Qualitative validation of an energy consumption behaviour-related survey for certified typical Walloon urban houses

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The EPC…

- ❑ Energy Performance Certification, obligatory assessment of the EP of an existing dwelling (in this case) when it is sold or rented


Consommation énergétique calculée du bâtiment

Consommation totale d'énergie primaire : **104185 kWh/an**

Consommation spécifique d'énergie primaire - E_{spec}(kWh/m².an) :

A++ E_{spec} ≤ 0

0 < E_{spec} ≤ 45 A+
45 < E_{spec} ≤ 85 A
85 < E_{spec} ≤ 170 B
170 < E_{spec} ≤ 255 C
255 < E_{spec} ≤ 340 D
340 < E_{spec} ≤ 425 E
425 < E_{spec} ≤ 510 F
E_{spec} > 510 G

kWh/m².an 566

Cette consommation est établie sur base d'une occupation, d'un climat intérieur et de conditions climatiques standardisés, de telle sorte que le résultat peut différer de votre consommation réelle. Cette approche standardisée permet de comparer les bâtiments entre eux, de manière théorique. Elle prend en compte la consommation pour le chauffage, la production d'eau chaude sanitaire, les auxiliaires et éventuellement, le refroidissement. Le résultat est exprimé en énergie primaire.

Indicateurs spécifiques

Enveloppe du bâtiment
TRÈS BON BON MOYEN MAUVAIS TRÈS MAUVAIS

Système de chauffage
TRÈS BON BON MOYEN MAUVAIS TRÈS MAUVAIS

Système de production d'eau chaude sanitaire
TRÈS BON BON MOYEN MAUVAIS TRÈS MAUVAIS

Ventilation
PRÉSENCE D'UN SYSTÈME DE VENTILATION SYSTÈME DE VENTILATION INCOMPLET PAS DE SYSTÈME DE VENTILATION

Système de production d'énergie renouvelable

- ■ Necessary evaluation of its primary energy consumption for heating, DHW, cooling (if) and auxiliaries that *should*
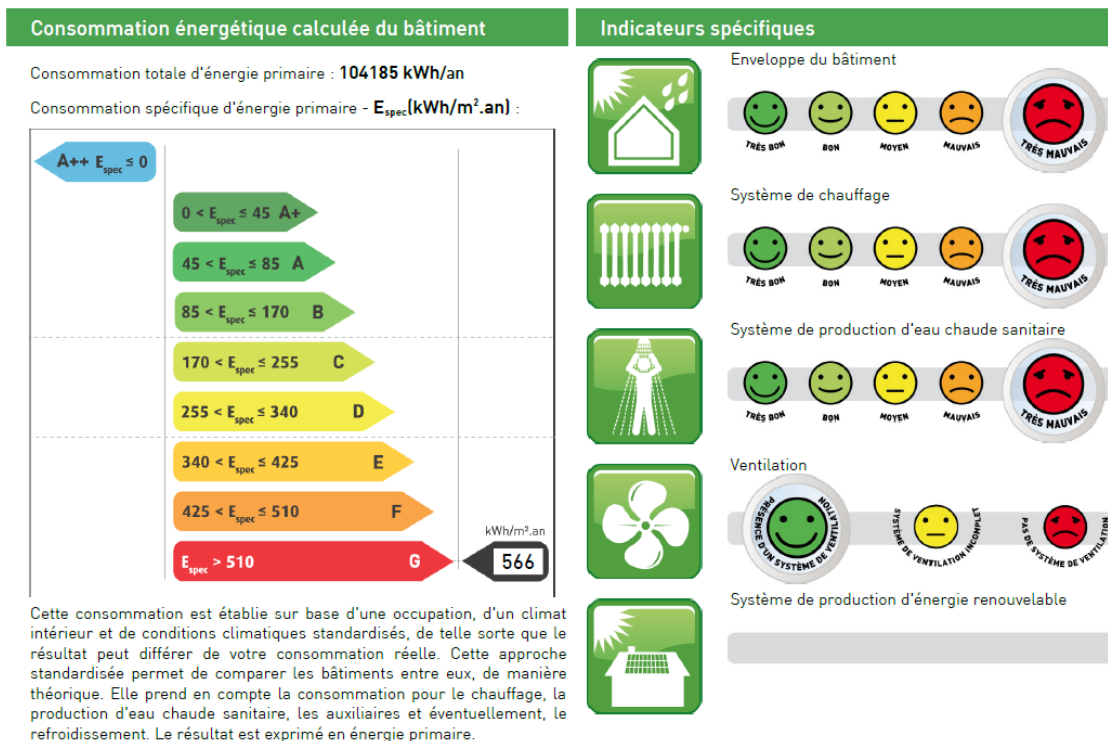
  - ■ … provide "clear" information on the EPB and renovation advice.
  - ■ … suggest energy performance as choice-making criterion
  - ■ … influence real-estate market values
  - ■ … increase investments in efficiency upgrade
  - ■ … help build-up databases and strategies

