

Lessons learned and closing remarks

Marc Delghust
Ghent University - UGent



Reducing the performance gap

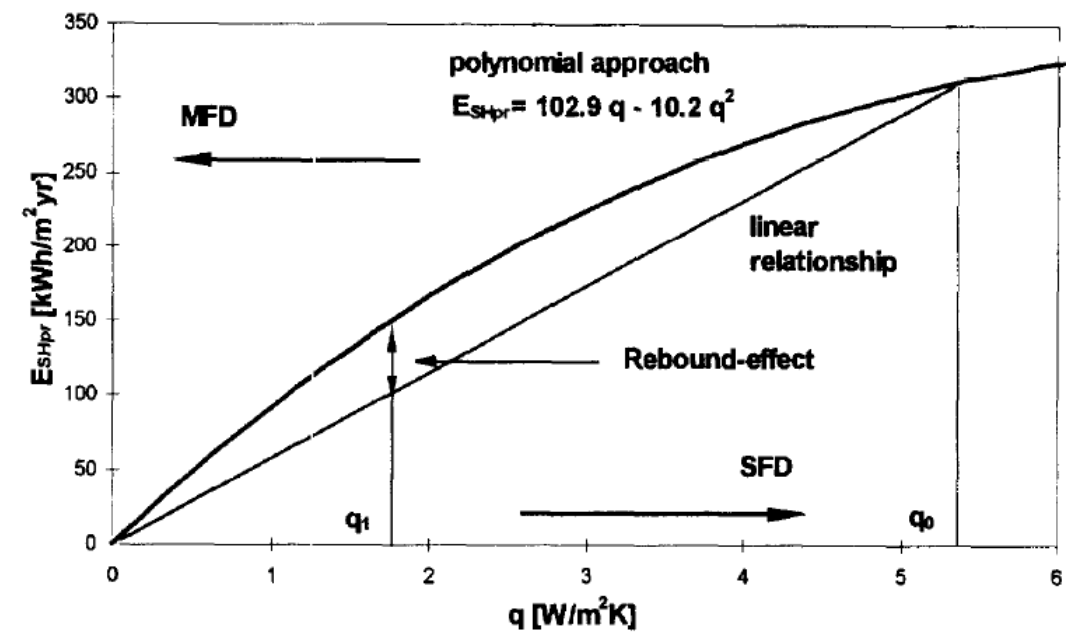
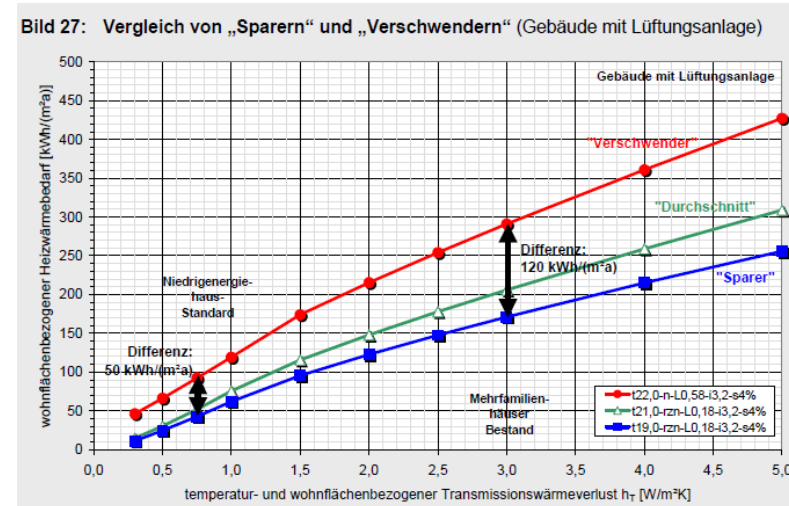
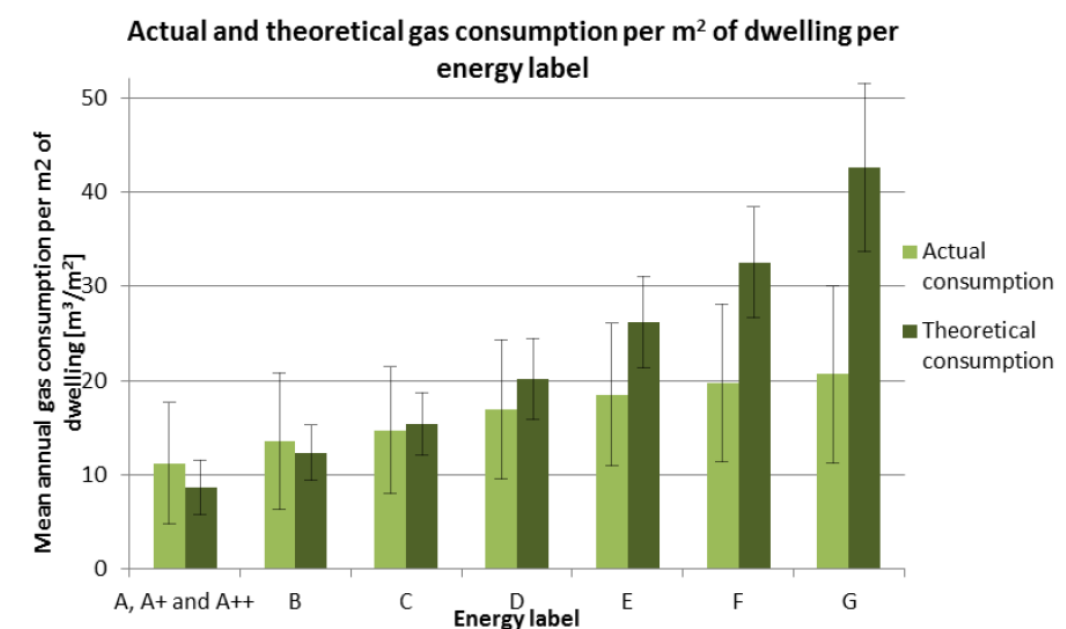


Fig. 5. Actual energy demand for space heating, E_{Shp} , in relation to the thermal quality of buildings, q .

