Building Energy Standards Can Fail to Deliver Expected Savings; The Importance of Code Compliance

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EPBD Recast

- EPBD Recast (Directive 2010/31/EU): 31 December 2020, new buildings
  - 'nearly zero' energy
  - 'to a very large extent' from renewable sources.

Will building standards deliver the expected savings?

- Focus on code compliance, but also evaluation of above standard buildings

Overview of studies

- US: 1 study (review of 50 studies)
- NL: 3 studies
- UK: 2 studies
- DK: 1 study

Lessons from the US- residential sector / services sector

Misuriello*, et al.*

- 50 studies of state energy code compliance and enforcement

Results:

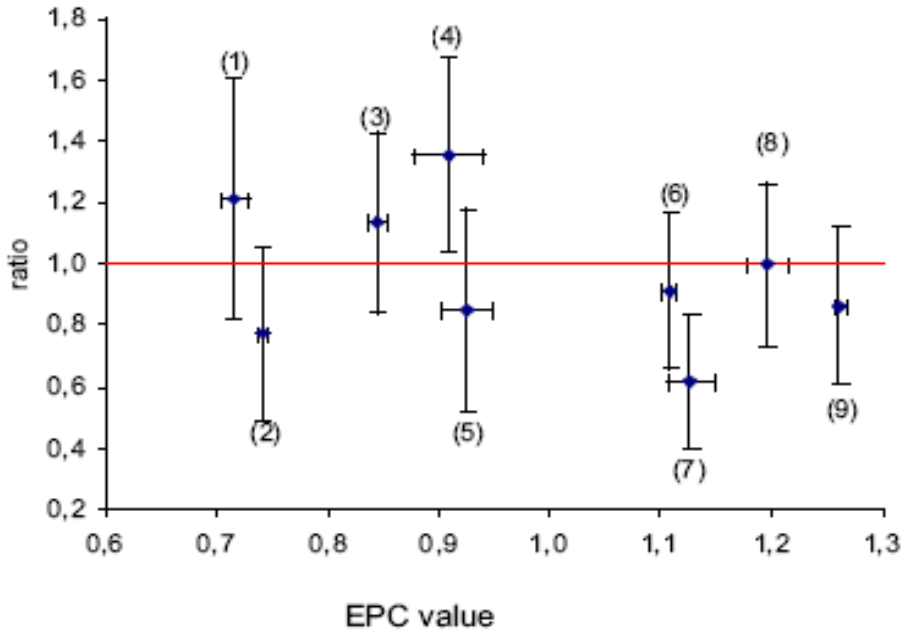
- As-built conditions <-> plans
- Little on-site review
- Substitution by non-compliant products
- Need for additional training & education
- Time & resource constraints→ enforcement

Conclusion:

- Different methodologies: comparing results difficult

The Netherlands – study 1 –Ratio actual & theoretical energy consumption

Jeeninga, Uijterlinde and Uitzinger



Source: Jeeninga, Uyterlinde & Uitzinger 2001

Conclusions: Due to small number of projects with EPC<1 difficult to draw general conclusions for more efficient dwellings.

The Netherlands – study 2 – residential sector

Menkveld, *et al.*

Results:

- Average savings in dwellings with EPC= 0.8 compared to EPC=1.0 → 8%
- Interviews
  - Doubts about savings claimed in certificates,
  - Little feedback from municipalities on calculations,
  - Very few compliance checks at construction sites.
  - Concerns about behavior of residents