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In Belgium…

❑ The calculation method is based on a standardized approach which purposefully and understandably gets the human factor out of the equation.

❑ Necessity of comparable EPCs

  ■ "Certify the building, not its users"

❑ → Unrealistic results, overestimates consumptions…

Annual final energy consumption
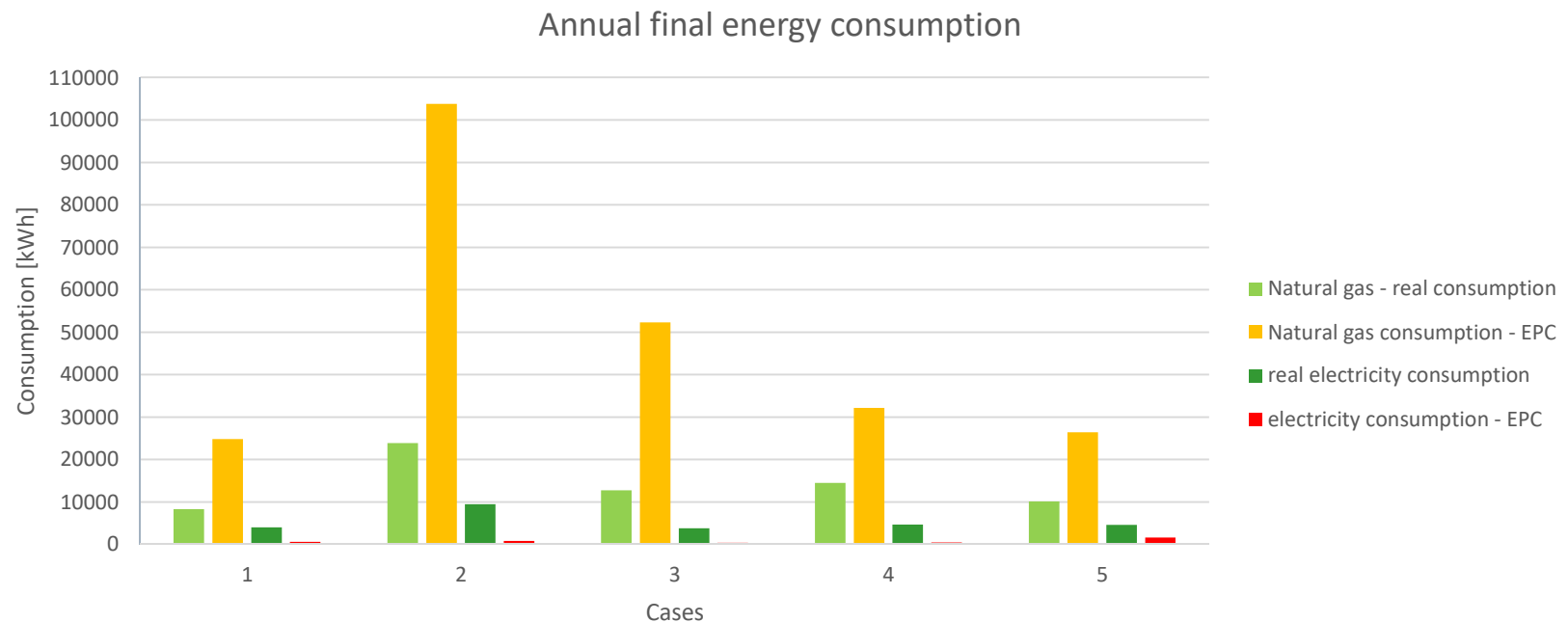
So…

- → No appropriation of results by end-users
- EPC suffers from bad reputation…
  - Unhelpful EPC = "Disguised tax"
    - Bad reputation that can taint other types of energy assessment (ex: EAP → v2)
- … and is consequently misused (or unused)

- Missed opportunity, certainly.