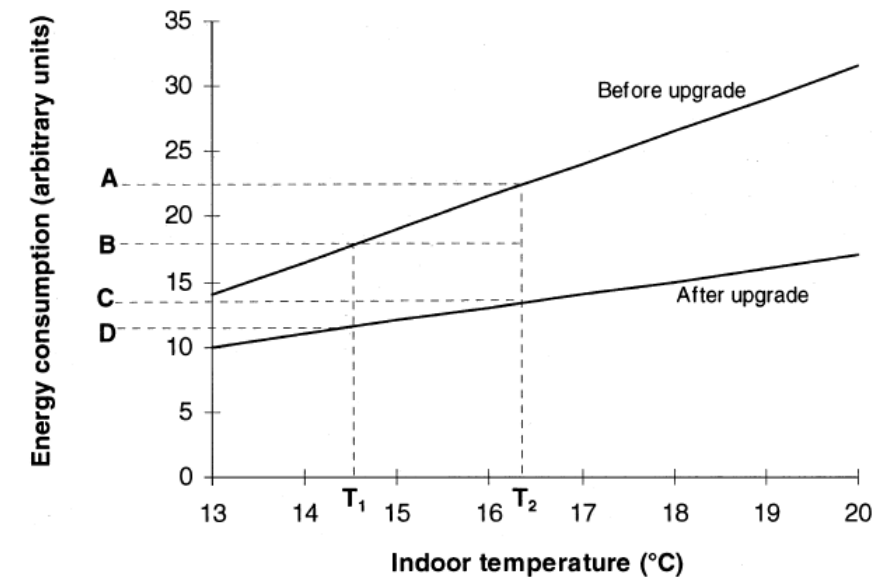
Haas et al. 1989



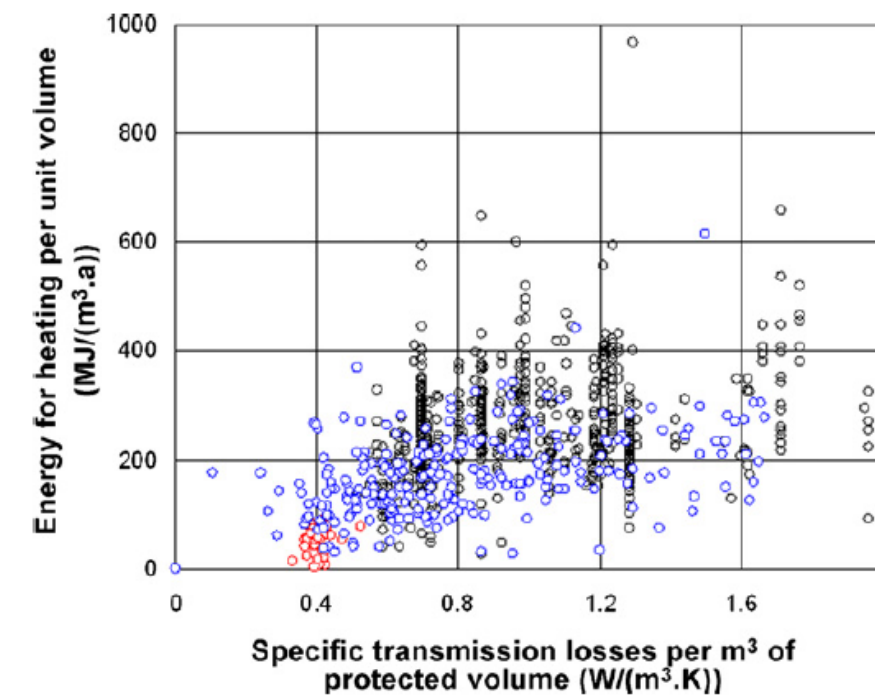
Loga et al. 2003



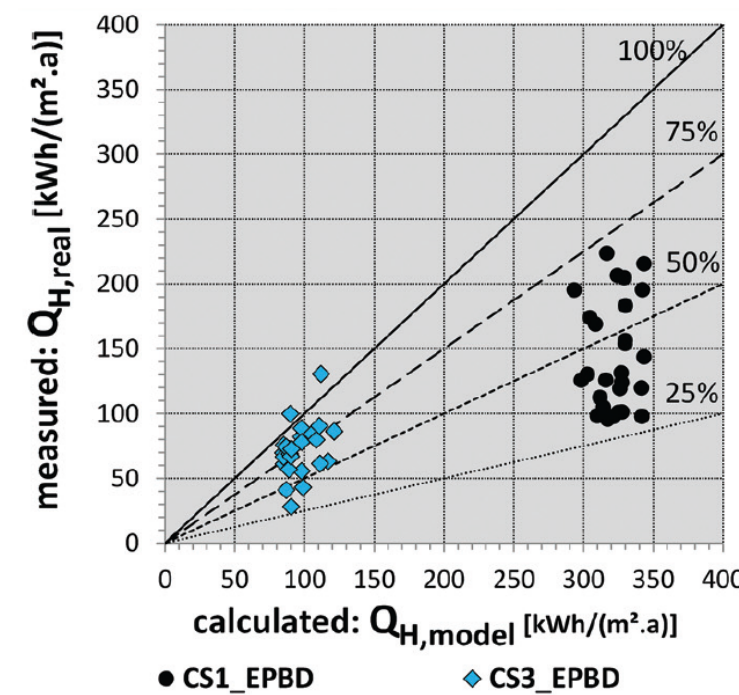
Majcen et al. 2012



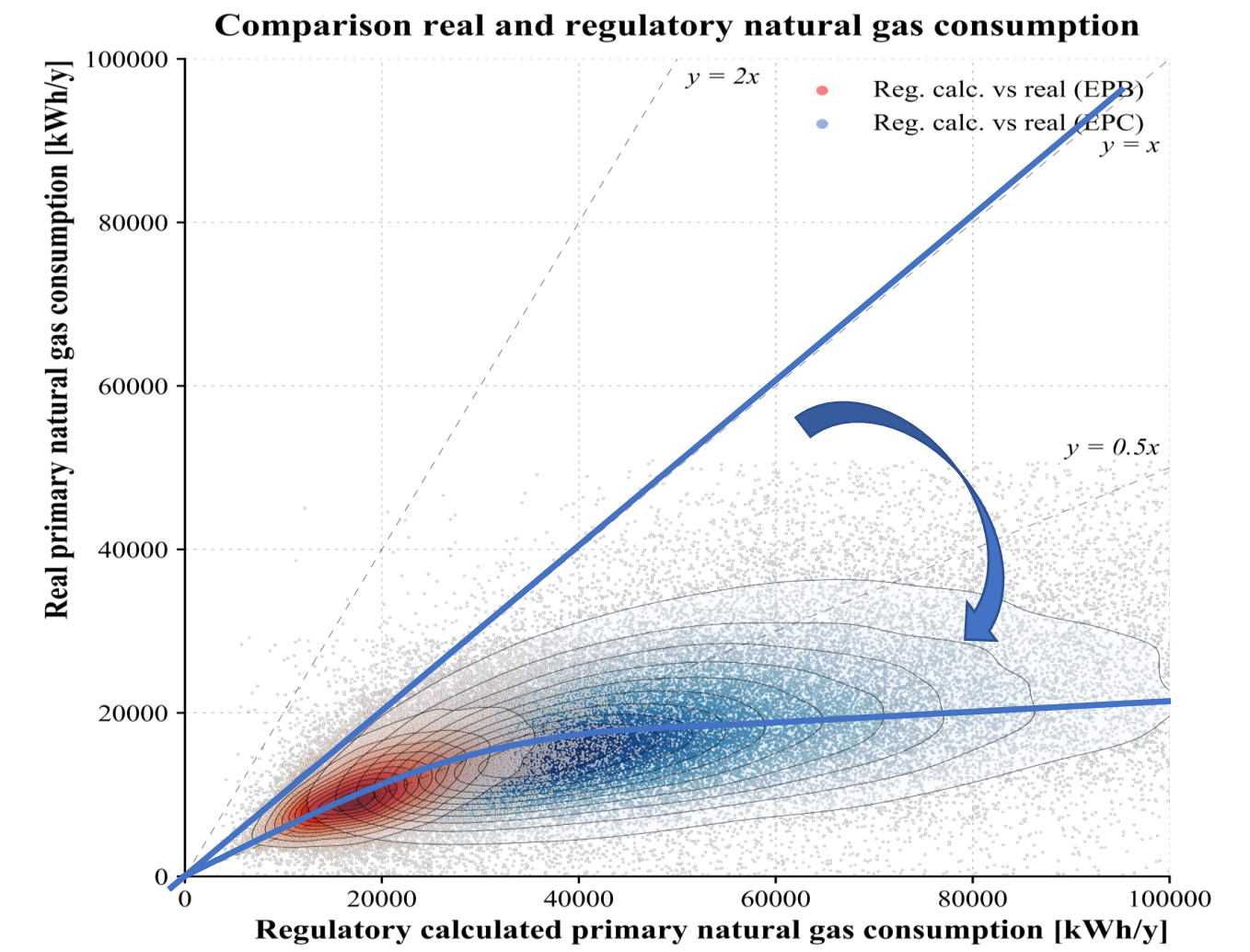