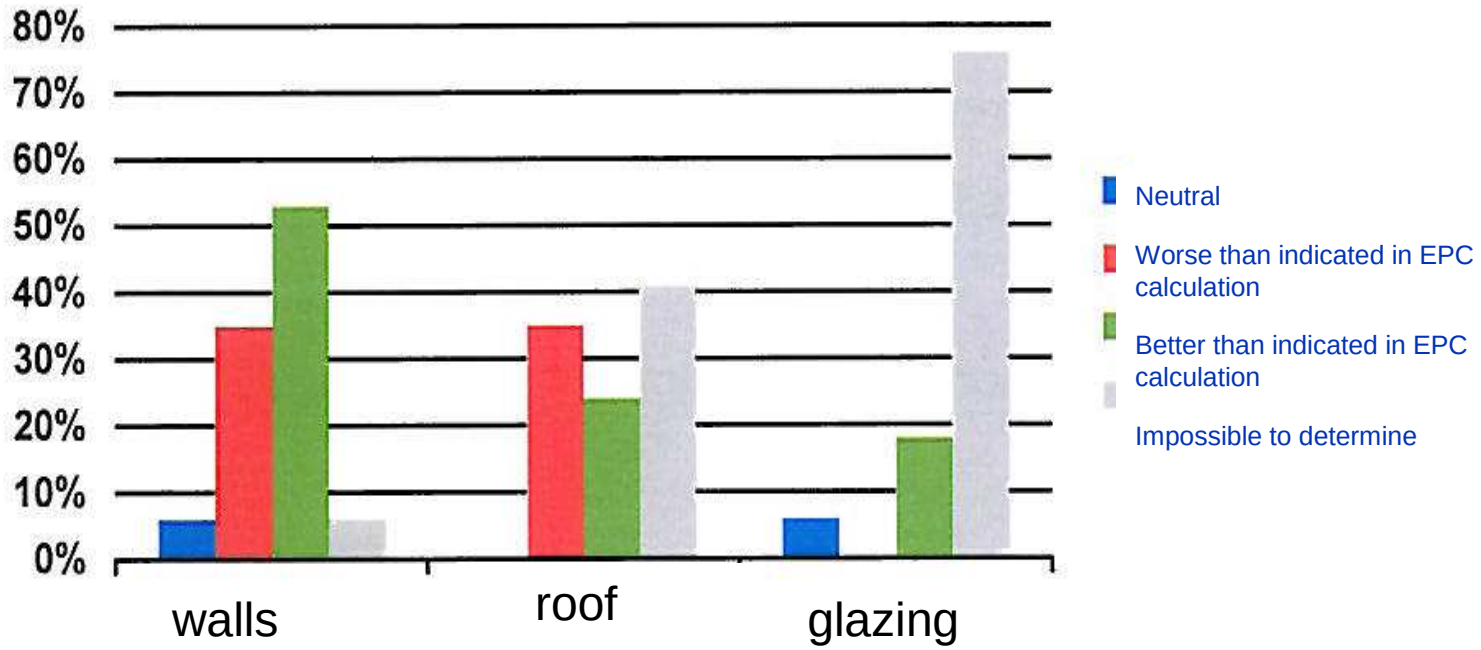
Conclusions:

- In this case the more stringent standard is not delivering the expected savings.

The Netherlands – study 3 – services sector

Buildsight b.v.

- Compliance checks at the construction site



Source: Buildsight b.v.

The Netherlands – study 3 – services sector

Conclusions:

- Availability of calculations in the right software problematic
- Building site visits time consuming (several visits needed)
- Quality of construction materials difficult to assess.
- Buildings not finalized, so no conclusions on final theoretical energy performance.

United Kingdom –study 1- residential sector

Baiche *et al.*

Results:

- Incorrect insulation of roofs & shortcomings in the construction of cavity walls
- Lack of skills and knowledge, shortcomings in site management→ Additional training required.

