Behave 2018

Hackenfort, Markus; Carabias-Hütter, Hartmann, Cathérine; Vicente; Janser, Marcel; Schwarz, Natalie; Stücheli-Herlach, Peter (Eds.)

5th – 7th September 2018
Zurich, Switzerland

Book of Abstracts

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ABUJIDI, Nurhan, page(s) X, Y.

Abstracts

BEHAVE 2018
5th European Conference on Behaviour and Energy Efficiency
Zurich, 6-7 September 2018

HOW DO INVESTORS CHOOSE INTERMEDIARIES FOR ENERGY EFFICIENCY REFURBISHMENTS?

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Keywords: Energy efficiency, Behaviour, Information, Communication, Laypersons, Experts

1. INTRODUCTION

In Germany, the refurbishment rate for more energy efficient buildings is lagging behind expectations. It is therefore important to understand which factors influence the decision of house owners to invest in energy efficiency measures. A group of actors which play an important role in this context are intermediaries [1][2], because they can function as change agents for laypersons in the highly complex field of energy efficiency refurbishment and can thus have a great influence on the final refurbishment decision. Despite their crucial role, research on the interaction of intermediaries with investors in the context of energy savings is scarce [1], and presents an “overlooked opportunity” for research [3]. Therefore, we analyse the interface between intermediaries (craftsmen, architects, energy advisors) and private house owners. The focus of the empirical analysis is the first occasion of contact, the search for suitable intermediaries and the decision of the house owner who to engage [4], as the choice of an intermediary can already influence the outcome of the refurbishment [5] and it has been shown that the influence of intermediaries is greatest before the actual installation phase [3]. It will further be analysed if choice criteria differ for different groups of intermediaries, especially for energy advisors, who have been shown to face acceptance problems among investors [6]. The results of the analysis can help to better understand the role of intermediaries for energy efficiency measures and identify possible levers for targeted policies.

2. METHOD AND RESULTS

First, interviews with house owners and intermediaries were conducted. The house owners (n=9) had conducted a variety of energy efficiency measures (installation of PV systems, change of heating system, insulation of facade, change of windows) and were asked about their decision process, experience during the refurbishment phase and their interaction with intermediaries. The intermediaries (n=12, craftsmen, architects and energy advisors) were interviewed about the decision process of their customers, their experience from consultations on refurbishments and their influence on the decision process of the investors. The interviews were supplemented by an online questionnaire (n=167) which aimed at uncovering participants’ experience with energy efficiency refurbishments and interaction with and trust in intermediaries.

How do investors search for intermediaries? Instead of detailed research on intermediaries, many investors reported that they relied on craftsmen or architects they were already acquainted with. Only if no suitable intermediary was found among their personal network, they used other sources. The interviewed intermediaries supported this finding, they reported that most clients knew them before or that they had been recommended. Availability was a further criterion which determined that those intermediaries were chosen which simply had time to be engaged. Concerning energy advisors, the investors had been contacted by them directly during a local

campaign or energy advisors had been recommended by the architect. Energy advisors reported that advertising (e.g., at their offices, or via stalls at local trade fairs) had also attracted clients.
According to which criteria do investors choose intermediaries? It was important for investors to have only one point of contact ("everything from a single source"). Price was also a criterion, although not the most important. The technical competence was mentioned as a further reason to engage an intermediary (e.g., experienced with eco-friendly refurbishments), as well as a general impression of competence. The quantitative analysis showed that indeed, professional suitability was the most important criterion for choosing an intermediary. Trust was a decisive factor for those who had chosen intermediaries as a result of recommendations from acquaintances. The advice by acquaintances was the second most important criterion for choosing an intermediary for those participants who had not yet engaged in energy efficiency refurbishment. The intermediaries also considered a trustful relationship important for the motivation of investors to finalize the measures. The intermediaries reported that they actively work on a good relationship with their clients by gaining an understanding what is important for them. One reported that, as a result of this, he had been working with the same client for decades.
Do choice criteria differ for different groups of intermediaries? On the basis of the interviews, it was found that energy advisors are chosen based on different criteria and also make contact to clients in different ways than architects and craftsmen. Because they cannot rely on trust based on personal contacts and recommendations as much (half of the respondents did not know energy advisors from their personal network), they have to find other ways to convince clients, such as, e.g., the membership in an official network, which, according to the quantitative analysis, is more important for choosing energy advisors than for architects and craftsmen.