Milne & Boardman 2000



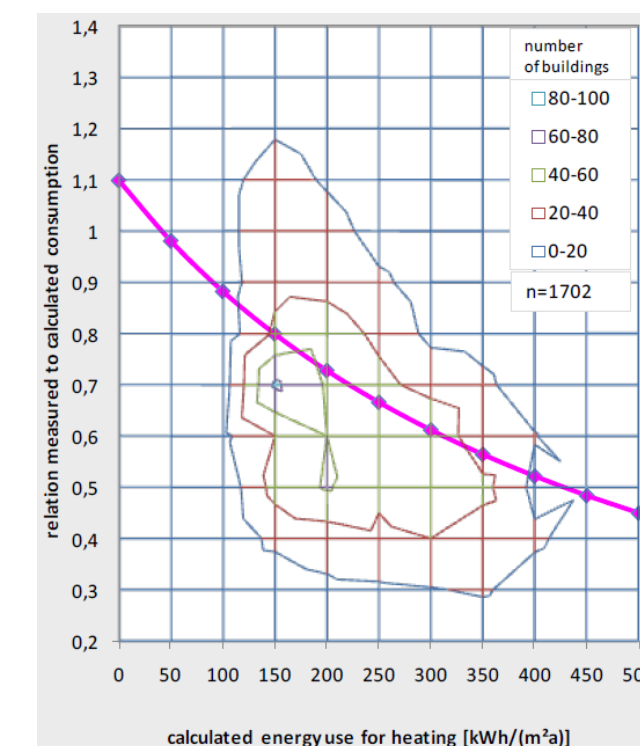
Hens et al. 2010



Delghust et al. 2013



Van Hove et al. 2021

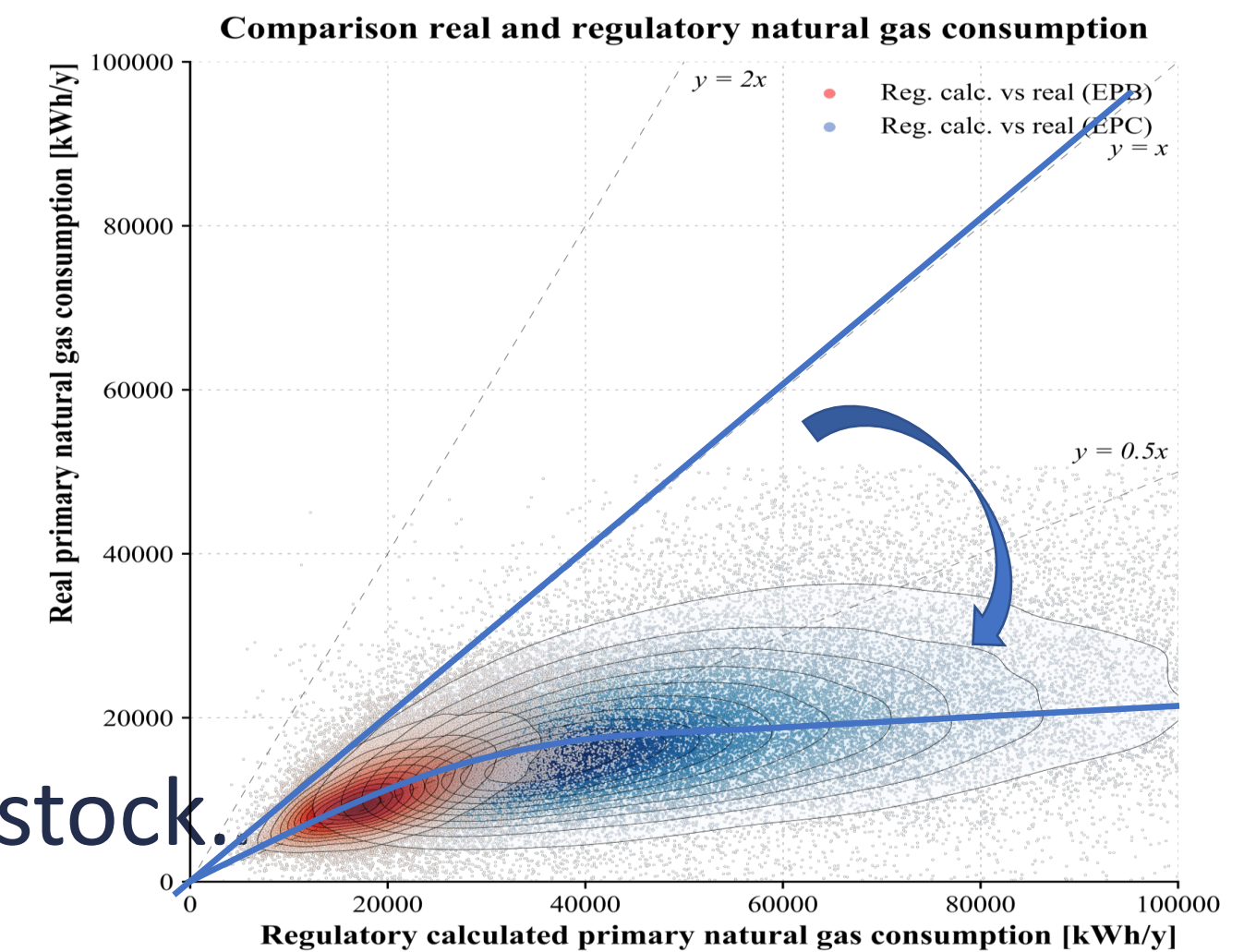


Loga et al. 2015

Looking at...