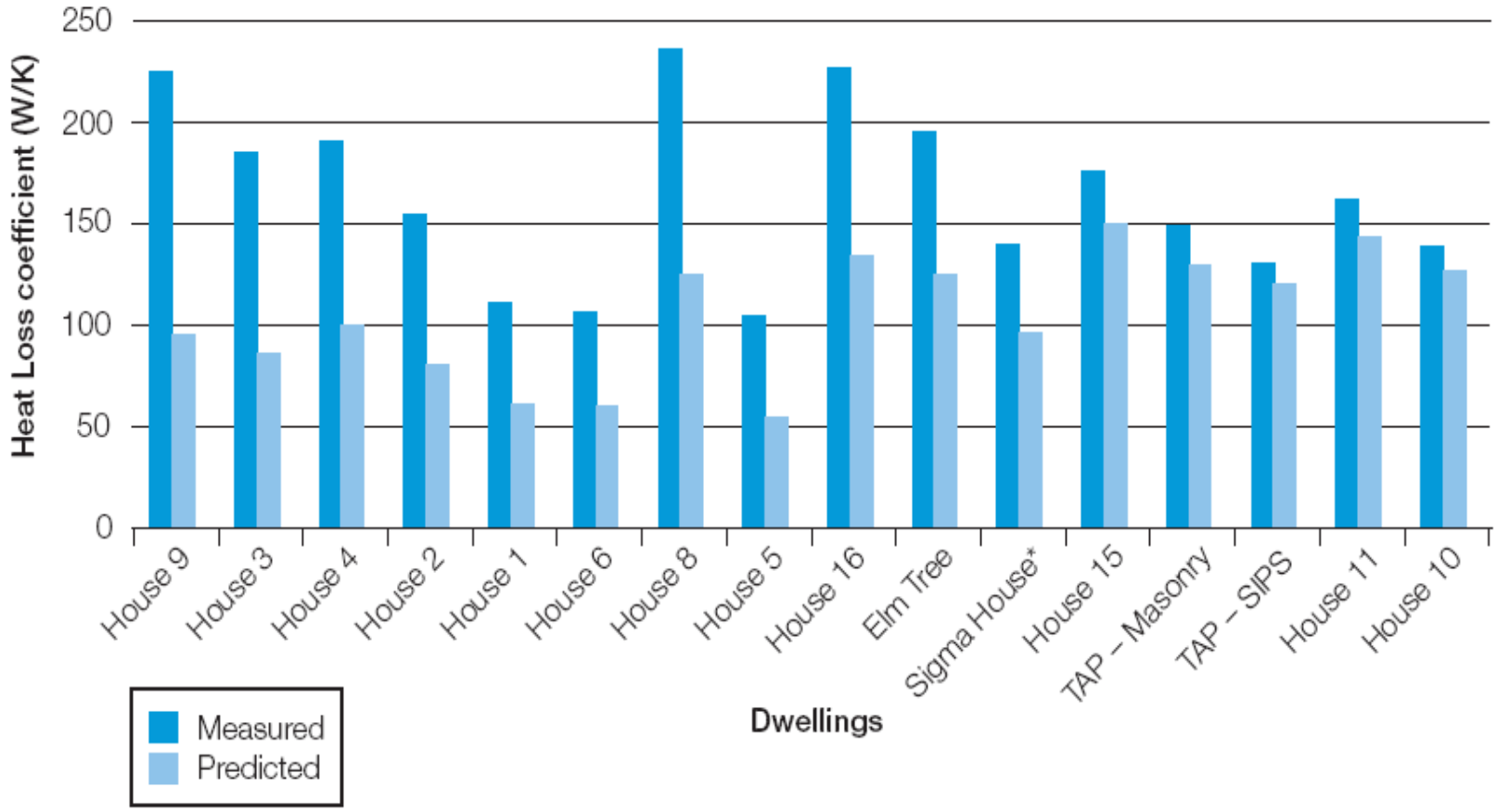
Conclusions:

- Level of compliance not always sufficient.
- No evidence of systematic and purposeful non-compliance



United Kingdom –study 2 - residential sector

Bell *et al.*



Source: Bell *et al.* 2010

United Kingdom –study 2 - residential sector

Results:

- Average heat losses 60% higher than the design phase
- Only 5 out of 15 dwellings have a discrepancy of 15% or less.
- All dwellings used more energy than predicted, only marginally better than the standard

