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Ambitions at work: Professional practices and the energy performance of non-residential buildings in Norway

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ABSTRACT

Globally, buildings are considerable energy users. Stricter regulations and instruments such as energy performance standards aim at raising energy performance ambitions and reducing energy use. They rely on the implementation and use of efficient technologies, but technical efficiency improvements do not guarantee low consumption. A gap between estimated and actual building energy performance represents a common challenge.

Over the building lifecycle, multiple professionals influence energy performance levels: architects, engineers, contractors and facility managers, but also building users. This article concentrates on the building use phase, and how building managers and end-users contribute to increasing or reducing the energy performance gap.

Capturing the relations between formal standards, technologies and actual professional work requires interdisciplinary research. Taking professional practices as the starting point, the article draws on facility management and social practice theory, and case studies mapping energy management and use practices in buildings with high performance ambitions in Norway, informed by interviews with owner, facility management and user representatives. This article presents and compares results from two office buildings. It demonstrates and discusses how characteristics of and relationships between professional practices and standards influence the realisation of ambitions, pointing out opportunities for actually achieving and sustaining the targeted energy performance levels.

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1. Introduction

In line with technical developments and following national and international commitments to mitigate climate change and reduce greenhouse gas emissions, the energy efficiency and performance ambitions of new and retrofitted buildings are steadily rising. European governments, for example, are bound to implement stricter energy goals in building regulations by the 2010 Energy Performance of Buildings Directive (EPBD) [1]. The directive requires all new buildings to be nearly zero-energy by the end of 2020. While such regulations and standards are developed to influence energy performance ambitions, for example through technical specifications, they do not necessarily address actual use.

In practice however, many buildings do not succeed in living up to their ambitions [2–4]. The gap between the predicted, calculated performance of buildings and their actual levels of energy use is frequently referred to as the energy performance gap. Two lenses from which this gap can be appraised are: firstly, the gap as a technical mismatch between the models we use to simulate energy use and the methodologies by which we measure energy consumption. This could for example be a question about failure to account for the energy used by occupants' equipment in design estimates of energy use [5]. Many studies have focused on narrowing the divide between prediction and measurement models [6,2]. Secondly, the gap as a sum of influencing factors occurring at different stages throughout the lifecycle of buildings. For example, changes and errors during construction, bad routines during commissioning, and, building use deviating from design intentions [2].

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The PROBE studies (Post-occupancy Review of Buildings and their Engineering) [42] is one of the most important investigations providing both evidence of the gap as well as insight regarding the factors that influence it. Running from 1995 to 2002, this project assessed the performance of 23 buildings of energy efficient design. Results suggested buildings often consume more energy than predicted during the design phase [5]. Furthermore, it highlighted the importance of addressing the management routines that take place once a building has been occupied [7]. This includes, but is not limited to, resolving conflicts between the needs of the different stakeholders who take interest in the building once it has been commissioned. For example, meeting the occupants' need for comfort versus achieving the building's energy efficiency goals.

In this paper, we take building use and management as the starting point for exploring how the energy performance ambitions of buildings can be realised.

When we concentrate on the operational stage, a different set of standards becomes relevant than those technically describing energy ambition levels during design and construction. Professional building and facilities service management and commercial or public use of buildings also involve rules and standards, as well as professional practices which relate in different ways. This includes the daily activities of and interactions between building users such as the managers and employees of the organisations owning or renting buildings, and service suppliers involved in the day-by-day building and facilities service provision. This can in turn be expected to affect energy use levels. Theory on facility management describes the management of this interaction as happening at a strategic, tactical and operational level (EN 15221-1) [8]. In practice, there is large variation in organisational models and how responsibilities are distributed. Facility managers are however often the ones who are in charge of activities such as the monitoring of building systems, management of relevant staff and following up of third-party contractors [9]. That said, depending on the characteristics of the building and the organisation(s) that manage(s) and use(s) it, completely different professional groups do also influence the resulting performance as they carry out their everyday activities. This for example goes for building users such as managers and teachers in schools, and the managers and employees of the public and private organisations using office buildings. Their professional targets and standards may or may not be aligned with performance ambitions and the ideas about intended building usages embedded in the theoretical specifications of building performance. Discussing the 'social potential' of the built environment, Janda [10] argues that interdisciplinary research on the relationship between occupants, organisations and efficient technologies is needed.

