Energy & Buildings 169 (2018) 388–396

Contents lists available at ScienceDirect

Energy & Buildings

journal homepage: www.elsevier.com/locate/enbuild

Stockholm Royal Seaport moving towards the goals—Potential and limitations of dynamic and high resolution evaluation data

Louise Holmstedt*, Anders Nilsson, Aram Mäkivierikko, Nils Brandt

Department of Sustainable Development, Environmental Science and Engineering, KTH Royal Institute of Technology, Teknikringen 10B, Stockholm SE-100 44, Sweden

ARTICLE INFO

Article history:
Received 27 November 2017
Revised 2 March 2018
Accepted 30 March 2018
Available online 6 April 2018

Keywords:
Dynamic evaluation
High resolution meter data
Stockholm Royal Seaport
Building evaluation

ABSTRACT

Cites have been identified as one key arena to meet future sustainability challenges. However, if cites are to be part of the transition it must become possible to confirm results of ongoing actions. By the introduction information and communication technologies, it has become easier to collect performance parameters from the built environment, thereby enable more detailed evaluation. The aim of this paper is therefore to examine the potential and limitation of using dynamic and high resolution meter data for evaluation of energy consumption in buildings and households. The novelty of this approach is that dynamic and high resolution meter data can increase the level of detail in evaluation results and ease detection of deviations in the structures performance. However, most benefits are found from the occupant perspective, as more detailed evaluation information enable better inclusion of this stakeholder group. Furthermore this study has shown that the commonly used indicator energy use per heated floor area is an insufficient communication tool when taking holistic approach to building energy evaluation. Limitation to full use of dynamic and high resolution meter data have been identified to data collection and management, preservation of personal integrity and incentives to react on the given evaluation information.

© 2018 Elsevier B.V. All rights reserved.

1. Introduction

The urban world is expanding and is today home to the majority of the worlds' population [47]. With a growing global population and increasing consensus on the need to shift our way of living towards a more sustainable mode, cities have been identified as one of the key arenas to meet future sustainability challenges [17,20]. Transformation and improvement of the built environment is therefore an ongoing process in many cities around the globe (e.g. [4,9,13,38]). Early tactics mainly focused on individual buildings and improvement of building specifics, e.g. construction materials and energy conservation [33]. More recent approaches acknowledge the importance of high performing structures, but also incorporate a view of the built environment as a holistic system constituting of more than just its buildings, e.g. also include behaviour aspects, green spaces, traffic, etc. (e.g. [10,49]).

However, in order to confirm that efforts and initiatives are guiding the built environment towards the desired outcome it must be possible to follow and evaluate the undertaken actions. Lately, the development in evaluation practice of the built environment has moved towards more individualisation, with the intent of making results more transparent, specific and accessible to a broader audience [37]. This represents a shift in evaluation approach and target audience, since the built environment traditionally mostly been statically evaluated i.e. evaluated as a single event and with authorities and property owners as the main information receiver [30]. With the introduction of information and communication technology (ICT) it has become easier to collect, monitor and adopt performance parameters. This technical introduction has also enabled the collection of more dynamic and high resolution evaluation data i.e. the possibility to shift the frequency on the temporal scale (dynamics), and separation of information streams and information retrieval at the source of consumption (high resolution).

However, the static evaluation scenario remains as the main regulated norm in building evaluation. For instance, houses in Sweden are legally required to be evaluated with regards to their yearly energy performance [41]. Parameters required to be accounted for are energy used for building functions and equipment's like lighting and elevators, energy used for heating (or cooling), and generation of hot tap water. The energy performance is presented as annual consumed energy per heated floor

* Corresponding author.
E-mail addresses: larman@kth.se (L. Holmstedt), anders.nilsson@abe.kth.se (A. Nilsson), aram.makivierikko@abe.kth.se (A. Mäkivierikko), nilsb@kth.se (N. Brandt).

https://doi.org/10.1016/j.enbuild.2018.03.078
0378-7788/© 2018 Elsevier B.V. All rights reserved.

