

A USER-CENTERED DESIGN APPROACH TO IDENTIFY BEHAVIOURAL BIASES IN HOUSHOLD SOLAR PV ADOPTION

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Introduction

Buildings offer a great potential for solar photovoltaics (PV) given that no land use change is required, the energy is used directly where it is generated, and it activates citizens within the energy system. In contrast, households have under-invested in energy technologies for decades, resulting in policies that force innovations into the market or rely on economic incentives [1]. Relevant behavioural research predominantly focuses on activities that use energy, however energy technology investments have the potential for much greater impact on sustainability goals [2,3]. Energy technology adoptions are typically described using Rogers' model of innovation diffusion, where information plays a prominent role in the decision making process [4]. The timing, source, and quality of information have all been identified as critical factors influencing consumer behaviour [5–7], however there is a lack of research into the methods of improving information delivery applied practically in the marketplace. Likewise, there is a lack of randomized field trials for testing energy investment behaviours at scale [8,9], which is critical for validating the impact of insights found using laboratory or qualitative methods [10].

Objective

This paper describes the first phase of an applied project to improve information delivery to Swedish consumers and nudge them towards increased PV adoption. This study's objective is to identify relevant behavioural techniques for randomized field trials within solar PV

investment. The trials will be conducted via web-based commercial tools, thereby having their own goal to increase lead conversion and reduce cost. Therefore, sub-objectives include:

- identifying the customer's needs, barriers, motives, and misconceptions about PV,
- defining promising information delivery methods to serve the customer's needs, and
- mapping PV market stakeholders to ensure robust and successful experimentation.

Methodology

The project uses a Design Thinking approach, starting with user journey mapping to understand behavioural insights in the decision making process. Twenty-eight semi-structured interviews are conducted with decision makers in three ownership categories – villas, multi-family cooperatives, and professional property owners. Existing communication channels are reviewed to describe the current state of information delivery in the market and improve the design process for experimentation in light of the required commercial features. The interviews and review combine to reveal specific decision contexts and behavioural techniques, which are matched with relevant theories in the scientific literature to form the foundation for field trials.

Results and Findings

The interviews reveal a wide range of barriers, motivations, triggers, activities and behaviours that span the entire adoption process, however the focus here is on information acquisition and presentation during the “gaining knowledge” and “forming an opinion” stages [5]. A number of barriers commonly found in the literature are present, such as long payback times, lack of knowledge about the technology, uncertainty about the technical or economic performance, and difficulty finding trustworthy information [6,11]. Some unexpected themes also arose, such as a desire to understand PV within the context of other energy options to make investments with the greatest impact. There are also misunderstandings, such as the expectation that PV is rapidly improving (motivating waiting) or that completely avoiding grid sales is a prerequisite to a good economy. This last point made batteries a frequent point of discussion, which are uneconomical and lead to the conclusion that PV as a concept is uneconomical.

PV providers and third parties are increasingly building professional looking web-based tools that calculate the energy generation potential of a user's roof, recommended a system, and provide a quotation with some economic savings indicators. On the surface, this appears to be valuable information, however many of the tools provide simple, limited information, overestimate energy generation and economic gains, and generally present a best-case scenario with some pushing the boundaries of plausibility. There is also a lack of interactivity or transparency such that using the tools to test different options with rapid feedback is difficult, limiting the educational value.

The shortcomings of online tools reveals an interesting conflict point between the motives of customers and providers; the websites are lures to generate leads and capture customers. The goal is to generate personal consultations where the provider has the customer's full attention,

builds trust and can be more personal/effective in their analysis. For the customer, this system requires consulting with multiple suppliers to cross-examine their offers and analyses, however they still lack input from a neutral, trusted source. The state government's energy agency has a PV calculator aimed at educating users, however the inputs do not make it easily comparable with commercial tools, reducing its effectiveness as an arbiter.

Discussions and Conclusions

The Swedish PV market is small, but growing rapidly with a disproportionately high number of suppliers. For individual companies trying to build a brand and capture market share, word-of-mouth recommendations and personal connections are a valuable strategy [12]. From the consumer perspective, it can create a barrier to information that prevents them from reaching the implementation stage [4,5]. Several interviewees reported that receipt of the first offer was the endpoint for their investigation into solar PV. While it may not fit into the relationship strategy for individual business, a personalized information source focused on educating consumers can lower the barriers to information and reduce information asymmetry, which also lowers transaction costs for the PV industry as a whole [13].

These insights are valuable in the creation of new communication strategies and reveal relevant behavioural techniques that may reduce barriers for users. At a base level is the need to consider information overload and decision fatigue, which promotes status quo bias. The user's understanding of performance indicators is also important [14], which quantifies their perceived value of a PV system (technical, economic, environmental). The framing of PV benefits as savings versus investment is a notable test point, and will need to consider time-inconsistent preferences such as present bias and hyperbolic discounting. A question of framing also arises where the tool can act as an authority to provide a specific recommendation, or as a dynamic educational tool that allows the user to explore options and receive feedback. Novel probability indicators inspired by finance can also be tested to reduce loss-aversion from economic uncertainties [15,16]. These key insights provide experimentation points to design randomized field trials to be executed via web-based channels during the second phase of the project.

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