3. CONCLUSION

Technical competence and trust play a major role for the choice of an intermediary, and trust can even overrule price. Trust, for craftsmen and architects, is established via personal experience or recommendations of trusted persons. Based on the findings, the difficult role of energy advisors [6] can partly be explained by the lack of those sources. The findings are insightful for the explanation of the special role of the energy advisors and they support the thesis that intermediaries are an important target group for policy measures. They can have a great influence on the diffusion of energy efficiency measures based on the trustful relationship they have with their clients. Serving as first insights into the contact-phase between private house owners and intermediaries, the results need follow-up studies to clarify their generalizability.

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A BOTTOM-UP APPROACH FOR SYSTEM INTEGRATION OF ENERGY INFRASTRUCTURES TO SUPPORT ENERGY FLEXIBILITY

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Keywords: Human-in-the-loop process control, system integration, energy infrastructure

1. INTRODUCTION

Energy consumption in buildings accounts for up to 40% of total energy consumption. In an effort to improve energy and environmental sustainability, buildings have been the target of a number of energy demand reduction strategies. Occupant behaviour in buildings is a key factor that significantly influences the energy consumption of buildings. Whilst researchers have focused considerable effort into understanding and developing strategies that address the impact of occupant behaviour on building energy consumption, the high-energy demand of buildings is considered a useful source of demand-side energy flexibility for the smart-grid. In addressing the influence of occupant behaviour in buildings. In harnessing the energy flexibility potentials of buildings, building energy management systems play a vital role. Traditional building energy management systems are however static and lack input of dynamic factors such as occupancy as well as occupant preference. In addition, traditional building energy management systems are limited in their ability to optimally coordinate the use of buildings energy flexibility without compromising occupant comfort on the room-level.

2. METHODOLOGY

Traditionally top down organized energy supply in electricity and gas networks have to cope with decentralized renewable energy production. Energy consumption could be predicted quite well on macro level, and large power plants pre-schedule their power generation based on this. However an increasing share of decentralized energy generation on micro level introduces growing complexities and uncertainties that have to be factored in operations. Using the flexibility within energy generation, distribution infrastructure, renewable energy sources and the built environment is the ultimate sustainable strategy. Clearly the energy demand characteristics of buildings, available from Building Energy Management Systems, are valuable information for grid optimization. Smart control of energy consumption and generation inside (naoGrid) and around buildings (microGrid) can provide major contributions to address the imminent energy problems within the total energy infrastructure, the SMART Grid. These problems are partly caused by the use of decentralized renewable energy sources. Breakthroughs need to be realized in the field of process control of heat, cold and electricity storage, demand and distribution. New process control strategies are needed for improving the energy interaction within the building, its environment and the energy infrastructure by effectively incorporate the occupant's behaviour. This research explored the use of increased sensor data and computational support for enhancement of energy management and energy flexibility in buildings. Specifically, the research focuses on the application of fine-grained information on building occupancy as well as multi-agent systems in enhancing the performance of traditional building energy management systems in office buildings, see Fig.1 [1]. This forms the basis for Human in the loop process control, see Fig 2.

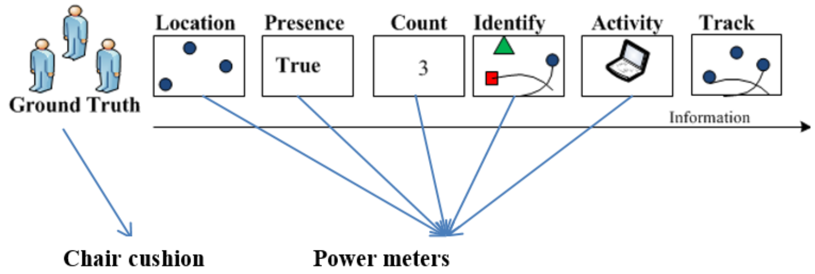

Figure 1: Fine grained user information [1]