- ✓ User behaviour
- ✓ Heat generation systems Grid interaction
- ✓ Primary & CO2 intensity
- ✓ Performance indicators
- ✓ Assessment framework
- ✓ Input accuracy & support
- ✓ Making it happen: barriers?
- ✓ ...

Looking beyond the (individual) building: people, grid, mix, finances, stock.



Van Hove et al. 2021

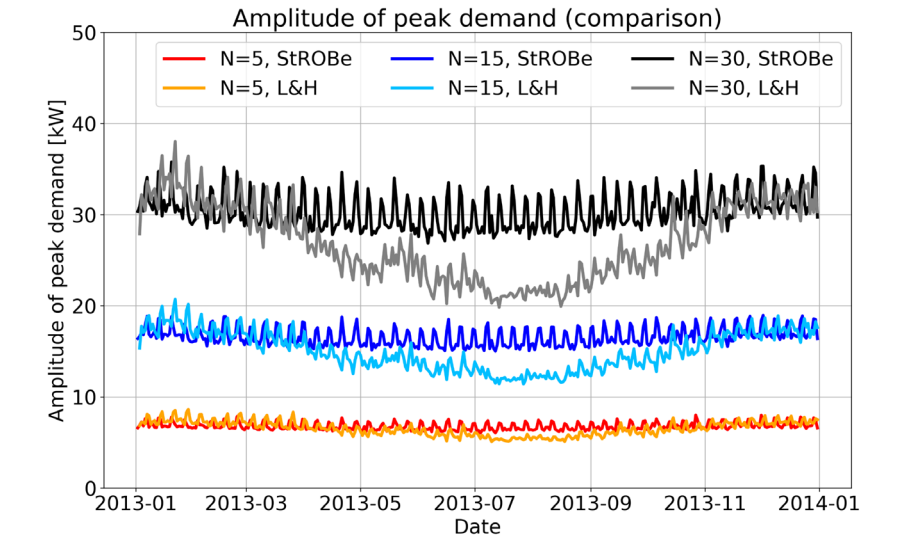
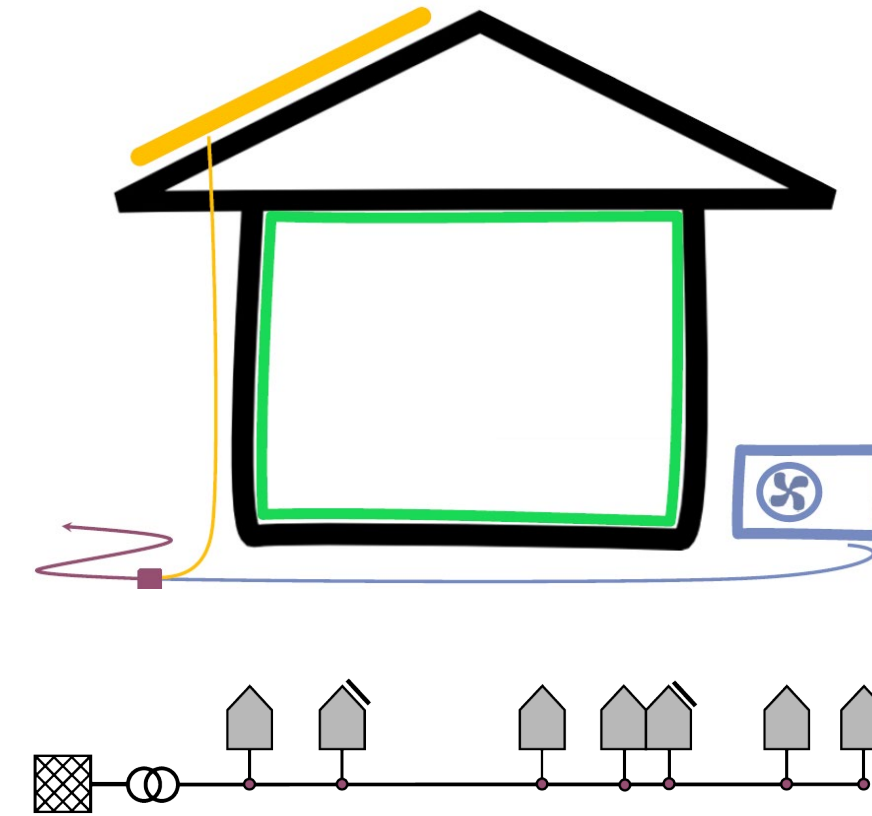
“Challenge 0”: defining clearly the objectives

- (1) to target them efficiently & keep focus
- (2) to debate based on well defined grounds
- (3) to distinguish main from side issues

Which “building energy performance” (gap)?

Energy performance of “buildings”?

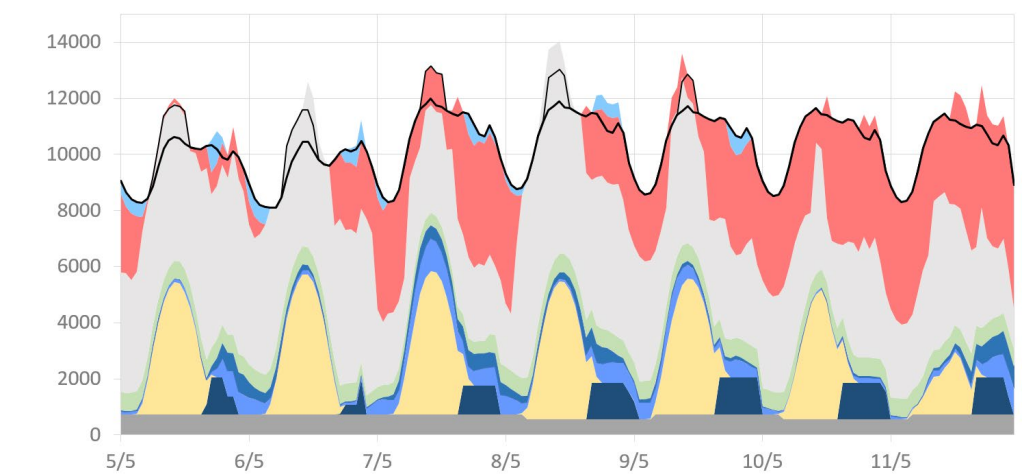
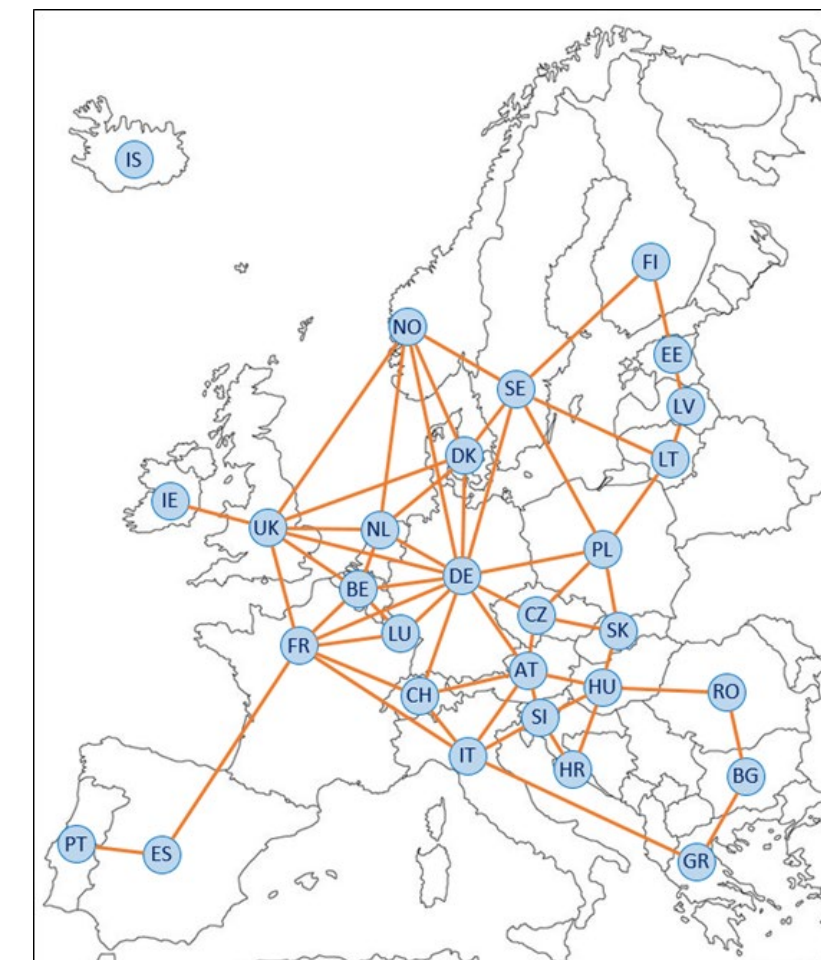
- ✓ Dynamics
- ✓ Looking beyond the individual building
 - Local conditions: *neighbourhood/street/...*
 - Cross boundaries: *electricity market*
- ✓ Future changes: *climate, energy mix, technology, behaviour...*



