-built**	Actual
Typical time frame →	Building permit		**After completion of the works**	<2 years after completion
Used for EPC →	Yes	No	**Yes**	Yes
Country ↓				
AT	•			
BE			•	
CY	•			
EE	•			
ES		•	•	
FR		•[b]	•	
GR	•			
RO		•[b]	•	
SE		•[b]		•

[a] Defined in FDIS ISO 52000-1:2016 (Energy performance of buildings — Overarching EPB assessment – Part 1: General framework and procedures)
[b] Not based on EPC method

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Control of performances!

Government

Accredited organisation(s)

Certified building contractor

Random checks

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Building airtightness

French approach in framework of new regulations introduced in 2012

OPTION 1: Certified tester

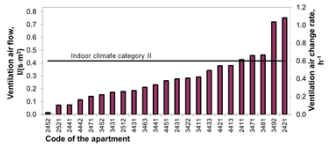
Control of the end result!

OPTION 2: Building firm with integral quality approach

Control of competence/organisation (and end result)!

Most of ventilation studies report poor performance

- In France 47% of inspected dwellings (604 dwellings out of 1.287) did not comply with the ventilation regulation (right)
- Airflow rates below the design value in nearly two thirds of Estonian new apartments (below)



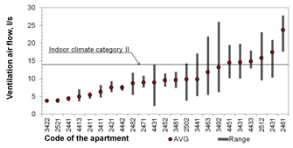
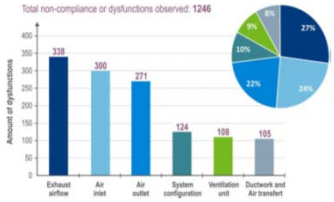


Table 1 Ventilation system failure modes in a study of 40 dwellings

Value	Description
33 (82.5%)	Ductwork incorrectly fitted (kinked / bent / poor joints / excessive length)
10 (25%)	Undersized fans to meet the minimum ventilation requirement
6 (15%)	Insufficient fans or terminal outlets for dwelling type
3	No boost function
3	Incorrect installation data
2	Missing ductwork
1	Blocked ductwork

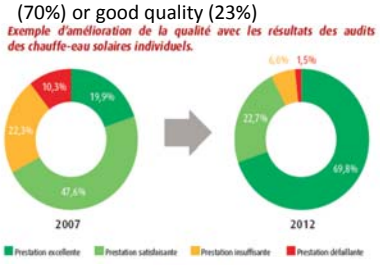


TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK Towards better quality eco-compliance

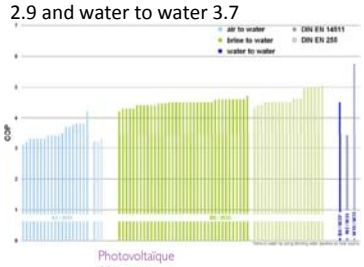
Mostly positive studies about renewable systems

- In France 93% of the audited solar thermal installations had an excellent (70%) or good quality (23%)

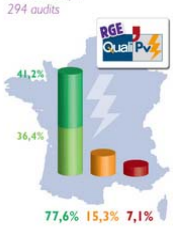


- Wood boilers

- In Germany ground source heat pumps reached an average seasonal performance factor (SPF) of 3.9, air to water heat pumps 2.9 and water to water 3.7



- PV



TALLINN UNIVE TECHNOLOGY

ICHECK

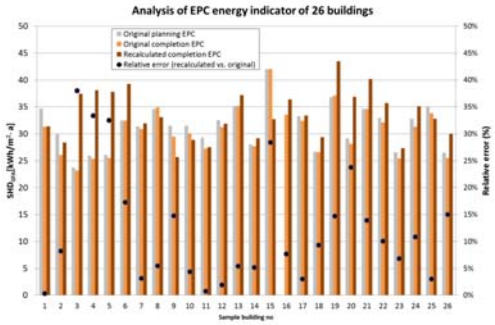
Austria: assessment of EPC based on recalculation and on-site validation

