Monfils, Stéphane

University of Liege (Belgium)

Hauglustaine, Jean-Marie

University of Liege (Belgium)

La politique européenne visant la réduction de la consommation d'énergie et des émissions de gaz à effet de serre a récemment imposé dans sa Directive 2002/91/CE, parmi bien d'autres réglementations qui s'appliquent principalement aux bâtiments neufs, la certification de tout bâtiment résidentiel existant vendu ou loué, témoignant de sa consommation d'énergie et de sa performance. Ce certificat PEB, calculé par une approche standardisée qui extrait délibérément (de manière compréhensible) le facteur humain des équations, vise à influencer le marché de l'immobilier en introduisant l'efficacité énergétique comme critère de décision dans la recherche d'un logement et en incitant aux investissements économiseurs d'énergie. Le certificat pourrait se révéler un outil précieux pour les stratégies de villes et régions « intelligentes ».

Mais afin d'atteindre ces objectifs, il faut que le certificat PEB s'implante durablement dans le paysage immobilier wallon. Or, dans le contexte actuel, les résultats du certificat sous leur forme actuelle n'aident pas à conscientiser le public : souvent distants de la réalité, surestimant la consommation, ils sont généralement incompris et le document, mal ou non exploité. L'intérêt d'un document si peu réaliste, qui ne renseigne finalement pas la consommation attendue d'un logement occupé par de vrais occupants, manque de visibilité. Il devient nécessaire, pour les autorités qui en connaissent le potentiel, d'en améliorer la publicité, notamment en réintégrant le facteur humain dans l'élaboration des solutions qu'ils veulent « intelligentes » : d'un côté, les solutions efficaces (en ce qui concerne le transport, la consommation d'énergie dans les bâtiments, la gestion de l'eau et des déchets…) doivent être mises en œuvre par une autorité décisionnaire intelligente qui comprend la complexité du contexte urbain et son impact sur l'environnement. D'un autre côté, ces solutions ne pourront être efficaces que si les utilisateurs sont conscients de leur impact sur l'environnement, mais aussi si on leur donne les outils pour comprendre le potentiel d'économie et l'activer de manière optimale.

Cette étude vise la création d'un certificat « sur mesure » complémentaire, au travers de l'analyse des représentations, attitudes et comportements liés à la consommation d'énergie résidentielle dans les ménages wallons, en vue de définir un certain nombre de profils comportementaux qui seront intégrés à la méthode de calcul réglementaire. Plus précisément, la population cible est composée de propriétaires de maisons urbains wallonnes dont la performance énergétique a été analysée par une méthode de calcul théorique tel que celle utilisée pour établir le certificat, afin de permettre l'analyse des données et la comparaison des résultats avec la consommation réelle.

Parmi les délivrables possibles de cette étude, citons a collection de données sur la consommation d'énergie du parc de logements existants, ou encore la création de bases de données fondamentales pour la mise en place de stratégies au niveau urbain, régional ou national.

# Survey and definition of household behavioural profiles of energy use in Walloon urban houses

# Enquête et définition de profils comportementaux de la consommation d'énergie des ménages dans les maisons urbaines wallonnes.

European Union's strategy for a sustainable growth makes the reduction of the energy consumption of the building sector a central objective for meeting the commitments taken under the Kyoto protocol on climate change. At the European level, this sector is thus regarded as one of the most cost-effective options for saving CO2 emissions[i]. Main policies have so far aimed at lowering the energy consumption of the new buildings sector, which can obviously enter the "low carbon" frame easily. But in order to reach significant goals in terms of energy consumption reduction, the existing buildings sector should be addressed in priority, for there lays the main reduction potential. Therefore, among other regulations, the European policy for energy consumption and greenhouse gases emission reductions has imposed, in its 2002/91/CE Directive, the certification of an existing building's energy performance, providing clear information about the energy performance of a building when it is sold or rented. The Energy Performance Certificates (EPC) includes an assessment of the building energy performance, a scale of reference values to allow comparisons between buildings and recommendations for technically possible improvements. The information given by the certificate aims at influencing real-estate market by introducing energy efficiency as a comparative criterion in the search for a dwelling and stimulating energy saving investments. In addition, the EPC could be great opportunity tool of the "smart cities"[ii] strategy, through data collection and actuation of the existing buildings stock that could help create comprehensive benchmarking databases and shape smart strategies on any level.