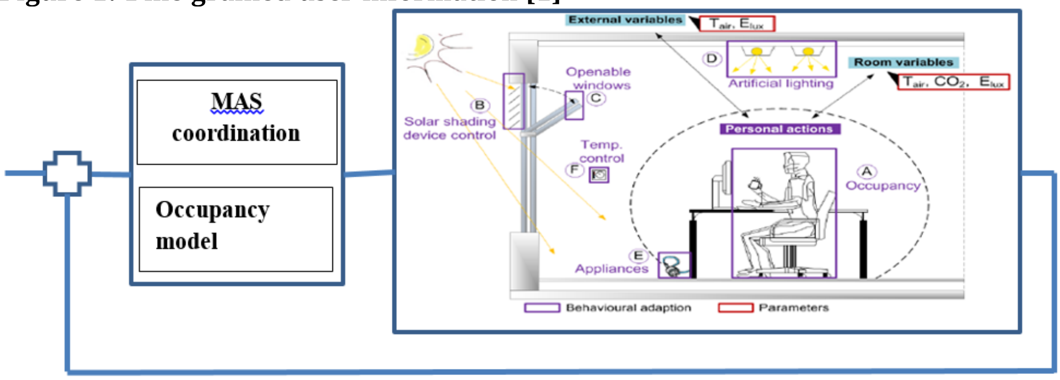

Figure 2: Control schematic Human-in-the-loop approach

3. CONCLUSIONS

Field experiments were conducted in an office building to evaluate alternative methods for obtaining fine-grained occupancy information that enhance energy management [1, 2]. Furthermore, a multi-agent system coordination framework was developed and assessed in the test-bed office building for coordination of occupant behaviour on the room-level and the building's energy flexibility. Next step is to define Neighborhood Energy Management systems and to look for possibilities of a virtual coupling with the SCADA systems of the Grid operators. Grouping energy demand of end-users and local renewable producers in neighbourhoods will enforce end-user involvement and automated lad shifting which greatly improves the efficiency of advanced energy management. This allows maximizing the utilization of flexible demand resources within neighbourhood and forms a bottom-up approach for system integration of energy infrastructures starting from the user to support the Smart grid.

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BETTER SAVED THAN SPENT? THE CARBON FOOTPRINT OF SAVINGS ACROSS SOCIOECONOMIC GROUPS

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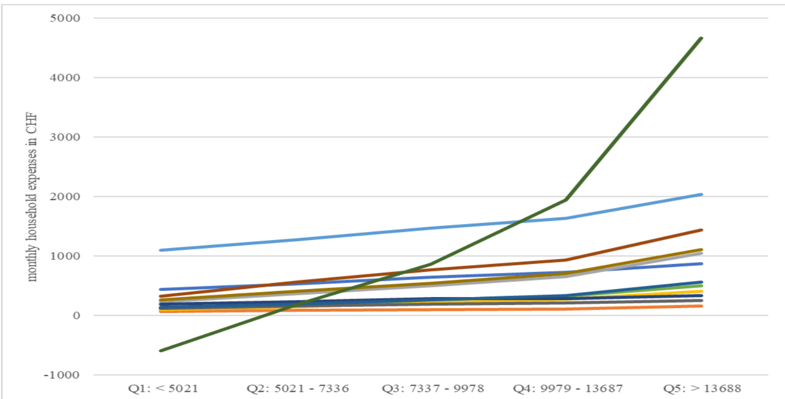
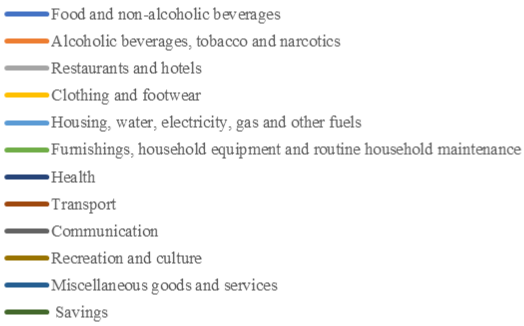
Keywords: Carbon footprint, Distributional impacts, Household savings, Rebound effects