- *"It is useless for old houses, it has been designed to promote new and efficient houses. It is not subtle enough to differentiate two old houses. They will both be at the bottom of the scale, and let's face it, the scale level is the only thing people understand."*

Uncertainty parameters

- ❑ Basic principle of the method : if the input data is not 100% sure, it will be replaced by a default value.
  - ■ A disadvantageous one.
  - ■ The whole dwelling stock (quite diverse in Belgium) is described by the same method and default values…
    - ■ Pre-WWII stone houses and 1960's flats alike
 - ■ → High diversity of uncertainty parameters

- ❑ Some are not related to human behaviours…
  - ■ Climate data
  - ■ Default values and standardized parameters
    - ■ In envelope description
    - ■ In ventilation and air-tightness description
    - ■ In systems description and efficiencies
      - ■ More understandably based on systems' age, but still disadvantageous

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Uncertainty parameters

- Some are more clearly related to the behaviour of someone…
  - Protocol
    - Rigid assessment method
      - Few liberties in the process
    - Accepted proofs
      - Short list of acceptable sources of accurate data in the dwelling description.
    - Trust issues ?

  - Trying to get the assessor's factor out of equations… when possible
    - Still variable: skills, knowledge and professionalism

Scores divergents pour une même habitation

Nous avons demandé cinq certifications pour chacune des cinq habitations de notre enquête; les scores finaux sont repris ci–dessous. Il y a parfois de grandes différences de score pour une même habitation.
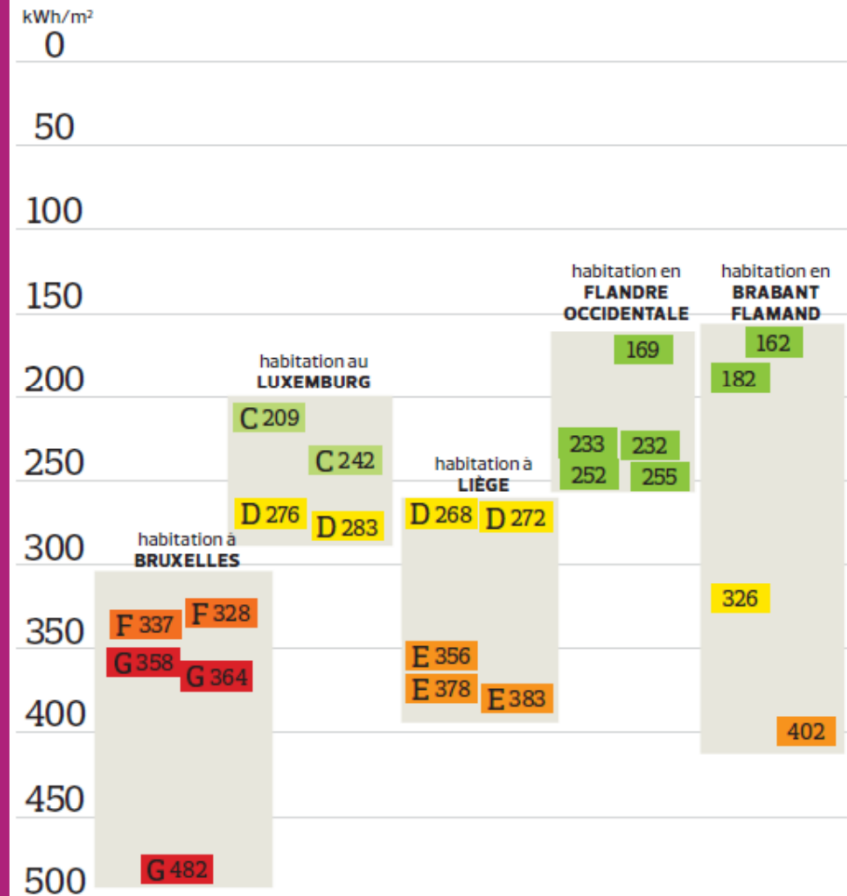
Uncertainty parameters