The impact on potential buyers or tenants is therefore crucial in order to reach these goals: one who reads a coveted dwelling's EPC should, at least, understand its content, at best, use it to compare results with those of other potential dwellings and choose wisely. In Wallonia, the actual certification calculation method is based on a standardized approach which purposefully gets human factor out of the equations; this is understandable, as the EPC should assess the performance of the building, not its users. But, as a consequence, it does not provide realistic results like owners apparently believed (or hoped) it would, and this is confirmed by energy bills. How can one relate to an EPC, when two different families, living in two identical homes, would receive identical EPCs, but their real consumption would vary by up to a factor of three[iii]? EPC is therefore often considered unrealistic (and mistrust), distant from reality, overestimating consumption, too long and technical, confusing… in a word, unhelpful. This "bad publicity" appears in several countries, as proven by studies that have been led in the UK[iv] or in Germany[v], so that the potential remains underexploited.

Though acknowledging the interest of the EPC, and the necessity of presenting a "legal" result as a comparison base, based on the approved standardized calculation method, it is believed that other results could be displayed, based on building characteristics and a minimum of behavioural inputs. A complementary "custom-made" certificate could help future renters/owners understand the results displayed in the EPC, and foresee a rough monthly bill (taking energy and rent or loan repayment into account). The first step is to identify in the regulatory calculation method those uncertainty parameters that create a gap between calculated and measured consumptions and put the software precision into perspective. The idea here is not to question every parameter or to blame the calculation method, as it often results from a difficult balance between necessary parameters, precision possibilities and the time and cost required to make a full calculation. Furthermore, uncertainties do not all stand in occupants' behaviour parameters, but also in other specificities of the protocol, like the subjectivity of the assessor (another kind of human factor), or the necessary use of default values that only secure more accurate results when more precise information is available, and induce obvious reservations towards consumption results. In this study, we focus on those general shortcuts that have been decided in order to withdraw human factor from equations.

First to be pointed out is the fundamental choice that led to the use of a standardised consumption calculation method instead of a measured-data based method. Measured certification normalizes real consumption data in order to reach standardized energy consumption, using calculation parameters such as climate, building size and type, behavioural habits and pattern of use. Besides the need to divide the measured energy into its different uses, adjustments to standardised energy use can be a huge problem, as real consumption data are obviously greatly influenced by the behaviour of the occupants, which imposes caution when comparing buildings. In contrast, the calculated energy rating evaluates the performance using building characteristics (as close to reality as possible), default values (when no accepted proof of a more accurate value is available) and standardized parameters (which cannot be replaced by more accurate values, even if they are known). If the comparison between buildings is easier, the results are often unrealistic.

The Belgian regulatory calculation method uses, for outside climate, the average monthly temperature in Uccle (near Brussels) for the last 50 years, preventing "unnecessary" geographical differentiation in such a small country. But variations do exist: there is a 3°C variation gap in the annual average temperatures of the main Belgian climatic station; one can easily argue that the lower the outside temperature, the higher the energy consumption in order to reach the same indoor climate.

Reality displays a complete range of behaviours, set temperatures and heating habits that are bound to influence greatly the final energy consumption. Since P. O. Fanger, and his largely acknowledged studies on behaviour – related residential energy consumption parameters in 1977[vi], several researches completed this knowledge until recently[vii], pointing metabolism, activity, gender and clothing amongst important comfort factors, providing insight into behavioural patterns, describing the inside climate as a rather energy-intensive heating habit or showing variations in household behaviours, equipment rates and energy consumption. In order to "certify the building, not its users" however, occupants' behaviour, comfort and building occupation have been standardized: the whole "protected volume" is considered used at all times, and heated at a constant temperature of 18°C; though permanent occupation increases internal loads, it also extends heating periods and, therefore, energy consumption levels. Furthermore, the method considers no interference with the running of the building's systems, which means that other ways of estimating consumptions had to be imagined. For example, domestic hot water (DHW) real needs should be based on the number of inhabitants and personal hygiene habits, ventilation rates should depend on household composition and windows opening habits, and internal gains should be evaluated with respect to the level of equipment and human occupation patterns. In the Walloon standardised approach, those consumptions are evaluated on the basis of the protected volume only.