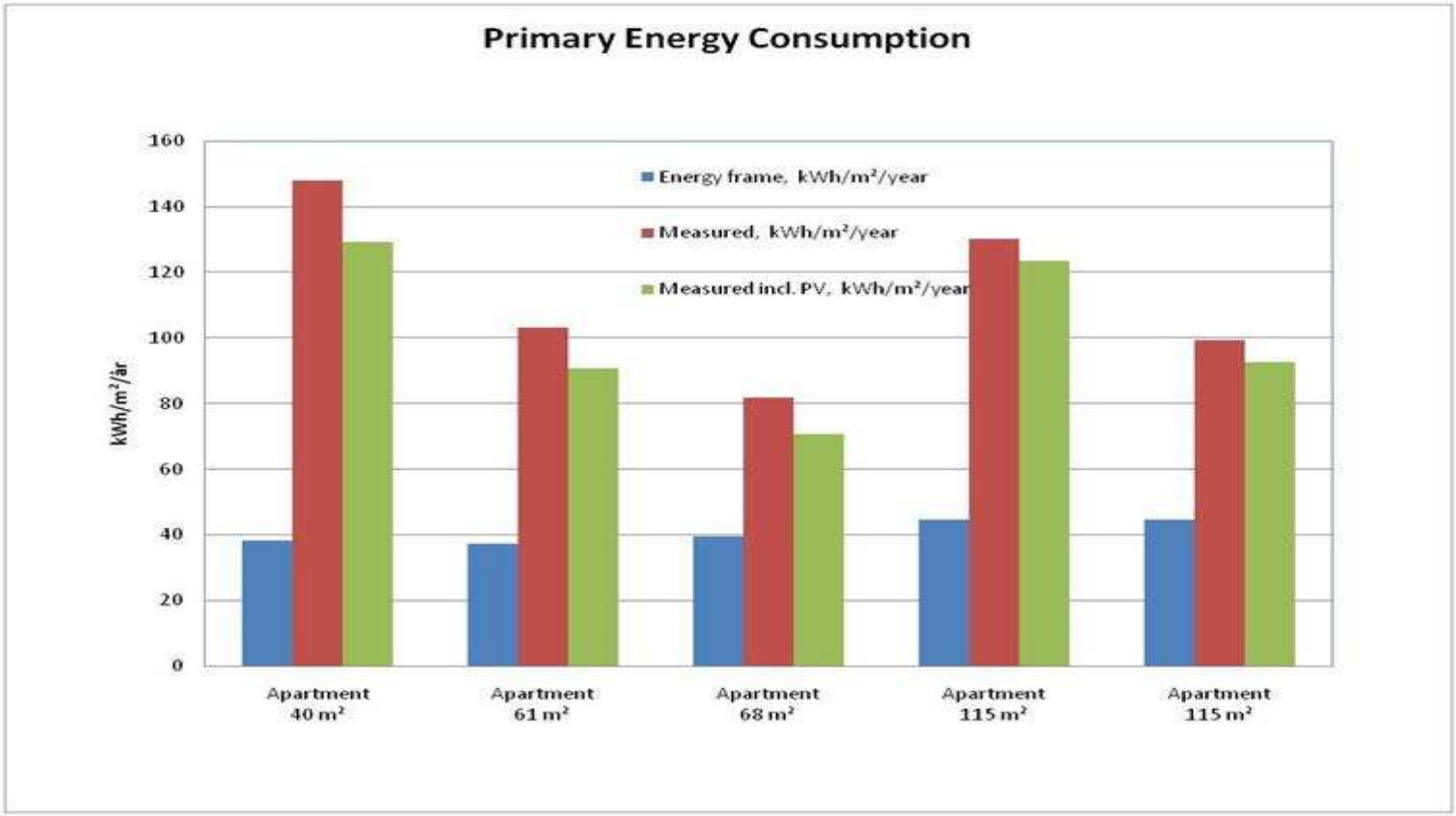
But: Residents were comfortable and pleased with their heating bills!

Conclusions:

- Small sample size,
- Improvement needed of
  - Design (focus on whole system performance)
  - Planning and control of construction
  - Services commissioning, testing and monitoring