area, kWh/m^2(A_{temp}), year.[1] While the static scenario fulfils all legal requirements in Sweden it disregards the fact that building energy consumption is not solely dependent on the performance of the buildings and its technical specifications. Over time, in the use phase of the building, the occupants and their consumption patterns will also impact the total performance [22]. On average, Swedish multi-dweller homes yearly consume 10,300 kWh/apartment for heating and hot tap water purposes [45] and 2500 kWh/apartment for household electricity [14]. Sweden holds approximately 2.7 million multi-dwelling apartments [39], resulting in an total energy use for heating, hot tap water and household electricity of approximately 34 TWh/year. These figures highlight two vital shortcomings in the regulated building evaluation scenario. First, the resolution in available and collected information in Sweden is low, as separation between energy used for heating and hot tap water cannot be done. Second, two important energy streams within Swedish multi-dwelling homes cannot and are not regularly followed, further highlighting the exclusion of important stakeholder groups affecting the built environment and the strong construction focus. In this light it becomes clear that there is a potential for energy reduction in the built environment and that building energy evaluation must become more useful, better mediate knowledge to all affecting stakeholders. These arguments are further supported by e.g. Darby [12], stating that direct energy feedback could result in energy saving in the built environment. Furthermore, while heating still remain the major energy consuming parameter in Swedish multi-dwelling homes [45] constructional improvements will result in increased relative impact from other parameters e.g. hot tap water [35], hence become more important to monitor. Previous studies acknowledge the difficulties to correctly manage the behaviour impact and the general gap between estimated and actual energy consumption in the built environment (e.g. [18,19,21]). Therefore, transitioning to the use of measured dynamic and high resolution meter data for energy evaluation can be a route to overcome identified shortcomings, enabling the possibilities to incorporate a more holistic view to energy reduction in buildings.

An urban district development intended to incorporate this more holistic approach to evaluation practice is the Stockholm Royal Seaport development in Stockholm, Sweden. The mixed-use development was initiated in 2008 as a response to a growing population in Stockholm [40], and it was decided in the planning process that the area should meet high environmental and sustainability standards. A environmental and sustainability programme was therefore developed to manage these issues [11]. The programme clearly emphasises the importance of evaluation and follow-up of the set out goals and visions [11, pp. 46–49]. It also stresses the importance of an evaluation process performed during all development phases and for a broad stakeholder base, i.e. follow-up from planning to user phase, covering the district scale down to the individual household level [11, p. 47]. The evaluation process should be facilitated by ICT, which also should enable real-time dynamics [11, p. 11].

However, more detailed evaluation information may also introduce new challenges regarding e.g. data management, information presentation, protection of personal integrity etc. [3,37]. For successful use and to fully unfold the benefits with personalised dynamic and high resolution evaluation data, these are all issues in need of deeper understanding.

[1] In Sweden A_{temp} includes all building floor area heated over 10 °C.

1.1. Aim and objectives

In order to provide a deeper understanding regarding the utilisation of more detailed evaluation information the aim of this study was to examine the potential and limitations of using dynamic and high resolution meter data for evaluation of energy consumption in buildings and households.

To fulfil the aim two residential buildings in Stockholm Royal Seaport are used for further investigations. The specific study objectives were to:

- Analyse the specific energy performance indicator based on dynamic and high resolution energy meter data, accounting for the two perspectives; building and occupant;
- Reflect on the usability of dynamic and high resolution energy data as a mean to improve building sustainability through reduced energy consumption;
- Reflect on the process of securing and collecting energy data for dynamic evaluation.

2. Overviewing background

In 2008, the global urbanisation rate exceeded 50%, reaching a landmark where most of the world's population is living in an urban setting [46]. In Europe this figure is even higher, with over 70% of the continents population living in cities [47]. With the growth of the urban sphere and the built environment sector representing a major proportion of the world's energy consumption (e.g. [26,36]), the built environment needs and can play a vital role in the transition towards sustainability. The importance of transforming our cities is also reflected in item 11 of the updated UN Sustainable Development Goals [48]. Similarly, the European Union has set a policy target of a minimum 20% energy reduction by 2020 and recognises that the built environment will play an important role for goal fulfilment [15].

While the built environment has been acknowledge as an important arena in the transition towards a more sustainable future, evaluation of undertaken actions need to be an incorporated part of the process, for progress confirmation and avoidance of sub-optimisation [1]. Building evaluation has traditionally largely been a matter of construction features and the possibility to account and present a performance snapshot in order to meet regulatory requirements [30]. The energy and construction focus has been strong which also reflects in the used indicators where annual energy consumption per heated floor area (e.g. kWh/m^2(A_{temp}), year) is one of the most commonly occurring evaluation markers [26]. Furthermore, building evaluation has been an activity generally performed early in a structure's lifetime e.g. in the planning stage as estimated energy calculations, in change of ownership e.g. transition from developer to final owner or when the formal construction warranty expires (e.g. [7]). Energy evaluation of the building stock is also usually performed and/or data are collected for yearly statistics e.g. for a national level accounting, further adding to the conservation of static evaluation (e.g. [44]).

With this legacy in mind it is logically to realise why building evaluation has focused on static environmental (energy) performance. Nevertheless, building performance is not just a matter of construction features, but is over time also influenced by energy flows originating from its occupant's behaviours and actions [28]. Furthermore, building evaluation has mainly been focused on the environmental part of sustainability, overlooking the economic and social parts of the subject [34]. These are two important drawbacks in conventional evaluation approaches and need to be resolved in order for the built environment to truly transition towards sustainability.

Download English Version:

https://daneshyari.com/en/article/6728160

Download Persian Version:

https://daneshyari.com/article/6728160

Daneshyari.com