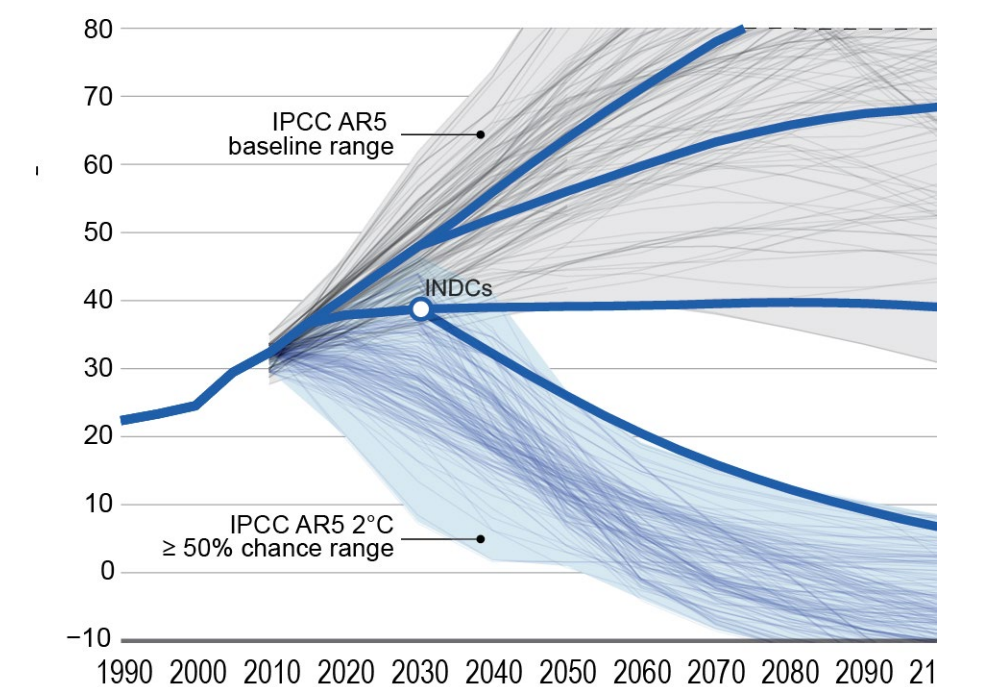
Energy performance assessment

- ⇒ Is itself dynamic
- ⇒ Should look ahead (at least the lifespan) and will need updating
- ⇒ Should it all be via EPB/C?
- ⇒ Theoretical calculation or real data?
- ⇒ To what level of detail?

- Renewable energy production
- Low PE and/or CO2: what matters most?
- Grid stability: for the (near) future
- Smart(readi)ness
- Cost optimality~real energy use(r?) and predictions/scenarios
- LCA
- ...



Emissions pathways



“energy performance of a building”

real energy use?

the amount of energy **actually consumed or estimated** to meet the different needs associated with a **standardised use** of the building, **interaction!?**

which may include, *inter alia*, heating, hot water heating, cooling, ventilation and lighting.

This amount shall be **reflected in one or more numeric indicators** which have been calculated, **for!?**

taking into account insulation, technical and installation characteristics, design and positioning **building & context?** **location & time dependent?**

in relation to climatic aspects, solar exposure and influence of neighbouring structures, own-energy generation and other factors, including indoor climate, that influence the energy demand;

(EPBD, EU Directive 2002/91/EC on the energy performance of buildings)

EPB/C: certificates reflect standardized indicators, not the actual energy use!

Simple versus complex?