Denmark – residential sector

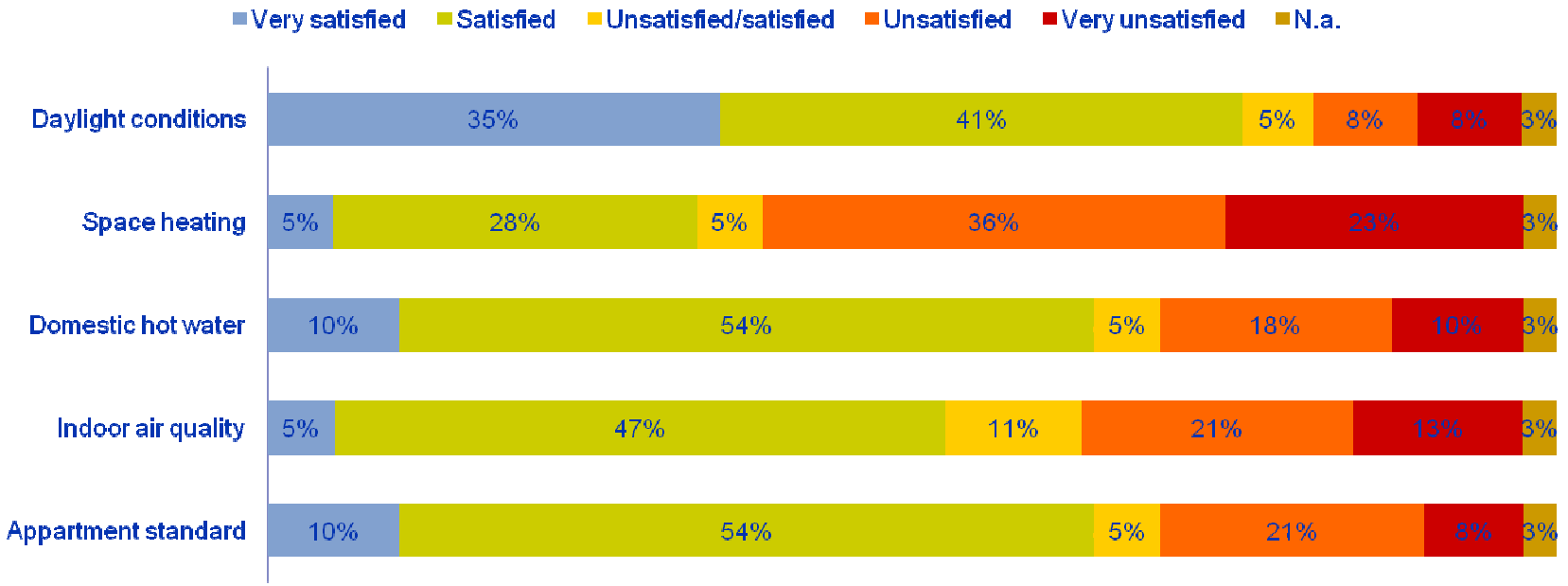
Weitzmann



Source: Weitzmann 2012

Denmark – residential sector

Survey : Residents least satisfied with space heating



Source: Weitzmann 2012

Denmark – residential sector

Results:

- Energy performance fell short by up to a factor 3 compared to as-designed energy performance
- Energy consumption per square meter of some dwellings higher than building standard

Conclusions: Poor energy performance, low satisfaction amongst residents

Conclusions

* Different approaches → difficult to draw general conclusions

Collection, analyzing & reporting of data

-Sample size and selection (a certain statistical confidence level)
-Data collection methods
-Presentation of results (compliance or non-compliance, level of compliance, above-code)

Methodologies

•Building plan review
•Buildings inspections
•Analysis of compliance software
• End-use metering
• Modeling to estimate lost energy savings.
•Interviews with code officials & builders

Conclusions

Will building standards deliver the expected savings?

- Deviations between the as – designed, and as-built energy performance .
- Main bottlenecks:
  - Estimating techniques are inaccurate (modeling of physic
  - Estimating techniques are inaccurate (modeling of behavior)
  - Code requirements are not understood
  - Energy code compliance has low priority (enforcement)
  - Unqualified site managers and poor workmanship.
  - Substitution of products during construction

Cost optimal levels

The higher the required energy performance, the more challenging compliance will be become.

Recommendations

- Develop a uniform methodology (recommendations by DOE Building Energy Codes Program & PNNL)
- Sample size and selection guidelines
- Data collection methods
  - Measures high/medium/low
  - On-site evaluation
  - Qualifications for personnel
  - Standardized checklist
- Compliance results: compliance rating of 0%-100% compliance levels

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