A first study[viii] allowed us to ascertain that, with a small amount of additional data, the certification calculation method is strong enough to approach real consumption data. In this study, real climatic data were used, lighting system loads have been evaluated considering more realistic installation power and use, occupation patterns, equipment data (including lighting installation) and realistic metabolism influenced internal loads evaluation, as well as heating and lighting patterns and consumptions. DHW needs have also been recalculated, considering the number of occupants and average use patterns. These results are encouraging but insufficient. As said before, more accurate data on systems parameters are needed (for example through the annual inspection of heating production systems, as required by the 200/91/CE European Directive), but also more accurate data on the inhabitants, their habits and other behaviour variables that influence energy consumption in the house. This should be obtained, thanks to a survey under construction, addressed to owners of Walloon urban houses that have been certified, and occupied for at least a year. In order to insure that the respondent panel is representative of regional statistics, and to draw useful statistical conclusions, a description of the household (as a consumer entity) socio-demographic variables is necessary: its size, its members' and head's age and gender, their level of education, professional situation, incomes and daily occupations share their part of influence on energy consumption. Also, the rights of the household on the dwelling (owner / tenant) is crucial, influencing comfort representation, social standards, financial interpretation of the consumption but, foremost, investment strategies. As a result, wealthier households are generally linked to ownership, better knowledge and awareness on energy consumption and its impact on environment; ecological convictions do not mechanically translate into sparing behaviour, though, and these households are generally bigger energy consumers.

The level of "environmental awareness" can evidently play a significant role on the energy consumption in dwellings, which can be further determined by cognitive factors such as attitudes and representations. Energy-related attitudes could be linked with price concern, environmental concern, energy concern, health concern, and attitudes toward personal comfort. Comfort representation, motivation to save energy, perceived behaviour efficiency, social standards or identification to others are representations that can be linked (as stated by several studies) with energy consumption practices. Can environment be defined as a major weight in decision-making processes, when it comes to energy consumption? Can a household bend its comfort standards in order to save energy? These matters are approached through global environmental concern questions, and particular attitudes in "rational use of energy".

When it comes to comfort parameters, global temperature management is crucially influential on consumption: the definition of "protected volume" could be redefined for each household, as well as "temperature settings". If the heat is often directly turned on in main rooms in winters, other rooms are, sometimes or often, either heated with another device, either indirectly heated by simple transfer of heated air, so that they cannot be considered as "unheated". The temperature in the main room is therefore no accurate data to represent the average temperature in the household. Furthermore, the presence of a thermostat in the living room is indication on a possible level of control on the heating system, but not on the occupants' skills and knowledge on how to use it to its full potential. Therefore, the perceived level of control might be as important as the presence of the regulation equipment itself.

Where to stop? As every parameter of the method could be questioned, every parameter of a household representations, attitudes and behaviours could be studied. It is therefore necessary to be aware of the limitations of such an approach: it is almost impossible (and unnecessary) to get exact correspondence between theoretical and real consumption data. Impossible because there are too many uncertainty parameters in the method to control, too many conscious and unconscious ways to influence consumption. Unnecessary, because if it is crucial to understand occupant-related parameters that could give more realistic calculation of residential energy consumption (so that the new owner of a house can project his energy bills), it would be unwise to bet anything on the consumption the same occupants would face in another dwelling, on a different location, the year following the purchase.

In conclusion, it is believed that statistical data on Walloon households' compositions and behaviour patterns are needed in order for the EPC to gain his way into real-estate potential buyers' trust and decision-making weighing balance. The next step will see the necessity to link socio-demographic variables, attitudes and representations to renovation strategies, in order to improve the "recommendation section" of the EPC and the incentive policy. Then, and only then, the EPC will be able to reach its goal and so become a tool for smarter cities.

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