- Some are very clearly linked to the calculation method itself...
  - Monthly (steady-state) calculation method
    - First clue of occupancy standardisation
  - Necessary standardisation
    - In metering: "Protected Volume", "Heated Area"
    - In ventilation needs
    - In DHW needs
    - In internal loads
    - In temperature management

- [When discussing regulation systems]: *"The coldest one, wins. Who will turn the valve to its maximum. That's the problem when you live with a lizard."*
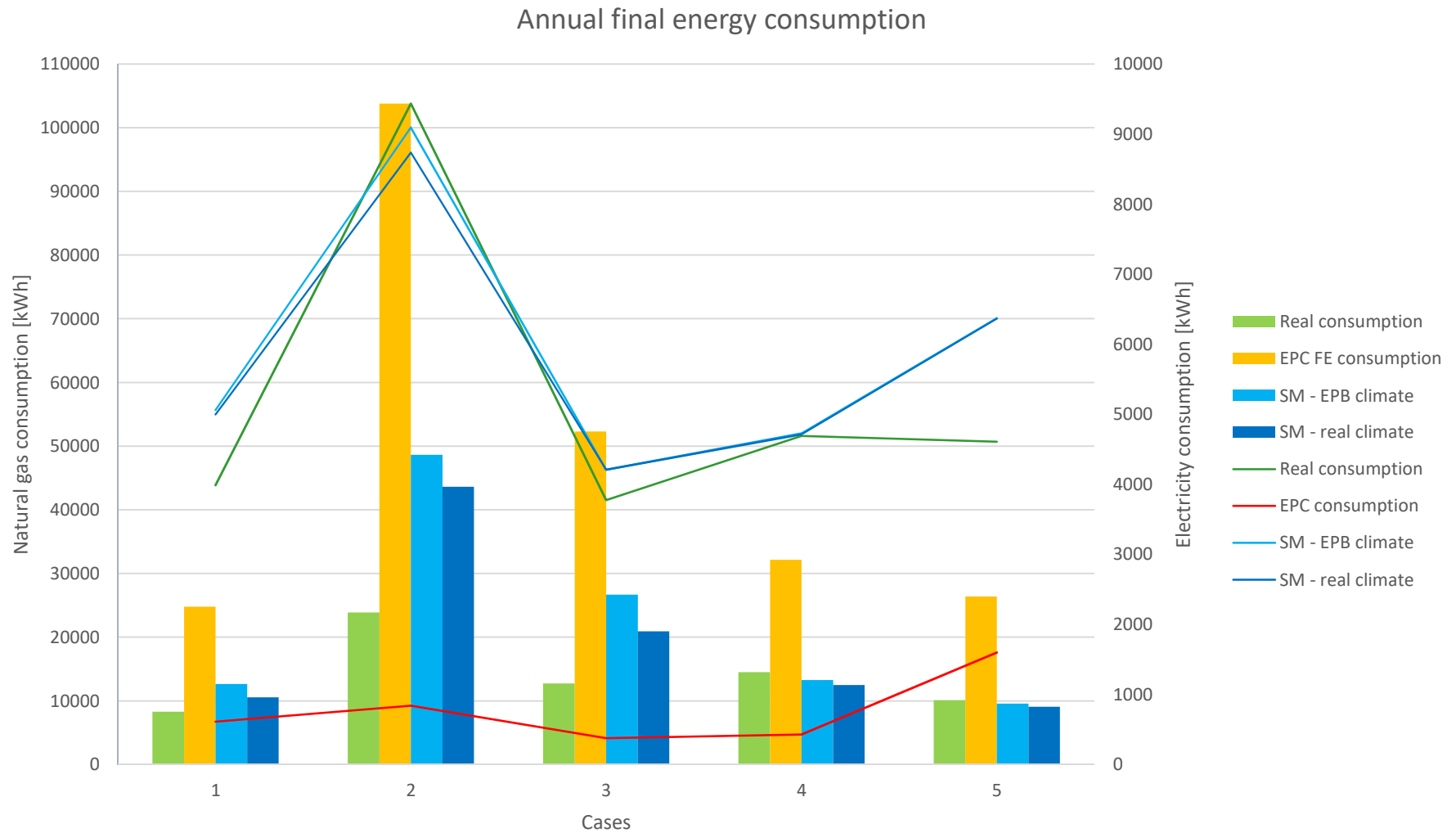
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This study…