- Compliance of 26 multi-family buildings in the Salzburg region constructed between 2009 and 2014 that applied for energy-efficiency subsidies was analyzed
- Subsidy system required an updated compliant EPC upon completion of the building
- The study recalculated EPCs based on original building documents such as site foreman's plan and, by comparing original EPCs and recalculated EPCs, investigated reasons for errors in determining input data

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Austria: assessment of EPC based on recalculation and on-site validation



- EPC input data not updated in 5 buildings out of 26 (20%) resulting in errors on space heating demand in the range of 5-28%
- The deviation between the planning and the original completion EPCs was less than 5% for 17 out of the remaining 21 buildings, mainly due to design changes
- Recalculated EPCs deviated from the completion EPCs between -29% and 38%, large deviations because of interpretation of rules and compliant multiple data input options

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Sweden: Compliance of Energy Performance Certificates

- EPC in Sweden is based on measured energy use (to be issued within 2 year after taken in use)
- The measured energy use is corrected for the reference year, and should also be corrected for the normal use, but as no standard methodology is available this is seldom done
- Differences between Measured and Calculated Energy Use in EPCs versus Building Permits have been analyzed

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Sweden: Compliance of Energy Performance Certificates

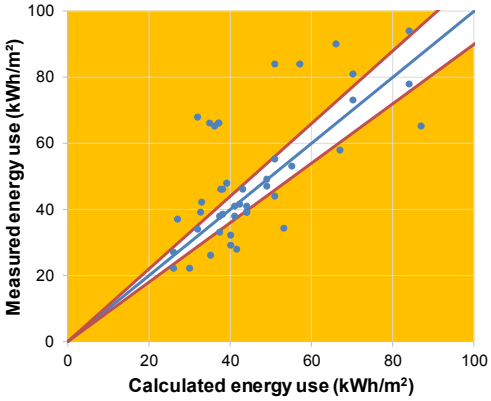
- 313 newly built houses were studied. Of these **100 houses** had been taken in use two years prior to this study.
- We found 44 EPCs which means **44% of the buildings complied with the requirements of the EPBD**.
- There are no court cases of home owners lacking a EPC and Boverket does not proceed with legal actions (applies for houses not sold or rented)
- The study revealed that the energy use in a single-family house can vary with more than 30% due to occupants' behaviour

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Sweden: calculated vs measured energy use

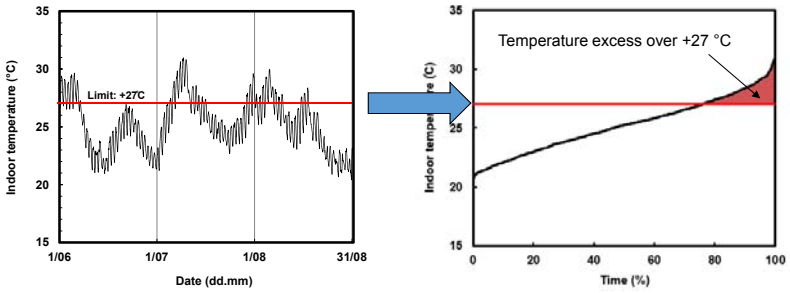
- Smaller difference than ± 10% is considered acceptable according to Sveby.
- 29 houses out of 44 (66%) had a larger difference than 10%.
- The average difference was 25%, max difference has 113% larger measured energy use than calculated.
- Calculations are performed at an early stage and may not have been updated with the latest drawings and information.
- It was shown that the difference was larger for houses heated by exhaust air heat pump than for houses heated by ground source heat pump.



TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

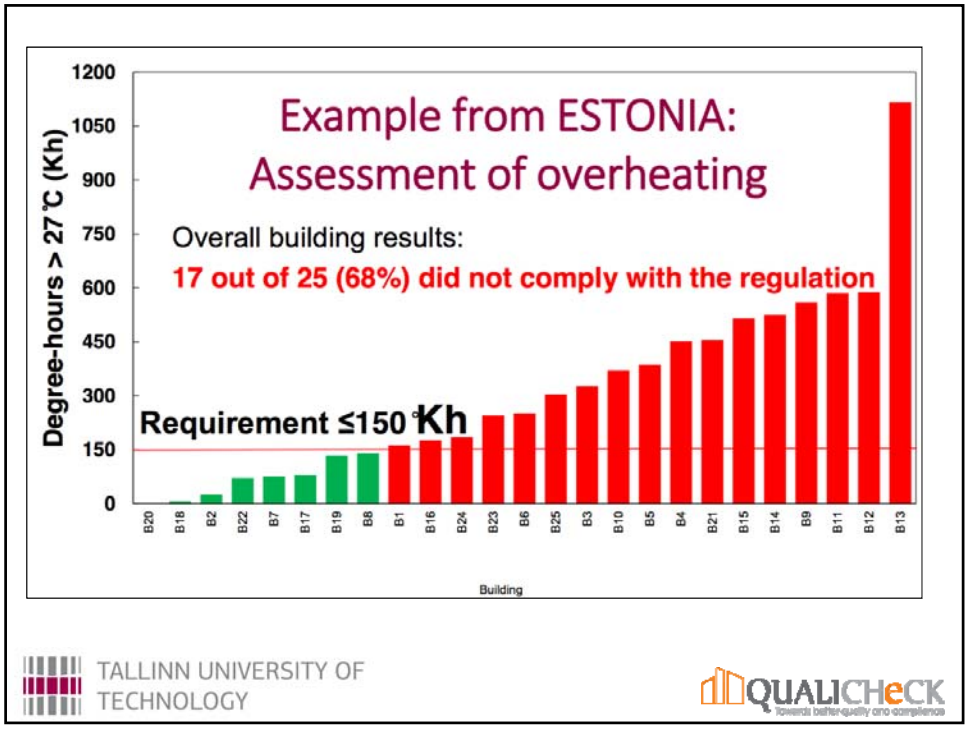
Estonia: summer thermal comfort



EPBD Annex I requirement:
"1. The energy performance of a building shall be determined … and shall reflect the … **cooling energy needs (energy needed to avoid overheating)** to maintain the envisaged temperature conditions ..."
Estonian legislation:
Addressed by a requirement not allowing to exceed +27°C more than 150Kh in residential buildings and +25°C more than 100Kh in non-residential buildings from June 1 till Aug 31

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

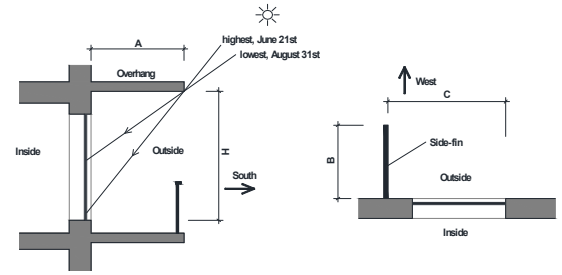


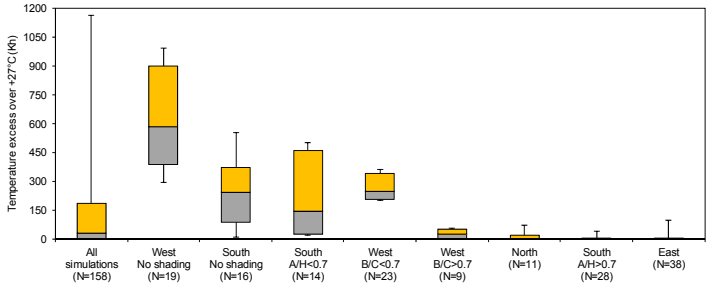
TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Solutions to prevent overheating

- Overhangs with A/H>0.7 in south orientation
- Side-fins with B/C>0.7 in west orientation
- North and east oriented rooms did not experience values over the threshold





TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Belgium: window U-values

Specified windows were compared to installed ones:

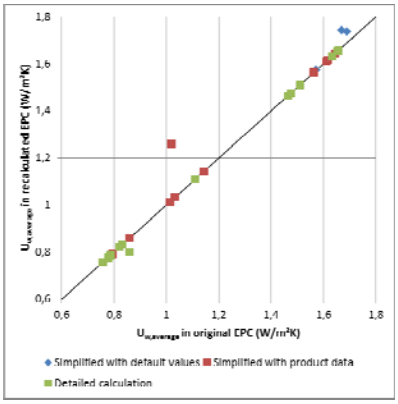
- EPB-files, EPB-declarations, architectural drawings and window component product data (glazing and framing) were collected for 32 randomly selected projects assessed by 15 different EPB-assessors: 1 office building, 22 single-family houses and 9 apartments (311 windows in total)
- For each of the 32 projects, the EPB-files were screened and the U-value of all the windows was recalculated
- The recalculated values were compared to the input data in the EPB-declarations

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Belgium: window U-values

- In 4 of the 32 EPB-declarations (12,5%), the window input data were not correctly reported compared to the information given in architectural drawings and manufacturer data
- Wrong values of window areas were used in 3 of these 4 cases, while in one case wrong U-values of the window frame were used, leading to a maximum deviation of 24% of the mean window U-value
- The method of calculation did not have an influence on the prevalence of reporting errors



TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Romania: EPC quality

- Analysis of quality and compliance by in-situ verification and EP recalculation for 26 residential buildings certified 2015

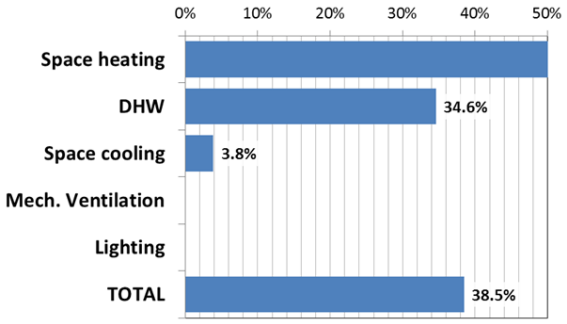
EPC quality problems:

- several cases of incomplete EPC data (e.g. building address without postal code, lacking of incorrect total unfolded built area or year of construction)
- incorrect calculations according to the EPB Methodology (e.g. calculation of penalties and energy rate/mark)
- deviations in the assumptions and calculation of input data (net floor area, internal (heated) volume of the building, U-values etc., heat transfer area of building envelope etc.) and in calculated energy performance indicators
- also the differences caused by software tools used, but as far there is no clear validation procedure one could not say that all deviations found are non-compliance issues

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Romania: EPCs with more than one energy class deviation



- the main causes due to not correct input data and filling in the EPC
- 50 % of the buildings had more than one class higher energy use for space heating
- **39 % of the buildings had at least one class higher total energy use**

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Conclusions: Measured performance

- Poor ventilation could be seen as a major European problem: ventilation rates and noise typically did not comply
- Ductwork air tightness an issue in Central Europe, not any more in North Europe
- Building leakage showed both good and bad examples
- Limited data on transmission characteristics (mostly inconclusive, additional studies needed)
- Heat pumps, solar thermal and other renewables showed good performance if certified installers etc. schemes applied
- Limited data on summer thermal comfort – addressed only in a half of studied building codes

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK

Conclusions

- In many countries development with 5 year step can be seen – new requirements and procedures 2007, 2012 etc. launched
- Systemic changes evidently will need time, legislative changes are to be supported with relevant compliance procedures, supervision, commissioning, performance measurements, piloting, model solutions, guidelines, training …
- More ambitious and sophisticated systems (Austria, Estonia, Sweden,) more difficult to implement in practice – longer learning curves
- Compliance frameworks are to be extended in many countries in order to be able to assess **as built performance** – in about half of studied countries control mechanisms stopped to **building permit** phase – issue EPC for completed building (permit of use)

TALLINN UNIVERSITY OF TECHNOLOGY

QUALICHECK