In order to theoretically capture such issues, we draw on social practice theory, and report on empirical data from an interdisciplinary project combining perspectives and approaches from facility management, sociology and design. Social practice theory is promoted as an alternative to the individually oriented and systemic or structural perspectives that have dominated sustainable consumption policy and research (e.g. Refs. [11,12]), but failed to take into account the relationship between individual agency and structure, and between the social and the technical. Social practice theory turns attention towards the social and the material side of energy use. It makes it possible to explore how the professional practices and standards of building occupants influence energy use and the prospects for achieving and sustaining energy performance standards. Here, we are particularly interested in the relationship between energy management practices and practices carried out by building users or occupants, and between the professional practices of different occupant groups and goals about achieving energy ambitions.

By concentrating on a different set of standards than those specifying ambition levels, namely those that guide the everyday

practices of building managers and users and set the standards for work and working environments, we are able to explore what is seen as normal, how that varies between occupant groups, and importantly, how it influences the prospects for achieving energy ambitions.

To do that, we further draw on data from case studies mapping energy management and use practices in eight non-residential buildings in Norway [13]. The case studies have been conducted as part of a larger project aiming to map approaches and practices in non-residential buildings with ambitious energy performance targets, identify the potential for improvement and develop methods that can help align energy performance targets with actual energy use levels. The selection of cases covers four school buildings and four office buildings located in south and mid Norway. The buildings have varying degrees of ambition in relation to energy efficiency, with the least ambitious building aiming at using 20% less energy than prescribed in the Norwegian building code, and the most ambitious one being designed as plus-energy building. The technical solutions chosen in the case buildings represent the international state of the art for energy efficient buildings in temperate climates (increased insulation, building automation, efficient installations). In this sense there is reason to believe that our observations can be generalised to other, comparable national contexts. Limiting the scope to the Norwegian context ensures that the cases face similar conditions, e.g. in terms of regulations, energy access and prices. In this context it allows for concentrating on and comparing the relationship between building energy performance targets and the ambitions of professionals managing and working in the buildings, the similarities and differences in approaches and practices. Shedding light on the interplay between building and practice-level ambitions, between theoretical predictions and the daily work of humans, to understand what affects actual energy use and the opportunities for achieving performance ambitions has relevance beyond the specific cases and the national context, as do the insights and recommendations resulting from the study.

This paper focuses on data from two of the office buildings. One is owned by a general contractor of building services, and the other by a private environmental research institute. The two are interesting to study in-depth due to organisational and material similarities which allow for comparisons at the level of local practices. Both are presented as reference buildings in the Norwegian context. They are privately owned, partly owner-occupied office buildings in which facility management is done in-house and space partly is rented out to other organisations. The kinds of professional practices undertaken in the buildings do however vary. We focus on the professional practices of owner representatives, facility managers and building occupants, the relationship between them, and their relationship to building-level ambitions and standards.

By doing so, we contribute to ongoing research in the field of energy research in the social sciences. More specifically, this practice-oriented, qualitative study contributes to the cultural studies of energy management and use described by Sovacool [14], and to debates about processes of normalisation, standardisation and change in energy service conventions, and what are relevant approaches to fostering change.

The article is structured as follows. First, we introduce an overview of building standards and standards for facility management, and then social practice theory, looking at how it can be used to theoretically capture professional work and the professional standards guiding it. Second, we introduce empirical data from the two case studies on Norwegian office buildings. Third, the results are discussed in light of theory, and with regards to their implications for the development of instruments to reduce the energy performance gap.

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