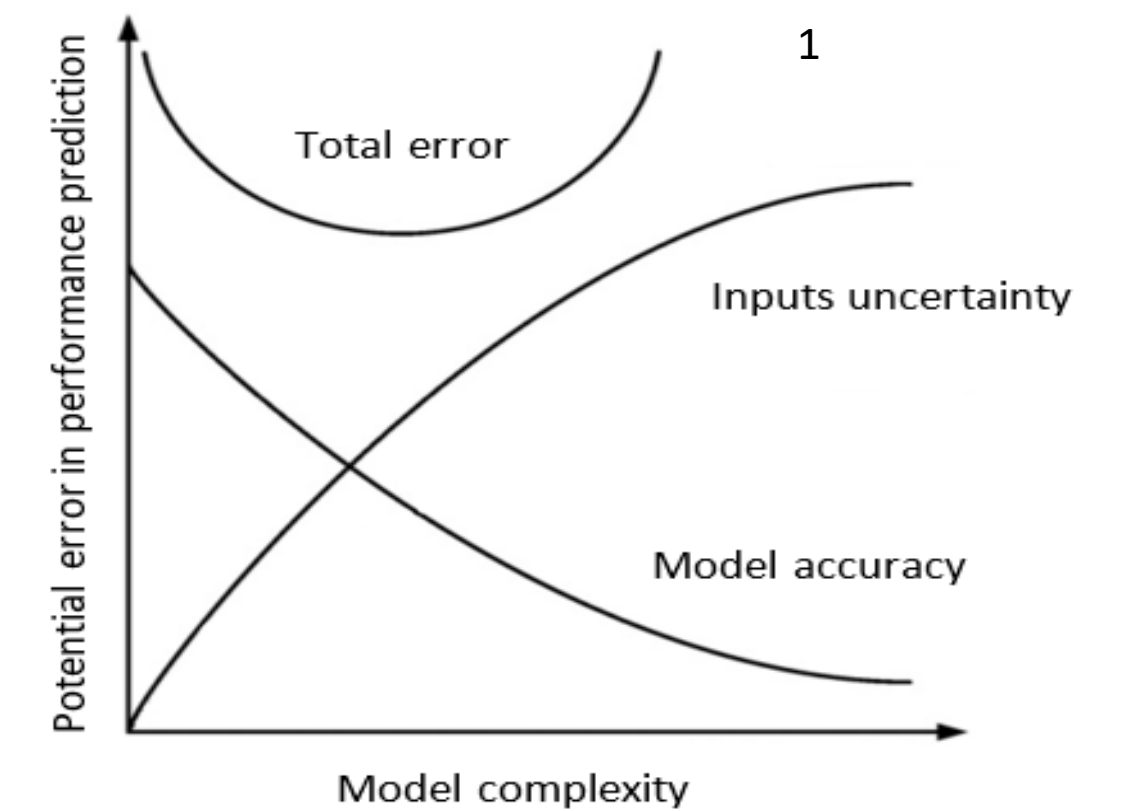
A higher complexity is not always beneficial/needed and might give a false impression of accuracy.

Distinguish simplicity/complexity at different levels

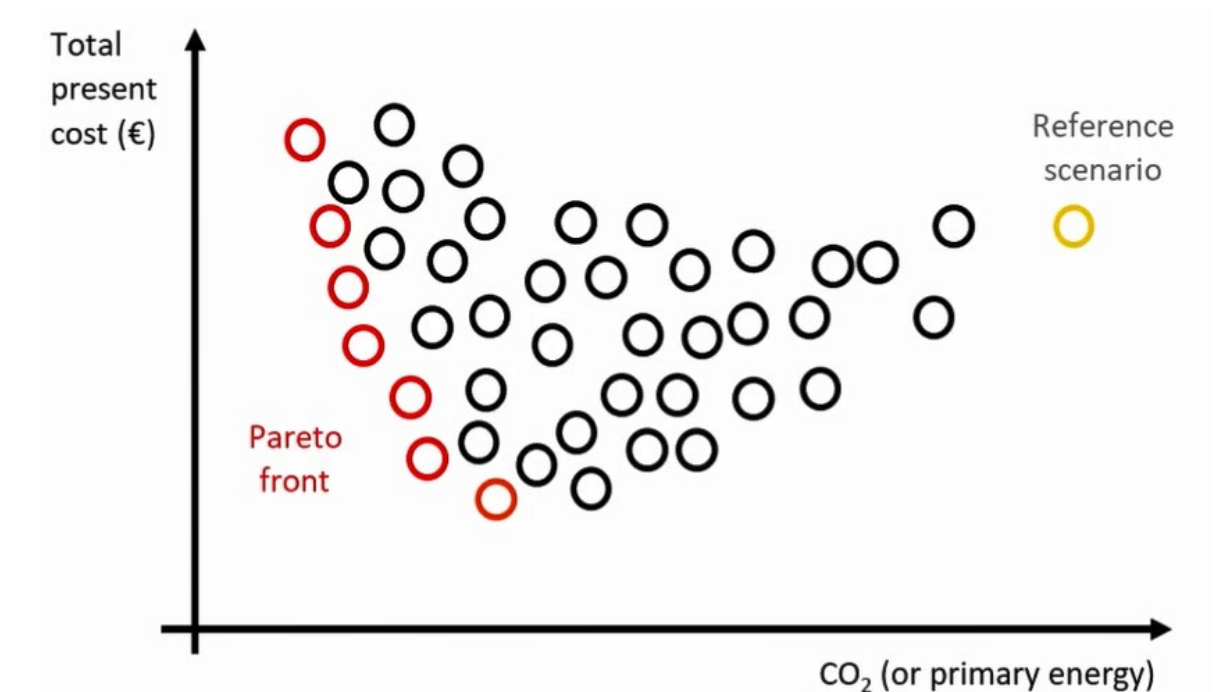
- ✓ Real life
- ✓ (Meta)model/algorithms
- ✓ Standardization
- ✓ Implementation for the end users(!)
- ✓ Communication to the (ultimate) stakeholders

Examples:

- ✓ **Generation efficiency**
more complex, better model, with more input data, but barely more work: data exists
- ✓ **User behaviour**
Improved modelling is possible, but an exact prediction is not
Stochastics (e.g. for robustness): longer calculation time doesn't mean more modelling work
Burden shifting: still choices to be made! (which profiles? Average/median/...?)
- ✓ **Cost-optimum @building & @societal level**
Future uncertainties: guaranteeing near optimum enough? (~robustness)
- ✓ **PEF/CO2:**
Complex European grid model for PE/CO2 in the grid
Seasonality => impact relatively limited(?) => "just" changing the average value?