❑ … shows an assessment of 5 urban houses with the application of sociology-inspired parameters in the EPC calculation method

- Objective : try and close the "prebound" gap
  - Not to replace the actual EPC , but to propose additional (and more accurate) results.
  - Predictive work in essence: how to approach future owners consumption
- Method : questionnaire and modification of the calculation method
- All EPCs made by trust-worthy assessors who stuck to the protocol
- In this case, we added data on:
  - Heating management and zoning of the "protected volume"
    - Schedule (occupancy)
    - Heated volume
    - Set temperatures
  - A new evaluation of otherwise standardised parameters :
    - internal gains
    - DHW needs
    - Ventilation needs

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Dwellings description

Case study	1	2	3	4	5
Photo					
Number of inhabitants [-]	4	5	4	4	3
Protected Volume [m³]	487	841.8	443.2	505.5	323.1
Heated Floor Area [m²]	160.7	254.9	138.1	162.6	101.3
AT - Total heat loss area [m²]	228.2	598.9	225.5	257.2	179.4
$H_{T,heat}$ [W/K]	180.6	951.2	397.1	297.6	217.4
Average U-value [W/m².K]	0.79	1.59	1.76	1.16	1.21
Number of exterior facades [-]	2	3	2	2	2
Presence of an extension ?	No	Yes	Yes	No	Yes
Inhabited(-able) upper floor ?	Inhabited	No	Inhabited	Inhabitable	Inhabitable
Kitchen open on living room ?	Yes	Yes	No	Yes	Yes
Temperature regulation device ?	Yes	Yes	Yes	Yes	No

Results

Annual final energy consumption

Discussion

- ❑ NHDs re-evaluated in a [27.1%; 43.4%] range, as percentage of the regulatory method NHDs
  - ◼ Regulatory calculation method shows higher NHD and lower DHW demand ; "Users-included" : lower NHD and higher DHW demand…
- ❑ Annual natural gas consumption gaps decrease from [221.9%; 434.3%] to [86.1%; 182.6%] of the real consumptions
- ❑ Electricity consumption rises from [8.9%; 34,7%] of the real consumption to… [92,6%; 138.1%].
- ❑ Still a gap :
  - ◼ Remaining pool of uncertainty parameters unrelated to the assessor's and/or end-user's behaviours
    - ◼ An indicator could advertise the level of certainty on both the envelope and the systems descriptions
  - ◼ Single zone steady-state calculation method

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Discussion

- ❑ Where to stop ?
    - Predictive work is, by essence, uncertain.
    - Respondent's reliability is influenced by the presence of the interviewer ; should the questionnaire be longer and self-administrated…
        - Number of added parameters is therefore limited
    - Too many uncertainty parameters in the method to control, too many local particularities or special occasions, too many (un)conscious and/or (un)conscious ways to influence the result…
    - We have replaced default values by others.
        - No monitoring here.
        - More accurately, we have multiplied the default values, in the belief that the sum of little uncertainties will be less damageable to the result than a few big uncertainties.
            - Still…

Conclusions

- ❏ The Walloon EPC appears insufficient to well-informed people, unclear to neophytes, generally too distant from real energy consumption, and useless when it comes to decision-making processes, whether in real-estate hunting or improvement investments
  - ■ How can an incentive become an obstacle ?
    - ■ Why would you **create** so much barriers and **obstacles** around it ?
    - ■ If you standardize the calculation method anyway, why would you choose disadvantageous parameters ?
- ❏ Lack of appropriation of the results by end-users
  - ■ Essential to make it understandable and understood, trusted and used
  - ■ Essential to engage social scientists in the design of such tools.
- ❏ Still necessary to present a "legal" result as a comparison base, following the approved standardized calculation method.
  - ■ Other results could be displayed, closing the gap between real and theoretical consumptions, allowing future owners to better understand and appreciate the EPC results, foresee a rough monthly energy bill or adequate renovation scenarios.

Thank you for your attention

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