To maximise the effectiveness of climate and energy policies designed to mitigate climate change, a clear understanding of the size and the cause of emissions from both production and consumption activities is paramount. We focus on the latter and in particular on household expenditures. There is a great variety of research addressing the environmental impacts of households, ranging from spatial differences [1] to income disparities and affluence [2] or individual consumption categories [3]. Meanwhile, one impact appears to have largely been overlooked, namely the carbon footprint of the share of household expenditures that is not spent: (monetary) savings, which comprise a key contribution to financing capital investment [4]. Figure 1 shows how household savings, after mandatory transfer (i.e. pension fund contributions), compare with other expenditures and across income groups [5]. The highest quintile saves exponentially more than the second highest and the bottom quintile even accumulates debt. Moreover, the difference between savings amongst the most and least affluent categories is much more pronounced than in any other expenditure categories.

Figure 1: Consumption Expenditure Categories and Savings Across Income Quintiles in Switzerland





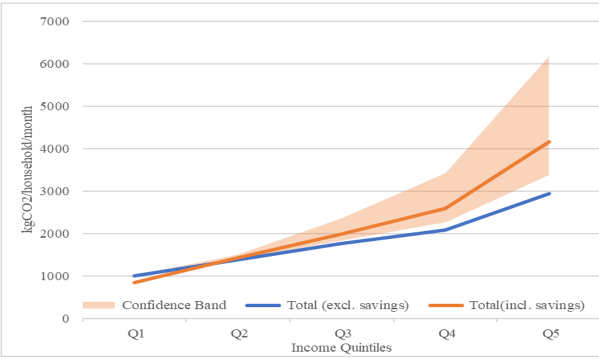
Rationale for study

This research investigates the possible implications of accounting for carbon emissions from household savings in three ways: (1) We analyse the impact of savings on the relationship between carbon emissions and income. In Europe, different income groups tend to contribute non linearly to total carbon emissions [6], potentially more so when accounting for the carbon intensity of savings. (2) We also test the hypothesis that when monetary savings from energy efficiency improvements are kept in green investments, a potentially significant reduction of emissions and rebound effects can be achieved, as postulated by [7]. (3) We further build on the current debate between weak and strong sustainable consumption, or efficiency vs. sufficiency [8] and provide a new perspective on whether any disposable income is better saved than spent from an emissions reduction standpoint.

Method and Results

In international comparison, households in Switzerland have high savings rates with large differences between income groups. Thus, we compare the total Swiss emissions from twelve consumption categories [3] to the total emissions from consumption *plus* the ones from savings. Carbon intensities of investments are used as proxies for the intensities of household savings on the basis of the savings equal investment hypothesis. We use a range of estimates from the literature, which comprised of carbon intensities of total investment, private investments and representative funds. Preliminary results are shown in Figure 2. Including emissions from savings accounts could indeed potentially increase the carbon footprint of almost all income groups, particularly the more affluent households. As shown by the spread of the confidence band, there is a large uncertainty due to the different estimates of carbon intensities.

Figure 2: Relationship between Carbon Emissions and Income Quintiles



Policy implications

Emissions from investments are technically accounted for in financial activities or capital formation and households may have limited power over where savings are invested into. Nonetheless, we conclude that in the case of Switzerland, the carbon footprint of household savings deserves more attention given their magnitude and potential impacts. The challenge is therefore to identify the emissions for which households are responsible through savings account and how this can be influenced by different income groups. Especially, since the results above indicate that money held in savings accounts by affluent households provides substantial potential to reduce their footprint, as well as increase investment in energy efficiency measures. This would also offer possibilities to reduce the rebound effects of household consumption and thus strengthen the rationale for energy efficiency policy. Finally, we argue that households' disposable income might be better spent, especially on energy efficiency measures, than saved in light of the carbon footprint of resulting investments.

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