M. Trcka and J. L. M. Hensen, 2010.

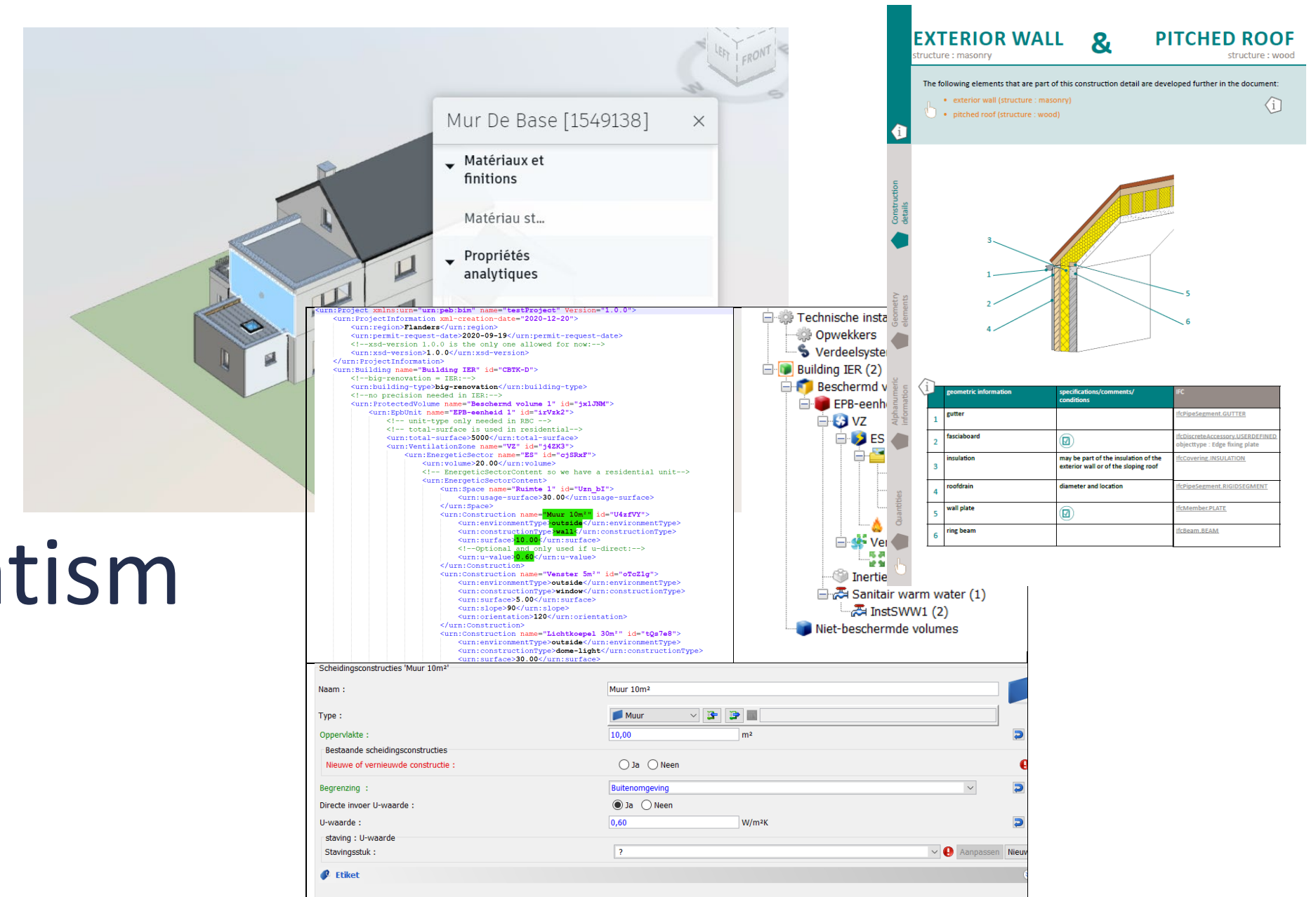


DATA & TOOLS: (availability) & accessibility

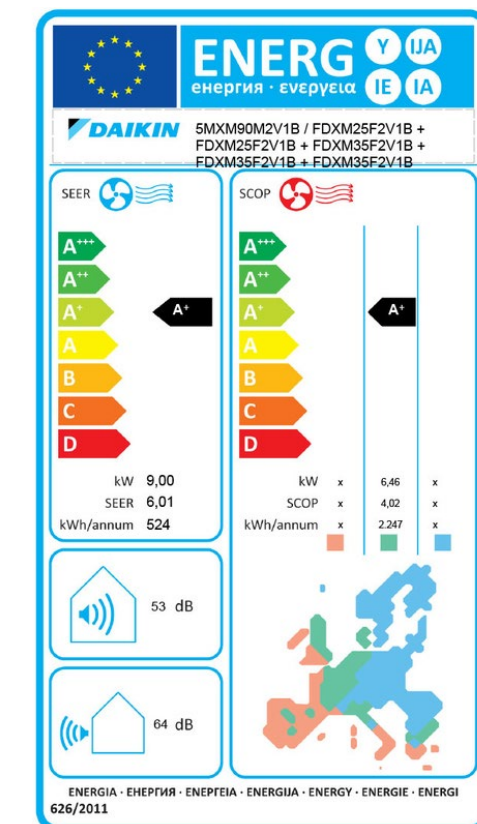
For EPB/C-assessment:

More about

- easy access
- exhaustiveness and detail versus pragmatism
- ✓ BIM
- ✓ Eco-design
- ✓ Product databases, EPREL
- ✓ ...



Casteleyn et al. 2021



RESULTS: (availability) & easy access



NEPBC: modelling tools, data and reports

- ✓ Scientific papers & PhD dissertations
- ✓ Public reports on <http://new.nepbc.be/results/>
- ✓ PEF & CO2 data for 28 countries
- ✓ EROB-model, building on StROBe, on GitHub
- ✓ ...

=> Feel free to contact us!



Results

On this page, the results and reports of the NEPBC project are published.



Report: Building-grid interaction: assessment framework 24 AUG 2021

This report presents a framework to assess the impacts of buildings on the low-voltage electricity grid. The interaction of buildings and the grid becomes a crucial aspect of the energy transition as more low-carbon technologies are adopted in buildings that require or produce large amounts of electricity. Technologies such as heat pumps and rooftop photovoltaic systems are among those expected to be widely adopted in Belgium in the near future. It is therefore important to assess what their impacts will be on the electricity grid, what the latter depend on, and how building design can contribute to limit them.

Report_Building-grid-interaction-Assessment-Framework.pdf

Report: Towards a grid friendliness assessment for buildings 24 AUG 2021

Low-carbon technologies, such as heat pumps and photovoltaic solar panels, could have important impacts on the low-voltage electricity distribution grid. To avoid that high penetration of these technologies is hindered by distribution grid constraints, and also to manage potential grid reinforcements efficiently, it is important to assess the interaction of buildings with the electricity grid. Taking a building perspective on this issue, a grid friendliness assessment of buildings is proposed. Such an assessment and rating of buildings could inform building owners and occupants, building designers, investors, technical system manufacturers and others to adopt practices that can benefit the integration of more low-carbon technologies while limiting the grid reinforcement costs.

This report investigates possibilities to develop such a grid friendliness assessment of buildings, by examining existing building energy-related performance rating approaches, reviewing possible available indicators, and employing a grid impact assessment framework to propose a method for deriving requirements for the indicators.

Report_Towards-a-grid-friendliness-assessment-for-buildings.pdf

Video presentation: on present and future Primary Energy Factors 30 OCT 2020

Sam Hamels provides an overview of the different aspects related to calculating primary energy factors (PEFs) for electricity consumed by buildings.

Aspects include the geographical scope, temporal resolution and taking into account electricity imports. Taking these aspects into account, Sam also provides indicative PEF results for the years 2020, 2025, 2030 and 2040.



Report: Barriers and motivators driving the renovation of the residential building stock 19 FEB 2020

Enormous investments in renovation activities are necessary to realize a carbon-neutral building stock by the year 2050. Home owners need to invest in a variety of measures, like replacing their heating system and improving insulation levels. However, the rate at which these invests are happening is much too slow.

To better understand what is causing this low renovation rate and how to increase it, this report reviews the most recent academic literature on the subject. Many so-called 'barriers' can be identified, which hinder renovation investments in some way. But we also identify many 'motivators'. These are just as important in order for the investments to happen.

Report_Barriers-and-Motivators-Renovation.pdf

Report: Trade-offs for a cost-efficient transformation of the residential buildings sector 18 FEB 2020

Why GitHub? Team Enterprise Explore Marketplace Pricing

EROB / Corpus / windowhabits.py

1 811 lines (771 sloc) 27.6 KB

```
1 # -*- coding: utf-8 -*-
2 ---
3 Created on Thu Apr 15 14:48:51 2021
4
5 @author: siverbru
6 ---
7 import math
8 import numpy as np
9 ...
11 This model calculates which window use has!
12 Based on the work presented in (REF)
13 ...
14 def get_habits(Vents, Dh, Year, members, HH
15 # load inputdata if available
16 if Vents == -1:
17     prnQWS = (8.061, 0.167, 0.171)
18     cumprQWS = np.cumsum(prnQWS)
19     rnd = np.random.random()
20     idx = 0
21     while rnd >= cumprQWS[idx]:
22         idx += 1
23     Vents = idx
24     Vent3_no = 1 if Vents == 0 else 0
25     Vent3_C = 1 if Vents == 1 else 0
26 if Dh == -1:
27     if np.random.random() < 0.204:
28         Dh = 1
29     else:
30         Dh = 0
31 Dh2 = 1 if Dh == 1 else 0
32 YEAR_unk = 1 if Year == -1 else 0
33 YEAR_1 = 1 if Year <= 1950 else 0
```

EROB-model

EROB Event-based Residential Occupant Behaviour model created by Silke Verbruggen at the research group of Building Physics (Ghent University) to model occupant behaviour in the residential setting and for the implementation in dynamic modeling environments (e.g. Modelica). The model is based on the StROBe-model as developed by Ruben Baetens (<https://github.com/open-ideas/StROBe>).

- ✓ Beyond residential: integrating EPB & EPC, residential & non-residential
- ✓ Not everything related to building energy use can/should be dealt with via EPB/C
- ✓ Fully implementable solutions?
 - SBO: not software, regulatory document, or even directly implementable formulas/data, but knowledge, models and data
 - Looking at the past: some very easily implementable solutions not yet implemented

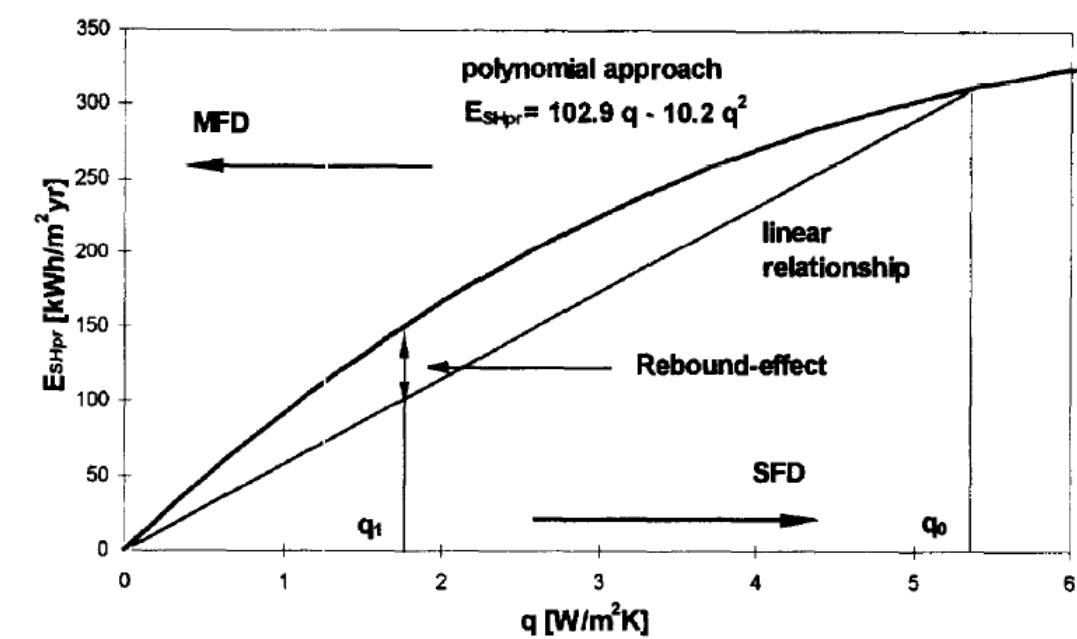
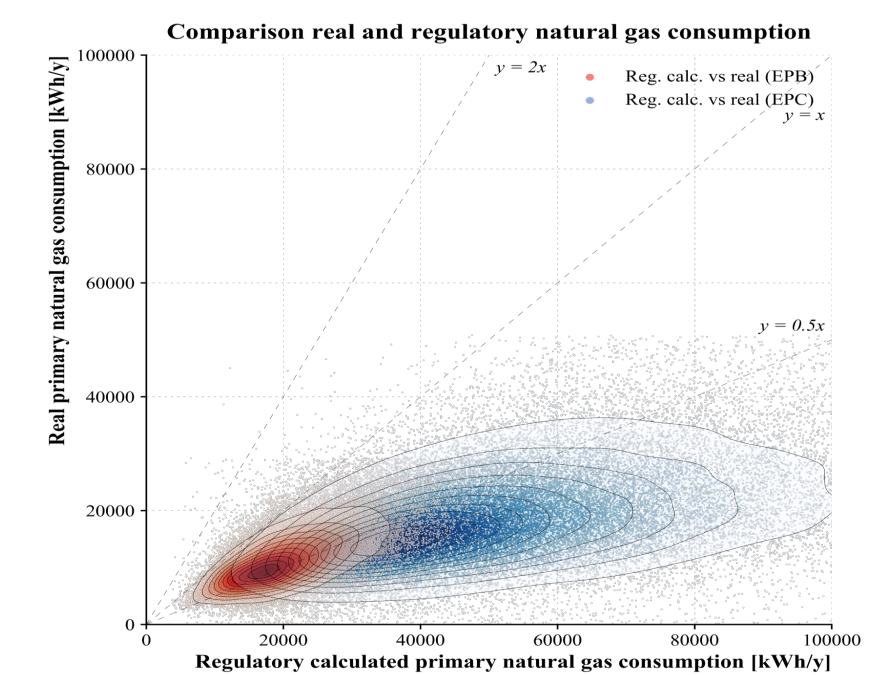


Fig. 5. Actual energy demand for space heating, E_{SHP} , in relation to the thermal quality of buildings, q .

Haas et al. 1989



Van Hove et al. 2021

- ✓ Focus on what matters the most!
 - Urgency: often better to implement best available knowledge now than delay (temperature take-back, climate change, CO2&PE-F)
 - Looking ahead: building life span, (averaged) future user, climate, PE/CO2 intensity...
- ✓ Not looking enough at real consumption data, looking back fast enough
- ✓ Framework: quality of assessment (of the assessment)
 - “Challenge 0”: defining clearly the objectives
- ✓ Performance gap vs. renovation gap: total saving = $\{\Delta * N\}$



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